Managing Emerging Market Currency Risk*

Nanyu Chen†
Columbia Business School

Haonan Zhou‡
HKU Business School

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Abstract

Using a novel dataset on U.S. mutual funds' emerging market (EM) currency forward usage at the contract level from 2010 to 2023, we find pervasive evidence that the currency risk exposure of major global investors in emerging markets is much larger and wider after taking into account their derivatives usage. An average emerging market-focused bond fund amplifies rather than hedges its currency risk through net long positions in short-term currency forwards, effectively speculating on currency appreciation. While we find that risk-return tradeoff and capital control could explain the average forward usage patterns across currencies, there exists substantial heterogeneity in the responses of mutual funds' currency forward positions to changes in currency returns, volatilities and CIP deviations, indicating sharp differences in the investment styles based on currencies versus bonds. Guided by these findings, we develop an equilibrium model of currency forward premium determination with heterogeneous investors. Consistent with model predictions, currencies with stronger speculative pressure are associated with high unhedged currency returns in the data, and their costs of hedging against depreciation spike during global downturns and local regulatory events, when speculative positions unwind. Our results shed light on the importance of speculative forces in driving the dynamics of emerging market exchange rates.

Keywords: Hedging, currency risk, speculation, emerging markets.

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†nc2741@gsb.columbia.edu. Columbia Business School

‡haonanz@hku.hk. HKU Business School

1 Introduction

Local currency emerging market (EM) bonds have taken an increasingly important place in global investors' fixed income portfolio. As of 2021, more than half of foreign investors' EM government debt portfolio is denominated in local currency (Onen, Shin and von Peter, 2023). Accompanying this trend is the sizable growth in offshore derivatives trading of major EM currencies, reaching a turnover of $1.6 trillion in 2019 (Patel and Xia, 2019). 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 and Jorion, 1993; Campbell, Medeiros and Viceira, 2010, for instance). While the literature has shown that international investors tend to deviate from the theoretical benchmark in their currency hedging patterns (Sialm and Zhu, 2022; Bräuer and Hau, 2024), there is to date little work documenting global investors' EM currency risk management practice and their ultimate currency risk exposure. Understanding how global investors use FX derivatives specifically for emerging market currencies is nevertheless important for three reasons. First, different from AE currencies, the high returns and high volatility of EM currencies could make the prediction of optimal derivative usage less clear cut. Second, the non-deliverability of currencies and strong capital account restrictions are features unique to emerging markets. Finally, the interactions between different investment objectives and styles in emerging markets could have meaningful implications on the dynamics of currency hedging costs.

This paper takes a first step towards filling these gaps. Using a novel dataset on U.S. investment funds' EM currency forward usage at the contract level from 2010 to 2023, we find pervasive evidence that the true currency risk exposure of major global fixed-income investors in emerging markets is much larger and wider 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 position instead of hedging the currency risk away. One dollar of EM local currency bond investment is associated with an average long forward position of 14 cents in the same currency. In addition, global mutual funds use forwards to seek direct exposure to currencies. For every five currencies in

an average mutual fund's EM investments, there are two currencies associated with zero or tiny bond investment positions. On-balance sheet holding, as a result, largely understates the degree of currency risk that global investors actually face in EMs.

Our dataset contains rich information on the characteristics of currency forward contracts, including the notional amount, maturity and the counterparty, based on which we document a set of new stylized facts. More than 80 percent of funds in our sample use EM currency forwards. They almost exclusively enter into short-term (with a tenor lower than six months) contracts with a limited set of global banks rather than local banks. We demonstrate that the direction and the degree of forward exposure to EM currencies can be explained by two layers of considerations. First, a simple uni-currency, mean-variance framework calibrated using data on short-term hedging costs and risk-return characteristics for both bonds and currencies can match the signs of the hedge ratios for most EM currencies in our sample if the risk aversion parameter is sufficiently low. This finding suggests that the average negative net forward sales in the data could be consistent with optimal risk-taking behavior that takes the full spectrum of risk-return tradeoff into account. Second, net forward purchases of local currencies are increasing in the number of capital account restrictions in place in the issuing countries. The difficulty of capital movement across borders is thus likely to be another important determinant of fund managers' choice between bond and derivatives position for gaining exposure to EMs.

The average pattern of currency forward usage masks substantial heterogeneity. We separate funds in our sample into currency "hedgers" and "speculators" based on the sign of their forward positions at both the currency level and that aggregated to the fund level. The difference between hedger funds and speculator funds reveal fundamental differences in global investors' investment strategies in emerging markets. First, speculator funds act as currency traders more than bond investors, as they are exposed to a larger number of currencies on average and takes larger gross forward positions than hedger funds do. Second, there is little evidence that hedgers' net forward positions are responsive to past currency returns or volatilities, and only weak evidence that their net forward positions respond to CIP deviations. We interpret these findings as indicating that hedger funds' demand for forward dollars is largely inelastic. Speculators, on the other hand, expand their speculative positions when the local currencies

appreciate over the previous quarter, consistent with a momentum trading interpretation. They also take on a larger long exposure when the previous period's exchange rate becomes more volatile, although this sensitivity to currency volatility is decreasing in the currency's share in the funds' bond portfolio. We see this as another indication of the opposing implications for forward usage between two distinct investment focus of global investors in emerging markets (currencies versus bonds).

The interaction between heterogeneous investors and different investment styles in the EM currency forward market could have important implications on the dynamics of currency forward premium of emerging markets. To delineate the economic mechanism underpinning the connection, we write down an equilibrium model of currency hedgers and speculators. In the model, hedgers' hedging motive arises from their predetermined bond positions. With mean-variance preference and a given size of EM local currency investment, they choose the amount of forward currencies to sell to hedge against future depreciation of the proceeds. Speculators are currency traders. With no underlying bond position but the same mean-variance preference, they take the other side of the market through a long position in local currency forward to gain from expected currency appreciation while accommodating hedgers' inelastic forward sales. We obtain sharp characterization of the equilibrium forward premium (the hedging cost) and the pattern of forward usage. In particular, the equilibrium hedging cost is positive, as the risk-averse speculators require a risk premium to be able to absorb the hedging demand, and hedgers would only partially hedge as it is costly to do so. The stronger is speculators' risk aversion, the higher is the hedging cost, as a tightening of speculators' risk appetite leads to unwinding of speculative positions that accommodate the hedging demand.

We show that the model predictions are largely verified in the data. First, the hedger funds in our sample on average hedges only 27% of their local currency bond positions, lending support to the partial hedge prediction. Then, we group major EM currencies into equal-weighted portfolios sorted by the degree of speculative pressure defined in various ways, and show that a long-short strategy buying high-speculative pressure portfolio and selling low-speculative pressure portfolio generates an excess return of 3.01% per annum. This finding indicates that currencies with higher returns are indeed more attractive to speculators. CIP deviations, on the other hand, are lower for curren-

cies with stronger speculative pressure, consistent with our model mechanism relating speculators' willingness of hedging service provision to expected currency returns. As a final exercise, we study the dynamics of currency hedging cost during periods of global downturns and local regulatory shocks that feature speculative position unwinding. We focus on two episodes, the onset of the COVID-19 crisis in early 2020, and the banning of domestic entity trading of offshore Malaysian Ringgit (MYR) derivatives by the local authority in November 2016. For the COVID episode, we find that the net long forward position on EM currencies sharply contracted over two quarters after the end of 2019, almost completely driven by the unwinding of speculative position. This reduction of speculative demand is in turn strongly associated with an increase in the cost to seek downside protection for currency hedgers. We observe similar pattern for MYR around the end of 2016, when the regulation change leads to a protracted decline in both speculative and hedging position, and a sharp spike of short-term CIP deviations.

Overall, our findings provide new insights in understanding exchange rate fluctuation and its connection to capital flow reversals in a number of ways. First, exchange rate movements could have stronger impact on capital inflow into emerging markets and the borrowing cost of EM issuers than previously thought, as the currency risk exposure of international investors is much larger and wider once we take into account the derivatives channel. Second, our results on speculative position unwinding during global downturns add to the literature on carry trades and currency crashes (Brunnermeier, Nagel and Pedersen, 2008) and the recent empirical literature documents a pervasive impact of currency index affecting capital flows and portfolio allocation beyond the impact of bilateral exchange rates (Jansen, Shin and von Peter, 2023, for example). From a policymaking perspective, our data also provides a rare look into the market of offshore currency forwards, whose activities could move exchange rates substantially but have received little attention to date due to strong market segmentation and data limitation.

Our paper contributes to three strands of literature. A growing literature documents the use of derivatives for institutional investors allocating capital worldwide. Closest to our paper is Sialm and Zhu (2022), who show that international fixed income funds' scale of currency hedging is in general smaller than what is theorized by standard models. Opie and Riddiough (2024) arrive at a similar finding in the case of equity. Cheema-Fox

and Greenwood (2024) use custodial records to show that currency hedgers maintain a target hedge ratio and rebalance accordingly. All three papers, however, focus on more advanced (G10) currencies and study funds' derivative use and performances. The only two exceptions are Du and Huber (2024) and Hacioğlu-Hoke, Ostry, Rey, Planat, Stavrakeva and Tang (2024), who collect data on currency hedging and speculating practices for a wide spectrum of financial and non-financial firms and currencies. Our paper uses granular data on fund-contract level forward usage, focusing on EM currencies, to understand the distinct feature of EM currencies driving mutual fund managers' hedging decision and the implication for exchange rate dynamics.

We also contribute to the nascent literature studying the hedging and speculative channel of exchange rate determination. Kubitza, Sigaux and Vandeweyer (2024) study the relationship between forward usage and deviations from EUR/USD CIP for Euro Area investors under maturity mismatch. Kremens (2024) demonstrates that hedge fund positioning in the currency futures market is informative of currency-equity correlation. Bräuer and Hau (2022) and Ben Zeev and Nathan (2024) establish a causal link between shifts in hedging demand from international bond and equity investors and exchange rates. Liao and Zhang (2024) study how hedging demand arising from dollar asset-liability gap and imperfect financial intermediation could jointly shape the dynamics of exchange rate for G10 currencies. In our theory, we focus on the interaction between hedging demand and risk averse speculator's hedging service provision in determining forward market pricing. In this sense, our paper is closely related to De Leo, Keller and Zou (2024), who use position data for Peruvian Sol 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 two major aspects. First, our model focuses on the heterogeneous risk-return tradeoff facing the ultimate parties on the forward intermediation chain. Second, we study the impact of speculative position unwinding during both global downturns and local regulatory events, while shedding light on factors driving foreign investors' speculation and hedging practices for a wide set of EM currencies.[1]

[1]From a broad perspective, our paper adds to the large literature on understanding deviations from interest rate parity (Du and Schreger, 2016; Du, Tepper and Verdelhan, 2018; Borio, Iqbal, McCauley, McGuire and Sushko, 2018; Kalemli-Özcan and Varela, 2022; Cerutti and Zhou, 2024, among others) by

The paper is also related to the literature on currency risk and optimal hedging (Solnik, 1974; Black, 1990; Campbell, Medeiros and Viceira, 2010; Verdelhan, 2018; Opie and Riddiough, 2020, among others). We provide granular data on emerging market currency forward usage and show that the large currency risk premia for EM currencies could be closely related to currency speculative forces.

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 provides a set of stylized facts associated with EM-focused mutual funds' currency forward usage. Section 4 focuses on the distinct role played by currency hedgers and speculators and delineates their differences. Section 5 discusses the connection between mutual funds' currency hedging and speculating to exchange rate dynamics through an equilibrium model and its associated empirical exercises. 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 an active offshore non-deliverable forward market and strong offshore-onshore segmentation. Forward pricing reflects such frictions. 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.[2] Consequently, international investors looking to hedge their currency risk arising from local currency bond or equity holding could face substantial hedging costs and rollover risk.

highlighting the equilibrium interactions between hedgers and speculators as the key force driving forward premia and CIP deviations in EM currencies.

[2]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.

Currency derivatives can also be employed to gain direct exposure to currency risk without the need to hold any cash position. The dual role of currency forward for EM currencies could be even stronger than G10 currencies, thanks to pervasive capital control, persistently positive interest rate spread over the U.S., and high currency volatility.[3] The availability of instruments to play this dual role, such as non-deliverable forwards, also suggests that data on local currency bond or equity position paints an incomplete picture at best for our understanding on global investors' true currency exposure to emerging markets.

2.2 Data

We focus on U.S.-domiciled fixed income mutual funds and ETFs with a mandate to exclusively invest in emerging market debt securities. We obtain the sample of funds from Morningstar (within the "Emerging Markets Fixed Income" category) and cross check with CRSP Survivor-Bias-Free Mutual Fund database. Our sample covers a total of 150 funds from 2010Q1 to 2023Q3.[4]

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 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 softwares. We also manually cross-check our final data with the filings to ensure the accuracy of our processed data.

[3] 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 and Chua, 2020).

[4] Due to fund entry and exit, the total number of funds each year vary from 34 to 100, and tend to stabilize after 2013.

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.[5] A total of 60 non-G10 currencies have forward contracts traded by mutual funds in our sample. We calculate summary statistics including all currencies. In subsequent analyses, we will also restrict attention to a subset of 20 major currencies for which we have high-quality data on hedging costs.[6]

Portfolio holding and fund characteristics Security-level holdings come from CRSP, available at quarterly frequency. We also collect fund characteristics including fund size (total net assets), return, expense 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.

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).

Forward pricing We follow Cerutti and Zhou (2024) to construct forward premia and CIP deviations. In the convention of Du, Tepper and Verdelhan (2018), CIP deviations of tenor n against the USD are given by

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

[5]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.

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

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 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 a foreign investor in EM. A negative $x_{t,t+n}$ corresponds to a lower hedging cost, as the currency-hedged local currency return exceeds 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.[7] Our focus on mutual funds and ETFs with EM investment mandates should capture a major share of activities in the EM currency forward 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.[8]

2.3 Currency risk management of investment funds: Measurement

Following standard practice in the literature (Sialm and Zhu, 2022; Opie and 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 notional amount is converted to USD value. More formally, let

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

[7] Sialm and Zhu (2022) and Opie and Riddiough (2024) use N-Q and N-CSR/CSRS, while Kaniel and Wang (2022) 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.

[8] Zhou (2024) shows that Germany-based banks, insurance companies and pension funds hold tiny position on local currency EM sovereign bonds. Jansen, Shin and von Peter (2023) show that Dutch pension funds employ little hedge for investments that are not USD, GBP or JPY denominated. Kubitza, Sigaux and Vandeweyer (2024) report that the net FX balance of the EUR/USD forward market is predominantly driven by investment funds.

Both $\widetilde{\text{FS}}_{ict}$ (forward sales) and $\widetilde{\text{FP}}_{ict}$ (forward purchases) are aggregated across contracts of all tenors.[9] 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 often 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

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

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

[9] Following Sialm and Zhu (2022), 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. The case of $\widetilde{\text{FP}}_{ict}$ is analogously defined.

currencies for each fund:

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

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

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

3 Understanding the currency exposure of EM investors

3.1 Currency risk amplification

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 and Zhou, 2024), these factors could deter investors from substantially hedging their currency exposure.

	Obs	Mean	STD	P25	P50	P75
Purchase EM currency against USD	244851	0.47	0.50	0.00	0.00	1.00
Sell EM currency against USD	244851	0.38	0.49	0.00	0.00	1.00
Purchase G9 currency against USD	244851	0.05	0.21	0.00	0.00	0.00
Sell G9 currency against USD	244851	0.07	0.26	0.00	0.00	0.00
Contracts with two Non-USD currencies	244851	0.04	0.19	0.00	0.00	0.00
Notional Amount ($ Million)	244851	6.32	30.82	0.23	0.90	3.58
Remaining Days to Maturity	244843	50.41	64.05	16.00	38.00	67.00
Observations	244851					

Table 1: Summary statistics: Forward-contract-level

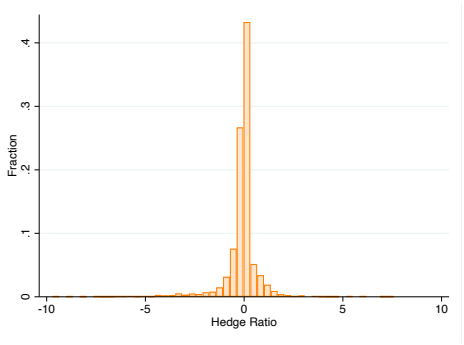
Notes: Table 1 presents summary statistics of the forward-contract level data. Sample currencies include 60 non-G10 and G9 (excluding USD) currencies. The sample period is from 2010Q1 to 2023Q3.

Table 2, Panel (a) verifies this logic, by providing a list of relevant summary statistics at the fund level. The average hedge ratio is -14% – for one dollar invested in an EM currency, investors on average *adds* 14 cents to the currency risk exposure. In addition, an average fund has a long or short position in 9 currencies but source the contracts from 5 counterparties, indicating a generally concentrated market for EM currency forwards. The counterparty banks are predominantly global banks. Local EM intermediaries barely serve as the immediate forward supplier.[10] Panel (b) reports average hedge ratio when we exclude tiny bond positions from the calculation – we get even more negative values converging towards -15%. The distribution of net forward positions and hedge ratios are highly spread out (Figure 1(a), 1(b)), but ultimately an average fund has a stronger net currency exposure compared to their bond-level portfolio weight, according to Figure 1(c). In comparison, Sialm and Zhu (2022, Figure 3) show that for a larger sample of mutual funds investing in both G10 and non-G10 currencies, a substantial portion of fund-level net foreign currency exposure is below its portfolio weight, indicating a stronger propensity to hedge against funds' G9 currency exposure.

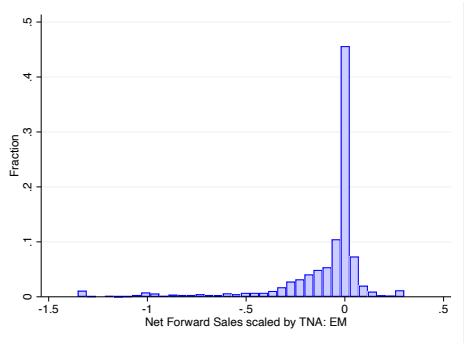
3.2 Explaning the negative average hedge ratio

The negative hedge ratio observed for an average EM-focused mutual fund seems counterintuitive: with substantial currency risk and volatility coming from EM currencies, investors do not choose to seek protection through currency hedges on average, but tend to enlarge their currency exposure. First, we use a simple mean-variance framework, incorporating rich interaction between bond return risk and currency risk as well as hedging cost calibrated from data as a benchmark to assess whether the observation substantially differs from what standard theory would predict. Our main finding is that the risk characteristics of EM bonds and currencies, high hedging cost and strong risk appetite could jointly rationalize the observed sign of the hedge ratio for almost all EM

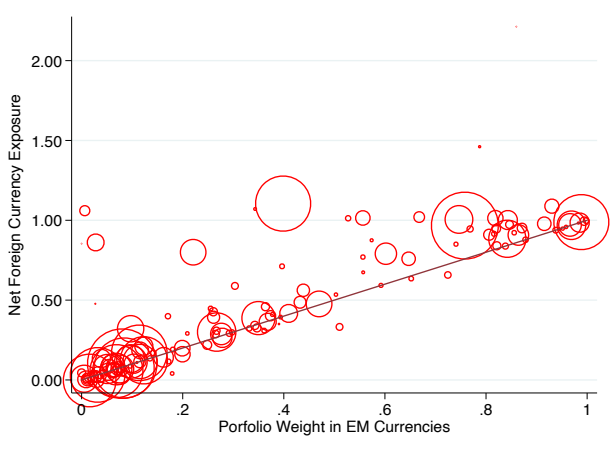
[10]The entire forward intermediation chain could nevertheless involve both global banks and onshore intermediaries, as global banks channel forward demand from ultimate offshore entities (De Leo, Keller and Zou, 2024). Appendix Table A2 lists all counterparty banks appearing in the sample.



(a) Histogram of hedge ratio



(b) Histogram of net forward sales



(c) Net currency exposure and portfolio weight

Figure 1: U.S. fixed income mutual funds' FX forward position and portfolio weight to EM

Notes: Figure 1 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.

	Obs	Mean	STD	P25	P50	P75
Fraction of Fund-Quarter with FX Forward	4145	0.78	0.42	1.00	1.00	1.00
Total Net Assets ($ Million)	4145	723.55	1455.05	38.00	162.20	658.10
Portfolio Weight of EM Currencies	4145	0.38	0.39	0.03	0.25	0.76
Portfolio Weight of G9 (non-USD) Currencies	4145	0.01	0.04	0.00	0.00	0.01
Portfolio Currency Concentration (HHI Index)	4145	0.25	0.30	0.08	0.11	0.30
Portfolio Weight of Sovereign Securities	4145	0.59	0.28	0.48	0.66	0.79
Portfolio Weight of Cash	4145	0.05	0.14	0.00	0.03	0.07
Hedge Ratio: EM	3338	-0.14	1.00	-0.21	0.00	0.00
Net Forward Sales scaled by TNA: EM	4145	-0.11	0.26	-0.13	-0.00	0.00
Net Currency Exposure	4145	0.49	0.47	0.08	0.34	0.97
Forward Purchases scaled by TNA: EM	4145	0.30	0.52	0.00	0.08	0.39
Forward Sales scaled by TNA: EM	4145	0.18	0.29	0.00	0.06	0.23
Gross Forward scaled by TNA: EM	4145	0.49	0.80	0.01	0.15	0.65
Number of Unique FX Counterparties	4145	5.06	4.89	1.00	4.00	8.00
Number of Unique Purchase Currencies	4145	9.89	9.18	1.00	7.00	17.00
Number of Unique Sale Currencies	4145	9.18	8.65	2.00	7.00	15.00
Number of Currencies with No Bond Investment	4145	5.09	6.20	0.00	3.00	8.00
Number of Currencies with Bond Investment	4145	8.38	7.43	1.00	7.00	16.00
Number of Contracts	4145	58.81	90.04	2.00	20.00	78.00
Maturity (Years)	4145	8.37	3.83	6.77	8.58	10.92
Management Fee	4145	0.31	0.75	0.00	0.52	0.70
Expense Ratio	4145	0.01	0.00	0.01	0.01	0.01
Turnover Ratio	4145	0.85	0.91	0.35	0.66	1.06
Institutional Share	4145	0.74	0.36	0.58	0.95	1.00
Observations	4145					

(a) Summary statistics: Fund-level

	P0.1	P0.5	P1.0
Hedge Ratio	-0.14	-0.15	-0.15
Observations	3,304	3,207	3,078

(b) Hedge ratio, with varying portfolio weight thresholds

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 60 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%. In Panel (a), the hedge ratio is based on fund-quarters with non-zero portfolio weights. 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 period is from 2010Q1 to 2023Q3.

currencies in our analysis. Second, we demonstrate that capital account restrictiveness – a distinct feature of EM currencies – is closely related to the net forward position of EM-focused funds. We conclude that the hedging motive may not be the natural benchmark to consider when evaluating global investors' EM currency forward usage.

Risk-return tradeoff and patterns of currency forward usage We consider a mean-variance framework of fixed-income investment with currency hedging. As the model largely follows Du and Huber (2024), we relegate most details to Appendix B and only present the key idea. A mean-variance investor faces risk-return tradeoffs in two risky assets, one denominated in an EM's local currency and the other in USD. The riskiness of the EM bond stems from two sources: the local currency return is random, and the exchange rate fluctuates. The bond and currency returns are potentially correlated with each other. The investor can choose to hedge its local currency investment, but needs to pay a hedging cost proportional to the CIP deviations associated with the currency.[11]

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.[12] Table 3 compares the optimal hedge ratio predicted from the model (column 1) 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, low risk aversion is necessary to generate a negative hedge ratio.[13] In the next section, we provide additional empirical evidence to justify the choice of a low level of risk aversion, by highlighting the differences between hedger and speculator funds.

[11] In this simple framework, we assume that investors hedge currency by currency. This is supported in Bräuer and Hau (2024), who find that European investors' hedging pattern is usually partial and focusing on one currency at a time.

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

[13] In our benchmark calibration, we set risk aversion γ to 0.1. In Appendix B.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 3: Signs of model-predicted versus observed hedge ratio

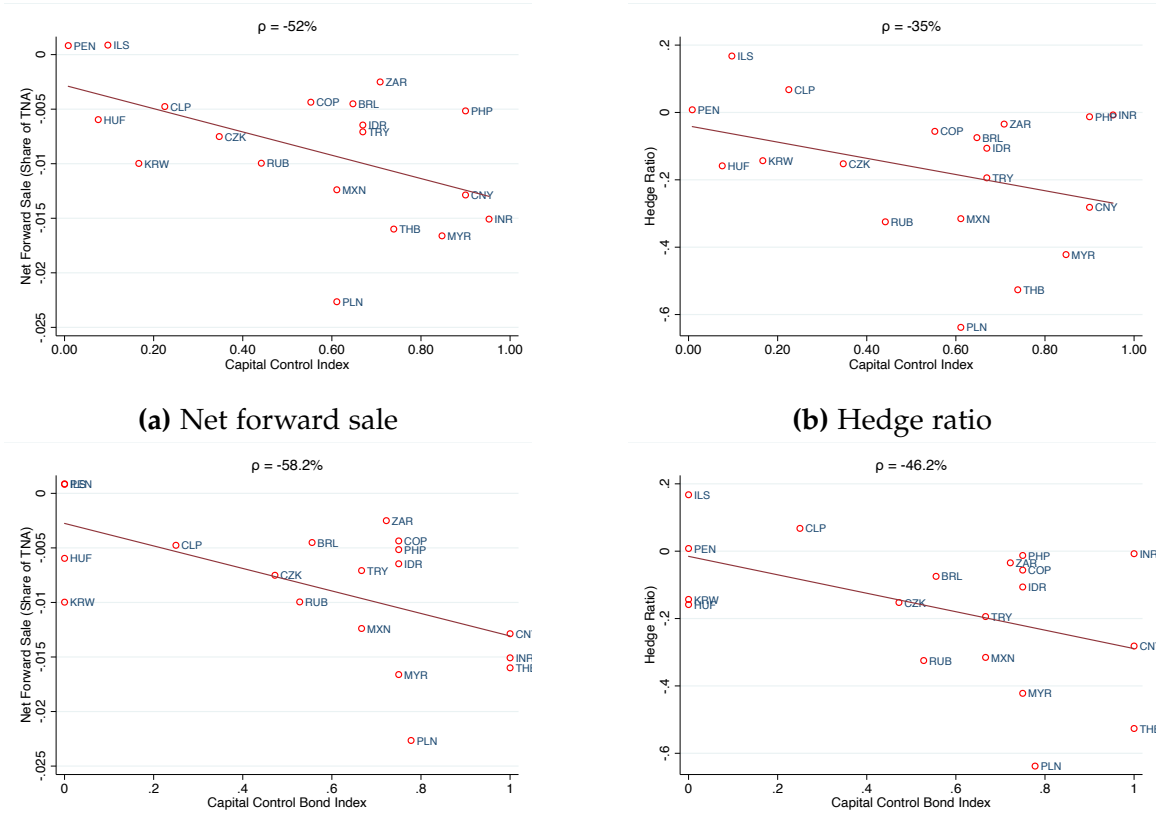
Notes: Table 3 compares the predicted hedge ratio from the optimal portfolio choice model versus observed hedge ratios in our sample. We use data on monthly bond and currency returns from 2000M1 to 2021M2 as model input, and then predict hedge ratio for each currency. Then, we compare predicted hedge ratio with average observed hedge ratio from 2021Q2 to 2023Q2 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 costs, 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 costs. 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. Model details can be found in Appendix B.

Importantly, the relative positions (both net and gross) of speculator funds in FX forward are much larger than the hedger funds, and speculator funds exhibit a more procyclical style in currency risk management.

The role of capital account restrictions While the portfolio choice framework could rationalize the direction of currency forward usage observed in data, capital account restrictions could play an important role in explaining the size of the forward position across currencies. Offshore-traded derivatives (such as non-deliverable forwards) offer fund managers the option to gain direct, long exposure and flexibly adjust positions while overcoming barriers to capital movement. Therefore, we expect to see a stronger propensity of EM funds to long a currency forward when the country issuing the currency imposes stronger capital account restrictions.

To operationalize the comparison, we use data on capital account restrictions from Fernández, Klein, Rebucci, Schindler and Uribe (2015) from 2011 to 2019, which constructs standardized indices (ranging from 0 to 1) of various types of capital account restrictions based on the IMF Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) filed by country authorities. Figure 2 shows that there is a strong negative relationship between a country's capital account restrictiveness and net forward sale position of the currency of that country. The negative relationship is only slightly weaker for hedge ratios (Figure 2(b)). We also look at subindices of the Fernández, Klein, Rebucci, Schindler and Uribe (2015) dataset and show in Figure 2(c) that consistent with our intuition, there is an even 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.[14]

[14]In unreported regressions, we find that the relationship between capital control and net forward position of EM-focused mutual funds cannot be explained away by currency returns. Capital control is thus a distinct layer of consideration for fund managers when choosing their derivative exposure.



(a) Net forward sale **(b)** Hedge ratio

(c) Net forward sale **(d)** Hedge ratio

Figure 2: FX forward usage and capital control

Notes: Figure 2 presents the cross-sectional correlation between FX forward usage and capital control. The upper panel focuses on the capital control index that captures all asset categories. The bottom panel focuses on the capital control index that captures restrictions on bond transactions. Left panel plots net forward sale position against the capital control index. Right panel plots hedge ratio against the capital control index. The capital control index ranges from 0 to 1. A higher capital control index indicates more stringent capital control. Data for capital control index is from Fernández, Klein, Rebucci, Schindler and Uribe (2015), which is updated to 2019. Therefore, both FX forward usage and capital control are computed based on a sample from 2011Q1 to 2019Q4.

4 Speculators and hedgers in the EM currency market

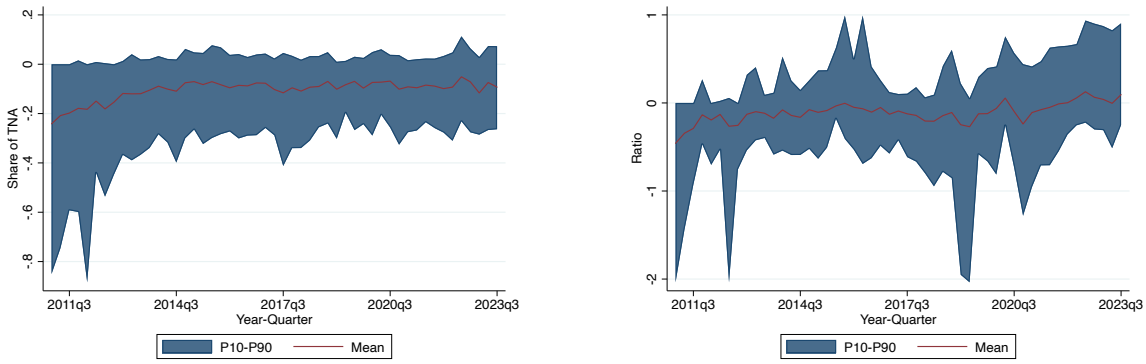
In Section 3, we have shown that there is substantial heterogeneity in currency management styles among investment funds. Figure 3 plots the time-series of FX forward usage and shows that there is a large cross-sectional dispersion. In this section, we focus on the split between hedgers – who on average reduce currency exposure via currency forwards – and speculators, who on average amplify their currency exposure through a long forward position. Here, we provide a precise definition of these two fund types.

A fund is classified as a speculator fund 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., $\overline{\text{NFS}_i} \geq 0$) and the mean of its portfolio weight is non-zero (i.e., $\overline{\omega_i} > 0$). For hedgers, the restriction on portfolio weight ensures that hedge ratio is well-defined. We further require that a fund needs to use FX forward frequently for classification such that the fund needs to 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 sporadic uses currency forwards.[15]

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. For speculators, the probability of switching signs quarter-to-quarter is 0.11, and for hedgers, the probability of switching is 0.12.[16] Figure 4 shows that the time-series average of net forward sale position of hedgers and speculators mostly stay in the positive and negative territories, respectively. Net forward sale position of speculator funds are more volatile.

[15] Our definition of hedgers and speculators at the fund level reflects the currency risk across all derivative positions. A fund may hold a long forward position in one currency while being classified as a hedger fund. Table A1 reports the total number of fund in our time with breakdown into hedger or speculator funds. In later analysis at the currency level, we define speculative and hedging position separately.

[16] Most of the switching instances occur among a few funds holding small (close to 0) net forward sale positions. Removing these funds would reduce the probability of switching even more, and our results are robust to the exclusion of these funds.



(a) Net forward sale

(b) Hedge ratio

Figure 3: Time-series of fund-level FX forward usage

Notes: Figure 3 presents the time-series average of fund-level net forward sale position (scaled by total net assets) and hedge ratio from 2011Q1 to 2023Q3. The shaded area indicates the 10th and 90th percentiles of the corresponding variable.

4.1 Cross-sectional differences reveal distinct investment styles

Table 4 reports basic characteristics of speculator and hedger funds. Several dimensions are worth highlighting. Speculators hold a substantially larger gross forward positions (71%) than hedger funds do (22%), and are simultaneously exposed to more currencies (14) than hedger funds are (7). This finding supports the notion that speculator mutual funds take on a role more similar to currency traders than bond investors. The average hedge ratio of hedger funds is 27%, while the corresponding number for speculators is a negative 38%. We also find that an average speculator's liabilities are less stable during downturns, as the comovement between fund flows and fund returns are much stronger than that associated with an average hedger fund.

4.2 Correlates of forward usage vary across hedgers and speculators

We assess how speculators and hedgers manage their currency forward positions across currencies by estimating the following specification:

	Obs	Mean	STD	P25	P50	P75
Hedger						
Total Net Assets ($ Million)	1085	767.59	1465.04	35.80	162.20	611.30
Hedge Ratio	893	0.27	0.99	0.00	0.12	0.65
Net Forward Sales scaled by TNA	1085	0.03	0.09	0.00	0.00	0.03
Forward Purchases scaled by TNA	1085	0.10	0.25	0.00	0.01	0.07
Forward Sales scaled by TNA	1085	0.13	0.30	0.00	0.03	0.10
Gross Forward scaled by TNA	1085	0.22	0.55	0.00	0.04	0.17
Number of Portfolio Currencies	1085	7.32	4.57	4.00	7.00	10.00
Number of Currencies in Speculative Position	1085	1.56	2.22	0.00	0.00	3.00
Number of Currencies in Hedging Position	1085	3.30	3.25	1.00	2.00	5.00
Flow-Performance Sensitivity	1085	0.48	5.98	-0.14	0.45	1.42
Speculator						
Total Net Assets ($ Million)	2223	669.71	1490.54	41.20	149.90	588.00
Hedge Ratio	1690	-0.38	1.10	-0.40	-0.16	-0.00
Net Forward Sales scaled by TNA	2223	-0.16	0.25	-0.21	-0.07	-0.00
Forward Purchases scaled by TNA	2223	0.45	0.76	0.07	0.25	0.59
Forward Sales scaled by TNA	2223	0.26	0.42	0.03	0.14	0.31
Gross Forward scaled by TNA	2223	0.71	1.21	0.12	0.41	0.93
Number of Portfolio Currencies	2223	14.11	5.55	11.00	16.00	18.00
Number of Currencies in Speculative Position	2223	7.66	5.25	3.00	8.00	12.00
Number of Currencies in Hedging Position	2223	4.26	3.25	1.00	4.00	7.00
Flow-Performance Sensitivity	2223	1.25	8.47	-0.50	0.95	5.48

Table 4: Fund characteristics: Speculators and hedgers

Notes: Table 4 presents fund-quarter level characteristics for speculators and hedgers. A fund is classified as a speculator 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 and the mean of its portfolio weight is non-zero. Flow-performance sensitivity is the flow beta to fund alpha, which is computed based on a one-factor (JPM GBI-EM index return) model. The sample period is from 2012Q1 to 2023Q3.

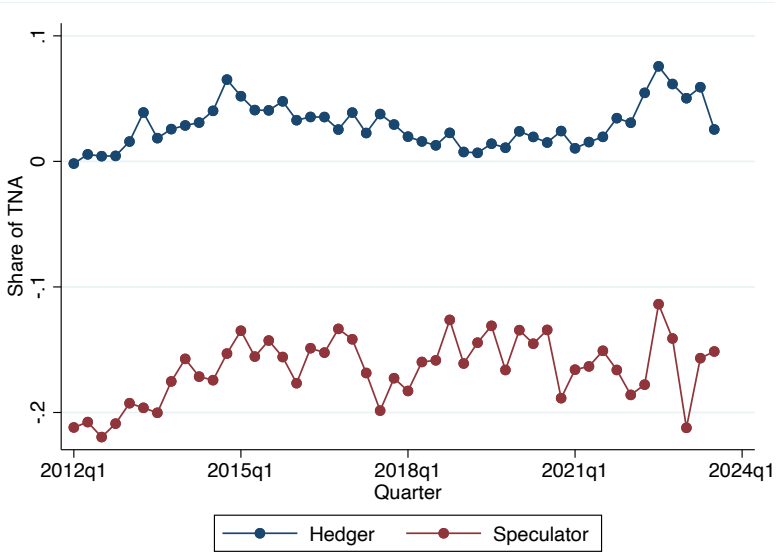


Figure 4: Time-series of net FX forward sales: Hedger and speculator funds

Notes: Figure 4 presents the time-series average of fund-level net forward sales position (scaled by total net assets) for hedger funds and speculator funds. A fund is classified as a speculator 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 and the mean of its portfolio weight is non-zero. The sample period is from 2012Q1 to 2023Q3.

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

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 variables that capture currency-specific characteristics, such as momentum, CIP deviation, and volatility. $\omega_{c,t-1}$ is the bond portfolio weight of currency c during the previous quarter. 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 speculator 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 estimate (8) with time or fund-time fixed effects, exploiting cross-currency variations and report the results in Table 5. Broadly, we find that hedger funds are not

	Speculator fund			Hedger fund		
	(1)	(2)	(3)	(4)	(5)	(6)
Lag-1 Portfolio Weight	0.166***	0.068	0.099**	0.305***	0.247	0.396***
	(0.045)	(0.050)	(0.041)	(0.088)	(0.164)	(0.118)
Lag-1 Momentum	-0.027	-0.026	-0.045*	0.015	-0.003	-0.013
	(0.020)	(0.022)	(0.025)	(0.020)	(0.026)	(0.025)
Lag-1 3-Month CIP Deviation	0.049***	0.052**	0.065***	-0.005	0.005	0.031*
	(0.018)	(0.021)	(0.024)	(0.019)	(0.016)	(0.017)
Lag-1 Currency Volatility	-0.018	-0.096**	-0.118***	0.016	-0.013	-0.062
	(0.036)	(0.046)	(0.040)	(0.033)	(0.043)	(0.041)
Lag-1 Momentum × Weight		-0.002	0.005		0.012	0.013
		(0.003)	(0.004)		(0.009)	(0.010)
Lag-1 CIP × Weight		0.006	0.004		-0.008	0.001
		(0.007)	(0.007)		(0.022)	(0.016)
Lag-1 Volatility × Weight		0.032***	0.027***		0.019	0.025
		(0.009)	(0.008)		(0.037)	(0.027)
Time FE	✓	✓		✓	✓	
Fund-by-Quarter FE			✓			✓
R-squared	0.042	0.045	0.319	0.129	0.130	0.331
N	28602	28602	28531	6490	6490	6374

Table 5: Net forward sale and currency characteristics: Speculators and hedgers

Notes: Table 5 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. A fund is classified as a speculator fund 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 and the mean of its portfolio weight is non-zero. The dependent variable is the net forward sale position of fund i in currency c at time t. The independent variables include momentum (computed by spot exchange rate return), 3-month CIP deviation, currency volatility (computed by past 12 months' exchange rate volatility). All independent variables are lagged by one quarter. Both dependent and independent variables are converted to percentage terms. Standard errors in parentheses are double-clustered by fund and time. The estimation is based on the sample period from 2012Q1 to 2023Q3. Our sample currencies include major EM currencies with sufficiently active foreign exchange markets and for which we have substantial data coverage on hedging cost: BRL, CLP, CNY, COP, CZK, HUF, IDR, ILS, INR, KRW, MXN, MYR, PEN, PHP, PLN, RUB, THB, TRY, TWD, ZAR.

responsive to past currency returns, volatilities, or hedging costs, indicating a generally inelastic demand for currency hedges possibly due to mandates or maintaining a targeted hedge ratio. Speculators trade on currency volatility, increasing long forward position when the exchange rate in the past 1 year is more volatile, and momentum, increasing long position when the exchange rate appreciates over the previous quarter. For speculators, their sensitivity of forward position to currency volatility fluctuations declines with bond portfolio weight. This finding constitutes further evidence that different investment styles of global investors (currencies versus bonds) could entail very different implications on forward usage.[17]

5 Connection to exchange rate dynamics

We now move to an equilibrium setup and investigate how the interactions between different investment styles and objectives in the FX forward market affect the forward premium of EM currencies. Towards this end, we start from a simple two-period equilibrium model, building on Tsiang (1959) and Acharya, Lochstoer and Ramadorai (2013), that nevertheless sharply characterizes the relationship between forward premium, currency volatility, the fundamental hedging demand and speculators' risk-bearing capacity. We then show that the predictions of the model are supported by the data. We conduct portfolio sorting exercises based on the speculative pressure faced by each currency, and document the close relationship between the spike of hedging cost and the unwinding of speculative currency positions during the height of the COVID-19 pandemic and the local regulatory changes of Malaysian Ringgit (MYR) in November 2016.

The model features two types of investors, hedgers and speculators, with mean-variance preferences who choose the amount of currency forward contract to sell or purchase. We make several assumptions grounded in the data to make the analysis transparent. First, hedgers are bond investors with a predetermined bond position, which gives rise to an inelastic component of their forward sales that is evident in the

[17] Table A3 in the Appendix shows that our findings remain robust when we replace 3-month CIP deviations by 1-month CIP deviations.

data. Second, speculators are currency forward traders that do not participate in the bond market. This assumption seeks to capture the stark distinction between a currency-based and a bond-based investment strategy by global investors in emerging markets. Finally, we assume exogenously given bond returns and spot exchange rates to narrow our focus on the equilibrium determination of forward premium.[18]

5.1 Hedging imbalance and exchange rate: A conceptual framework

Hedger A fixed income investor (the hedger) in local currency debt issued by an emerging market economy enters period 0 with wealth $W_0^{\$}$ in US dollar. Her investment mandate prompts her to convert the entire amount of wealth to the local currency of the issuer (henceforth labeled "peso" for clarity) at spot exchange rate S_0 (in units of peso per USD) and invest in the local currency bond, whose price is normalized to one and which yields a risk-free, exogenous gross return $(1+r)$ in period 1. The USD payoff from the bond is however uncertain, as the peso-dollar exchange rate in period 1 is random. The U.S. and the peso interest rates are exogenously given. For simplicity, we normalize the USD risk-free rate to one. The spot exchange rate is also exogenously given.[19]

The hedger can simultaneously enter into a forward agreement that sells (or buys) peso in period 1 at a predetermined exchange rate F (also in units of peso per USD). For tractability, we assume the forward contract is non-deliverable, involving no currency exchange at inception, similar to the market structure in a large number of emerging market currencies. 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

[18] We map our model prediction to U.S. mutual fund positions, as foreign mutual funds are important players in the short-term FX derivative market and EM bond market in general (see references in footnote 8 and Zhou (2024)). Different from De Leo, Keller and Zou (2024), we abstract from explicitly modeling intermediaries but highlight the role of heterogeneous risk-return tradeoff from the ultimate entities of the forward intermediation chain.

[19] The risk-free return assumption is made to sharpen the analysis. As speculators do not hold bonds, introducing correlation structure between currency and bond returns only affects the intensity of hedgers' hedging motive without interfering with the core mechanism of the model.

profit from selling peso forward and locking in the exchange rate at F.

The hedger has mean-variance preference over wealth at period 1. 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:

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

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 investment on the local currency bond (the hedge ratio) is implied from the first-order condition:

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

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 hedge ratio can be more intuitively expressed as

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

(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 hedging cost S_0/F relative to expected appreciation of the peso; and the variance of appreciation, scaled by the hedger's risk aversion. Notably, the existence of predetermined bond position generates an inelastic hedging demand component $(1+r)$ that is insensitive to exchange rate expectation or hedging cost.[20] A number of comparative statics are immediate:

[20]The model assumes exogenous risk-free return and normalize US interest rate to 1. Therefore, the equilibrium hedging cost is only driven by the forward premium S_0/F. In the data, we also investigate the behavior of CIP deviations that take into account interest rate movements.

Lemma 1. *The optimal hedging demand $\tilde{h}$ is increasing when*

- *The hedging cost decreases (S_0/F goes up).*
- *The local currency is expected to depreciate by more.*
- *The local currency depreciation becomes more volatile.*

Speculators Speculators are designated investment managers that specialize in currency forward trading. They hold no underlying investment position other than derivatives. A unit mass of identical speculators chooses the notional amount of forward peso to purchase, h_s, to solve the following mean-variance problem:

$$\max_{h_s} h_s \mathbb{E}[S_1^{-1} - F^{-1}] - \frac{\gamma_s}{2} Var(h_s(S_1^{-1} - F^{-1}))$$

where γ_s denotes the risk aversion of speculators. The optimal supply of hedging services, scaled by the hedger's wealth, is given by

$$\tilde{h}_s \equiv \frac{h_s}{W_0^{\$} S_0} = \frac{\mathbb{E}\left[\frac{S_0}{S_1}\right] - \frac{S_0}{F}}{\gamma_s Var\left(\frac{S_0}{S_1}\right)} \tag{11}$$

The speculator's supply curve for the hedging service is upward-sloping, in the sense that a lower hedging cost (higher S_0/F) corresponds to a lower willingness of the speculator to take the opposite position and absorb the hedger's potential hedging demand. Meanwhile, when the speculator is long peso forward, a higher expected appreciation of the peso enlarges the expected return and pushes up the optimal hedging service provision.[21]

[21] In the data, speculator funds could simultaneously hold an underlying bond position and enter into both a long and a short forward contract with a net long forward position. One can think of such funds in our model as a combination of a forward-only speculator and a bondholding hedger.

Market clearing The market clearing condition $\tilde{h} = \tilde{h}_s$ implies that the equilibrium forward premium is given by

$$\frac{S_0}{F} = -(1+r)\Big(\frac{1}{\gamma_h} + \frac{1}{\gamma_s}\Big)^{-1} Var\Big(\frac{S_0}{S_1}\Big) + \mathbb{E}\Big[\frac{S_0}{S_1}\Big]. \tag{12}$$

Our model endogenously generates a negative gap between forward premium, S_0/F, and the expected appreciation of the peso, when the risk aversion parameters γ_h, γ_s are non-zero. (12) also uncovers a close inverse relationship between equilibrium hedging cost and expected peso appreciation: speculators with long forward position are willing to lose on the benefit of accommodating hedgers' inelastic forward demand from hedging their bond position, when the peso is expected to sufficiently appreciate to compensate for the equilibrium drop in the hedging cost.[22]

(12) also implies the following comparative statics:

Lemma 2. *The equilibrium hedging cost is increasing in the risk aversion of the hedger or speculator, and decreasing in the expected appreciation of the peso.*

A higher risk aversion increases hedging demand while depressing the willingness of the speculator to supply hedging services. Meanwhile, when the peso is expected to appreciate, speculator with a long forward peso position is expected to gain while the hedger lowers her hedging demand, driving down the hedging cost.

Rearranging (12) and using (10), we also see that the model provides a sharp characterization of the equilibrium pattern of hedging services:

Lemma 3. *If $\gamma_h, \gamma_s < \infty$, then in equilibrium, the hedger hedges her currency risk, but not fully:* $\tilde{h} = (1+r)\Big[1 - \frac{\gamma_h^{-1}}{\gamma_h^{-1}+\gamma_s^{-1}}\Big] \in (0, 1+r)$.

The intuition for Lemma 3 is the following: the hedger has an incentive to hedge its preexisting peso exposure as long as the hedging cost is not too large relative to

[22] De Leo, Keller and Zou's (2024) model also generates an inverse relationship between CIP and UIP deviations, through an intermediary-based mechanism different from ours. In their model, local intermediaries cannot take currency risk. They require profits to overcome portfolio frictions and accommodate a higher speculative forward demand driven by UIP violations.

the expected peso depreciation. In order, however, to make the risk averse speculator willing to take the opposite position, the speculator must be compensated by a risk premium – the distance between expected peso appreciation and the forward premium. In equilibrium, this premium is always positive, resulting in partial hedge. Lemma 3 is consistent with our finding for hedger funds, whose currency hedging is sporadic and seldom full.

To sharpen the intuition, consider two polar cases. If $\gamma_h \to \infty$, the hedger is infinitely risk averse, and by (10) will hedge out the entire position, $1 + r$ at any price. If $\gamma_s \to 0$, the speculator's risk-bearing capacity is infinite, and is willing to supply hedging service at any level of the forward premium. By (12), hedging will be costless and the hedger also fully hedges.

5.2 Hedging cost in the data: The role of speculative positions

Supported by the model, we set out to investigate how speculative and hedging positions are related to hedging cost and currency returns. We take a two-step approach. Motivated by (11), we first show that the portfolios of currencies that offer higher returns are also associated with stronger speculator fund positioning. We then show that, consistent with (12), hedging cost is lower for currencies receiving higher speculative pressure, reflecting the stronger willingness of speculators to provide hedging services for high-return currencies.

We first propose three measures at the currency level that can be used to characterize the cross-currency difference in the strength of speculative pressure. Our primary measure is the share of speculative position for each currency, defined as

$$\text{Speculative Share}_{ct} = \frac{|\sum_i NFS_{ict} \times \mathbb{1}\{NFS_{ict} < 0\}|}{|\sum_i NFS_{ict} \times \mathbb{1}\{NFS_{ict} > 0\}| + |\sum_i NFS_{ict} \times \mathbb{1}\{NFS_{ict} < 0\}|}. \tag{13}$$

The denominator, $|\sum_i NFS_{ict} \times \mathbb{1}\{NFS_{ict} < 0\}|$, is sum of the absolute net long forward position across all funds trading currency-c forward contracts. (13) is a monotonic transformation of the ratio between hedging and speculating mutual fund positions in our data, and intuitively separates currency risk-taking from currency risk-hedging due to underlying bond investment. A currency faces more speculative pressure from mutual funds if the risk-taking component is larger compared to the amount of hedging in place.

We also define two alternative measures:

$$\text{NFP}^{\$}_{ct} = -\sum_i (\widetilde{FS}_{ict} - \widetilde{FP}_{ict}) \tag{14}$$

$$\text{NFP}_{ct} = \frac{\text{NFP}^{\$}_{ct}}{\sum_i TNA_{it}} \tag{15}$$

where $\widetilde{FP}_{ict}$ and $\widetilde{FS}_{ict}$ follow the definition in Section 2, measuring the PV of gross forward long/short position of fund i in currency c. $\text{NFP}^{\$}_{ct}$ and NFP_{ct} are the currency-level counterparts to the negative of fund-currency level net forward sales NFS_{ict}, except that $\text{NFP}^{\$}_{ct}$ is the dollar PV and NFP_{ct} is scaled (or weighted) by the total net assets of all funds in our sample at time t.

Portfolio sorting One important cross-sectional implication of the model is that holding all else constant, speculators are more willing to hold a long forward position if the local currency is expected to appreciate by a larger extent. We test this hypothesis following the usual approach of constructing sorted portfolios. For each month, we group 20 major EM currencies in our sample into three equal-weighted portfolios, sorted by the speculative pressure faced by the currencies (13). We calculate the currency return ($f_t - s_{t+1}$) and the long-short strategy of longing Portfolio 3 (the one with the highest speculative pressure) and shorting Portfolio 1 (the one facing the lowest speculative pressure), and report the results in Table 6. The long-short strategy generate an excess return of 3.01% per annum, indicating that the speculators are expected to earn a risk premium from taking a long forward position to engage in hedging service provision.

	Mean	STD	SE	Fwd Disc	Int Diff	CCI	Sharpe Ratio
High-Low	3.01	5.62	1.63				0.54
High Speculative Share	0.38	7.26	2.09	3.01	3.08	0.64	0.05
Medium Speculative Share	0.20	7.27	2.00	3.85	3.56	0.51	0.03
Low Speculative Share	-2.63	8.14	2.26	3.73	3.35	0.44	-0.32

Table 6: Summary statistics: Currency portfolios sorted on speculative pressure

Notes: Table 6 presents the summary statistics of the currency portfolios formed based on currency-level speculative position defined in Equation (13). Portfolios are rebalanced every quarter. STD refers to standard deviation. Standard error (SE) is estimated using Newey-West method with 3 lags. All variables are annualized and in percentage terms. "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 Fernández, Klein, Rebucci, Schindler and Uribe (2015). The estimation is based on a monthly sample from 2012M1 to 2023M12. 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, TWD, ZAR.

Cross-sectional implication on CIP deviations Table 7 shows that consistent with (12), our various measures of speculative and hedging pressure defined in (13) to (15) are systematically related to cross-currency differences in short-term (3-month) CIP deviations. In particular, we find that a stronger level of speculative pressure is associated with more negative CIP deviations in the cross-section. For instance, for our primary measure of speculative pressure in Equation (13), a 10 percentage point increase in a currency's share of speculative position is associated with an decrease of 16 basis points in CIP deviations. As currencies receiving stronger speculative mutual fund positioning have higher returns (Table 6), this finding is consistent with the intuition in (12) that speculators are willing to receive a lower benefit from supplying the hedging contract for high-return currencies.[23]

[23]This finding is conceptually distinct from those associated with the exchange rate determination model of Liao and Zhang (2024) through the net hedging channel, where higher net hedging demand leads to a wider level of equilibrium CIP deviation for G10 currencies. Unlike Liao and Zhang (2024), who show that net external position is positively associated with net hedging demand in G10 currencies, we find a negative correlation between gross and net external positions of the U.S. against EMs and the level of CIP deviations (see Table A4 in the Appendix. Also see Cerutti and Zhou (2024) and De Leo, Keller and Zou (2024) for a similar analysis using net foreign assets). This suggests that unlike the bilateral external position between U.S. and other G-9 economies, hedging demand by U.S. in EM currencies is not positively associated with their net external position.

	CIP3M	CIP3M	CIP3M
Speculative Share (%)	-1.569**		
	(0.716)		
$NFP^{\$}(\$100m)$		-2.863**	
		(1.141)	
NFP(%)			-20.205**
			(8.574)
Time FE	✓	✓	✓
R-squared	0.114	0.104	0.104
N	928	930	930

Table 7: Measures of speculative pressure and CIP deviations

Notes: Table 7 presents results on the cross-sectional relationship between three measures of speculative pressure and the level of CIP deviations. The first measure, speculative share, is the sum of the absolute net long forward position across all funds in a given currency, scaled by the sum of the absolute net long and short forward positions across all funds in a given currency. The second measure, $NFP^{\$}$, is the dollar PV of net forward purchase (long) positions across all funds in a given currency. The third measure, NFP, is the dollar PV of net forward purchase (long) positions across all funds in a given currency, scaled by total net assets of all funds in our sample at a given quarter. CIP deviations are in basis points. Speculative share and NFP are in percentage terms. $NFP^{\$}$ is in the scale of $100 million. Standard errors are clustered at time level. Significance of the coefficients at the 10%, 5%, and 1% levels of statistical significance are denoted by the superscripts *, **, and ***. The estimation is based on the sample period from 2012Q1 to 2023Q3. 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, TWD, ZAR.

5.3 Unwinding of speculation during global and local risk-off episodes

In the model, a contraction of speculators' capacity to accommodate hedging demand, encoded in their risk aversion coefficient, would widen the equilibrium forward discount. To see this clearly in the data we focus on two episodes featuring strong unwinding of speculator position.

Global downturn: COVID-19 crisis Figure 5 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, driven mostly by speculators' unwinding of long forward position in EM currencies. Looking at the cross-section of currencies, Figure 6 confirms a substantial correlation between the scale of speculative position unwound and the rise in hedging costs, measured by the difference in the forward premium for each currency between 2019Q4 and 2020Q2.

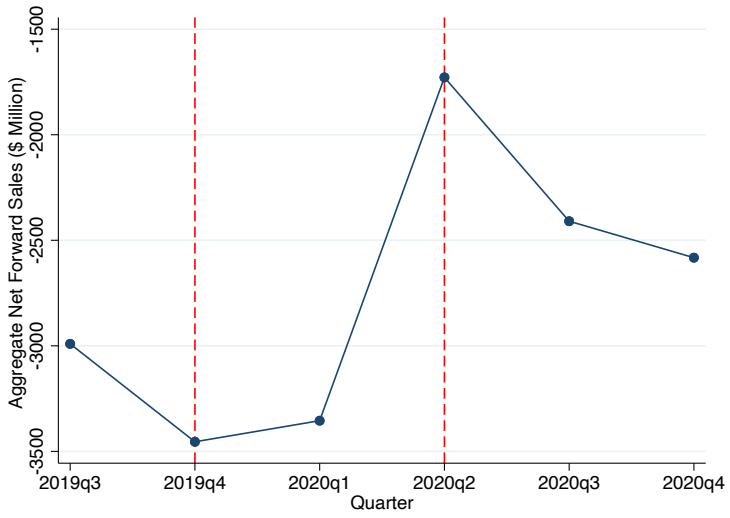


Figure 5: Aggregate net forward sales during the COVID-19 crisis

Notes: Figure 5 presents 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). Our sample currencies include: BRL, CLP, CNY, COP, CZK, HUF, IDR, ILS, INR, KRW, MXN, MYR, PEN, PHP, PLN, RUB, THB, TRY, TWD, ZAR.

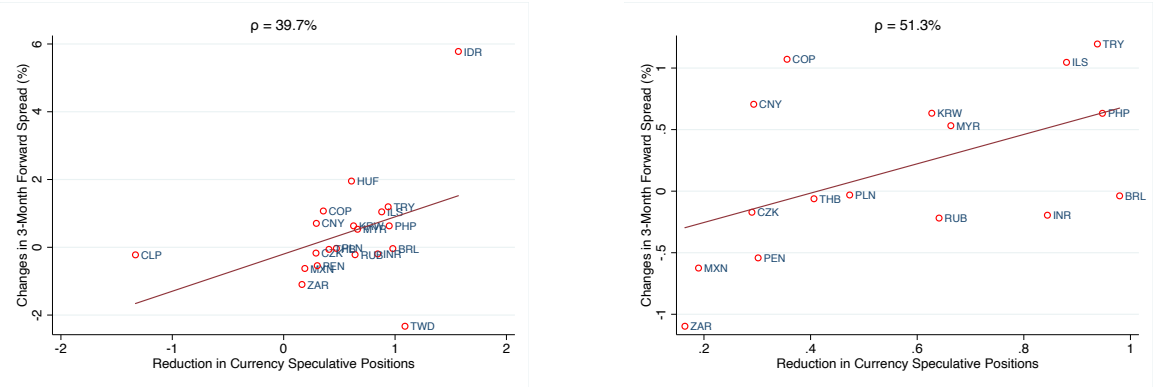
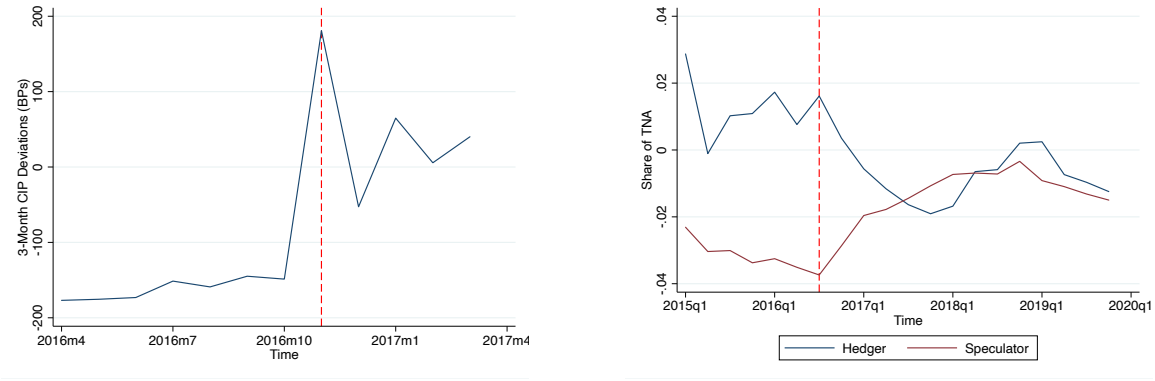


Figure 6: Changes in hedging cost and speculative net forward positions during COVID-19 across currencies

Notes: Figure 6 illustrates the correlation between the scale of reduction in currency speculative position and rise in hedging costs. The y-axis in both panels refers to change in 3-month forward spread $(f_t - s_t)$ between 2019Q4 and 2020Q2, which is expressed in percentage point. The x-axis in both panels indicates change (reduction) in currency speculative position between 2019Q4 and 2020Q2. The left panel includes a sample of 20 major EM currencies for which we have substantial data coverage on hedging cost: BRL, CLP, CNY, COP, CZK, HUF, IDR, ILS, INR, KRW, MXN, MYR, PEN, PHP, PLN, RUB, THB, TRY, TWD, ZAR. The right panel removes four currencies (TWD, IDR, CLP, HUF) to make the plot more graphically interpretable. The definition of currency speculative position is defined in the same spirit of equation 13. In particular, the change in currency speculative position is defined as:

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

Local regulatory event: MYR NDF trading restrictions The Malaysian Ringgit boasted a large NDF market before 2017. The central bank, Bank Negara Malaysia, does not allow domestic entities trading in the offshore NDF market, but did not enforce the ban until November 2016.[24] Following the ban, Figure 7 shows that 3-month CIP deviations spike by more than 200 basis points, accompanied by a protracted decline in both speculative and hedging position.[25] Furthermore, while speculator funds in MYR partly unwind their speculative positions, hedger funds in MYR move from a net short forward position to a net long forward position after the shock, suggesting that the tighter FX regulation to discourage forward trading may have nevertheless pushed fund managers to use forwards to directly gain currency exposure to MYR.[26]



(a) 3-Month CIP deviation **(b)** Net forward sales

Figure 7: FX Hedging Cost and Speculative Positions around 2016Q4 for MYR

Notes: Figure 7 presents time-series of MYR's 3-month CIP deviation and FX net forward sale position of hedgers and speculators around the regulatory event in November 2016 that banned residents from trading in FX NDF markets. The definition of fund type is based on fund-level FX net forward sale position in MYR from 2015Q1 to 2016Q3. In particular, a fund is classified as a speculator in MYR if its average net forward sale position in MYR is strictly negative, and a hedger if its average net forward sale position in MYR is positive and the mean of its portfolio weight in MYR is non-zero.

[24] More concretely, banks are required to attest that they do not trade in the NDF market, and 75% of export proceeds are mandated to convert back to MYR. Schmittmann and Teng (2020) discuss the policy detail.

[25] Speculator and hedger funds are defined based on the sign of average MYR net forward sale position for each fund from 2015Q1 to 2016Q3. As a result, a hedger's position can go negative after the shock.

[26] This is consistent with our findings on the relationship between capital control and net forward sale position in Section 3.

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 investors are much bigger and wider than previously understood. We demonstrate that a mean-variance portfolio choice framework and capital account restrictions could explain the direction and degree of currency forward positions observed in data. We then unpack the average pattern of currency forward usage by separating funds into currency hedgers and speculators, and explore the key drivers of their currency risk management decisions and show how they differ in important dimensions. In an equilibrium model featuring currency hedgers and speculators, we study the implications of currency hedging and speculation on exchange rate dynamics.

This paper offers a unique perspective to rationalize the strong relationship between currency indices and global capital allocation and CIP deviations (Avdjiev, Du, Koch and Shin, 2019; Jansen, Shin and von Peter, 2023) and the currency crashes during global downturns (Brunnermeier, Nagel and Pedersen, 2008). It provides a rare look into the market of offshore currency forwards, whose activities could move exchange rates substantially but have received little attention due to strong market segmentation and data limitation. The paper also opens up new avenues for future work to understand international shock spillovers through the FX derivative channel.

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Online Appendix

A Additional Figures and Tables

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

Year	Speculator	Hedger	Non-FX User	Total
2012	43	21	7	71
2013	53	26	11	90
2014	56	27	11	94
2015	57	29	15	101
2016	57	29	16	102
2017	55	30	13	98
2018	55	27	14	96
2019	49	28	13	90
2020	44	23	10	77
2021	44	23	11	78
2022	46	24	8	78
2023	42	22	10	74

Table A1: Fund type over time

Table A1 tabulates the number of speculator and hedger funds over time. A fund is classified as a speculator fund 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 and the mean of its portfolio weight is non-zero. The sample period is from 2012Q1 to 2023Q3.

FX Counterparty	Percent
ABN AMRO	0.00
ANZ	0.22
AXA	0.00
BBVA	0.00
BNP Paribas	5.39
BT Brokerage	0.01
Banco Santander	0.40
Bank Of Georgia	0.01
Bank of America	5.11
Bank of Montreal	0.03
Bank of New York Mellon	0.07
Bank of Nova Scotia	0.09
Barclays	8.64
Baring	0.00
Brown Brothers Harriman	0.16
Canadian Imperial Bank of Commerce	0.04
Cantor Fitz & Co.	0.00
Citigroup	14.41
Commonwealth Bank of Australia	0.02
Credit Agricole	0.34
Credit Suisse	2.13
Danske Bank	0.00
Den Norske Bank	0.00
Deutsche Bank	5.37
Deutsche Boerse	0.00
Dresdner	0.01
Goldman Sachs	9.56
HC Istanbul	0.00
HH Clearing Services	0.00
HSBC	6.02
Hencorp	0.00
Highland Information Services	0.00

ING	0.03
Industrial and Commercial Bank of China	0.10
JP Morgan	13.95
Macquarie	0.01
Mimlic	0.00
Morgan Stanley	11.14
National Australia Bank	0.03
Natixis	0.00
Natwest	0.62
Nomura	0.17
Northern Trust Co	0.01
Payden	0.00
Raiffeisen	0.00
Royal Bank of Canada	0.76
Scotiabank	0.00
Siam Commercial Bank	0.02
Societe Generale	1.29
Standard Bank	0.67
Standard Chartered	5.99
Standard and Poor's Securities	0.00
State Street	1.92
Stifel, Nicolaus & Company	0.01
Toronto Dominion	0.37
Truist	0.00
UBS	4.64
VTB Capital Plc	0.02
Wells Fargo	0.02
Westpac	0.22
Total	100.00

Table A2: List of FX counterparties

Notes: Table A2 tabulates the list of all FX counterparty banks (at parent level) in our sample. The second column indicates the percentage of observations associated with each bank.

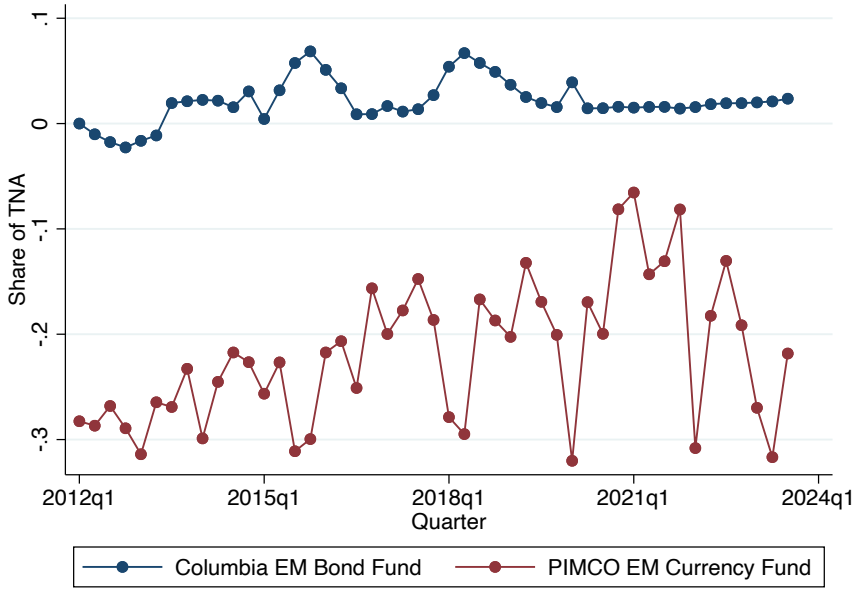


Figure A2: Example: Speculator and hedger funds

Notes: Figure A2 presents the time-series average of net forward sale position of two funds in our sample – PIMCO EM Currency Fund (speculator) and Columbia EM Bond Fund (hedger). A fund is classified as a speculator fund 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 and the mean of its portfolio weight is non-zero.

	Speculator fund			Hedger fund		
	(1)	(2)	(3)	(4)	(5)	(6)
Lag-1 Portfolio Weight	0.166***	0.068	0.100**	0.305***	0.247	0.396***
	(0.045)	(0.050)	(0.041)	(0.088)	(0.164)	(0.119)
Lag-1 Momentum	-0.030	-0.029	-0.049*	0.016	-0.001	-0.013
	(0.020)	(0.023)	(0.026)	(0.020)	(0.026)	(0.025)
Lag-1 1-Month CIP Deviation	0.042***	0.045**	0.055**	-0.005	0.012	0.029*
	(0.016)	(0.019)	(0.021)	(0.012)	(0.013)	(0.015)
Lag-1 Currency Volatility	-0.017	-0.094**	-0.115***	0.016	-0.013	-0.060
	(0.036)	(0.046)	(0.040)	(0.032)	(0.043)	(0.040)
Lag-1 Momentum × Weight		-0.001	0.005		0.012	0.013
		(0.003)	(0.004)		(0.009)	(0.010)
Lag-1 CIP × Weight		0.004	0.003		-0.017	-0.005
		(0.005)	(0.006)		(0.013)	(0.010)
Lag-1 Volatility × Weight		0.032***	0.027***		0.018	0.024
		(0.009)	(0.008)		(0.036)	(0.027)
Time FE	✓	✓		✓	✓	
Fund-by-Quarter FE			✓			✓
R-squared	0.042	0.046	0.319	0.129	0.131	0.331
N	28602	28602	28531	6490	6490	6374

Table A3: Net forward sale and currency characteristics: Speculators and hedgers [1-month horizon]

Notes: Table A3 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. A fund is classified as a speculator fund 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 and the mean of its portfolio weight is non-zero. The dependent variable is the net forward sale position of fund i in currency c at time t. The independent variables include momentum (computed by spot exchange rate return), 1-month CIP deviation, currency volatility (computed by past 12 months' exchange rate volatility). All independent variables are lagged by one quarter. Both dependent and independent variables are converted to percentage terms. Standard errors in parentheses are double-clustered by fund and time. The estimation is based on the sample period from 2012Q1 to 2023Q3. Our sample currencies include major EM currencies with sufficiently active foreign exchange markets and for which we have substantial data coverage on hedging cost: BRL, CLP, CNY, COP, CZK, HUF, IDR, ILS, INR, KRW, MXN, MYR, PEN, PHP, PLN, RUB, THB, TRY, TWD, ZAR.

	CIP3M	CIP3M
Gross External Position	-0.124***	
	(0.036)	
Net External Position		-0.119***
		(0.034)
Time FE	✓	✓
R-squared	0.148	0.143
N	806	789

Table A4: Bilateral external position and CIP deviation

Notes: Table A4 presents results on the cross-sectional relationship between bilateral external position and level of CIP deviations. Gross external position is the total debt holding of U.S. in a country. Net external position is the net debt holding of U.S. in a country. Measures of bilateral positions are in billion USD. Measures of CIP deviations are in basis points. Standard errors are clustered at time level. Data on bilateral positions is from the IMF's Coordinated Portfolio Investment Survey (CPIS). CPIS publishes data semi-annually. We forward-fill missing observations at quarterly frequency. Significance of the coefficients at the 10%, 5%, and 1% levels of statistical significance are denoted by the superscripts *, **, and ***. The estimation is based on the sample period from 2011Q1 to 2023Q3. Our sample currencies include: BRL, CLP, COP, CZK, HUF, IDR, INR, MXN, MYR, PEN, PHP, PLN, RUB, THB, TRY, ZAR.

B A mean-variance model of optimal hedging

We sketch a simple mean-variance framework to take the empirical hedge ratio to the data (see Section 3). 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:

$$rx^{\$}_{t+1} = r^{\$}_{t+1} - rf^{\$}_{t} \tag{16}$$

$$rx^{j}_{t+1} = r^{j}_{t+1} - rf^{j}_{t} \tag{17}$$

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:

$$rx_{t+1}^{j,NH} = r_{t+1}^{j} - \Delta s_{t+1} - rf_t^{\$} \tag{18}$$

$$= (r_{t+1}^{j} - rf_t^{j}) + \underbrace{(rf_t^{j} - rf_t^{\$} - \Delta s_{t+1})}_{:=rx_{t+1}^{FX}} \tag{19}$$

$$= rx_{t+1}^{j} + rx_{t+1}^{FX} \tag{20}$$

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

$$rx_{t+1}^{j,H} \approx r_{t+1}^{j} - (f_t - s_t) - rf_t^{\$} \tag{21}$$

$$= (r_{t+1}^{j} - rf_t^{j}) + \underbrace{(rf_t^{j} - rf_t^{\$} - (f_t - s_t))}_{:=x_t} \tag{22}$$

$$= rx_{t+1}^{j} + x_t \tag{23}$$

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:

$$\max_{w_j, w_{j,NH}} \mathbb{E}[rx_{t+1}^{P}] - \frac{\gamma}{2}\mathbb{V}[rx_{t+1}^{P}], \tag{24}$$

where

$$rx_{t+1}^{P} = (1 - w_j) rx_{t+1}^{\$} + w_{j,NH}(rx_{t+1}^{j} + rx_{t+1}^{FX}) + (w_j - w_{j,NH})(rx_{t+1}^{j} + x_t) \tag{25}$$

$$= (1 - w_j) rx_{t+1}^{\$} + w_j rx_{t+1}^{j} + w_{j,NH} rx_{t+1}^{FX} + (w_j - w_{j,NH}) x_t \tag{26}$$

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

$$\mathbb{E}[rx_{t+1}^P] = (1 - w_j)\overline{rx}^{\$} + w_j\overline{rx}^j + w_{j,NH}\overline{rx}^{FX} + (w_j - w_{j,NH})x \tag{27}$$

$$\begin{aligned}\mathbb{V}[rx_{t+1}^P] = &(1 - w_j)^2\sigma_{\$}^2 + w_j^2\sigma_j^2 + w_{j,NH}^2\sigma_{FX}^2 \\ &+ 2w_j(1 - w_j)\sigma_{\$,j} + 2w_{j,NH}(1 - w_j)\sigma_{\$,FX} + 2w_j w_{j,NH}\sigma_{j,FX}\end{aligned} \tag{28}$$

The optimal portfolio weights are:

$$w_j = \frac{(\sigma_{j,FX} - \sigma_{\$,FX})(\overline{rx}^{FX} - x - \gamma\sigma_{\$,FX}) - \sigma_{FX}^2(\overline{rx}^j - \overline{rx}^{\$} + x - \gamma\sigma_{\$,j} + \gamma\sigma_{\$}^2)}{\gamma[(\sigma_{\$,FX} - \sigma_{j,FX})^2 - \sigma_{FX}^2\sigma_{j-\$}^2]}, \tag{29}$$

$$w_{j,NH} = \frac{\gamma\sigma_{\$,FX}(\sigma_j^2 - \sigma_{\$,j}) + \gamma\sigma_{j,FX}(\sigma_{\$}^2 - \sigma_{\$,j}) + (\sigma_{j,FX} - \sigma_{\$,FX})(\overline{rx}^j - \overline{rx}^{\$} + x) + \sigma_{j-\$}^2(x - \overline{rx}^{FX})}{\gamma[(\sigma_{\$,FX} - \sigma_{j,FX})^2 - \sigma_{FX}^2\sigma_{j-\$}^2]}, \tag{30}$$

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

The implied hedge ratio is then:

$$\text{HR}_j = \frac{w_j - w_{j,NH}}{w_j} \tag{31}$$

B.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 31. Then, we compare predicted hedge ratio with observed hedge ratio from 2021Q2 to 2023Q2 in our sample.[27] We focus on one- and three-month horizons.

For bond returns, we compute holding period return based on 10-year government

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

bond pricing data from Du and Schreger (2016) and Du, Im and Schreger (2018). For currency return and hedging costs, 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:

$$rx^j_{t+1} = y_{10Y,t} - 119\Delta y_{10Y,t+1} - rf^j_t, \tag{32}$$

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

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

$$rx^{FX}_{t+1} = rf^j_t - rf^\$_t - 12\Delta s_{t+1} \tag{33}$$

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:

$$rx^j_{t+1} = y_{10Y,t-2} - 39(y_{10Y,t+1} - y_{10Y,t-2}) - rf^j_{t-2}, \tag{34}$$

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

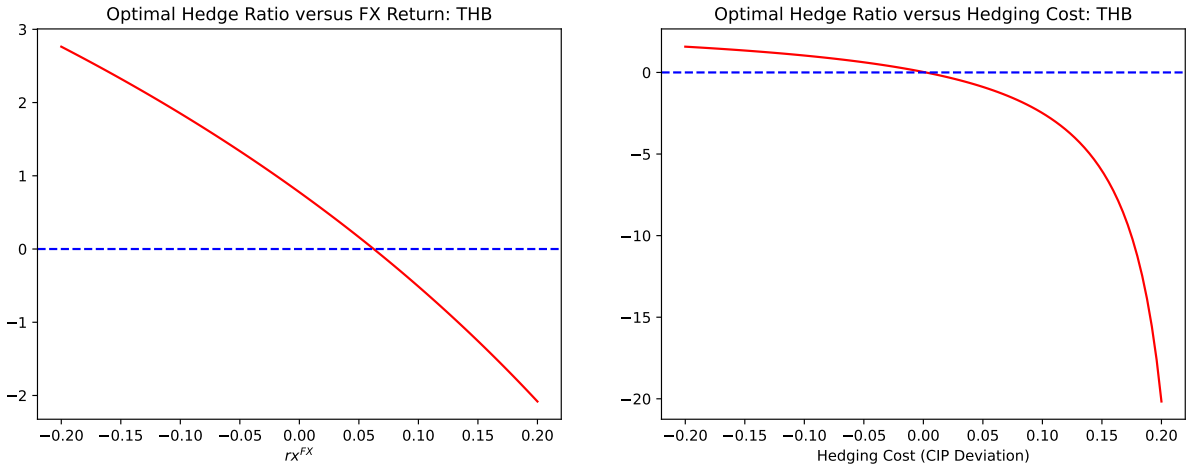
Similarly, three-month currency return can be computed by:

$$rx^{FX}_{t+1} = rf^j_{t-2} - rf^\$_{t-2} - 4(s_{t+1} - s_{t-2}) \tag{35}$$

B.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 B1 shows that higher FX return and higher hedging costs could lead a mean-variance investor to amplify her currency risk exposure by taking negative hedge ratio. Figure B2 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.



(a) THB **(b)** THB

Figure B1: Optimal hedge ratio, FX return, and hedging cost

Notes: Figure B1 shows the relationship between the model-implied optimal hedge ratio and FX return and hedging cost, given returns of Thailand and US government local currency bonds, 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 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.

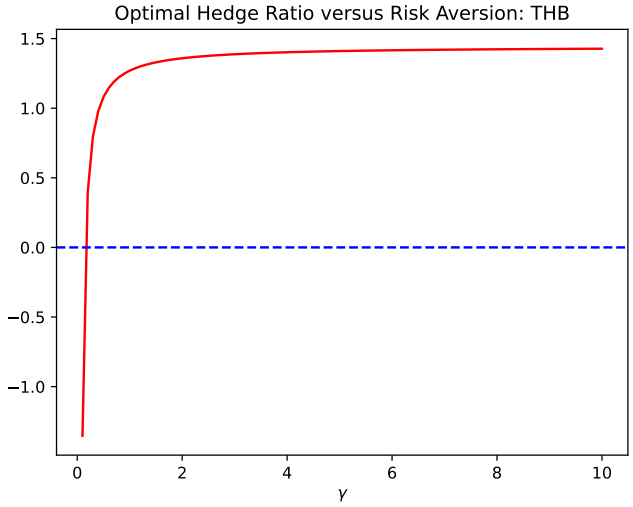


Figure B2: Optimal hedge ratio and risk aversion: The case of THB

Notes: Figure B2 presents how optimal hedge ratio of THB responds to risk appetite, given returns of Thailand and US government local currency bonds, as well as variance-covariance matrix of bond and FX returns. The following parameters 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.