Deviations of Covered Interest Parity, Dollar Funding Pressure, and Currency Risk Premia

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Abstract

This paper investigates the relationship between deviations from Covered Interest Rate Parity (CIP) and the cross-sectional variation in currency risk premia. Motivated by the currency hedging channel proposed by Liao & Zhang (2025), I use CIP violations as a measure of dollar funding pressure in postcrisis era, reflecting imbalances between excessive dollar hedging demand and constrained funding supply due to intermediation costs. Utilizing G10 currency data, I show that currencies with higher unconditional cross-currency basis values yield significantly higher excess returns, compensating investors for bearing greater dollar funding pressure risk. A tradable trading strategy that longs in currencies with high basis and shorts currencies with low basis, referred to as the "global cross-currency basis" factor, delivers economically large and statistically significant returns, explaining a large variation in cross-sectional variation in currency returns, particularly during the postcrisis period. Besides, the basis factor also encompasses information embedded in nominal interest rates (i.e., carry trade) and global imbalances in trade and capital flows during the postcrisis period.

JEL classification: G15, F3, F31, F34

keywords: international finance, covered interest rate parity, cross-currency basis, dollar hedging, currency risk premia

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1 Introduction

The U.S. dollar plays a dominant role in international finance, serving as the primary currency for global reserves, cross-border lending, and trade settlement. A large portion of dollar-denominated financial positions is held by non-U.S. institutions,[1] generating persistent hedging demand that is primarily intermediated through FX forward markets.[2] However, post-Global Financial Crisis (GFC) regulatory reforms, such as non-risk-weighted capital requirements of Basel III, have imposed significant balance sheet constraints on the intermediation sector. These constraints reduce their ability to absorb hedging flows, leading to persistent and systematic deviations from Covered Interest Parity (CIP) and having profound implications for asset pricing.[3] Du et al. (2023) interpret the absolute magnitude of cross-currency basis as a proxy for the shadow cost of constrained intermediaries, linking the balance sheet costs directly to the currency pricing. However, the extent to which unconditional CIP deviations inform the pricing dynamics of currency markets remains an open and unexplored question.

Building on the hedging channel framework of exchange rate determination developed by Liao & Zhang (2025), this paper interprets the CIP deviations in the post-GFC era as a proxy for dollar funding pressure risk. The unconditional level of the cross-currency basis reflects structural imbalances between an excessive dollar hedging demand and constrained dollar supply. Specifically, lower (more negative) basis values in dollar-terms indicate lower dollar funding pressure, while higher (positive) values signal greater pressure.[4] This study empirically examines the asset pricing implications of the dollar funding pressure by evaluating its relationship with the cross-sectional currency excess returns. The findings provide novel evidence that the basis embeds a distinct source of priced risk, subsuming information contained in nominal interest rate differentials (carry factor of Lustig et al. (2011)) and dollar imbalance measures (e.g., the global imbalance factor of Corte et al. (2016)).

[1]For instance, data from the Bank for International Settlements (BIS) locational banking statistics (July 2014) indicates that European banks alone accounted for approximately 28% of the U.S. syndicated loan market between 2005 and 2007.

[2]Many market participants face barriers to getting access to direct dollar funding from dollar-rich lenders, making financial intermediaries (i.e., large global banks) essential in channeling the global supply of dollars to accommodate the strong demand for dollars (Du & Schreger, 2022).

[3]A growing literature on intermediary asset pricing emphasizes that constraints on financial intermediaries have significant implications for asset prices (e.g., He & Krishnamurthy, 2013, 2018; Kondor & Vayanos, 2019). A growing body of research, among others, documents persistent and systematic deviations from CIP in the postcrisis period (Ivashina et al., 2015; Borio et al., 2016; Du et al., 2018; Cerutti et al., 2021; Du & Schreger, 2022; Keller, 2024; Moskowitz et al., 2024).

[4]Note that in the postcrisis period, dollar-denominated cross-currency bases are predominantly negative for G10 currencies, indicating that synthetic dollar interest rates in the FX swap market exceed direct dollar funding rates for most of G10 currencies. Consistent with the literature, the cross-currency basis in this paper is defined in dollar terms unless otherwise specified.

The empirical analysis in this paper is structured around two testable hypotheses, as introduced in Section 2. The first hypothesis posits that currencies with higher basis values earn higher excess returns, reflecting compensation for greater exposure to dollar funding risk. Conversely, currencies with lower basis values are deemed safer and yield lower risk premia. This hypothesis is grounded in Liao & Zhang (2025) where the cross-currency basis arises from two joint forces: dollar hedging demand, driven by excessive external dollar debt imbalances, combined with the constrained intermediary supply. For example, countries with positive net dollar asset positions, such as Japan, hedge the Yen appreciation by selling dollars and purchasing domestic currencies in the forward market on the demand side. Intermediaries, in turn, fulfill this hedging demand by borrowing dollars, converting them to local currency in the spot market, investing domestically, and delivering the currency at forward maturity. Under postcrisis regulatory constraints, arbitrageurs' limited balance sheet capacity significantly raises the cost of providing dollar hedging services, leading to a persistent global shortage of dollar liquidity. In equilibrium, the price of the Japanese Yen in forward markets has to be elevated relative to spot markets after adjusting for interest rate differentials, because the financial intermediary must be compensated for using their precious balance sheet capacity in supplying FX forward contracts.[5] Therefore, countries with hedging demand to sell dollars and purchase domestic forwards must pay a premium to obtain domestic currency forwards. This premium shows up as a negative basis. By supplying dollars, these countries face less dollar scarcity and are therefore less exposed to dollar funding pressure risk. Consequently, their currencies are perceived as safer and offer lower expected excess returns. The logic is symmetric for countries with negative net dollar positions, which engage in hedging by exchanging domestic currency for forward dollars. They must pay a premium in purchasing dollar forwards, resulting in a positive basis. Such hedging demand for purchasing dollar forwards exacerbates the dollar shortage, exposing them to higher dollar funding pressure. Accordingly, their currencies yield higher expected excess returns as compensation for this risk.

Before the financial crisis, intermediaries were largely unconstrained, and FX swap markets exhibited a perfectly elastic dollar supply. As a result, CIP held tightly, with any deviations reflecting transient market frictions such as counterparty credit risk or temporary liquidity dry-up.[6] In this context, the assumption of constrained intermediaries, as

[5]Despite rising intermediation costs, demand for dollar hedging and borrowing remained strong. As documented by Puriya & Bräuning (2021), major banking sectors outside the U.S. exhibit large dollar funding gaps, with significant mismatches between dollar-denominated assets and on-balance-sheet dollar liabilities. In contrast to supply-side explanations of CIP deviations (see,e.g., Du et al., 2018; Avdjiev et al., 2019), they highlight the importance of demand-side forces in driving deviations from arbitrage conditions and shaping FX forward pricing.

[6]Market frictions that may lead to temporary CIP deviations include counterparty risk, market turbulence, liquidity risk, capital controls, and pricing errors (e.g., Taylor, 1989; Dooley & Isard, 1980; Akram et al., 2008; Baba et al., 2008; Coffey et al., 2009).

in Liao & Zhang (2025), does not hold, and therefore cannot account for the temporary CIP deviations observed during this period. However, a broader interpretation of basis values as indicators of currency-specific funding pressures remains valid. Keller (2024) offers such a framework, in which the sign of the basis reflects relative currency scarcity, regardless of its underlying source. Under this interpretation, a negative basis signals dollar scarcity, while a positive basis reflects scarcity of currency i. When dollars are scarce, countries with more hedging demands in dollars face higher dollar funding pressure, a mechanism that mirrors the post-GFC period and aligns with Liao & Zhang (2025). In contrast, when the domestic currency is scarce, countries with greater hedging demand to sell dollars in exchange for domestic currency forwards face higher funding pressure in the domestic currency. However, such transitory funding mismatches and CIP deviations in the precrisis period do not reflect persistent or systematic risks and thus fail to generate significant currency risk premia. Therefore, this paper focuses on the postcrisis period, during which basis values persistently deviated from zero, and interprets the basis as a proxy for dollar-specific funding pressure.

The second hypothesis examines whether the cross-currency basis subsumes information embedded in both nominal interest rate and external dollar imbalances. As mentioned earlier, a country's external dollar position shapes its hedging demand, making the bases naturally incorporate information about dollar imbalances. Importantly, however, the basis also captures dollar constraints from the supply side, making it a more comprehensive indicator of global dollar funding conditions than dollar imbalances. This hypothesis also extends to nominal interest rates. In the framework of Liao & Zhang (2025), during periods of heightened market volatility, currencies with negative basis values (i.e., held by countries with large positive net dollar asset positions) tend to appreciate in both spot and forward markets, while currencies with positive basis values (i.e., negative dollar positions) tend to depreciate. This pattern closely mirrors the well-documented uncovered interest parity (UIP) puzzle, where high-interest-rate currencies tend to depreciate in bad times, while low-interest-rate currencies act as safe havens and appreciate.[7] Consistent with this linkage, Du et al. (2018) document a strong positive correlation between the basis and interest differentials across time and cross-section. They attribute this relationship to greater demand for dollar-denominated assets in lower-interest-rate countries relative to the U.S., which intensifies dollar hedging needs in selling dollar forwards and purchasing domestic forwards, driving basis values more negative. While both interest rates and external imbalances contribute to variation in the basis, neither captures the intermediary supply-side frictions embedded within the basis. Hence, this hypothesis posits that the basis not only subsumes the information in interest rate differentials and exter-

[7]The failure of UIP leads to the profitability of carry trade strategies, which borrow in low-interest-rate currencies and invest in high-interest-rate currencies, generating persistent excess returns and forming a common risk factor in the cross-section of currency returns (e.g., Lustig et al., 2011, 2019).

nal dollar positions, but also contains a distinct source of variation from the supply-side impacts.

The empirical analysis employs the most liquid G10 currencies over the period from January 1999 to January 2024. Given the substantial violation of CIP in the post-GFC era, the analysis is conducted separately for the swap and cash markets. In empirical analysis, I sort currencies into quintile portfolios ($P1$ to $P5$) based on their lagged cross-currency basis values at t–1 and compute currency excess returns in both markets. The descriptive statistical results reveal a larger and more statistically significant return spread between $P1$ and $P5$ in the swap market than in the cash market, both over the full sample and, in particular, during the postcrisis period. Although the pattern is not strictly monotonic, excess returns generally increase from $P1$ to $P5$.

To formally test the first hypothesis, I construct a global basis factor (HML_x) which takes long positions in high-basis currencies and short positions in low-basis currencies. The cross-sectional asset pricing tests show that this factor commands a statistically significant annualized risk premium of 4.0–4.8% in swap markets and of 3.5-4.1% in cash markets in postcrisis period, with variation depending on the choice of test assets. The difference between the two markets reflects that tighter postcrisis balance sheet constraints significantly reduce access to dollar funding via forward contracts, unlike in cash markets, where access to dollar liquidity was relatively limited both before and after the crisis. Moreover, HML_x explains a substantial share of the cross-sectional variation in currency excess returns and provides significant incremental explanatory power beyond standard currency risk factors, including the dollar factor (DOL) and the carry factor (CAR) of Lustig et al. (2011). In swap markets, the inclusion of HML_x increases explanatory power by more than 15%. Notably, the pricing power of the traditional carry factor declines sharply or even disappears once HML_x is included.

Subsample analysis in the pre-and post-GFC periods provides further insights. While the estimated magnitude of the risk price of dollar funding pressure remains relatively stable across subsamples, its pricing power is predominantly concentrated in the postcrisis period. Specifically, HML_x subsumes the explanatory power of CAR after the crisis but is itself subsumed by CAR before the crisis. This pattern is consistent with theoretical predictions: before the crisis, CIP deviations were small and transient, and investors were largely unaware of funding pressure risk, which failed to translate into a systematically priced risk. Accordingly, no persistent compensation was required for bearing such risk prior to the crisis.

To test the second hypothesis and distinguish HML_x from CAR and external imbalance factors, I conduct a series of empirical analyses, including spanning regressions and horse race tests. I begin by constructing factor-mimicking portfolios based on the

two measures of a country's net dollar positions: net foreign asset ratio (nfa) (Corte et al., 2016; Liao & Zhang, 2025) and the net U.S. dollar debt holding ratio (ndt) (Liao & Zhang, 2025). Consistent with the theoretical predictions and the framework in Liao & Zhang (2025), I observe a strong negative relationship between the cross-currency basis and net dollar positions across both the full sample and the postcrisis subsample: the basis and these two dollar imbalance measures exhibit strictly opposite signs. Countries in the most negative basis quintile ($P1$) exhibit the most positive net dollar positions, while those in the highest basis quintile ($P5$) exhibit the most negative dollar imbalances. In addition, I incorporate the global imbalance portfolio of Corte et al. (2016), which is double-sorted on nfa and the share of external liabilities denominated in domestic currency (ldc). The resulting factor, IMB, captures variation in countries' external funding imbalances and their propensity to issue foreign-currency-denominated liabilities, reflecting broader imbalances in trade and capital flows.

Spanning regressions reveal that HML_x is not spanned by any of the three dollar imbalance measures, nor by a broad set of established FX risk factors potentially linked to the drivers of CIP deviations. Specifically, HML_x spans not only the three imbalance factors and CAR, but also other commonly used FX risk factors, delivering positive and statistically significant unexplained alphas. Besides, I also show that HML_x mainly differs from CAR by its short-leg, and the global dollar funding pressure risk constitutes an important role in explaining the forward premium puzzle (i.e., carry trade excess returns) over both full-sample and postcrisis periods. Horse race tests further demonstrate that HML_x consistently subsumes the explanatory power of CAR and all three external imbalance proxies in the post-GFC period, increasing the explanatory power (R^2) by more than 10%. While many standard FX risk factors, including CAR, exhibit limited pricing power after the crisis, HML_x emerges as a robust and consistently priced factor capable of explaining a substantial share of cross-sectional return variation in that period. Noteably, based on my sample, HML_x also subsumes the pricing power of currency momentum and value factor (Menkhoff et al., 2012a; Asness et al., 2013; Menkhoff et al., 2017) during the postcrisis periods. The pricing power of HML_x remains robust even after accounting for transaction costs such as bid-ask spreads. To summarize, the results support the research hypothesis by showing that HML_x captures a distinct, dominant, and priced source of risk in currency markets during the post-GFC era, one that is not captured by existing FX risk factors.

This paper contributes to the existing literature in three aspects. First, it complements the growing research on CIP deviations by providing novel empirical evidence on their asset pricing implications. While most of the existing literature focuses on exploring

structural determinants of CIP deviations,[8] few studies investigates its direct relationship with currency pricing. A notable exception is Du et al. (2023), who interpret the *absolute magnitude* of the basis as a proxy for shadow costs of balance sheet constraints. Their approach emphasizes the supply-side impact of constrained intermediaries on asset prices and contributes to the broader intermediary asset pricing literature (see, e.g., Garleanu & Pedersen, 2011; He & Krishnamurthy, 2013; Gabaix & Maggiori, 2015; He & Krishnamurthy, 2018).. In contrast, this study differs by employing the unconditional level of the cross-currency basis as a proxy for dollar funding pressure driven jointly by constrained intermediary supply and hedging demand, providing a new channel for understanding how CIP deviations affect the cross-section of currency risk premia.

Second, this paper contributes to the literature on the forward premium puzzle (e.g., Lustig & Verdelhan, 2007; Brunnermeier et al., 2008; Burnside et al., 2009; Burnside, 2011) by demonstrating that carry trade excess returns are, at least partly, compensation for cross-sectional differences in currencies' exposure to funding pressure risk. Building on Keller (2024), who interprets currency basis as relative currency scarcity, this study departs from the conventional literature that links the postcrisis CIP deviations with FX hedging demands and limits to arbitrage arising from constrained balance sheet capacity (e.g., Borio et al., 2016; Liao & Zhang, 2025) by showing that currency funding pressure explains a substantial portion of carry trade returns not only in the postcrisis period but also across the full sample, even when intermediaries were unconstrained and basis values were close to zero, thus offering a new risk-based interpretation of carry trade excess returns.

Third, this paper contributes to the broader currency asset pricing literature, which seeks to explain cross-sectional variation in currency returns through a risk compensation perspective (see, e.g., Lustig et al., 2011; Menkhoff et al., 2012a; Mancini et al., 2013; Corte et al., 2016; Colacito et al., 2020), among others. In the postcrisis period, the narrowing of nominal interest differentials across currencies diminishes the explanatory power of traditional benchmarks such as the carry trade. Similarly, several risk factors that perform well in the precrisis period or over the full sample exhibit limited pricing power post-GFC, with most of their explanatory power actually concentrated before the crisis happened. This paper contributes by introducing a novel risk factor, global dollar funding pressure, which not only subsumes demand-side factors such as carry and external

[8]Prior studies have linked CIP deviations to factors such as regulatory capital constraints (Ivashina et al., 2015), funding liquidity frictions (Mancini-Griffoli & Ranaldo, 2011), balance sheet costs for global banks (Du et al., 2018; Avdjiev et al., 2019), international imbalance in funding supply and investment demand (Du et al., 2018), limited arbitrage capital (Anderson et al., 2021), segmentation in U.S. dollar funding markets (Rime et al., 2022), market power and markups in FX swap markets (Wallen, 2020), and macroeconomic imbalances in safe-asset scarcity coupled with concentrated dollar demand (Moskowitz et al., 2024).

dollar imbalances, but also subsumes momentum and value factors in the postcrisis period. As such, it plays an important role, both economically and statistically, in explaining the cross-sectional variation in currency excess returns in the post-GFC environment.

The remainder of the paper is organized as follows. Section 2 reviews the CIP condition and outlines the theoretical framework and research hypotheses. Section 3 describes the data sources and the construction of currency portfolios sorted by the cross-currency basis. Section 4 describes the empirical methodology and conducts empirical analysis. Section 5 explores the relationship between the basis factor and other well-established FX risk factors, particularly carry trade and external imbalances. Section 6 concludes.

2 CIP Deviation and Economic Mechanism

In this section, I begin by reviewing the Covered Interest Parity (CIP) condition and introducing the calculation of the cross-currency basis. Building on the theoretical framework of Liao & Zhang (2025), I then describe how deviations from CIP influence currency risk premia in the cross-section through a hedging mechanism that links global investors' dollar hedge demand with the constrained supply of dollar funding with financial intermediation costs.

2.1 Review of CIP Condition and Cross-Currency Basis

Let $y^{\$}_{t,t+n}$ and $y^{i}_{t,t+n}$ denote n-year risk-free interest rates in U.S. dollars and in foreign currency i, respectively, both observed at time t. The spot exchange rate is denoted by S_t and the n-year outright forward exchange rate at time t is denoted by $F_{t,t+n}$. Both S_t and $F_{t,t+n}$ are quoted in units of foreign currency per U.S. dollar, so an increase in exchange rates corresponds to an appreciation of the U.S. dollar. Under the well-known no-arbitrage condition, the CIP relationship is given by:

$$(1 + y^{\$}_{t,t+n})^n = (1 + y^{i}_{t,t+n})^n \frac{S_t}{F_{t,t+n}}. \tag{1}$$

The intuition behind the CIP condition is straightforward. An investor can either invest one U.S. dollar domestically to receive $(1 + y^{\$}_{t,t+n})^n$ U.S. dollars after n years, or convert the dollar into S_t units of foreign currency today, then invest in foreign market to receive $(1 + y^{i}_{t,t+n})^n S_t$ units of foreign currency after n years, and simultaneously enter into a forward contract promised to convert the foreign currency into U.S. dollars at locked forward rate $F_{t,t+n}$. If both domestic and foreign notes are risk-free aside from

currency risk, and forward contracts are free of counterparty risk, then the two strategies yield equivalent returns, making the CIP condition a direct implication of no-arbitrage.

When the CIP does not hold, following Du et al. (2018), the CIP deviation is measured as the cross-currency basis $x^i_{t,t+n}$ in log forms, which is defined as the difference between the direct dollar rate $y^{\$}_{t,t+n}$ from the cash market and the synthetic dollar interest rate $(y^i_{t,t+n} - \rho^i_{t,t+n})$ from the FX swap market, obtained by converting the foreign currency interest rate in U.S. dollars using currency forward contracts:

$$x^i_{t,t+n} = \underbrace{y^{\$}_{t,t+n}}_{Cash\ Market\ Dollar\ Rate} - \underbrace{(y^i_{t,t+n} - \rho^i_{t,t+n})}_{FX\ Swap\ Market\ Dollar\ Rate}, \tag{2}$$

where $\rho_{t,t+n}$ is annualized forward premium in logs of selling foreign currency i in exchange for the U.S. dollar:

$$\rho^i_{t,t+n} \equiv \frac{1}{n}(f_{t,t+n} - s_t), \tag{3}$$

where s and f denotes the log of the spot and the forward exchange rate between foreign currency i and dollars, respectively. As soon as the basis is not zero, arbitrage opportunities theoretically appear. When CIP holds, the equation (1) implies that the currency basis should equal zero. The sign of $x_{t,t+n}$ reflects the direction of CIP deviations. A negative (positive) currency basis means that the direct dollar interest rate is lower (higher) than the synthetic dollar interest rate.

2.2 Theoretical Framework and Testable Hypothesis

I now explain how the cross-currency basis affects currency risk premia, following the theoretical framework developed by Liao & Zhang (2025). In this framework, they consider an two-periods (t=1, 2) economy with I countries, where each country contains a representative investor. A currency trader creates forwards by trading the spot exchange rate while borrowing and lending in the associated currencies. Exchange rates are quoted in terms of foreign currency per dollar.

Hedging demand: In period 1, it is assumed that the representative investor in a country i has an exogenous preexisting net external position of ω^i in U.S. dollar-denominated debt that matures in period 2 and earns the return $y^{\$}$. When $\omega^i > 0$, it means that this country has a positive external imbalance (e.g., holding net USD assets), while a country with $\omega^i < 0$ means that this country has a negative external

imbalance (e.g., holding net USD liabilities). In either case, the investor faces exchange rate risk and needs to hedge this risk exposure by trading dollars in the forward market.[9] If taking the forward exchange rate and interest rates as given, the optimal hedge ratio h^i is:

$$h^i = 1 - \frac{E\left[\frac{S_2}{S_1}\right] - \left(\frac{F}{S_1}\right)}{\gamma \operatorname{Var}\left[\frac{S_2}{S_1}\right] \omega^i S_1 y^{\$}}, \tag{4}$$

where γ is a level of risk aversion and the parameter space is restricted such that the hedge ratio h is bounded in [0,1].[10] The derivation of equation (4) is reported in the Online Appendix.

Supply of forwards: FX swap dealers act as financial intermediaries, devoting capital to provide liquidity in forward currency markets. Letting q^i denote the position in U.S. dollars that the intermediary takes in period 1 to accommodate the hedging demand of the country-i investor. The forward trader ultimately earns a profit of $q^i x^i$ from liquidity provision:

$$q^i x^i = q^i \left[(1 + y^{\$}) - \frac{S}{F}(1 + y^i) \right], \tag{5}$$

Forward traders supply liquidity in the forward market only if doing so yields non-negative profits, i.e., $q^i x^i \geqslant 0$. This condition implies that the signs of position q^i taken by the intermedairy must align with the sign of the cross-currency basis x^i, and it follows that q_i and x_i must have opposite signs to ω_i. To illustrate the economic rationale, consider a country i with a positive net external imbalance ($\omega^i > 0$), meaning the representative investor holds net U.S. dollar assets maturing in period 2. To hedge against domestic currency appreciation, the investor sells dollars and purchases currency i in the forward market. To fulfill this demand, arbitrageurs provide liquidity without incurring FX risk by borrowing U.S. dollars ($q^i < 0$) in cash markets and converting currency i in the spot

[9] If the representative investor in country i holds a positive external imbalance ($\omega > 0$) in U.S. dollars at time t=1, she is entitled to receive a net inflow of U.S. dollars at t=2. To hedge an appreciation of domestic currency, the investor must convert these future dollars into domestic currency. This is achieved by selling dollars and buying the domestic currency forward, i.e., entering a forward contract to sell USD and purchase currency i at the predetermined forward rate.

[10] The following two additional assumptions are made to guarantee that the optimal hedge ratio is bound between 0 and 1: (i). $\frac{E[S_2/S_1]-(F/S_1)}{\omega^i} > 0$; (ii). $\gamma S_1 y^{\$} \operatorname{Var}[S_2/S_1] \geqslant \frac{E[S_2/S_1]-(F/S_1)}{\omega^i}$. The first assumption requires that countries with net USD assets (creditors) expect dollar appreciation, while countries with net USD liabilities (debtors) expect dollar depreciation, aligning expected returns with their external positions, align with Gabaix & Maggiori (2015); Corte et al. (2016). The second assumption ensures that investors are risk-averse enough and their imbalances large enough such that the optimal hedge ratio never drops below zero.

market in period 1 at spot rate S, and investing the proceeds locally at domestic interest rates y^i. At maturity, the forward traders deliver currency i to the country i's investors and receive dollars at the forward price of F. The traders then repay the initial dollar loans at $q^i(1+y^{\$})$. For this transaction to be profitable with the presence of balance sheet costs, the return from investing in the foreign currency and converting it back to dollars must exceed the cost of dollar loans, which corresponds to a negative basis ($x^i < 0$). Hence, a non-zero basis arises as an intermediation fee charged by large global banks to compensate for their swap provision activities.

Following Garleanu & Pedersen (2011) and Ivashina et al. (2015), arbitrageurs entering forward contracts must post a margin (haircut) proportional to the position size q^i, given by $\kappa H(q^i)$, where κ is a positive constant intermediation cost parameter.[11] The trader's total haircut is the sum of the haircuts for each position $\kappa \sum_i H(q^i)$. Assuming the initial wealth W, the forward traders retain $\pi = W - \kappa \sum_i H(q^i)$ dollars to an alternative investment, generating profit functions of $G(\pi)$.[12] The swap dealers choose the optimal amount of capital devoted to providing liquidity for each currency to maximize

$$\max_{q^i} \sum_i x^i q^i + G\left(W - \kappa \sum_i H(q^i)\right). \tag{6}$$

Upon solving the forward traders' profit maximization problem (the calculation procedure is detailed in the Online Appendix), the traders' first order condition (F.O.C) determines the cross-currency basis endogenously as follows:

$$x^i = \kappa G'\left(W - \kappa \sum_j H(q^j)\right) H'(q^i). \tag{7}$$

where $j \neq i$, denoting the capital amount available for alternative investments in other countries. This F.O.C. equates the marginal gain from investing an additional unit of capital in supplying liquidity to the forward markets with the marginal profitability from alternative investment opportunities. In equilibrium, forward traders take the hedging demand of country-i investor as given and respond by supplying dollars in the forward market:

$$q^i = -h^i \omega^i. \tag{8}$$

[11] For a nonzero position q, it is assumed that for $q > 0$; for $q > 0, H'(q) > 0$ and for $q < 0$, $H'(q) < 0$; $H''(q) > 0$.

[12] It is assumed that investments in alternative opportunities yield positive profits. For a given positive investment, $G'(\pi) > 0$, and $G''(\pi) < 0$.

Substituting $q = -h\omega$ into equation (7) shows that the cross-currency basis as defined by equation (2) is jointly determined by *two* forces: (i) the average financial intermediary cost in supplying dollar funding and (ii) the investors' hedge demand, as determined by external imbalances.[13] This framework aligns with the interpretation of Du et al. (2018), who identify constrained intermediation and global imbalances in investment demand and funding supply as the two principal sources of CIP deviations.

In the post-GFC period, regulatory reforms (e.g., leverage ratio constraints) significantly tightened intermediaries' balance sheet capacity, raising the cost of supplying dollar liquidity in FX swap markets and constraining arbitrage activity (Du et al., 2018). Consequently, forward dealers require compensation for deploying balance sheet resources to absorb global hedging imbalances, resulting in an upward-sloping supply curve for dollar funding and persistent deviations from CIP. Countries with larger imbalances are subject to larger cross-currency bases in absolute magnitude. The conditional level of cross-currency basis, measuring the spread between the cost of dollar borrowing and the return from providing forwards, thus reflects a degree of severity of dollar scarcity, shaped jointly by supply-side constraints and demand-side hedging pressures.

Therefore, as described earlier, countries with hedging needs to sell dollars forward ($\omega > 0$) effectively supply dollars to the FX swap market during periods of global dollar strain, and thus face lower dollar funding pressure. Intermediaries accommodate this flow by borrowing dollars ($q < 0$) and converting them into domestic currency, resulting in a more negative basis ($x < 0$) that signals reduced dollar scarcity. These currencies are perceived as safe havens with limited exposure to dollar funding stress and consequently offer lower risk premia. In contrast, countries with more negative external imbalances ($\omega < 0$) exhibit greater hedging demand for dollars in forward markets. Swap dealers respond by borrowing foreign currency and converting it to dollars ($q > 0$), resulting in a positive cross-currency basis ($x > 0$). Currencies in these countries are considered riskier due to their greater exposure to dollar funding pressure, as their excessive demand for dollars exacerbates existing funding scarcity and intensifies the imbalance between hedge demand and constrained dollar supply. Consequently, investors require higher expected excess returns as compensation for bearing higher dollar funding pressure. Based on this economic rationale, I propose the following testable hypothesis:

Hypothesis 1: *Currencies with higher dollar funding pressure yield higher expected excess returns, whereas those with lower exposure yield lower excess returns.*

This hypothesis is tested in two steps. First, I sort currencies into portfolios based on

[13] When $q^i = 0$, it means the country-i investor does not demand dollars in the forward market, so the liquidity provision and basis reduce to zero. When providing liquidity in the forward market is costless, $\kappa = 0$.

their unconditional cross-currency basis, defined in Equation (2), and compute average excess returns. If currency risk premia increase with dollar funding pressure, the return spread between currencies with less negative (or positive) basis and those with more negative basis should be statistically positive. Second, I construct a tradable long-short factor, the "*global high-minus-low cross-currency basis*" strategy, which shorts currencies with the most negative basis and longs those with positive basis. I then examine whether this factor is priced in the cross-section of currency excess returns by estimating its risk price in the presence of controls for traditional carry and dollar risk factors. If dollar funding pressure constitutes a priced risk, this strategy should earn significantly positive average excess returns as compensation for bearing systematic exposure to variations in funding pressure.

The precrisis period presents a fundamentally different environment from the post-GFC regime. During this time, financial intermediaries operated with largely unconstrained balance sheet capacities, enabling them to supply FX swaps and hedging services at negligible cost, regardless of the quantity demanded (Du & Schreger, 2022). This implies a flat dollar funding supply curve, which violates the core assumption in Liao & Zhang (2025), namely, that constrained intermediaries require compensation for absorbing hedging demand. As a result, the theoretical framework of Liao & Zhang (2025), which models the basis as the outcome of costly intermediation and hedging demand, does not apply in the precrisis context. Instead, the precrisis market structure was characterized by the adherence to the CIP condition, with cross-currency basis values near zero, short-lived, and swiftly eliminated through arbitrage (e.g., Akram et al., 2008; Du et al., 2018). While minor and temporary deviations did occur, driven by market frictions such as counterparty credit risk or liquidity risk (see, e.g., Taylor, 1989; Dooley & Isard, 1980; Baba et al., 2008), these were not a reflection of systematic risks.

To explain these deviations, I adopt the interpretation of Keller (2024), who views the basis as a measure of relative currency scarcity regardless of its source. This property is particularly well-suited for the precrisis period, where deviations of CIP likely stemmed from transitory mismatches in currency supply and demand caused by market frictions. Under this view, a negative basis signals a relative dollar scarcity compared to currency i, while a positive basis indicates scarcity of currency i compared to dollars. When dollars are scarce, it implies investors that might not have access to the dollar cash rate are willing to borrow dollars in the currency i swap market at a higher rate than the cash rate. An analogous interpretation is that a market preference for borrowing rather than lending dollars. A higher basis reflects more severe dollar funding pressure, and countries with greater dollar demand face tighter dollar funding conditions and earn higher expected excess returns. This mechanism aligns closely with the post-GFC regime. In contrast, a positive basis indicates dollar abundance and relative scarcity of currency i, suggesting the

market is more inclined to lend in dollars or borrow in currency i. In such cases, countries with hedging demands in selling dollars and purchasing currency i face higher currency i funding pressure and are expected to earn higher returns. However, with ample global dollar liquidity and unconstrained intermediary balance sheets, these precrisis pressures were neither persistent nor perceived as systematic risks. As a result, such risk failed to generate meaningful or statistically significant risk premia.

To summarize, while the unconditional basis may capture relative currency pressures in both regimes, this paper focuses on the postcrisis period, during which basis values remained persistently negative and are interpreted specifically as a signal of dollar funding pressure. The relationship between basis values, funding stress, and currency risk premia across regimes is illustrated in Figure 1.

[Figure 1 about here]

Since the cross-currency basis is jointly determined by constrained intermediation from the supply side and dollar hedging demands, where the latter is closely linked to a country's external imbalances, the *high-minus-low* cross-currency basis factor is naturally expected to reflect information about global trade and capital flow imbalances. Such imbalance is empirically measured by three measurements: the net foreign asset (NFA) to GDP ratio, the net USD debt holding ratio, and the IMB factor proposed by Corte et al. (2016). Besides, I also argue that the basis factor also contains information about currency appreciation and depreciation risks, as reflected through interest rate differentials. This argument is supported by the following mechanism. Following Liao & Zhang (2025), the spot exchange rate is determined by the following equilibrium condition:

$$S = \frac{\xi}{\tau + \Gamma - h^i \omega^i}, \tag{9}$$

where ξ, τ, and Γ represent dollar demand from different sectors that are not explicitly modeled: domestic demand from country-i households, demand from U.S. households residing in country i, and other financial sector flows, respectively.

Taking the derivative of S^i with respect to $Var(S_2^i)$,[14] it can be shown that currencies of countries with positive external imbalances (i.e., negative basis) tend to appreciate in high-volatility states, while those with negative imbalances (i.e., positive basis) tend to depreciate. This economic mechanism closely mirrors the well-documented phenomenon, the failure of UIP (e.g., Hansen & Hodrick, 1980; Fama, 1984). Empirically, high-interest-rate currencies tend to depreciate in bad times and earn higher expected returns in normal

[14] See Online Appendix for detailed derivation.

times, while low-interest-rate currencies appreciate in bad times and deliver lower excess returns during normal periods. Our result maps directly into this phenomenon: countries with positive basis values, typically associated with high nominal interest rates and low external imbalances, behave like the investment currencies in carry trade strategies, exhibiting a property of risky assets and demanding a risk premium. Conversely, currencies with negative basis values, often from creditor countries with low interest rates, serve as funding or safe-haven currencies, appreciating in bad states and earning lower expected returns during normal times.

This economic mechanism can be explained by and aligns with the empirical findings of Du et al. (2018), who document a strong positive relation between the cross-currency basis and nominal interest differentials. As noted by Du et al. (2024), the basis increases with nominal interest differentials because countries with lower interest rates than the U.S. exhibit stronger demand for dollar assets. This drives external imbalances and induces dollar hedging via FX swaps, selling dollars and buying currency i, which pushes the basis more negative to compensate balance sheet costs. This channel highlights how nominal interest rate differentials information can ultimately be reflected in basis values through their impact on external dollar imbalances. Therefore, I propose the second testable hypothesis:

Hypothesis 2: *In addition to dollar funding risk, the global cross-currency basis portfolio captures information embedded in interest rate differentials (i.e., the carry trade factor of Lustig et al. (2011)) and external imbalances (i.e., the global imbalance factor of Corte et al. (2016)).*

To test this hypothesis, I conduct both spanning regressions and cross-sectional horse races to check whether the cross-currency basis factor survives in the presence of other related factors, including carry and global imbalance risk factors. If indeed the dollar funding pressure risk factor captures the interest rate differential and global imbalance portfolios, the high-minus-low basis portfolio should subsume the explanatory power of the FX carry trade and global imbalance risk factors rather than the other way around. Besides, I also test the incremental pricing power of the basis factor with the control of carry and global imbalance factor.

3 Data and Currency Portfolios

This section first outlines the construction of currency portfolios and the global dollar funding shortage risk factor, and describes the main data sources used in the empirical analysis. Due to the deviation of CIP condition, I calculate the currency excess returns

in FX swap (or forward) market and cash market separately.

3.1 Cross-Currency Basis Sorted Currency Portfolios

Let s_t denote the log of mid-spot exchange rate and f_t the log of the one-month mid-forward exchange rate.[15] The log excess return on buying a foreign currency in the forward market and selling it in the spot market after one month is:

$$r_{t+1} = f_t - s_{t+1}. \tag{10}$$

In frictionless market, forward rates satisfy the CIP condition: the forward discount is equal to the interest rate differential $f_t - s_t = y_t - y^{\$}$. Therefore, an approximation of the excess return from investing in foreign currency in the cash market, expressed in U.S. dollar terms, is expressed as:

$$r_{t+1} = f_t - s_t - \Delta s_{t+1} \approx y_t - y_t^{\$} - \Delta s_{t+1}. \tag{11}$$

However, if the CIP condition is violated and the cross-currency basis is not zero ($x_t \neq 0$), the currency excess returns in forward markets differ from the cash markets:[16]

$$\begin{aligned} f_t - s_{t+1} &\neq y_t - y_t^{\$} - \Delta s_{t+1} \\ &= y_t - y_t^{\$} - \Delta s_{t+1} + x_t. \end{aligned} \tag{12}$$

This equation implies that, for any investor borrowing in U.S. dollars and investing in foreign currency assets, the excess return earned through forward contracts $f_t - s_{t+1}$, differs from the excess return on risk-free investments in the cash market $y_t - y_t^{\$} - \Delta s_{t+1}$ by the amount of the cross-currency basis. While the theoretical framework illustrates the demand and supply of U.S. dollars in the forward market, the presence of such wedge requires separate calculation of currency risk premia across markets. In contrast to the traditional literature in currency markets (e.g., Burnside et al., 2011; Lustig et al., 2011; Menkhoff et al., 2012a), which typically computes currency excess returns using forward contracts under the assumption that CIP holds, I compute excess returns and construct

[15] The transaction costs are ignored in the baseline analysis and analysis of excess returns with bid-ask spread is presented in Section 6.1.

[16] The "theoretically-existing" CIP arbitrage profits are not considered when calculating currency excess returns. This exclusion is due to the fact that such arbitrage profits, while present in theoretical models, are typically not realizable in practice due to high transaction costs, market frictions, and regulatory constraints.

portfolios separately for the swap and cash markets. This separation is important because, when CIP fails, the two investment strategies may generate distinct currency return profiles. Moreover, while most non-U.S. banks obtain dollar funding through the FX swap market rather than directly borrowing in the cash market (Du & Schreger, 2022), examining currency excess returns in both markets provides a more comprehensive view of currency markets.

Motivated by the theoretical framework discussed in Section 2, I construct global cross-currency basis portfolios as follows: At the end of each period t, I sort currencies based on their countries' cross-currency basis values and allocate them into five portfolios. Portfolio 1 ($P1$) contains currencies with the most negative basis values, typically associated with most negative dollar hedge demand or even net dollar supply (safe currencies). In contrast, Portfolio 5 ($P5$) comprises currencies with the least negative or positive basis values, indicating the highest demand for U.S. dollars and, correspondingly, with highest exposure to dollar funding shortage risk (riskiest currencies). All portfolios are rebalanced monthly and their excess returns are computed using the equal-weighed scheme. We refer to these portfolios as the global cross-currency basis portfolios. As for all other currency portfolios, we compute the excess return for each portfolio as an equally weighted average of the currency excess returns within that portfolio. I assume that the investor has to establish a new position in each single currency in the first month and that he has to sell all positions in the last month. I refer to the zero-cost dollar-neutral strategy that takes a long position in $P5$ (investment currency) and a short position in $P1$ (funding currency) as the global cross-currency basis strategy. Then I construct the tradable global dollar funding shortage (HML_x) risk factor as the difference between $P5$ and $P1$ that reflects the global spread in cross-sectional currency excess returns of associated currencies with lowest and highest exposure to dollar funding shortage. I also build and report results for portfolios adjusted for the transaction costs, that is, I consider the bid-ask spread in borrowing and selling. The detailed transaction costs adjustment process and results are reported in the Section 6.1.

3.2 Data and Descriptive Statistics

In the empirical analysis, I examine cross-currency basis deviations using U.S. dollar currency pairs, constructed from mid-point spot and one-month forward exchange rates quoted against the U.S. dollar (USD). The data are obtained from LSEG Datastream and cover the G10 currencies, which are among the most liquid in global foreign exchange markets. These include the Australian dollar (AUD), Canadian dollar (CAD), Danish krone (DKK), euro (EUR), Japanese yen (JPY), Norwegian krone (NOK), New Zealand dollar (NZD), Swedish krona (SEK), Swiss franc (CHF), and British pound ster-

ling (GBP). In computing the cross-currency basis, I use the respective IBOR (formerly LIBOR) rates as the reference interest rates for each currency. The full sample period spans from January 1999 to January 2024, with all exchange rate and interest rate data sourced from LSEG Datastream.

Figure 1 shows the equally weighted average one-month IBOR-based cross-currency basis across the G10 currencies. The figure reveals that deviations from CIP were close to zero prior to the GFC, surged substantially during the crisis, and have since remained systematic, persistent, and economically significant, highlighting a structural shift in global dollar funding conditions. This result is consistent with many cross-currency basis literature (see, for example, Du et al., 2018; Cerutti et al., 2021).

[Figure 2 about here]

Descriptive statistics for the five cross-currency basis–sorted portfolios, the high-minus-low (HML_x) portfolio, and the equally weighted average portfolios in both the swap and cash markets across G10 currencies over the full sample period are reported in Table 1. These statistics provide an initial evaluation of the testable hypothesis. The cross-currency basis is negative in four out of the five portfolios, with an average value of -19.10 basis points, indicating that the synthetic U.S. dollar interest rate (implied by FX swaps) generally exceeds the direct U.S. dollar interest rate, reflecting a persistent excess demand for U.S. dollars in forward markets relative to supply. A monotonic decreasing trend is also observed in net foreign asset ratios (nfa) and net U.S. dollar debt holdings ratio (ndt) from $P1$ to $P5$. These two measures, adopted by Corte et al. (2016) and Liao & Zhang (2025), are both used to capture a country's external imbalance. Consistent with theoretical predictions, countries in portfolios with more positive basis values tend to have more negative nfa and ndt, thus implying greater dollar hedge demand.

In addition, the currency average excess returns increase monotonically across the basis-sorted portfolios, rising from -1.77% (swap market) and -1.93% (cash market) per annum in $P1$ to 0.87% and 0.34% in $P5$, respectively. Sharpe ratios exhibit a similar trend, rising from -0.20 and -0.21 to 0.36 and 0.31 in swap and cash markets, respectively. These results indicate that currencies with less negative (or positive) cross-currency basis values have more negative external imbalances and earn higher expected excess returns. This finding supports the first hypothesis, suggesting that periods of higher dollar funding pressure, characterized by greater demand for U.S. dollars and constrained dollar supply, are associated with higher currency risk premia. Moreover, both the forward discount and the interest rate differential increase from the first to the fifth portfolio. This pattern aligns with the second hypothesis and the empirical findings of Du et al. (2018), who

show that the cross-currency basis is positively associated with the nominal interest rate differential between foreign currencies and the U.S. dollar.

Overall, currencies of net debtor countries with positive cross-currency basis values tend to have higher interest rates and earn higher expected returns, whereas currencies of net creditor countries with negative basis values tend to have lower interest rates and lower expected returns, consistent with the our two hypothesis outlined in Section 2.

[Table 1 about here]

4 Does Dollar Funding Pressure Risk Price Currency Excess Returns?

This section presents cross-sectional asset pricing tests for currency portfolios and the global dollar funding risk factor, and provides empirical evidence that the global cross-currency basis portfolio is priced in a broad cross-section of currency portfolios. The objective of this analysis is to assess whether the relationship between currency risk premia and deviations from CIP can be understood from a perspective of compensation of risk.

4.1 Method

I first denote the currency excess returns in levels of portfolio j in period $t+1$ by Rx^j_{t+1}. All asset pricing tests are run on excess returns in levels, not log excess returns, to avoid having to assume joint log-normality of returns and the pricing kernel. In the absence of arbitrage opportunities, this excess return has a zero price and satisfies the following Euler equation:

$$E_t\left[M_{t+1}Rx^j_{t+1}\right] = 0, \tag{13}$$

where a stochastic discount factor (SDF) M_{t+1} linear in the pricing factors Φ_{t+1}, given by

$$M_{t+1} = 1 - b'(\Phi_{t+1} - \mu), \tag{14}$$

where b is the vector of factor loadings, and μ denotes the factor means. The above

SDF specification implies a beta pricing model in which the expected excess return on portfolio j is equal to the factor risk price λ times the beta β_j. The beta pricing model is defined as

$$E[Rx^j] = \lambda'\beta^j, \tag{15}$$

where $\lambda = \Sigma_{\Phi\Phi} b$, $\Sigma_{\Phi\Phi} = E(\Phi_t - \mu)(\Phi_t - \mu)'$ is the variance-covariance matrix of the factor, and β^j denotes the regression coefficients of the return Rx^j on the factors. To estimate the factor prices λ and the portfolio betas β, I first use the Generalized Method of Moments (GMM) estimation applied to linear factor models, following Hansen (1982). Since the objective is to test whether the model can explain the cross-section of expected currency excess returns, I only rely on unconditional moments and do not employ instruments other than a constant and a vector of ones. Factor means and the individual elements of the covariance matrix of risk factors Σ_Φ are estimated simultaneously with the SDF parameters by adding the corresponding moment conditions to the asset pricing moment conditions implied by equation (8). I use one-step GMM approach to address the estimation uncertainty (e.g., Burnside et al., 2011). Besides, I also report the Hansen-Jagannathan distance (Hansen & Jagannathan, 1997) to gauge model misspecification, where the p-values for tests of whether the HJ distance is equal to zero are reported. Following Jagannathan & Wang (1996), I simulate p-values of using a weighted sum of χ^2_1 distributed random variables. I also report the Newey-West standard error with optimal lag length selection according to Andrews (1991).

To supplement the GMM tests, I conduct a two-stage ordinary least squares (OLS) estimation following Fama & MacBeth (1973), henceforth FMB, to estimate portfolio betas and factor risk prices. In the first step, I run a time-series regression of returns on the factors. In the second step, I run a cross-sectional regression of average returns on the betas. I do not include a constant in the second step ($\lambda_0 = 0$), implying that I do not allow a common over- or underpricing in the cross-section of returns.[17] The standard errors are calculated from asymptotic Newey–West (NW) standard errors from the cross-sectional regression, the method that further adjusts for first-stage estimation error in betas via GMM with NW adjustments (NW-GMM), or the asymptotic adjustment standard errors following Shanken (1992).

[17] According to Lustig et al. (2011), adding a constant is redundant because the dollar factor acts like a constant in the cross-sectional regression (all of the portfolios' loadings on this factor are equal to one).

4.2 Risk Factor and Pricing Kernels

As risk factors, the recent literature on cross-sectional asset pricing in currency markets has considered the expected market excess return, approximated by the average excess return on a portfolio strategy that is long in all foreign currencies with equal weights and short in the domestic currency – the DOL factor, following Lustig et al. (2011). For the second risk factor, the literature has employed several return-based factors such as the slope factor (carry trade) (Lustig et al., 2011), the global volatility risk factor (Menkhoff et al., 2012a), etc.. In baseline analysis, I first consider a two-factor SDF with DOL and the global HML_x in the regressions to test the validity of the theoretical prediction in Hypothesis 1 that currencies with higher exposure to dollar funding risk and with positive basis offer a higher risk premium. Later in the paper, I also include more common risk factors in the pricing kernel for comparison. The pricing kernel of our basic analysis is thus express as the following parametric form:

$$M_{t+1} = 1 - b_{DOL}(DOL_{t+1} - \mu_{DOL}) - b_{HML_x} HMLx_{t+1}. \tag{16}$$

Our primary test assets are the five currency portfolios sorted on cross-currency basis deviations, as described in Section 3. Table 2 reports the cross-sectional asset pricing results using these five portfolios. However, as emphasized by Lewellen et al. (2010), a strong factor structure in test asset returns can generate misleading model fits. Specifically, when the proposed risk factor is even moderately correlated with the true underlying factor, the model may exhibit an artificially high cross-sectional R^2 that overstates its explanatory power. This is particularly problematic in small cross-sections. To provide a higher hurdle for a proposed model, we follow the recommendation of Lewellen et al. (2010) and expand the set of test assets to include a broader range of currency strategies that are less correlated with the pricing factors. Accordingly, I extend the test assets to comprise 30 currency strategy portfolios: 5 portfolios sorted on cross-currency basis deviations, 5 on interest rate differentials (carry) (Lustig et al., 2011), 5 on global volatility (Menkhoff et al., 2012a), 5 momentum portfolios (Menkhoff et al., 2012b; Asness et al., 2013), 5 on currency value (Asness et al., 2013; Menkhoff et al., 2017), and 5 on net foreign asset (NFA) ratios (Corte et al., 2016). The construction details for each strategy portfolio and their associated factor are provided in the online Appendix. The estimation results based on the extended cross-section currency strategy portfolios are presented in Panel A of Table 3. Futt Lewellen et al. (2010) emphasize that misleading model performance can be exacerbated when empirical tests ignore theoretical restrictions on the intercept and slope coefficients in cross-sectional regressions. In other words, when HML_x is a tradable factor, its price of risk must equal its expected return (i.e., $\lambda_{HMLx} = E(R_{HML_X})$), that is,

the price of global dollar funding risk cannot be estimated as a free parameter. To impose restrictions, they suggest including the tradable pricing factors as test assets. A related concern is raised by Harvey & Liu (2021), using characteristic-sorted portfolios as test assets tends to bias asset pricing tests towards identifying risk factors constructed from the same characteristics used in portfolio formation. Following these insights, Panel B of Table 3 presents an out-of-sample cross-sectional asset pricing test in which the basis-and carry-sorted portfolios are excluded from the test asset set. Instead, the test assets consist of the nfa, value, momentum, and volatility portfolios, along with the pricing factors HML_x, to ensure that their prices of risk are not estimated as free parameters, but are instead pinned to their respective average returns, in line with theoretical restrictions. In each panel, the asset pricing tests are conducted using GMM under three specifications: (i) a two-factor model including DOL and HML_x; (ii) DOL and traditional carry trade factor (CAR), which is the most common benchmark in the literature since its introduction by Lustig et al. (2011);[18] and (iii) a three-factor model that includes three pricing factors (DOL, CAR, and HML_x simultaneously.

4.3 Cross-Sectional Asset Pricing Test Results

Panel A of Table 2 presents estimates of factor loadings b, risk prices λ, the cross-sectional R^2, and the HJ distance. The analysis first focuses on the sign and statistical significance of the risk price associated with the global dollar funding risk factor, λ_{HML_x}. The results indicate that λ_{HML_x} is statistically significant at the 5% level, with monthly estimates of 0.28% in the swap market (left panel) and 0.21% in the cash market (right panel), based on both GMM and FMB estimations. These findings suggest that the global currency risk is systematically priced in the swap market and, in a weaker level, in the cash market over the full sample period. This disparity reflects the greater impact of balance sheet constraints on forward liquidity provision in swap markets: while investors could easily access dollar funding via swaps prior to the crisis, postcrisis regulatory constraints have made such access significantly more difficult. In contrast, access to dollar cash has been consistently limited both before and after the crisis, making balance sheet constraints less influential in cash markets.

A significant positive estimate λ_{HML_x} implies that currency portfolios with returns that positively covary with the global cross-currency basis demand higher expected excess returns. Conversely, portfolios with negative covariance receive lower risk compensation. In other words, investors are compensated with higher currency risk premia for bearing

[18]Due to violations of CIP condition, the carry trade portfolios sorted on forward discount and interest rate differential do not necessarily generate same results in particular during postcrisis period. I will discuss this case in details in later section of this paper.

greater systematic risk associated with heightened dollar hedge demand and limited dollar funding supply, which is consistent with Hypothesis 1. The two-factor model also demonstrates strong explanatory power, with high cross-sectional R^2 values exceeds 80% in both markets. However, recall that I only consider the five currency basis-sorted portfolios, so high R^2 values can be much less informative than the insignificant HJ distance. As emphasized by Lewellen et al. (2010), high R^2 can be easily achieved when test assets exhibit a strong factor structure.

Panel B of Table 2 reports beta estimates (factor loadings) across the five basis-sorted currency portfolios. Estimates of β_{HMLx} increase monotonically from the first to the fifth portfolio. Specifically, $P1$, which contains currencies with the most negative basis, exhibits significantly negative exposure ($\beta = -0.46$), indicating that these currencies perform well during episodes of widening CIP deviations. These currencies thus act as hedges against global dollar funding shortages, and investors are willing to accept lower returns to hold them as safe assets. In contrast, $P5$, consisting of currencies with the least negative or positive basis, shows significantly positive exposure to the basis ($\beta = 0.54$), indicating that investors tend to perform poorly during periods of dollar funding stress, and therefore investors require a higher risk premium to hold them. The significant spread in factor loadings across portfolios provides strong evidence that the global cross-currency basis factor captures systematic variation in global dollar funding risk. This pattern supports the interpretation that the cross-currency basis factor is a priced source of global risk in the cross-section of currency excess returns.

[Table 2 about here]

Next, I present results on the fit of our model in Figure 2, which plots realized mean excess returns along the horizontal axis and fitted mean excess returns implied by our model along the vertical axis. The main finding from this figure is that the two-SDF model is able to reproduce the spread in mean returns of portfolios quite well, both in swap and cash markets. Overall, these results provide the preliminary evidence to support Hypothesis 1.

[Figure 3 about here]

In Panel A of Table 3, we report the cross-sectional asset pricing results using the broader set of 30 currency strategy portfolios as test assets. As expected, the cross-sectional R^2 values decrease markedly compared to those in Table 2, reflecting a more "stringent" performance of a model. Nevertheless, the model still achieves a good model

fit, with R^2 reaching approximately 60% in both swap and cash markets when the specifications include both DOL and HML_x. The HJ-distance remains insignificant, indicating no evidence of model misspecification. The pricing error of using a wide range of currency portfolios as test assets is plotted in the online Appendix. In addition, the estimated risk prices for HML_x increase in magnitude compared to Table 2, rising to 0.40% per month (4.8% annually) in the swap market and 0.33% per month (3.6% annually) in the cash market under the two-factor model. These estimates remain highly statistically significant across all three specifications. Importantly, once HML_x is included in the model, the originally significant factor CAR loses its significance in λ_{CAR}. This pattern suggests that HML_x subsumes much of the pricing power previously attributed to the carry trade factor, and also captures a distinct source of risk not accounted for by the carry trade. Consistent with this, the cross-sectional R^2 increases notably from approximately 45%-50% to over 60%.

To examine whether the pricing power of HML_x is due to a bias in favor of the pricing factors constructed from the currency portfolios included in the test assets set, Panel B reports out-of-sample tests based on 20 currency portfolios sorted on alternative characteristics, namely, momentum, net foreign assets, value, and volatility, and also includes risk factors as test assets. Panel B results mirror those of Panel A. Specifically, the estimated risk premium of HML_x is 0.37% and 0.30% per month in the swap and cash market, respectively. The significance of λ_{CAR} disappears upon inclusion of HML_x, whereas HML_x consistently retains its pricing power across specifications. The explanatory power of the model also increases substantially with the addition of HML_x. The results in this Panel confirm the robustness of HML_x and provide strong out-of-sample validation of its pricing power. This implies that the pricing power of HML_x is not solely attributable to its ability to price portfolios constructed on basis-related characteristics; rather, it reflects a systematic risk factor that extends beyond its construction universe and is relevant across a broader cross-section of currency portfolios.

To summarize, the results reinforce Hypothesis 1: investors with greater exposure to dollar funding stress are compensated with higher currency risk premia, amounting to approximately 4% per annum in the swap market and slightly lower in the cash market. Moreover, the findings underscore the robustness of the global cross-currency basis's pricing power over the full sample, even when controlling for theoretically related carry trade factors. In fact, the basis subsumes the explanatory power of traditional carry, providing evidence that it contains independent and distinct pricing information beyond nominal interest rate differentials, thus offering evidence to support Hypothesis 2.

[Table 3 about here]

4.4 Beta Sorted Portfolios

I now show the explanatory power of the cross-currency basis factor for currency portfolios in another dimension. If the basis is a priced factor, then currencies sorted according to their exposure to aggregate dollar funding risk as measured by HML_x should yield a cross-section of portfolios with a significant spread in mean returns. I therefore sort currencies into again five portfolios depending on their past beta to the cross-currency basis. For each date t, I first regress each currency i log excess return rx^i on a constant and HML_x using a 36-month rolling window that ends in period t-1. This gives us currency i's exposure to HML_x and I then sort currencies into five groups based on the estimated slope coefficients $\beta^i_{HMLx,t}$. $P1$ contains currencies with the largest negative exposure to the global imbalance factor (lowest betas) and $P5$ contains the most positively exposed currencies (highest betas).

Table 4 reports summary statistics on these portfolios in swap and cash markets. We find that buying currencies with a low beta (e.g., insurance against global dollar funding risk) yields a significantly lower return than does buying currencies with a high beta (e.g., high exposure to global dollar funding risk). The spread between the last portfolio and the first portfolio is in excess of 4% per annum for both markets. Average excess returns and Sharpe ratio also generally increase, albeit not always monotonically, when moving from $P1$ to $P5$. Moreover, I also find an increase pattern in both average preformation and postformation betas when moving from $P1$ to $P5$, which is in line with the results obtained in Table 2 that investing the currencies with high basis beta leads to a significant higher return. Clearly, currencies that co-vary more with our basis risk factor (thus with more dollar funding pressure), are expected to provide higher excess returns. The postformation beta that vary monotonically from -0.09 to 0.18 indicates that the finding is robust. Moreover, sorts based on forward discount and sorts based on betas and on cross-currency basis, which implies that the cross-currency basis beta conveys information about riskiness of individual currencies and mirrors carry trade portfolios as in Lustig et al. (2011). Overall, this section shows that market dollar funding risk, as measured by the systematic changes of the global cross-currency basis, matters for understanding the cross section of currency excess returns and supports both of our hypothesis.

[Table 4 about here]

4.5 Country-Level Asset Pricing

Thus far, cross-sectional asset pricing tests have been conducted on various sets of currency portfolios as test assets. However, portfolio formation reduces the dispersion in factor loadings and inflates standard errors, potentially weakening statistical inference (Ang et al., 2020). To mitigate these issues, employing individual asset returns rather than portfolios provides an unbiased test of factor pricing and guards against the "data-snooping" issue (Lo & MacKinlay, 1990) inherent in portfolio-based approaches. Therefore, I conduct both GMM and FMB analyses directly using country-level individual currency excess returns as a robustness check.

Table 5 presents the results of the country-level cross-sectional asset pricing tests. Despite variation in the magnitudes of estimated factor loadings and risk price, λ_{HMLx} remains positive and significantly priced in both swap and cash markets. The two-factor model (DOL and HML_x) also exhibits stronger explanatory power than portfolio analysis, with R^2 exceeding 75% for both markets and alongside insignificant HJ distances. Figure OA3 in the Online Appendix further visualizes model fitness by plotting pricing errors, where the predicted versus realized mean excess returns for each currency are shown. The close alignment of the observations around the 45-degree line in both markets indicates minimal pricing error and reinforces the model's goodness of fit. Collectively, these results confirm the robustness of our main findings in the portfolio-level analysis.

[Table 5 about here]

4.6 Pre- and Post-Global Financial Crisis Analysis

Till now, although the tradable cross-currency basis factor HML_x is found to be significantly priced over the full sample, it remains important to investigate whether this factor and currency returns exhibits structural shifts around the GFC. As discussed in the theoretical section, prior to the crisis, financial intermediaries operated without regulatory constraints, and the CIP condition holds or only temporarily violated, primarily reflecting short-lived market frictions. As such, the stylized model proposed by Liao & Zhang (2025), which relies on assumption of constrained intermediaries, does not provide an appropriate explanation for precrisis basis values and their pricing implications. Instead, I interpret the cross-currency basis as the currency scarcity as from Keller (2024). To assess how the pricing of dollar funding risk evolved pre- and post-GFC, I split the full sample into two sub-samples. The pre-GFC period spans from January 2001 to August 2008, while the post-GFC period covers August 2009 to January 2024.

Table 6 reports summary statistics for currency portfolios across two subsamples. While the CIP condition is generally regarded as holding prior to the GFC, small but non-zero basis values were still observed. Among G10 currencies, even if the average cross-currency basis during the precrisis period is narrow and negligible at only –5.5 basis points, with a standard deviation of 9.39%. The maximum value peaked at 10.4 basis points in $P5$, signaling a domestic currency scarcity. In postcrisis periods, basis becomes much more negative overall (with avg of –27.39 bps), with only $P5$ has a small positive mean, indicating systematic dollar scarcity. In the pre-GFC period, both currency excess returns and Sharpe ratios in the forward and cash markets exhibit a non-monotonic pattern: they increase from $P1$ (most negative basis) to $P3$ (least negative basis), but decline at $P4$ when basis is slightly positive and again increase when basis is more positive. This strange pattern results in a positive yet statistically insignificant HML return spread, with t-statistics of 1.29 and 1.16 in the swap and cash markets, respectively. The relationship between the cross-currency basis and external imbalances is similarly nonlinear.

This result is not surprising and can be rationalized through the framework of Keller (2024), where she shows that the sign of the CIP deviation can be interpreted as the relative scarcity of currencies. For $P1$ to $P3$, the (dollar-denominated) basis is negative, which indicates a scarcity of dollars relative to currency i. In this context, countries with hedging demand in selling dollars and purchasing currency i (i.e., these with positive dollar external imbalances) face relatively low dollar funding pressure and hence earn lower currency risk premia. This explanation is consistent with the logic of the hedging channel, despite arising from a different theoretical foundations. In contrast, $P4$ and $P5$ exhibit positive basis, indicating an abundance of dollars and a relative scarcity of currency i. Here, countries with positive net dollar external imbalances which demand more currency i and sell dollars face more severe scarcity of the foreign currency. This leads to greater exposure to foreign currency funding pressure and, accordingly, yields higher expected currency returns. However, it is important to emphasize that during the precrisis period, when global dollar liquidity was ample and intermediary balance sheet constraints were largely absent, CIP deviations are short-lived and reflected only temporary currency mismatches. Consequently, funding pressures, whether in dollars or in foreign currencies, were not perceived as systematic risks by investors and therefore did not translate into large enough and statistically significant risk premia. As such, this precrisis result also partially supports the argument that the net dollar imbalance measures like ndt and nfa is not a good measure of currency funding pressure, as the external imbalances are both high and positive when a country either face low dollar funding risk and high other currency funding risk.

In contrast, during the post-GFC period, the overall results remain qualitatively con-

sistent with the full-sample analysis. Specifically, the average excess returns across the five portfolios sorted by cross-currency basis continue to exhibit a generally increasing pattern, with the HML portfolio delivering a statistically significant annual return of 3.92% and a Sharpe ratio of 0.52 in the swap market. Moreover, nominal interest rates display a similar upward trend across the sorted portfolios, while external imbalances exhibit an opposite, decreasing pattern. Figure 4 provides a more straightforward comparison between the full sample, pre- and post-GFC currency excess returns across the different portfolios.

[Table 6 about here]

[Figure 4 about here]

To further examine the relationship between the cross-currency basis factor and currency excess returns across the pre- and post-crisis periods, I conduct separate one-step GMM estimations within each subsample for the three SDF specifications, following the same approach as in the full-sample analysis. Panel A of Table 7 reports results using 30 currency portfolios. Panel B presents the results of using country-level individual currency excess returns as test assets directly. Specifically, while the estimated factor prices for HML_x are positive, they are not statistically significant across any of the three SDF specifications, regardless of whether CAR factor is included. In contrast, when using country-level excess returns as test assets, CAR factor is significantly priced in all model specifications, highlighting its significance during this period and consistent with Lustig et al. (2011). Notably, the inclusion of the HML_x factor in addition to the DOL and CAR only leads to very limited improvements in the model's explanatory power, as evidenced by the relatively stable R^2 values. These findings align with those reported in Table 6 and suggest that investors either did not perceive basis as a market risk or were not sufficiently compensated for bearing it. A plausible explanation is that, before the GFC, the market did not widely recognize dollar funding pressure as a systematic source of risk, and financial intermediaries had not yet encountered the balance sheet costs necessary to generate substantial compensation for bearing such risks.

By contrast, the post-GFC results reveal a significant structural change. In the model specification that includes all three SDFs simultaneously, λ_{HMLX} increases substantially, reaching values between 0.36% and 0.38% per month in the swap market with magnitudes similar to those in the full-sample results reported in Table 3, and becomes statistically significant. Consistent with the full-sample findings, the estimated price of risk for the CAR is only weakly significant in the swap market in Panel A and remains statistically insignificant across other specifications. Moreover, the weak significance of CAR fully

disappears once HML_x is included in the model, suggesting a limited pricing power for traditional carry trade in explaining the cross-section of currency excess returns in the postcrisis period. This provides further support for the view that, while the cross-currency basis is positively correlated with nominal interest rates (Du et al., 2018; Liao & Zhang, 2025, e.g.,), the basis factor captures additional information about global dollar funding pressures that is not captured by interest rate differentials alone. Results from the cash market largely mirror those from the swap market across both panels.

To summarize, the crucial finding of this section is that global dollar funding pressure risk explains a large portion of the cross-sectional variation in currency excess returns. Notably, the explanatory power of the basis-based liquidity risk factor is not confined to portfolios sorted on basis exposure or interest rate differentials (i.e., carry trade portfolios), but extends to a broad cross-section of currency portfolios, including those sorted on global volatility, momentum, etc.. However, the empirical evidence also reveals that the pricing power of the basis factor is concentrated in the post-GFC period. It is only after the crisis that the basis emerges as a significant and systematically priced risk component, effectively absorbing the explanatory power of traditional carry trade factors. The "postcrisis effects" reflect heightened investor awareness of global dollar funding shortage risk, driven by rising balance sheet costs under a tighter regulatory regime and excessive dollar hedging demands.

[Table 7 about here]

5 Dollar Funding Risk and Other Risk Factors

In the previous section, I provide evidence that an alternative asset pricing model using the global cross-currency basis risk factors performs much better than the standard FX asset pricing model based on the dollar and carry factor (Lustig et al., 2011) and subsumes the pricing power of carry trade in post-GFC era. Building on this result, this section focuses on a comprehensive comparative analysis between HML_x and a set of well-established SDF in the FX literature. The primary objective is to assess whether HML_x captures systematic variation in currency excess returns beyond that explained by these existing SDFs. Furthermore, I empirically test Hypothesis 2 by further examining the relationship between HML_x and two theoretically related benchmarks: the carry trade of Lustig et al. (2011), and the global external imbalance factors (IMB) introduced by Corte et al. (2016).

5.1 A First Look at the Relation Between Basis Risk and Other Risk Factors

As theoretically expected in Hypothesis 2, the cross-currency basis captures overlapping information not only with a country's nominal interest rate differentials but also with dollar hedging demand stemming from external dollar-denominated positions. Thus far, postcrisis empirical evidence indicates that the global basis factor, HML_x, is not subsumed by the carry factor (CAR); rather, the reverse holds—HML_x subsumes the explanatory power of CAR. These findings raise important questions: To what extent does the pricing power of HML_x reflect a distinct source of economic risk, as opposed to being driven by global imbalance factors that proxy for countries' external dollar exposures and international capital flow imbalances? More broadly, is HML_x a novel and priced risk factor that is not spanned by the SDF commonly employed in FX asset pricing models?

To answer these questions, in addition to CAR and IMB factors, I examine a broad set of risk factors employed in the literature that can be potentially correlated with CIP deviation. These risk factors include: the carry trade factor sorted on the forward discount (FDS), business gap (GAP) (Colacito et al., 2020), low-frequency FX systematic liquidity risk (IML) (Mancini et al., 2013; Karnaukh et al., 2015), short-term momentum (MOM3) and long-term momentum (MOM12) (Menkhoff et al., 2012b; Asness et al., 2013), net U.S. dollar foreign debt holdings (NDT) (Liao & Zhang, 2025), net foreign asset positions (NFA) (Corte et al., 2016; Liao & Zhang, 2025), term spread (TER) (Chen & Tsang, 2013; Lustig et al., 2019), currency value (VAL) (Asness et al., 2013; Menkhoff et al., 2017), the implied volatility of the S&P 500 (VIX) (Brunnermeier et al., 2008), and global volatility (VOL) (Menkhoff et al., 2012a).[19] The construction details of each factor (or corresponding factor-mimicking portfolios) are provided in the online Appendix.

To provide preliminary evidence on the relationship between the basis factor and other FX risk factors, I report the pairwise correlation matrix between these factors in swap market over the full sample period.[20] As shown in Table 8, the basis factor exhibits highly significant positive correlations with the returns associated with the carry trade factors CAR and FDS, with correlation coefficients of 0.52 and 0.56, respectively. This result is

[19]Given that CIP condition has been persistently violated since the global financial crisis, the carry trade portfolios sorted by the interest rate and forward discount does not necessarily yield same results. Therefore, I include both carry trade based on forward discount (FDS) and interest rate differential (CAR). Prior to the crisis, these two factors exhibit an almost perfect correlation of 1, while their postcrisis correlation drops to 0.97.

[20]Additional correlation matrices for the pre- and post-crisis periods, and for the cash markets, are reported in the online Appendix.

in line with the theoretical expectations and provides additional evidence that the basis factor captures overlapping information related to interest rate differentials (or forward discounts), so as the term spread (TER) factor also exhibits significance. In addition, the basis factor demonstrates strong and statistically significant positive correlations with the global imbalance-related portfolios, namely IMB, NDT, and NFA. This finding also aligns with the interpretation that deviations from CIP are partially driven by persistent global imbalances in investment demand and funding supply, as emphasized by Du et al. (2018). The basis factor also exhibits significant but weaker correlations with the currency value (VAL) and low-frequency liquidity (IML) risk factors. It is no surprise, since the deviation of CIP is partially driven by the funding liquidity and market segmentation (e.g., Moskowitz et al., 2024). Regarding VAL, Asness et al. (2013) argues that value strategy is partly driven by global funding liquidity risk, which is also one of the key determinants of deviations from CIP.

[Table 8 about here]

5.2 Explanatory Regressions

In this subsection, I conduct spanning tests to evaluate whether the global basis factor HML_x is captured by existing risk factors that exhibit significant correlations with it. Specifically, I regress HML_x on each of these correlated risk factors individually, alongside a constant term. To account for potential serial correlation in the basis, particularly due to well-documented quarter-end effects in CIP deviations (Du et al., 2018), I include an additional specification that controls for the three-month lag of the dependent variable. The results from both regression specifications, estimated over the full sample and the post-GFC subsample in swap markets, are reported in Table 9.

Across both the full and postcrisis samples, the results indicate that only two carry-related factors (CAR and FDS) and three external dollar imbalance measures (IMB, NDT, and NFA) exhibit statistically significant slope coefficients (β) in explaining HML_x, consistent with theoretical expectations. However, their explanatory power remains limited: all R^2 values range between 30% and 44%, and the estimated β coefficients are far from one. Moreover, the intercept terms (α) from regressions of the basis factor on all considered SDFs remain consistently and significantly different from zero across specifications— particularly in the postcrisis period — with the sole exception of the NDT factor. I further investigate this exception in greater detail in the following subsection. These results suggest that, although HML_x is correlated with and can be partially explained by some existing risk factors, it contains a distinct source of risk that is unlikely

to be fully spanned by them. The cash market results are qualitatively similar to those in the swap market and are reported in the Online Appendix.

[Table 9 about here]

In Online Appendix Table OA3, I report reverse spanning test results by regressing various SDFs on the global basis factor HML_x, both with and without controlling for the lagged values of the dependent variables.[21] In this table, HML_x exhibits statistically significant slope coefficients, ranging from 0.64 to 0.76, in explaining the two carry-based factors. Notably, the associated unexplained excess returns α are statistically insignificant and, in some cases, negative during the postcrisis period. These results further corroborate the conclusion drawn from the previous section, namely, that the pricing power of traditional carry factors is largely subsumed by the global basis factor HML_x. Besides, it also provides evidence that the dollar funding pressure risk, at least partially, explains the carry trade excess returns.

Given that HML_x explains the unconditional carry trade, a risk-based interpretation implies that high interest rate currencies load more positively on dollar funding pressure risk than low interest rate currencies. To explore this interpretation, Table 10 presents time-series regressions of individual portfolio excess returns on HML_x,

$$rx_{it}^{fac} = \alpha_i + \beta_i HML_{x,t} + \epsilon_t, \tag{17}$$

where $rx_{i,t}^{fac}$ is the excess returns of portfolios ($i = 1, 2, ..., 5$) and fac is either CAR or FDS, referring to the portfolios used in the construction of the two carry trade risk factors. The regression results for both groups of carry trade portfolios yield qualitatively similar patterns. As documented in Table 10, HML_x explains 36% and 45% of variation in postcrisis carry trade returns sorted by interest rate differential and forward discount, respectively. Moreover, factor loadings on HML_x exhibit a monotonic increase across carry trade quintiles from low to high interest rate currencies. These loadings are statistically significant in all cases, with the exception of the lowest quintile portfolio ($P1$) in the full sample period, and marginally significant for $P2$ in the post-GFC subsample. The explanatory power of the model, as measured by adjusted R^2, is notably higher in the postcrisis period, consistent with our results in the former section. Importantly, the unexplained excess returns α, are consistently insignificant across all specifications and both sample periods, suggesting that the variations in carry trade portfolios is largely accounted for by exposure to dollar funding pressure. Notably, the high-interest-rate

[21] For model parsimony, the inclusion of lagged dependent variables is applied consistently across specifications for each SDF.

currencies in the top quintile portfolio ($P5$) exhibit the strongest exposure to HML_x, indicating that the high interest rate countries bear the largest exposure dollar funding risk. However, the HML_x significantly differs from the carry trade by their short legs, namely, the lowest interest rate currencies are not necessarily those with the lowest exposure to dollar funding pressure. In sum, these findings suggest that dollar funding risk is a key driver of carry trade excess returns in both the full sample and the postcrisis subsample, providing an additional risk-based explanations of forward premium puzzle.

[Table 10 about here]

5.3 Horse Races

5.3.1 Dollar Funding Pressure Risk Factor vs. External Imbalances Factor

Consistent with the theoretical predictions, I provide evidence that HML_x is significantly correlated with both the traditional carry trade factor and proxies for external imbalances. However, it is unlikely to be spanned by them or by other potentially correlated sources of risk. In particular, HML_x contributes incremental explanatory power beyond the common FX risk factor model and appears to subsume the pricing power of carry trade in post-GFC. This subsection formally tests whether HML_x provides incremental pricing information beyond the three external imbalance measures via a horse race. I employ two sets of SDF specifications. The first set includes DOL, CAR, and one of the external imbalances measures, either IMB, NDT or NFA.[22] The second set augments each of these specifications by including HML_x. Table 11 reports the swap market results in both full and post-GFC sample periods.

Across both sample periods, the inclusion of HML_x significantly improves the explanatory power of the model, increasing R^2 by at least 13% across all specifications. In the full sample (Panel A), λ_{HML_x} is economically large at approximately 0.37% per month and remains significantly distinguishable from zero. Another important finding is that, once HML_x is included, CAR and any of the three external imbalance risk factors completely lose their pricing power. Panel B shows similar patterns in the postcrisis period. The point estimate of λ_{HMLx} remains relatively stable at 0.39% per month, yet its statistical significance weakens in specifications that include IMB and NDT. Importantly, however, this decline in significance does not suggest that the explanatory power of HML_x is absorbed by IMB, NDT or carry trade, as none of these competing factors are statistically significant either. The lack of significance can be attributable to

[22]For model parsimony, I only include the carry trade sorted on interest rate differential from this section unless specified otherwise.

two reasons: potential collinearity between these variables in the smaller post-GFC subsample size, and also the application of currency portfolios as test assets. As discussed earlier in section 4.5, Ang et al. (2020) pinpoint that although using diversified currency portfolios as test assets reduces idiosyncratic volatility and allows more precise estimates of factor loadings, and consequently, risk premia, it destroys the information by shrinking the dispersion of betas and inflating standard errors of cross-sectional risk premium estimates. Therefore, a trade-off exists between the precise estimates of factor loadings and the efficiency losses of estimates of factor risk premia. To address this issue, I re-estimate the models using individual currency excess returns as test assets. The results, presented in the online Appendix Table OA5, indicate that the point estimates of λ_{HMLx} range from 0.36% to 0.41% per month in post-GFC. Although these estimates exhibit greater dispersion compared to those based on currency portfolios, the associated standard errors decline markedly. As a result, λ_{HML_x} becomes statistically significant across specifications, while competing factors remain insignificant. Furthermore, the inclusion of HML_x raises R^2 by approximately 10% in the full sample and 20% in the postcrisis period, confirming its incremental explanatory power. Similar findings hold in the cash market, reinforcing the robustness of results.

In summary, I draw two conclusions. First, HML_x provides substantial and statistically significant incremental pricing power beyond both carry trade and external imbalance factors, in both the full sample and the postcrisis subsample. Second, the inclusion of HML_x renders the pricing of carry and external imbalance proxies insignificant in the post-GFC period, indicating that dollar funding pressure constitutes a distinct and dominant source of risk in the cross-section of currency excess returns. Together, these findings offer strong empirical support for Hypothesis 2.

[Table 11 about here]

5.3.2 Dollar Funding Pressure Risk Factor vs. Other Risk Factors in Postcrisis Period

I further assess the pricing power of HML_x and other related factors in the postcrisis period. There are two different specifications. First, I simply include DOL and controlled SDF, including business cycle gap (GAP), FX low-frequency liquidity (IML), short- and long-term momentum ($MOM3$ and $MOM12$), term spread (TER), currency value (VAL), the VIX index (VIX), global volatility (VOL), and the VIX index; second, I include HML_x in the benchmark group. Results on swap markets are reported in Table 12 where Panel A reports the results of using 30 currency portfolios as test assets, while Panel B reports the results of using country-level currency excess returns as test assets.

Two panels in Table 12 yield qualitatively similar results. This table reveals the following important findings. First, within the G10 sample over the post-GFC period, the majority of standard currency risk factors exhibit limited explanatory power across both test asset sets, with most yielding R^2 values below 20% and statistically insignificant risk prices. Only a few factors, $MOM12$, TER and VAL, are significant and demonstrate some degree of pricing relevance by improving R^2 to around 50%. However, the inclusion of HML_x fully subsumes the explanatory power of even these significant factors, rendering their estimated risk premia insignificant and leading to a substantial increase in R^2 values to typically more than 80% across all specifications in both panels. Meanwhile, λ_{HML_x} remains economically meaningful and stable at approximately 0.34–0.39% per month, and statistically significant across models. The results on cash markets are reported in online Appendix and are qualitatively similar. These findings further highlight the important role of global dollar funding pressure in explaining the cross-sectional variation in currency excess returns during the postcrisis period. Compared with traditional risk factors, not only restricted to carry trade and external imbalance proxies, HML_x demonstrates superior and robust pricing power, particularly in an environment where many conventional risk factors lose their pricing power.

[Table 12 about here]

6 Conclusion

Driven by dollar hedging demand from the demand side and constrained dollar funding supply from the supply side, violations of Covered Interest Rate Parity (CIP) can be interpreted as a manifestation of dollar funding pressure in the postcrisis era. This paper interprets the unconditional level of the cross-currency basis as a market-based proxy for such pressure in global FX markets and examines its asset pricing implications. Empirically, I construct a basis-sorted factor—long currencies most exposed to dollar funding stress and short those least exposed—and show that this factor explains a substantial portion of the cross-sectional variation in currency excess returns over both the post-GFC and full sample periods. This factor earns an economically significant risk premium of approximately 4.5% per annum in swap markets.

Importantly, I show that in the post-GFC era when a wide range of traditional currency risk factors lose their pricing power, the dollar funding pressure factor emerges as a robust and significantly priced source of cross-sectional variation in currency excess returns. It not only subsumes the explanatory power of basis-related factors, such as the carry trade and various external imbalance measures (e.g., global imbalance portfolios),

but also absorbs the pricing ability of other conventional risk factors, including currency value and momentum. These findings underscore the importance of incorporating dollar funding risk into global currency pricing models and suggest that global dollar funding stress has become a key determinant of carry trade excess returns after the global financial crisis. By linking market-based measures of dollar funding stress to the cross-currency basis that reflects structural imbalances between excessive dollar hedging demand and financial intermediary constraints, this paper offers new insights into the pricing of global currency risk premia in the postcrisis environment.

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Figures and Tables

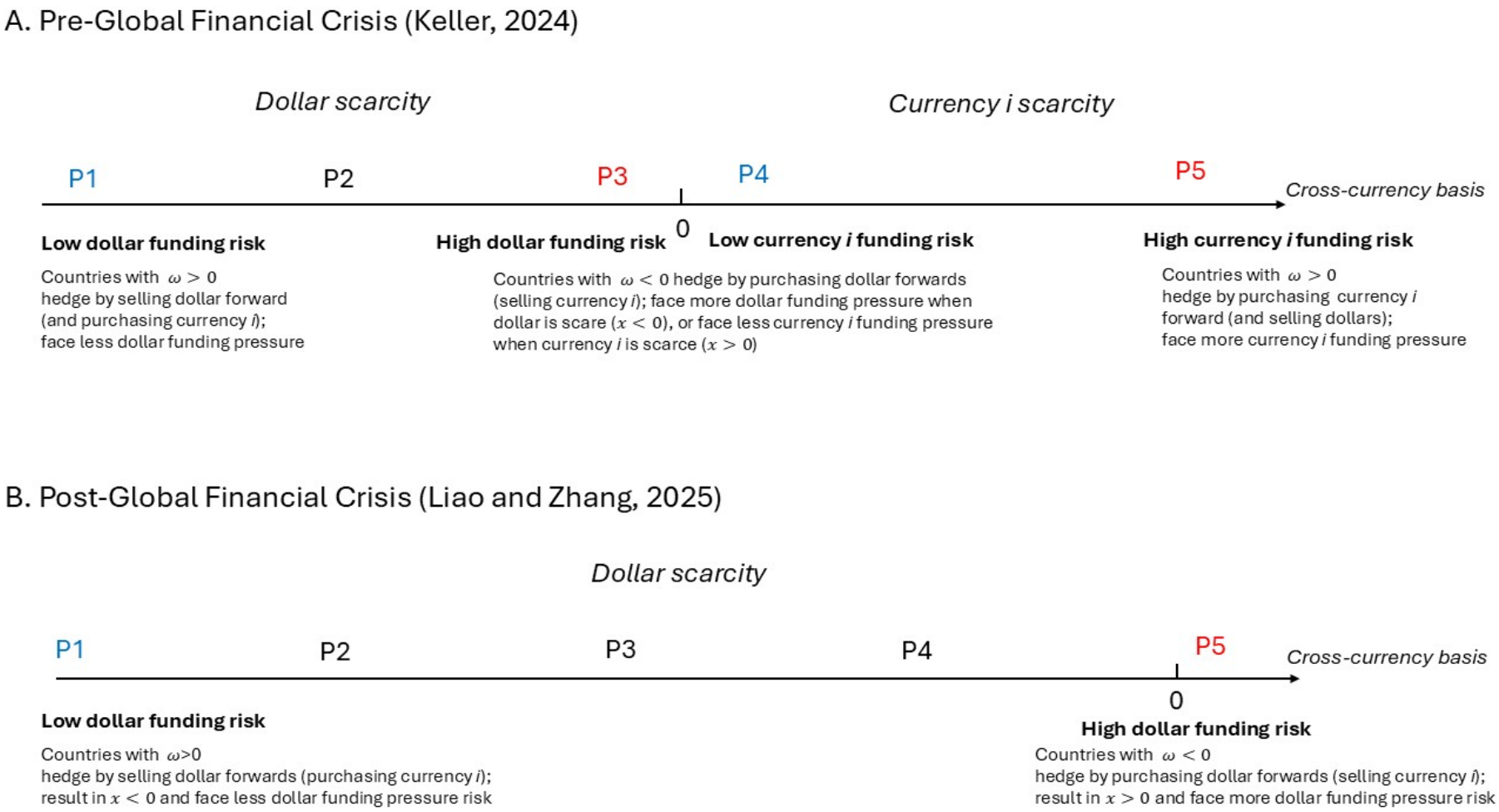


Figure 1: **Cross-currency Basis and Currency Funding Pressure.** This figure plots the relationship between the dollar-denominated cross-currency basis and currency funding pressure in pre- and post-crisis periods. The numerical axis indicates cross-currency basis levels, with portfolios $P1$ through $P5$ sorted by unconditional basis values. Panel A covers the pre-Global Financial Crisis (GFC) period (January 1999–August 2008), following Keller's (2024) interpretation of the basis as indicative of currency scarcity: a negative basis ($x < 0$) signifies dollar scarcity, whereas a positive basis ($x > 0$) indicates scarcity of currency i. Panel B presents the post-GFC period (August 2009–January 2024), applying the framework of Liao and Zhang (2025), which attributes the cross-currency basis to the joint behaviors of hedging demands and constrained intermediaries. Since there is a global dollar funding strain in postcrisis era, the basis values are dominantly negative and indicate dollar funding pressure risks.

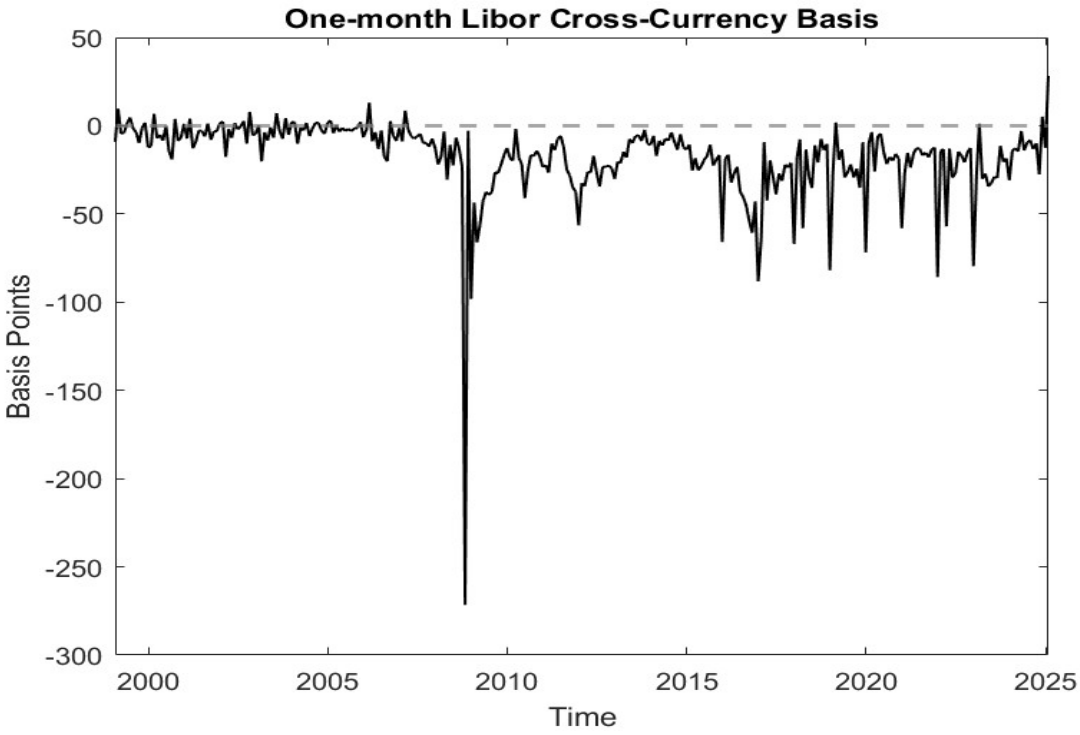


Figure 2: **Average Short-Term Libor-Based Deviations from Covered Interest Rate Parity (CIP).** This figure plots the equally-weighted average one-month Libor cross-currency basis for G10 currencies, measured in basis points. One-hundred basis points equal one percent. The Libor basis is equal to $x_{t,t+n} = y_{t,t+n}^{\$,Libor} - (y_{t,t+n}^{Libor} - \rho_{t,t+n})$, where n = one month, $y_{t,t+n}^{\$,Libor}$ and $y_{t,t+n}^{Libor}$ denote the U.S. and foreign one-month Libor rates respectively, and $\rho_{t,t+n} = \frac{1}{n}(f_{t,t+n} - s_t)$ denotes the forward premium obtained from the swap and spot exchange rates. The sample period is January 1999 to January 2024.

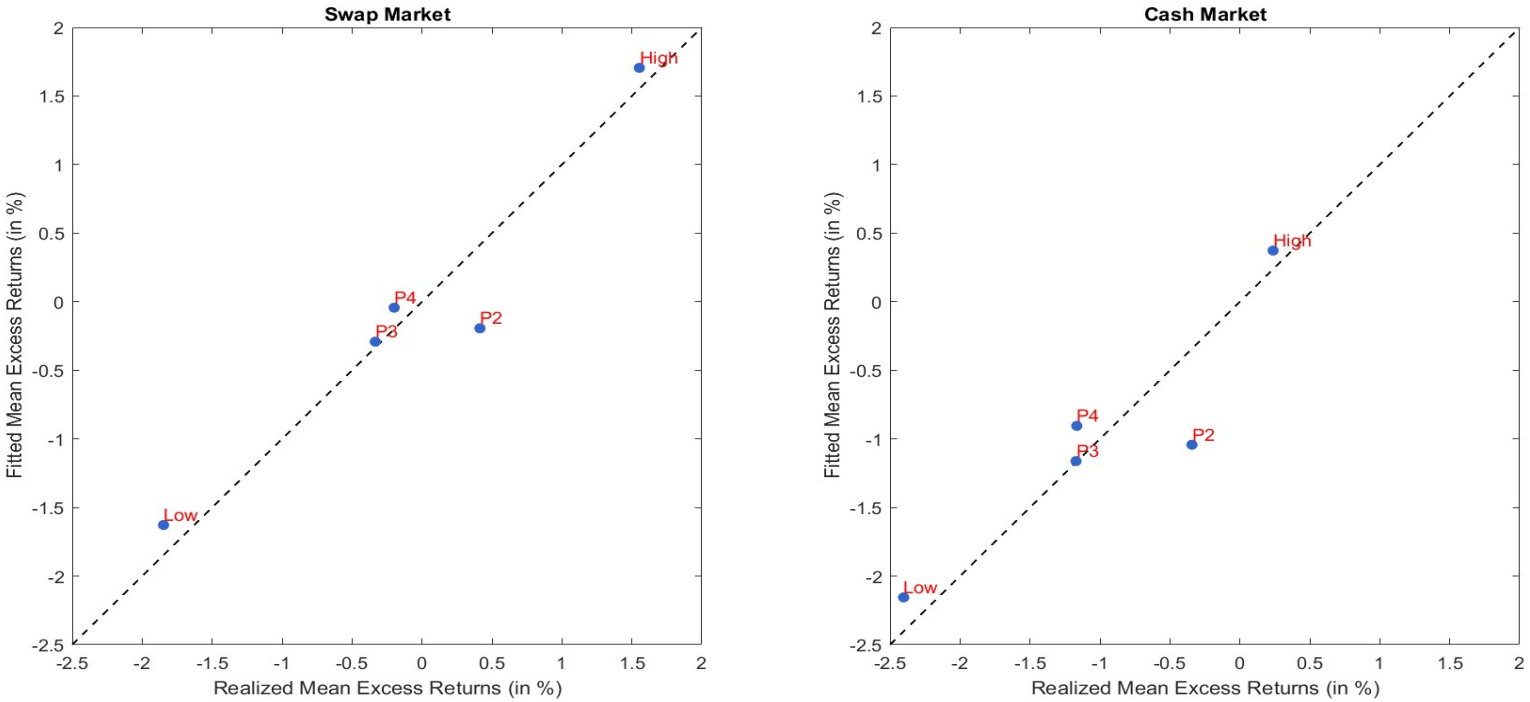


Figure 3: **Pricing Error Plots.** The figure presents the pricing errors from a cross-sectional asset pricing model estimated at the portfolio level, where the cross-currency basis and the dollar factor serve as common risk factors. The x-axis depicts the realized mean excess returns, while the y-axis displays the model-implied (fitted) mean excess returns for currency portfolios. These portfolios are constructed conditional on the cross-currency basis falling within quintiles ranging from the lowest (most negative) to the highest (least negative) values of cross-currency basis. Panel A shows results for currency returns obtained from forward contracts on FX swap markets, while Panel B shows results for cash markets. The sample period is January 1999 to January 2024.

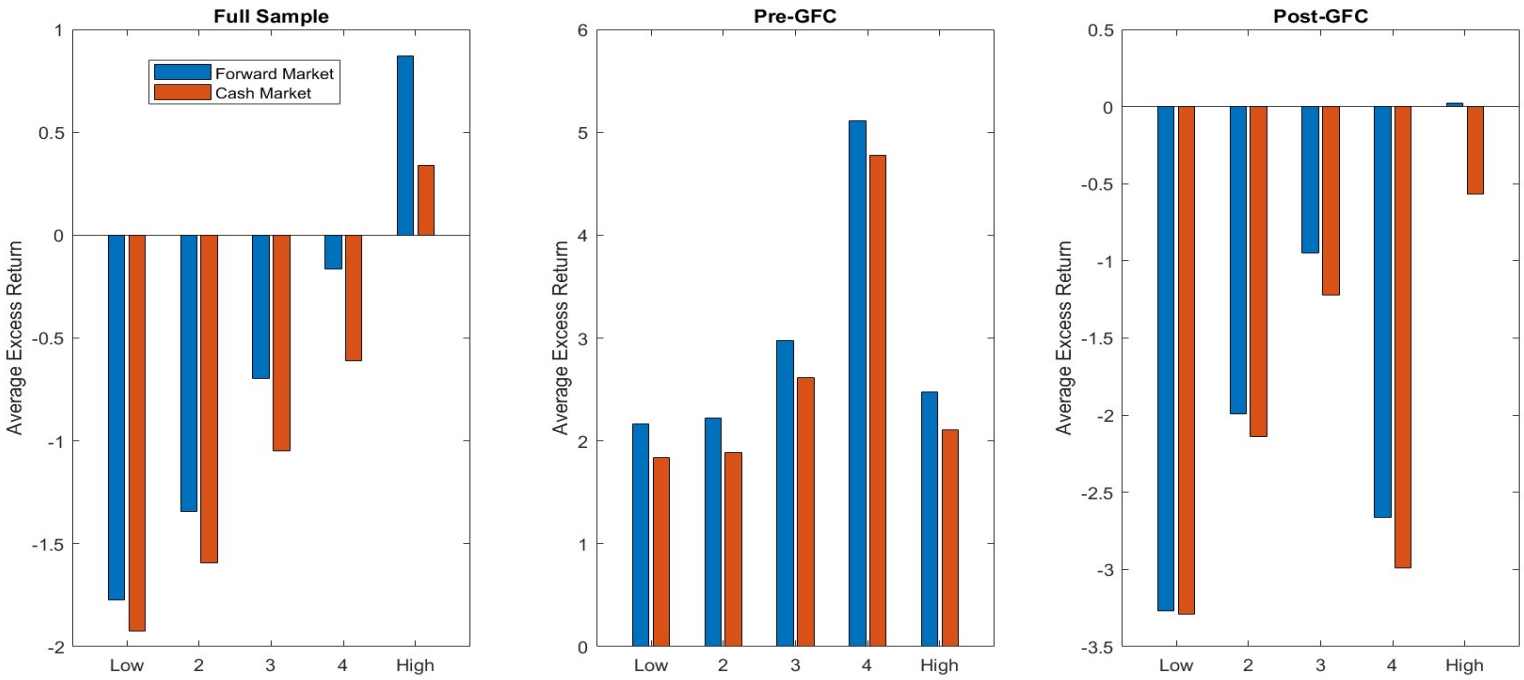


Figure 4: **Pre and post GFC Average Excess Returns and Cross-Currency Basis** The figure reports the mean excess returns of currency portfolios sorted by the cross-currency basis, categorized into quintiles based on the distribution of the basis across the sample. The x-axis in each panel represents the five quintile groups, ranging from "lowest" to "highest" basis values. The bars display the equally-weighted log currency excess returns for each portfolio obtained via currency forward contracts in FX swap markets and risk-free deposits in cash markets, computed as $rx^j_{t+1} = f^j_t - s^j_{t+1}$ and $rx^j_{t+1} = y^j_t - y^\$_t - \Delta s^{j+1}_t$, respectively. The sample includes G10 currencies. Panel (a) presents the results for the full sample from January 1999 to January 2024. Panel (b) displays results for precrisis period from January 1999 to August 2008. Panel (c) displays results for postcrisis period from August 2009 to January 2024.

Table 1: Descriptive Statistics

This table reports, for each portfolio j, the average cross-currency basis x^j reported in bps, the average log excess return rx^j, the average change in log spot exchange rates Δs^j, the average log forward discount $f^j - s^j$, the interest rate differential $y^j - y^\$$, the net foreign asset relative to GDP (nfa) in percentage, and the net USD debt holdings relative to GDP (ndt) in percentage in both forward and cash markets. Log currency excess returns obtained via currency forward contracts in FX swap markets and risk-free deposits in cash markets are computed as $rx^j_{t+1} = f^j_t - s^j_{t+1}$ and $rx^j_{t+1} = y^j_t - y^\$_t - \Delta s^{j+1}_t$, respectively. The t-statistic is Newey and West (1987) HAC t-statistics. All moments are annualized and reported in percentage points. Standard errors are reported below the mean. For both markets, the portfolios are constructed by sorting currencies into five groups at time t based on the cross-currency basis at the end of period $t-1$. The first portfolio contains currencies with the lowest cross-currency basis. The last portfolio contains currencies with the highest cross-currency basis. Data are monthly, from LSEG Datastream. The sample period is from January 1999 to January 2024.

Portfolio	1	2	3	4	5	HML	Avg.
Cross-currency basis (x^j)							
Mean	-44.70	-28.33	-18.94	-10.04	6.50	51.20	-19.10
SD	40.71	32.00	23.51	19.44	15.35	38.27	24.08
Excess returns on swap markets (rx^j)							
Mean	-1.77	-1.31	-0.73	-0.16	0.87	2.65	-0.62
t-statistics	-0.92	-0.70	-0.35	-0.09	0.45	1.93	-0.36
SD	8.99	8.84	9.32	9.54	9.84	7.36	8.19
Sharp ratio	-0.20	-0.15	-0.08	-0.02	0.09	0.36	-0.08
Excess returns on cash markets (rx^j)							
Mean	-1.93	-1.56	-1.08	-0.61	0.34	2.27	-0.97
t-statistics	-1.00	-0.83	-0.52	-0.34	0.18	1.65	-0.56
SD	9.03	8.87	9.36	9.60	9.87	7.40	8.23
Sharp ratio	-0.21	-0.18	-0.12	-0.06	0.03	0.31	-0.12
Spot change (Δs^j)							
Mean	0.83	0.87	0.42	0.02	-0.17	-1.00	0.39
SD	0.03	0.03	0.03	0.03	0.03	0.02	0.02
Forward discount ($f - s$)							
Mean	-1.04	-0.48	-0.31	-0.13	0.80	1.84	-0.23
SD	1.85	1.66	1.48	1.50	1.97	2.35	1.33
Interest rate differential ($y^j - y^\$$)							
Mean	-0.59	-0.20	-0.12	-0.03	0.74	1.33	-0.04
SD	1.82	1.57	1.44	1.46	1.93	2.29	1.28
Net foreign asset ratio (nfa)							
Mean	30.36	22.98	24.04	18.10	-15.37	-45.73	16.02
SD	36.94	47.76	50.00	54.32	53.82	76.32	17.22
Net USD debt holding ratio (ndt)							
Mean	9.97	7.07	7.26	7.34	-4.78	-14.76	5.37
SD	13.14	16.37	17.11	20.27	19.63	28.43	6.22

Table 2: Pricing the Global Cross-Currency Basis Factor

The table reports cross-sectional pricing results for the linear factor model based on the dollar risk factor (DOL) and global "*high-minus-low*" cross-currency basis risk factor HML_x. The test assets are the monthly excess returns to the five equally-weighted currency portfolios sorted by the exposure to the currency basis risk from swap markets (the left panel) or cash markets (the right panel). Panel A shows coefficient estimates of SDF parameters b and factor risk prices λ) obtained by GMM and FMB cross-sectional regressions. I use first-stage GMM and do not use a constant in the second-stage FMB regressions. Standard errors (s.e.) of coefficient estimates are reported below the estimates and are obtained by the Newey and West (1987) procedure with the optimal lag selection according to Andrews (1991). I also report the cross-sectional R-squared and the Hansen and Jagannathan (1997) (HJ dist) along with the (simulation-based) p-value for the test of whether the HJ distance is equal to zero. The reported FMB standard errors and chi-square test statistics (with p-values below the estimates) are based on both the Shanken (1992) adjustment (Sh) or the Newey–West approach with optimal lag selection (NW). Panel B reports results for time-series regressions of excess returns on a constant, the dollar risk factor (DOL), and global high-minus-low cross-currency basis HML_x. HAC standard errors (Newey–West with optimal lag selection) are reported below the estimates. All moments are monthly and reported in percentage points (%). The sample includes G10 currencies and the sample period is from January 1999 to January 2024.

Panel A: Factor Prices

Swap Market					Cash Market				
GMM	DOL	HML_x	R^2	HJ dist	GMM	DOL	HML_x	R^2	HJ dist
b	-0.01	0.06	93.47%	0.03	b	-0.03	0.05	85.69%	0.04
s.e.	0.02	0.03		0.99	s.e.	0.02	0.03		0.99
λ	-0.01	0.28			λ	-0.08	0.21		
s.e.	0.13	0.12			s.e.	0.14	0.12		
FMB	DOL	HML_x	x^2_{Sh}	x^2_{NW}	FMB	DOL	HML_x	x^2_{Sh}	x^2_{NW}
λ	-0.01	0.28	0.61	0.60	λ	-0.08	0.21	1.13	0.97
Sh	0.14	0.13	0.99	0.99	Sh	0.14	0.12	0.95	0.96
NW	0.14	0.11			NW	0.15	0.11		

Panel B: Factor Betas

Swap Market					Cash Market				
Portfolio	α	DOL	HML_x	R^2	Portfolio	α	DOL	HML_x	R^2
1	-0.01	1.01	-0.46	90.03%	1	-0.02	1.02	-0.46	90.06%
	0.04	0.03	0.03			0.04	0.03	0.03	
2	0.05	0.95	-0.03	74.00%	2	0.05	0.95	-0.05	73.38%
	0.06	0.10	0.03			0.06	0.10	0.03	
3	0.00	1.03	-0.06	82.01%	3	0.00	1.02	-0.06	81.51%
	0.06	0.06	0.04			0.06	0.06	0.04	
4	-0.01	1.00	0.01	79.22%	4	-0.02	0.99	0.03	79.38%
	0.06	0.04	0.03			0.06	0.04	0.03	
5	-0.01	1.01	0.54	93.11%	5	-0.02	1.02	0.54	93.16%
	0.04	0.03	0.03			0.04	0.03	0.03	

Table 3: Asset Pricing: Using A Large Set of Currency Portfolios

The table reports cross-sectional pricing results for the linear stochastic discount factor (SDF) model based on the dollar risk factor (DOL), traditional FX carry trade factor of Lustig et. al (2011) (CAR), and global "*high-minus-low*" cross-currency basis risk factor (HML_x). The test assets in Panel A are the excess returns to six equally-weighted currency strategy portfolios sorted by interest rate differential (Lustig et al., 2011), global volatility (Menkhoff et al., 2012a), three-month momentum (Menkhoff et al., 2012b; Asness et al., 2013), currency value (Asness et al., 2013; Menkhoff et al., 2017), net foreign asset ratios (Corte et al., 2016), and cross-currency basis. This results in 30 currency portfolios spanning the full sample period from January 1999 to January 2024. The Panel B conduct the cross-sectional out-of-sample tests in which the basis and carry portfolios are excluded from the test assets. The test assets only include currency value, momentum, volatility, and net foreign asset ratio portfolios. Note that the tradable pricing factors HML_x and CAR are included in test assets to ensure that the risk price is not estimated as a free parameter. This table shows coefficient estimates of SDF parameters b and factor risk prices λ obtained by the first-stage GMM. Standard errors (s.e.) of coefficient estimates are reported below the estimates and are obtained by the Newey and West (1987) procedure with the optimal lag selection according to Andrews (1991). I also report the cross-sectional R-squared and the Hansen and Jagannathan (1997) (HJ dist) along with the (simulation-based) p-value for the test of whether the HJ distance is equal to zero. All moments are monthly and reported in percentage points (%).

Panel A: A large set of currency strategy portfolios as test assets

Forward Market						Cash Market					
GMM	DOL	HML_x	CAR	R^2	HJ dist	GMM	DOL	HML_x	CAR	R^2	HJ dist
b	-0.02	0.09		59.97%	0.25	b	-0.03	0.07		60.12%	0.24
s.e.	0.03	0.03			0.36	s.e.	0.02	0.03			0.88
λ	-0.01	0.40				λ	-0.08	0.33			
s.e.	0.13	0.15				s.e.	0.14	0.15			
b	-0.02		0.05	45.51%	0.25	b	-0.04		0.05	50.92%	0.23
s.e.	0.03		0.03		0.32	s.e.	0.03		0.03		0.76
λ	-0.01		0.34			λ	-0.08		0.26		
s.e.	0.13		0.16			s.e.	0.14		0.17		
b	-0.02	0.07	0.01	61.09%	0.24	b	-0.03	0.06	0.02	61.82%	0.23
s.e.	0.03	0.04	0.03		0.50	s.e.	0.03	0.04	0.03		0.44
λ	-0.01	0.37	0.27			λ	-0.08	0.28	0.21		
s.e.	0.13	0.14	0.17			s.e.	0.14	0.14	0.17		

Panel B: Out-of-sample currency strategy portfolios as test assets

Forward Market						Cash Market					
GMM	DOL	HML_x	CAR	R^2	HJ dist	GMM	DOL	HML_x	CAR	R^2	HJ dist
b	-0.02	0.07		64.07%	0.20	b	-0.03	0.07		71.64%	0.21
s.e.	0.02	0.03			0.77	s.e.	0.02	0.03			0.39
λ	-0.01	0.34				λ	-0.08	0.30			
s.e.	0.13	0.14				s.e.	0.14	0.14			
b	-0.02		0.05	51.67%	0.21	b	-0.04		0.05	70.05%	0.21
s.e.	0.03		0.03		0.57	s.e.	0.03		0.02		0.99
λ	-0.01		0.33			λ	-0.08		0.28		
s.e.	0.13		0.16			s.e.	0.14		0.16		
b	-0.02	0.05	0.02	68.18%	0.19	b	-0.03	0.04	0.03	77.02%	0.20
s.e.	0.03	0.03	0.03		0.66	s.e.	0.03	0.03	0.03		0.60
λ	-0.01	0.30	0.27			λ	-0.08	0.24	0.24		
s.e.	0.13	0.13	0.16			s.e.	0.14	0.13	0.16		

Table 4: Beta Sorted Currency Portfolios

The table reports statistics for portfolios constructed by sorting currencies into five groups based on the slope coefficient β_t^i. Each β_t^i is obtained by regressing currency log excess returns rx_t^i on HML_x on a 36-month rolling window regression that ends in period $t-1$. $P1$ contains currencies with the lowest β. $P5$ contains currencies with the highest β. I report the average post-formation betas for each portfolio, where betas are estimated by regressing portfolio j's realized log excess returns on HML_x. I report average preformation and post formation forward discounts for each portfolio (in % per annum). Preformation discounts are calculated at the end of the month just prior to portfolio formation, whereas post-formation forward discounts are calculated over the 6 months following portfolio formation. I also report presorting (pre-) and post sorting (post-) cross-currency basis. All moments are annualized and reported in percentage points (%). This table also reports annualized Sharpe ratios, computed as ratios of annualized means to annualized standard deviations. The sample includes G10 currencies and the sample period is from January 1999 to January 2024.

Panel A: Swap market sorts on cross-currency basis beta

Portfolio	1	2	3	4	5	HML	Avg.
Mean excess returns							
Mean	-2.20	0.57	-0.65	0.86	2.28	4.48	0.17
t-statistics	-1.10	0.29	-0.31	0.40	1.04	2.43	0.09
SD	9.22	8.68	9.32	9.01	10.85	9.73	8.14
Sharpe ratio	2.01	1.94	2.12	2.12	2.19	1.84	1.86
Preformation beta							
Mean	-0.23	-0.02	0.13	0.29	0.62		
s.e	0.22	0.26	0.29	0.35	0.41		
Postformation beta							
Mean	-0.09	0.06	0.11	0.17	0.18		
s.e	0.11	0.13	0.14	0.15	0.20		
Preformation forward discount							
Mean	-1.02	-0.34	-0.01	-0.04	1.18		
SD	1.46	1.68	1.09	1.46	2.13		
Postformation forward discount							
Mean	-1.02	-0.34	0.00	-0.04	1.18		
SD	1.39	1.64	1.05	1.40	2.13		
Preformation cross-currency basis							
Mean	-33.25	-23.66	-19.42	-13.95	-1.15		
SD	41.24	28.45	28.76	25.22	18.54		
Preformation cross-currency basis							
Mean	-32.76	-23.62	-19.22	-13.81	-1.63		
SD	23.94	22.53	19.14	17.80	11.71		

Panel B: Cash Markets sorts on cross-currency basis beta

Portfolio	1	2	3	4	5	HML	Avg.
Mean excess returns							
Mean	-2.76	0.69	-0.97	0.32	1.80	4.55	-0.18
t-statistics	-1.31	0.36	-0.43	0.16	0.82	2.44	-0.10
SD	9.46	8.64	9.09	9.15	10.94	10.05	8.17
Sharpe ratio	2.10	1.90	2.23	2.03	2.19	1.86	1.87
Preformation beta							
Mean	-0.23	-0.03	0.13	0.29	0.62		
s.e	0.22	0.26	0.30	0.35	0.41		
Postformation beta							
Mean	-0.10	0.06	0.09	0.19	0.19		
s.e	0.11	0.13	0.14	0.15	0.20		
Preformation forward discount							
Mean	-0.98	-0.36	0.00	0.01	1.12		
SD	1.45	1.69	1.05	1.58	2.20		
Postformation forward discount							
Mean	-0.98	-0.36	0.00	0.00	1.11		
SD	1.40	1.64	1.02	1.52	2.20		
Preformation cross-currency basis							
Mean	-32.58	-24.31	-19.65	-13.72	-1.18		
SD	34.78	33.33	29.06	25.12	18.59		
Preformation cross-currency basis							
Mean	-32.17	-24.24	-19.39	-13.54	-1.71		
SD	22.94	23.94	20.23	16.97	11.80		

Table 5: Country-Level Asset Pricing

The table reports currency-level cross-sectional pricing results for the linear factor model based on the dollar risk factor (DOL) and global "*high-minus-low*" cross-currency basis risk factor (HML_x). The test assets are the excess returns of G10 currencies from swap markets (the left panel) or cash markets (the right panel). Panel A shows coefficient estimates of SDF parameters b and factor risk prices λ) obtained by GMM and FMB cross-sectional regressions. I use first-stage GMM and do not use a constant in the second-stage FMB regressions. Standard errors (s.e.) of coefficient estimates are reported below the estimates and are obtained by the Newey and West (1987) procedure with the optimal lag selection according to Andrews (1991). I also report the cross-sectional R-squared and the Hansen and Jagannathan (1997) distance (HJ dist) along with the (simulation-based) p-value for the test of whether the HJ distance is equal to zero. The reported FMB standard errors and chi-square test statistics (with p-values below the estimates) are based on both the Shanken (1992) adjustment (Sh) or the Newey–West approach with optimal lag selection (NW). Panel B reports results for time-series regressions of excess returns on a constant, the dollar risk factor (DOL), and global high-minus-low cross-currency basis HML_x. HAC standard errors (Newey–West with optimal lag selection) are reported below the estimates. All moments are monthly and reported in percentage points (%). The sample includes G10 currencies and the sample period is from January 1999 to January 2024.

Panel A: Factor Prices

Forward Market					Cash Market				
GMM	DOL	HML_x	R^2	HJ dist	GMM	DOL	HML_x	R^2	HJ dist
b	-0.02	0.20	87.88%	0.10	b	-0.03	0.16	75.41%	0.21
s.e.	0.03	0.08		0.93	s.e.	0.02	0.07		0.10
λ	-0.01	0.88			λ	-0.08	0.60		
s.e.	0.13	0.39			s.e.	0.14	0.26		
FMB	DOL	HML_x	x^2_{Sh}	x^2_{NW}	FMB	DOL	HML_x	x^2_{Sh}	x^2_{NW}
λ	-0.01	0.88	3.05	3.13	λ	-0.08	0.60	8.92	7.98
Sh	0.14	0.33	0.98	0.98	Sh	0.14	0.27	0.54	0.63
Nw	0.14	0.32			Nw	0.15	0.26		

Panel B: Factor Betas

Forward Market					Cash Market				
Porfolio	α	DOL	HML_x	R^2	Portfolio	α	DOL	HML_x	R^2
AUS	0.16	1.26	0.17	74.60%	AUS	0.15	1.27	0.16	74.73%
	0.06	0.07	0.09			0.07	0.07	0.09	
CAD	0.06	0.74	-0.01	51.35%	CAD	0.07	0.74	0.03	51.80%
	0.08	0.04	0.07			0.08	0.04	0.06	
DKK	-0.04	1.04	-0.11	83.06%	DKK	-0.01	1.04	-0.11	82.89%
	0.05	0.03	0.06			0.06	0.03	0.06	
EUR	-0.04	1.04	-0.11	82.85%	EUR	-0.03	1.04	-0.11	82.77%
	0.06	0.03	0.06			0.05	0.03	0.06	
JPY	-0.20	0.49	-0.30	20.87%	JPY	-0.20	0.50	-0.43	24.58%
	0.14	0.14	0.15			0.14	0.13	0.09	
NZD	0.19	1.30	0.28	72.58%	NZD	0.16	1.30	0.33	73.32%
	0.07	0.09	0.09			0.08	0.07	0.10	
NOK	-0.01	1.22	-0.01	73.79%	NOK	-0.02	1.22	0.00	73.64%
	0.06	0.07	0.06			0.07	0.06	0.06	
SEK	-0.09	1.21	-0.02	81.52%	SEK	-0.08	1.20	-0.03	81.58%
	0.06	0.03	0.04			0.06	0.03	0.04	
CHF	0.01	0.96	0.02	64.08%	CHF	0.02	0.95	0.00	64.14%
	0.07	0.05	0.07			0.07	0.05	0.08	
GBP	-0.05	0.75	0.08	52.70%	GBP	-0.06	0.74	0.15	53.62%
	0.09	0.03	0.05			0.10	0.03	0.04	

Table 6: Descriptive Statistics: Pre- and Post Global Financial Crisis

This table reports, for each portfolio j, the average cross-currency basis x^j reported in bps, average log excess return rx^j with and without bid-ask (b-a) spreads, the average change in log spot exchange rates Δs^j, the average log forward discount $f^j - s^j$ and the interest rate differential $y^j - y^\$$ in both forward and cash markets. Log currency excess returns in swap markets and cash markets are computed as $rx^j_{t+1} = f^j_t - s^j_{t+1}$ and $rx^j_{t+1} = y^j_t - y^\$_t - \Delta s^{j+1}_t$, respectively. All moments are annualized and reported in percentage points. Standard errors are reported below the mean. For both markets, the portfolios are constructed by sorting currencies into five groups at time t based on the cross-currency basis at the end of period $t-1$. The first portfolio contains currencies with the lowest cross-currency basis. The last portfolio contains currencies with the highest cross-currency basis. Data are monthly, from LSEG Datastream. I split the whole sample from January 1999 to January 2024 into two subsamples based on the global financial crisis in 2008 where Panel A reports statistics of the sample period from January 1999 to August 2008 (pre-GFC) and Panel B reports the results of the sample period from September 2009 to January 2024 (post-GFC).

Panel A: Pre-Global Financial Crisis (2008)								Panel B: Post-Global Financial Crisis (2008)							
Portfolio	1	2	3	4	5	HML	Avg.	Portfolio	1	2	3	4	5	HML	Avg.
Cross-currency basis								*Cross-currency basis*							
Mean	-22.70	-10.42	-5.17	0.37	10.44	33.14	-5.50	Mean	-58.96	-38.93	-27.05	-16.14	4.14	63.11	-27.39
SD	14.93	10.99	9.30	8.23	10.82	15.88	9.39	SD	45.72	35.42	25.50	21.46	17.05	44.10	26.29
Excess returns on forward markets								*Excess returns on forward markets*							
Mean	0.49	2.63	5.72	2.56	3.54	3.05	2.99	Mean	-3.66	-3.32	-2.46	-2.99	0.26	3.92	-2.43
t-statistics	0.17	0.84	2.21	0.86	1.27	1.29	1.15	t-statistics	-1.62	-1.44	-0.96	-1.43	0.10	2.18	-1.17
SD	7.83	9.23	8.02	7.74	8.24	7.73	7.13	SD	9.12	9.11	9.62	10.29	10.67	7.55	8.64
Sharp ratio	0.06	0.29	0.71	0.33	0.43	0.39	0.42	Sharp ratio	-0.40	-0.36	-0.26	-0.29	0.02	0.52	-0.28
Excess returns on cash markets								*Excess returns on cash markets*							
Mean	0.28	2.27	5.42	2.20	3.04	2.76	2.64	Mean	-3.71	-3.52	-2.79	-3.49	-0.36	3.34	-2.78
t-statistics	0.10	0.72	2.11	0.74	1.09	1.16	1.02	t-statistics	-1.63	-1.51	-1.08	-1.65	-0.15	1.84	-1.32
SD	7.84	9.20	7.94	7.72	8.23	7.76	7.10	SD	9.19	9.19	9.68	10.39	10.72	7.61	8.70
Sharp ratio	0.04	0.25	0.68	0.28	0.37	0.36	0.37	Sharp ratio	-0.40	-0.38	-0.29	-0.34	-0.03	0.44	-0.32
Spot change								*Spot change*							
Mean	-1.64	-2.72	-5.74	-2.33	-2.71	-1.08	-3.03	Mean	2.77	2.62	1.97	2.63	0.44	-2.33	2.08
SD	0.02	0.03	0.02	0.02	0.02	0.02	0.02	SD	0.03	0.03	0.03	0.03	0.03	0.02	0.02
Forward discount								*Forward discount*							
Mean	-1.15	-0.09	-0.02	0.23	0.83	1.98	-0.04	Mean	-0.97	-0.74	-0.50	-0.35	0.77	1.74	-0.36
SD	2.34	2.01	1.72	1.71	2.34	3.27	1.51	SD	1.47	1.38	1.25	1.31	1.71	1.60	1.19
Interest rate differential								*Interest rate differential*							
Mean	-0.91	0.03	0.05	0.25	0.75	1.65	0.04	Mean	-0.39	-0.35	-0.22	-0.19	0.73	1.12	-0.08
SD	2.31	1.97	1.69	1.67	2.29	3.22	1.47	SD	1.42	1.28	1.24	1.28	1.66	1.46	1.16
Net foreign assets ratio (nfa)								*Net foreign assets ratio (nfa)*							
Mean	5.94	-5.54	-4.11	-8.68	5.49	-0.45	-1.38	Mean	43.52	41.03	40.63	33.76	-27.72	-71.24	26.24
SD	33.50	32.86	32.09	29.91	46.05	70.05	3.69	SD	30.28	47.47	51.36	59.18	54.33	67.00	13.45
USD net debt holding ratio (ndt)								*USD net debt holding ratio (ndt)*							
Mean	5.26	-1.87	-2.29	-3.30	4.68	-0.58	0.50	Mean	13.58	14.03	14.73	15.59	-12.19	-25.76	9.15
SD	12.46	11.77	11.40	11.48	14.41	24.20	3.36	SD	12.52	16.09	17.11	21.76	20.00	26.63	5.23

Table 7: Cross-Sectional Asset Pricing Tests: Pre-and Post-GFC

The table reports cross-sectional pricing results for the linear stochastic discount factor (SDF) model based on the dollar risk factor (DOL) and global "*high-minus-low*" cross-currency basis risk factor (HML_x). Panel A reports the test results using 30 currency portfolios as test assets. The test assets are the excess returns to six equally-weighted currency strategy portfolios sorted by interest rate differential (Lustig et al., 2011), global volatility (Menkhoff et al., 2012a), three-month momentum (Menkhoff et al., 2012b; Asness et al., 2013), currency value (Asness et al., 2013; Menkhoff et al., 2017), net foreign asset ratios (Corte et al., 2016), and cross-currency basis. Panel B reports the test results using country-level individual currency excess returns as test assets. Note that I also include risk factors to ensure that the point estimate of factor price equals to the expected returns of tradable risk factors. This table shows coefficient estimates of SDF parameters b and factor risk prices λ obtained by the first-stage GMM. Standard errors (s.e.) of coefficient estimates are reported below the estimates and are obtained by the Newey and West (1987) procedure with the optimal lag selection according to Andrews (1991). I also report the cross-sectional R-squared and the HJ distance (HJ dist) along with the (simulation-based) p-value for the test of whether the HJ distance is equal to zero. The sample includes G10 currencies. All moments are monthly and reported in percentage points (%). The full sample period is from January 1999 to January 2024. The post-Global Financial Crisis (GFC) period refers to the period from August 2009 to January 2024.

Panel A: Currency portfolios as test assets

Pre-Global Financial Crisis

	Swap Market					Cash Market				
GMM	DOL	HML_x	CAR	R^2	HJ dist	DOL	HML_x	CAR	R^2	HJ dist
b	0.05	0.08		42.17%	0.49	0.03	0.07		37.43%	0.43
s.e.	0.04	0.06			0.10	0.04	0.06			0.42
λ	0.24	0.43				0.18	0.38			
s.e.	0.25	0.38				7.60	5.69			
b	0.03		0.08	68.02%	0.45	0.02		0.08	67.67%	0.38
s.e.	0.04		0.05		0.21	0.05		0.05		0.85
λ	0.24		0.53			0.17		0.50		
s.e.	0.19		0.34			0.25		0.37		
b	0.03	0.01	0.08	68.10%	0.45	0.02	0.00	0.08	67.67%	0.38
s.e.	0.04	0.06	0.06		0.34	0.05	0.06	0.05		0.84
λ	0.24	0.23	0.53			0.17	0.19	0.50		
s.e.	0.32	0.25	0.44			0.23	0.32	0.44		

Post-Global Financial Crisis

	Swap Market					Cash Market				
GMM	DOL	HML_x	CAR	R^2	HJ dist	DOL	HML_x	CAR	R^2	HJ dist
b	-0.05	0.10		57.73%	0.31	-0.05	0.09		54.58%	0.30
s.e.	0.03	0.04			0.77	0.03	0.04			0.27
λ	-0.14	0.38				-0.16	0.34			
s.e.	0.17	0.18				0.17	0.18			
b	-0.06		0.07	39.93%	0.35	-0.06		0.07	41.36%	0.31
s.e.	0.04		0.04		0.44	0.03		0.04		0.91
λ	-0.14		0.34			-0.16		0.30		
s.e.	0.17		0.19			0.17		0.19		
b	-0.06	0.09	0.01	58.04%	0.31	-0.05	0.07	0.02	55.48%	0.30
s.e.	0.04	0.05	0.04		0.91	0.03	0.05	0.04		0.94
λ	-0.15	0.36	0.23			-0.16	0.31	0.21		
s.e.	0.17	0.17	0.19			0.17	0.17	0.19		

Panel B: Country-level currency excess returns as test assets

Pre-Global Financial Crisis

	Swap Market					Cash Market				
GMM	DOL	HML_x	CAR	R^2	HJ dist	DOL	HML_x	CAR	R^2	HJ dist
b	0.05	0.09		21.49%	0.33	0.03	0.09		23.31%	0.36
s.e.	0.04	0.06			0.43	0.04	0.06			0.28
λ	0.25	0.48				0.18	0.45			
s.e.	0.20	0.25				0.20	0.25			
b	0.03		0.09	89.95%	0.24	0.02		0.09	88.16%	0.29
s.e.	0.05		0.05		0.90	0.05		0.05		0.73
λ	0.24		0.61			0.17		0.57		
s.e.	0.20		0.23			0.20		0.24		
b	0.03	0.00	0.09	89.95%	0.24	0.02	0.00	0.09	88.16%	0.29
s.e.	0.05	0.06	0.05		0.91	0.05	0.06	0.05		0.75
λ	0.24	0.23	0.61			0.17	0.22	0.57		
s.e.	0.20	0.22	0.23			0.20	0.22	0.24		

Post-Global Financial Crisis

	Swap Market					Cash Market				
GMM	DOL	HML_x	CAR	R^2	HJ dist	DOL	HML_x	CAR	R^2	HJ dist
b	-0.05	0.10		89.96%	0.26	-0.06	0.08		88.33%	0.20
s.e.	0.03	0.04			0.44	0.03	0.04			0.85
λ	-0.14	0.37				-0.21	0.30			
s.e.	0.17	0.18				0.17	0.18			
b	-0.05		0.07	65.29%	0.29	-0.06		0.06	67.16%	0.23
s.e.	0.04		0.04		0.23	0.03		0.04		0.67
λ	-0.14		0.29			-0.20		0.23		
s.e.	0.17		0.19			0.17		0.19		
b	-0.05	0.11	-0.01	90.43%	0.26	-0.06	0.10	-0.01	88.78%	0.20
s.e.	0.03	0.05	0.04		0.46	0.03	0.05	0.04		0.83
λ	-0.14	0.39	0.17			-0.20	0.33	0.11		
s.e.	0.17	0.16	0.18			0.17	0.16	0.19		

Table 8: Correlation of Cross-Currency Basis Factor and Common FX Risk Factors on Swap Market

This table reports the correlations of the high-minus low cross-currency basis factor HML_X and other common FX risk factors on swap markets across G10 currencies. These risk factors include: the carry trade factor sorted on the forward discount (FDS), business gap (GAP) (Colacito et al., 2020), low-frequency FX systematic liquidity risk (IML) (Mancini et al., 2013; Karnaukh et al., 2015), short-term momentum (MOM3) and long-term momentum (MOM12) (Menkhoff et al., 2012b; Asness et al., 2013), net foreign asset positions (NFA) (Corte et al., 2016; Liao & Zhang,2025), term spread (TER) (Chen et al., 2013; Lustig et al., 2019), currency value (VAL) (Asness et al., 2013; Menkhoff et al., 2017), the implied volatility of the S&P 500 (VIX) (Brunnermeier et al., 2008), and global volatility (VOL) (Menkhoff et al., 2012a). The sample covers the full period from January 1999 to January 2024. *, **, *** denotes significant correlations at the 90%, 95%, and 99% levels, respectively.

	HML_x	CAR	FDS	GAP	IMB	IML	MOM3	MOM12	NDT	NFA	TER	VAL	VOL	VIX
HML_x	1.00													
CAR	0.52 ***	1.00												
FDS	0.56 ***	0.98 ***	1.00											
GAP	0.06	0.08	0.09	1.00										
IMB	0.51 ***	0.78 ***	0.78 ***	0.06	1.00									
IML	-0.14 **	-0.10	-0.11 *	-0.03	-0.08	1.00								
MOM3	-0.00	-0.21 ***	-0.19 ***	-0.01	-0.19 ***	-0.05	1.00							
MOM12	0.02	-0.14 **	-0.13 **	0.16 ***	-0.23 ***	-0.01	0.43 ***	1.00						
NDT	0.47 ***	0.87 ***	0.87 ***	0.08	0.77 ***	-0.17 ***	-0.14 **	-0.16 ***	1.00					
NFA	0.36 ***	0.71 ***	0.73 ***	0.01	0.58 ***	-0.11 *	-0.08	-0.09	0.80 ***	1.00				
TER	0.32 ***	0.46 ***	0.47 ***	0.24 ***	0.29 ***	-0.14 **	0.09	0.15 **	0.41 ***	0.39 ***	1.00			
VAL	0.11 *	0.13 **	0.12 **	0.16 ***	0.04	-0.34 ***	-0.00	0.12 **	0.06	-0.05	0.31 ***	1.00		
VOL	-0.02	-0.19 ***	-0.16 ***	0.02	-0.18 ***	-0.08	0.10 *	0.02	-0.11 *	-0.05	0.08	-0.00	1.00	
VIX	0.10	0.14 **	0.14 **	-0.05	0.11 *	-0.02	-0.10	-0.16 ***	0.06	0.01	-0.03	0.06	-0.10	1.00

Table 9: Spanning Tests

The table presents time-series regression estimates for spanning tests. In this table, I employ two model specifications: the first specification regresses the excess returns of the global *high-minus-low* cross-currency basis excess returns (HML_x) on the various SDFs; the second specification extends the analysis by adding the lagged 3-month HML_x as an additional explanatory variable, as CIP violations exhibit strong quarter-end effects. These SDFs include: the carry trade factor sorted on nominal interest rate (CAR) and the forward discount (FDS) respectively, business gap (GAP) (Colacito et al., 2020), low-frequency FX systematic liquidity risk (IML) (Mancini et al., 2013; Karnaukh et al., 2015), short-term momentum (MOM3) and long-term momentum (MOM12) (Menkhoff et al., 2012b; Asness et al., 2013), net foreign asset positions (NFA) (Corte et al., 2016; Liao & Zhang, 2025), term spread (TER) (Chen et al., 2013; Lustig et al., 2019), currency value (VAL) (Asness et al., 2013; Menkhoff et al., 2017), the implied volatility of the S&P 500 (VIX) (Brunnermeier et al., 2008), and global volatility (VOL) (Menkhoff et al., 2012a). Each of these common risk factors is constructed using our sample and following their respective methodology. Newey and West (1987) standard errors with Andrews (1991) optimal lag selection are reported below each estimated coefficient. The intercept (α) is reported in percentage (%) and in monthly terms. The sample includes G10 currencies, covering the full sample period from January 1999 to January 2024 (Panel A) and postcrisis period from August 2009 to January 2024 (Panel B).

	CAR	FDS	GAP	IMB	IML	MOM12	NDT	NFA	TER	VAL
Panel A: Full Sample										
$HML_{x,t} = \alpha + \beta SDF_t + \epsilon_t$										
alpha	0.16	0.13	0.30	0.20	0.29	0.10	0.22	0.24	0.29	0.29
s.e.	0.10	0.10	0.12	0.11	0.11	0.12	0.12	0.12	0.12	0.12
beta	0.41	0.45	-0.11	0.41	0.04	0.38	0.31	0.29	0.07	0.07
s.e.	0.06	0.06	0.10	0.07	0.09	0.06	0.09	0.10	0.14	0.14
R square	0.27	0.31	0.01	0.26	0.00	0.22	0.12	0.10	0.00	0.00
$HML_{x,t} = \alpha + \beta SDF_t + \gamma HML_{x,t-3} + \epsilon_t$										
alpha	0.15	0.12	0.27	0.19	0.26	0.10	0.20	0.23	0.26	0.26
s.e.	0.10	0.10	0.11	0.11	0.11	0.12	0.11	0.11	0.11	0.11
beta	0.42	0.45	-0.10	0.41	0.04	0.38	0.32	0.29	0.08	0.08
s.e.	0.06	0.06	0.10	0.07	0.09	0.06	0.09	0.10	0.14	0.14
gamma	0.02	0.03	0.07	0.03	0.08	0.04	0.08	0.06	0.09	0.09
s.e.	0.04	0.04	0.06	0.05	0.05	0.05	0.05	0.05	0.06	0.06
R square	0.27	0.32	0.02	0.26	0.01	0.23	0.13	0.10	0.01	0.01
Panel B: Post-Global Financial Crisis										
$HML_{x,t} = \alpha + \beta SDF_t + \epsilon_t$										
alpha	0.22	0.18	0.31	0.26	0.31	0.08	0.20	0.34	0.28	0.28
s.e.	0.11	0.10	0.13	0.14	0.13	0.15	0.12	0.12	0.14	0.14
beta	0.52	0.58	-0.18	0.53	0.05	0.57	0.60	0.16	-0.20	-0.20
s.e.	0.07	0.07	0.12	0.12	0.12	0.09	0.13	0.12	0.20	0.20
R square	0.35	0.44	0.03	0.35	0.00	0.37	0.29	0.03	0.02	0.02
$HML_{x,t} = \alpha + \beta SDF_t + \gamma HML_{x,t-3} + \epsilon_t$										
alpha	0.23	0.18	0.31	0.25	0.30	0.08	0.18	0.33	0.27	0.27
s.e.	0.11	0.11	0.13	0.14	0.13	0.16	0.12	0.12	0.14	0.14
beta	0.52	0.58	-0.18	0.53	0.05	0.57	0.60	0.16	-0.19	-0.19
s.e.	0.07	0.07	0.13	0.11	0.12	0.09	0.13	0.12	0.19	0.19
gamma	-0.01	0.01	0.00	0.02	0.03	0.00	0.06	0.02	0.02	0.02
s.e.	0.05	0.04	0.07	0.06	0.07	0.06	0.06	0.07	0.06	0.06
R square	0.35	0.44	0.03	0.35	0.00	0.37	0.30	0.03	0.02	0.02

Table 10: Time Series Regressions: Carry Trade Portfolios on Dollar Funding Pressure Risk Factors

This table presents the results from time-series regressions of monthly carry trade returns and individual carry trade quintile portfolios (i.e., $P1$, $P2$,...,$P5$) on the global dollar funding pressure risk, HML_x. The carry trade portfolios are constructed under two alternative sorting schemes: one based on the interest rate differential, $y^j - y^\$$, and the other based on the forward discount, $f^j - s^j$. For each specification, currencies are independently sorted into quintile portfolios according to their respective sorting variable. The excess return on the high-minus-low carry trade strategy is constructed by calculating return differences between the highest and lowest quintiles ($P5 - P1$). The resulting carry trade excess returns are denoted as CAR (sorted on interest rate differentials) and FDS (sorted on forward discount), respectively. Newey and West (1987) standard errors with Andrews (1991) optimal lag selection are reported below each estimated coefficient. The intercept (α) is reported in percentage (%) and in monthly terms. The sample includes G10 currencies. The full sample period results covering January 1999 to January 2024 are reported in Panel A. The postcrisis period results from August 2009 to January 2024 are reported in Panel B.

Panel A: Full sample period							***Panel B: Post-Global Financial Crisis (GFC) period***						
$rx_{it}^{CAR} = \alpha_i + \beta_i HML_{x,t} + \epsilon_t$													
	P1	P2	P3	P4	P5	CAR		P1	P2	P3	P4	P5	CAR
alpha	-0.08	-0.18	-0.07	-0.08	0.03	0.11	alpha	-0.12	-0.28	-0.17	-0.33	-0.15	-0.02
s.e.	0.13	0.16	0.16	0.16	0.18	0.15	s.e.	0.16	0.17	0.17	0.19	0.19	0.12
beta	0.00	0.14	0.16	0.30	0.64	0.65	beta	0.08	0.16	0.18	0.44	0.77	0.69
s.e.	0.06	0.07	0.06	0.07	0.08	0.07	s.e.	0.09	0.09	0.09	0.11	0.09	0.08
R-square	0.00	0.01	0.02	0.05	0.19	0.27	R-square	0.00	0.01	0.02	0.10	0.27	0.36
$rx_{it}^{FDS} = \alpha_i + \beta_i HML_{x,t} + \epsilon_t$													
	P1	P2	P3	P4	P5	FDS		P1	P2	P3	P4	P5	FDS
alpha	-0.11	-0.17	-0.06	-0.10	0.05	0.15	alpha	-0.14	-0.24	-0.23	-0.31	-0.14	0.00
s.e.	0.13	0.16	0.15	0.16	0.18	0.14	s.e.	0.17	0.17	0.17	0.19	0.19	0.12
beta	-0.01	0.11	0.17	0.29	0.69	0.70	beta	0.05	0.12	0.22	0.40	0.83	0.78
s.e.	0.06	0.07	0.06	0.07	0.08	0.07	s.e.	0.09	0.08	0.08	0.11	0.10	0.07
R-square	0.00	0.01	0.02	0.05	0.21	0.31	R-square	0.00	0.01	0.04	0.08	0.30	0.45

Table 11: Horse Races: DOL, HML_x, CAR and External Imbalances as Risk Factors

The table reports the cross-sectional asset pricing results for currency strategies sorted on time $t-1$ information across G10 currency swap markets. The test assets are 30 currency portfolios, including portfolios sorted on a cross-currency basis, interest rate differentials (carry), global volatility, momentum, value, and net foreign asset ratios. In addition to the high-minus-low cross-currency basis portfolios (HML_x), the set of pricing risk factors includes the dollar factor (DOL), carry trade sorted on interest rate differential (CAR), as well as three different measures of external dollar imbalances, namely, the global imbalance portfolios of Corte et al.(2016) (IMB), the high-minus-low portfolio sorted on net USD debt holdings relative to GDP of Liao & Zhang (2025) (NDT), and the high-minus-low portfolio sorted on net foreign asset relative to GDP of Corte et al. (2016) and Liao & Zhang (2025) (NFA). I report first-stage GMM estimates of the factor loadings (b_x), the market price of risk (λ_x), the cross-sectional R-square, and HJ-distance. Standard errors are computed using the heteroskedasticity and autocorrelation consistent estimator of Newey and West (1987), with optimal lag length determined according to Andrews (1991). The Hansen and Jagannathan (1997) distance (HJ-dist) is reported to assess the null hypothesis that the distance equals zero, with simulated p-values reported in parentheses. All moments are monthly and reported in percentage points (%). The portfolios are rebalanced monthly. Panel A presents results for the full sample spanning from January 1999 to January 2024 (from January 1999 to December 2020 for IMB and NDT portfolios due to data availability). Panel B summarizes results for the postcrisis period spanning from August 2009 to January 2024 (from August 2009 to December 2020 for IMB and NDT portfolios due to data availability).

	b_{DOL}	b_{CAR}	b_{IMB}	b_{NDT}	b_{NFA}	b_{HML_x}	λ_{DOL}	λ_{CAR}	λ_{IMB}	λ_{NDT}	λ_{NFA}	λ_{HML_x}	R-square	HJ-dist
Panel A: Full sample period														
coeff.	-0.01	0.04	0.00				0.09	0.36	0.28				55.26%	0.24
s.e.	0.03	0.05	0.06				0.15	0.19	0.21					0.87
coeff.	0.00	0.02	-0.02			0.07	0.08	0.29	0.21			0.37	69.18%	0.25
s.e.	0.03	0.05	0.06			0.04	0.15	0.19	0.21			0.15		0.81
coeff.	-0.01	0.08		-0.03			0.08	0.38		0.27			55.71%	0.24
s.e.	0.03	0.10		0.10			0.15	0.19		0.22				0.81
coeff.	0.00	-0.01		0.02		0.07	0.08	0.27		0.28		0.37	68.87%	0.25
s.e.	0.03	0.10		0.09		0.04	0.15	0.19		0.22		0.15		0.85
coeff.	-0.02	0.05			0.01		0.00	0.35			0.25		53.74%	0.24
s.e.	0.03	0.04			0.04		0.13	0.16			0.15			0.70
coeff.	0.03	0.04			0.02	0.08	0.13	0.17			0.23	0.38	70.90%	0.24
s.e.	-0.02	-0.01			0.04	0.04	0.00	0.25			0.15	0.13		0.81
Panel B: Post-Global Financial Crisis														
coeff.	-0.03	0.07	-0.01				0.03	0.38	0.23				48.00%	0.33
s.e.	0.04	0.06	0.06				0.22	0.33	0.28					0.96
coeff.	-0.02	0.03	-0.04			0.09	0.03	0.27	0.11			0.39	65.87%	0.31
s.e.	0.04	0.06	0.06			0.06	0.24	0.29	0.37			0.33		0.70
coeff.	-0.03	-0.04		0.12			0.03	0.29		0.43			52.92%	0.26
s.e.	0.04	0.12		0.13			0.24	0.28		0.39				0.87
coeff.	-0.02	-0.08		0.10		0.07	0.03	0.19		0.36		0.39	66.19%	0.27
s.e.	0.04	0.11		0.12		0.06	0.22	0.30		0.22		0.23		0.85
coeff.	-0.05	0.04			0.07		-0.10	0.34			0.33		54.62%	0.31
s.e.	0.03	0.05			0.07		0.17	0.20			0.16			0.59
coeff.	0.03	0.06			0.03	0.09	0.17	0.20			0.25	0.39	68.18%	0.28
s.e.	-0.05	-0.01			0.07	0.05	-0.10	0.24			0.16	0.17		0.88

Table 12: Horse Races between HML_x and other risk factors in post-GFC period

This table presents two sets of cross-sectional asset pricing results for the post-GFC period, evaluating the pricing performance of the global dollar funding pressure factor (HML_x) relative to a broad set of established risk factors on swap markets. The first specification includes the dollar risk factor (DOL) alongside various benchmark stochastic discount factors (SDFs). The second specification augments each benchmark model by additionally including HML_x, allowing for a direct comparison of its incremental explanatory power. The SDFs considered include the business cycle gap (GAP) (Colacito et al., 2020), low-frequency systematic FX liquidity (IML)(Mancini et al., 2013; Karnaukh et al., 2015), short-term momentum (MOM3) and long-term momentum (MOM12) (Menkhoff et al., 2012b; Asness et al., 2013), net foreign asset position (NFA) (Corte et al., 2016), term spread (TER) (Ang and Chen, 2010; Lustig et al., 2019), currency value (VAL) (Asness et al., 2013; Menkhoff et al., 2017), the VIX index (Brunnermeier et al., 2008), and global FX volatility (VOL) (Menkhoff et al., 2012a). All cross-sectional regressions are estimated using GMM. Standard errors for the estimated risk prices are reported in parentheses and are computed using the Newey and West (1987) heteroskedasticity- and autocorrelation-consistent procedure with optimal lag selection following Andrews (1991). Factor loadings for the dollar risk factor and each control SDF are denoted b_{DOL} and b_x, respectively, with corresponding risk prices λ_{DOL} and λ_x. For each specification, I also report the cross-sectional R^2, Hansen–Jagannathan (HJ) distance, and the simulated p-value for the test of zero pricing error. All moments are monthly and reported in percentage points (%). Panel A reports results using currency portfolios as test assets, while Panel B presents results using individual currency excess returns. The sample comprises G10 currencies and spans the postcrisis period from August 2009 to January 2024.

	Panel A: Currency portfolio as test assets								***Panel B: Individual currency as test assets***							
	b_dol	b_x	b_hml	λ_{DOL}	λ_x	λ_{HML_x}	R-square	HJ -distance	b_dol	b_x	b_hml	λ_{DOL}	λ_x	λ_{HML_x}	R-square	HJ-dist
GAP	-0.04	0.20		-0.13	0.63		11.04%	0.31	-0.05	0.36		-0.12	1.16		38.77%	0.30
	0.04	0.17		0.17	0.54			0.99	0.04	0.20		0.17	0.64			0.34
	-0.04	-0.17	0.11	-0.14	-0.54	0.34	81.35%	0.27	-0.06	0.09	0.09	-0.14	0.33	0.38	89.95%	0.24
	0.04	0.14	0.05	0.17	0.47	0.16		0.99	0.03	0.15	0.04	0.17	0.51	0.17		0.47
IML	-0.05	-0.10		-0.14	-0.37		14.18%	0.00	-0.08	-0.24		-0.13	-0.90		34.14%	0.25
	0.04	0.07		0.17	0.26			0.99	0.04	0.11		0.17	0.43			0.56
	-0.06	-0.03	0.09	-0.14	-0.09	0.35	78.14%	0.25	-0.07	-0.09	0.09	-0.14	-0.34	0.36	91.92%	0.21
	0.04	0.06	0.04	0.17	0.25	0.16		0.99	0.04	0.09	0.04	0.17	0.36	0.17		0.72
MOM3	-0.03	-0.16		-0.13	-0.90		12.06%	0.37	-0.03	-0.22		-0.12	-1.23		14.32%	0.27
	0.03	0.13		0.17	0.69			0.99	0.03	0.21		0.17	1.15			0.60
	-0.05	0.03	0.10	-0.14	0.15	0.36	77.82%	0.24	-0.05	0.07	0.10	-0.14	0.35	0.38	88.99%	0.26
	0.03	0.10	0.04	0.17	0.57	0.16		0.99	0.04	0.17	0.04	0.17	0.92	0.17		0.34
MOM12	0.02	0.29		-0.13	1.44		36.75%	0.21	0.02	0.25		-0.11	1.22		34.64%	0.30
	0.05	0.13		0.17	0.61			0.99	0.05	0.12		0.17	0.57			0.35
	-0.03	0.12	0.08	-0.14	0.65	0.36	82.17%	0.24	-0.03	0.11	0.09	-0.14	0.61	0.39	93.66%	0.25
	0.04	0.10	0.04	0.17	0.46	0.17		0.99	0.04	0.11	0.04	0.17	0.52	0.17		0.55
TER	-0.04	0.15		-0.14	0.81		34.13%	0.23	-0.04	0.14		-0.12	0.73		23.33%	0.28
	0.03	0.08		0.17	0.44			0.99	0.03	0.10		0.17	0.52			0.40
	-0.05	0.03	0.09	-0.14	0.22	0.35	78.54%	0.25	-0.05	-0.01	0.10	-0.14	0.01	0.38	88.31%	0.25
	0.03	0.06	0.04	0.17	0.32	0.16		0.99	0.03	0.10	0.04	0.17	0.50	0.17		0.42
VAL	0.00	-0.13		-0.13	-0.30		23.76%	0.31	0.04	-0.27		-0.12	-0.59		51.16%	0.33
	0.04	0.07		0.17	0.15			0.99	0.05	0.14		0.18	0.27			0.10
	-0.06	0.01	0.10	-0.14	-0.08	0.36	77.69%	0.23	-0.05	0.00	0.10	-0.14	-0.10	0.38	88.24%	0.25
	0.04	0.06	0.04	0.17	0.12	0.16		0.99	0.05	0.13	0.05	0.17	0.25	0.17		0.44
VIX	-0.03	-0.01		-0.13	-0.51		4.87%	0.38	-0.03	-0.04		-0.11	-1.63		8.90%	0.26
	0.03	0.04		0.17	1.46			0.99	0.04	0.06		0.17	2.21			0.96
	-0.05	0.02	0.10	-0.14	0.86	0.36	78.49%	0.26	-0.05	0.01	0.10	-0.14	0.24	0.38	88.33%	0.25
	0.03	0.03	0.04	0.17	1.41	0.16		0.99	0.03	0.05	0.04	0.17	2.10	0.17		0.79
VOL	-0.03	0.00		-0.13	-0.02		4.52%	0.29	-0.05	0.28		-0.11	1.46		11.56%	0.32
	0.03	0.03		0.17	0.17			0.99	0.04	0.23		0.17	1.20			0.41
	-0.05	-0.02	0.10	-0.14	-0.09	0.35	78.98%	0.23	-0.05	-0.06	0.10	-0.14	-0.31	0.36	88.59%	0.25
	0.03	0.03	0.04	0.17	0.17	0.16		0.99	0.04	0.20	0.04	0.17	1.07	0.17		0.48

Appendix

A. Theoretical Derivation

Hedging demand: The optimal hedge ratio of a representative investor in a country i is derived as follows. For brevity, I omit the notation of i in the derivation process unless specified otherwise. It is assumed that investors exhibit mean-variance utility over their second-period wealth:

$$U = E[W_2] - \frac{\gamma}{2}\text{Var}(W_2), \tag{A1}$$

where W_2 is the investor i wealth in domestic currency, and γ is the coefficient of risk aversion. The investor's wealth is given by:

$$W_2 = h\omega y^{\$} F + (1-h)\omega y^{\$} S_2, \tag{A2}$$

where h is the hedge ratio, ω is the dollar position, $y^{\$}$ is the dollar risk-free rate returns, F is the predetermined forward rate, and S_2 is the spot exchange rate at time 2. The expected value and variance of wealth is:

$$\begin{aligned} E[W_2] &= h\omega y^{\$} F + (1-h)\omega y^{\$} E[S_2], \\ \text{Var}(W_2) &= (1-h)^2\omega^2 (y^{\$})^2 \text{Var}(S_2). \end{aligned} \tag{A3}$$

Inserting the equation (A3) back to (A1) and maximizing the investor's utility with respect to h, we take the derivative

$$\frac{\partial U}{\partial h} = \omega y^{\$}\left(F - E[S_2]\right) + \gamma(1-h)(\omega y^{\$})^2 \text{Var}(S_2).$$

Then calculating the first-order-condition (F.O.C) and solving for h

$$(1-h) = -\frac{F - E[S_2]}{\gamma\omega y^{\$}\text{Var}(S_2)},$$

$$h = 1 - \frac{E[S_2/S_1] - (F/S_1)}{\gamma\,\text{Var}(S_2/S_1)\omega S_1 r^{\$}}.$$

Supply of forwards: The forward trader's optimization problem seeks to maximize expected profits from providing liquidity. Assuming their initial wealth is W and their objective function is:

$$\max_{q} \sum xq + G\left(W - \kappa \sum H(q)\right). \tag{A4}$$

For a nonzero position q, it is assumed that for a nonzero position q, it is assumed that: (i) $H(q) > 0$; (ii) $H'(q) > 0$ for $q > 0$ and $H'(q) < 0$ for $q < 0$; and (iii) $H''(q) > 0$. These assumptions imply that the cost of intermediation is increasing and convex in the magnitude of the liquidity providing position. To solve the maximization problem, I take the derivative of the objective function with respect to q, and we obtain the following F.O.C, which is equivalent to the equation (6) in the main text:

$$\frac{\partial}{\partial q}\left(\sum xq + G\left(W - \kappa \sum H(q)\right)\right)$$

$$x - G'\left(W - \kappa \sum_{j} H(q^j)\right)(-\kappa H'(q)) = 0$$

$$x = \kappa G'\left(W - \kappa \sum_{j} H(q^j)\right) H'(q).$$

Derivation of Hypothesis 2: Recall the spot exchange rate determination as given by the equation (9)

$$S = \frac{\xi}{\nu^D + \Gamma^D - h\omega} \tag{A5}$$

Taking the derivative of S with respect to $\mathrm{Var}(S_2)$:

$$\begin{aligned}
\frac{\partial S}{\partial \mathrm{Var}(S_2)} &= \frac{\partial}{\partial \mathrm{Var}(S_2)}\left(\frac{\xi}{\nu^D + \Gamma^D - h\omega}\right) \\
&= \frac{\partial}{\partial h}\left(\frac{\xi}{\nu^D + \Gamma^D - h\omega}\right) \cdot \frac{\partial h}{\partial \mathrm{Var}(S_2)} \\
&= -\frac{\xi\omega}{(\nu^D + \Gamma^D + h\omega)^2} \cdot \frac{\partial h}{\partial \mathrm{Var}(S_2)},
\end{aligned} \tag{A6}$$

where

$$\frac{\partial h}{\partial \text{Var}(S_2)} = \frac{\partial}{\partial \text{Var}(S_2)}\left(1 - \frac{E[S_2/S_1] - (F/S_1)}{\gamma \,\text{Var}(S_2/S_1)\omega S_1 r^{\$}}\right)$$
$$= \frac{E[S_2/S_1] - (F/S_1)}{\gamma \,\text{Var}(S_2/S_1)^2 \omega S_1 r^{\$}}$$

Given the assumptions that $\frac{E[S_2/S_1]-(F/S_1)}{\omega^i} > 0$, and $\gamma S_1 y^{\$} \,\text{Var}\left[S_2/S_1\right] \geqslant \frac{E[S_2/S_1]-(F/S_1)}{\omega^i}$, we can drive that: $\frac{\partial h}{\partial \text{Var}(S_2)} > 0$. Then the sign of the equation (A6) is:

$$\text{sign}\left(\frac{\partial S}{\partial \text{Var}(S_2)}\right) = -\text{sign}(\omega) \tag{A6}$$

Based on this equation, we can obtain the following hypothesis that if countries with $\omega > 0$ or equivalently $x < 0$, their currencies appreciate as volatility rises. If $\omega < 0$ (i.e., negative external imbalance) or equivalently $x > 0$, their currencies depreciate as volatility rises.

B. Generalized Method of Moments

The empirical cross-sectional asset pricing tests in this paper are based on a SDF $M_{t+1} = 1 - b'(\Phi_{t+1} - \mu)$ that is linear in the k risk factors Φ_{t+1}. Thus, the basic asset pricing equation (5) implies the following moment conditions for the N-dimentional vector of test asset excess returns Rx^j_{t+1}:

$$E\left\{[1 - b'(\Phi_{t+1} - \mu)]Rx^j_{t+1}\right\} = 0. \tag{A7}$$

In addition to these N moment restrictions, our set of GMM moment conditions also includes k moment conditions $E(\Phi_t - \mu) = 0$, accounting for the fact that the factor means μ have to be estimated. Factor risk prices λ can easily be obtained from our GMM estimates via the relation $\lambda = \Sigma_{\Phi\Phi} b$, where $\Sigma_{\Phi\Phi} = E[(\Phi_t - \mu)(\Phi_t - \mu)']$ is the factor covariance matrix. Hence, the estimating function takes the form

$$g(z_t, \theta) = \begin{bmatrix} [1 - b'(\Phi_t - \mu)]Rx_t \\ \Phi_t - \mu \\ \text{vec}((\Phi_t - \mu)(\Phi_t - \mu)') - \text{vec}(\Sigma_{\Phi\Phi}) \end{bmatrix}, \tag{A8}$$

where θ contains the parameters $(b', \mu', \text{vec}(\Sigma_{\Phi\Phi})')'$ and z_t represents the data (Rx_t, Φ_t).

By exploiting the $N + k(1 + k)$ moment conditions $E[g(z_t, \theta)] = 0$ defined by equation (A8), estimation uncertainty (due to the fact that factor means and the factor covariance matrix are estimated) is incorporated in our standard errors of factor risk prices. Our (first-stage) GMM estimation uses a prespecified weighting matrix W_T based on the identity matrix I_N for the first N asset pricing moment conditions and a large weight assigned to the additional moment conditions (for precise estimation of factor means and the factor covariance matrix). Standard errors are computed based on a heteroscedasticity and autocorrelation consistent (HAC) estimate of the long-run covariance matrix $S = \sum_{j=-\infty}^{\infty} E[g(z_t, \theta)g(z_{t-j}, \theta)']$ by the Newey–West (1987) procedure, with the number of lags in the Bartlett kernel determined optimally by the data-driven approach of Andrews (1991).

C. Risk Factor Constructions

Next, I describe the currency risk factor (or factor-mimicking investment strategies) that deliver the portfolios (e.g., test assets) under investigation in our empirical analysis.

Carry based on interest rate differential (CAR). The construction process of carry strategy based on interest rate differential is the same with CAR strategy, except that for IDF, $P5$ includes the currencies with highest interest rates while $P1$ contains the currencies with lowest interest rates. Traditional literature usually assumes the CIP conditons hold, so sorting based on the forward discount is equivalent as based on the interest rate differential, however, in this study, I mainly focus on the postcrisis period where the cross-currency basis is non-negligible so I construct carry strategy based on forward discount and interest rates differential separately. Data are from WM/Reuters accessed via LSEG Datastream.

Business Gap (GAP). Following Colacito et al. (2020), at each month t, I sort currencies on difference between each foreign country's output gap and the U.S. output gap over the last month, e.g., $GAP_{t-1} - GAP_{t-1}^{US}$. $P5$ corresponds to countries with the highest output gap relative to the U.S., whereas $P1$ comprises countries with the lowest output gap relative to the U.S.. I calculate to the zero-cost dollar-neutral strategy that takes a long position in $P5$ and a short position in $P1$, which is a tradeable investment portfolio that exploits the relative cross-sectional spread in business cycle conditions around the world. The portfolios are rebalanced every month and the sample runs from January 1999 to January 2024. Output gaps are calculated by using industrial production data from Datastream. Output gaps are estimated using the Hodrick-Prescott (HP) filter to extract a cyclical component from the data. Industrial production data are accessed via LSEG Datastream.

Carry based on forward discount (FDS). At each month t, currencies are allocated to five portfolios according to their forward discounts premium $f - s$ over the last month t-1, where f and s are the log of spot and forward exchange rate mid-quotes for foreign currency i, respectively (Lustig et al., 2011). While portfolio 1 ($P1$) collects the currencies with the lowest forward discounts, portfolio 5 ($P5$) collects currencies with the highest forward discounts. I calculate the dollar-neutral CAR strategy returns by longing the $P5$ and shorting the $P1$. Due to a large violation of CIP conditons post financial crisis, in constrast with Lustig et al. (2011) $P1$ ($P5$) do not necessarily correspond to the currencies with the lowest (highest) interest rate differential relative to the United States. Portfolios are rebalanced monthly and the sample runs from January 1999 to January 2024. Data are from WM/Reuters accessed via LSEG Datastream.

Global imbalance in trades and capital flows (IMB). Following Corte et al. (2016), I sort currencies into portfolios according to the proportion of liabilities denominated in domestic currency (LDC) and net foreign assets relative to GDP (NFA). At the each month, currencies are first grouped into two baskets using the median value of the net foreign asset to GDP ratio and then into three baskets using the share of foreign liabilities in domestic currency over the last month. The first portfolio ($P1$) contains the top 20% of all currencies with high NFA and high LDC (creditor nations with external liabilities denominated mainly in domestic currency), and the last portfolio ($P5$) contains the top 20% of all currencies with low NFA and low LDC (debtor nations with external liabilities denominated mainly in foreign currency). The global imbalance factor (IMB) is constructed as the excess return on $P5$ minus the excess return on $P1$. I thank Agustin Benetrix (Bénétrix et al., 2015) and Federico Nucera (Nucera et al., 2024) for kindly sharing the data of LDC. Note that the dataset for LDC only updates to December 2020, so the IMB portfolio returns run from January 1999 to December 2020.

Low-frequency systematic FX liquidity (IML). As documented by Karnaukh et al. (2015), foreign exchange (FX) liquidity can be accurately measured using low-frequency (LF) daily data by constructing an equally weighted average of two standardized components: the relative bid-ask spread (BA) and the Corwin-Schultz spread estimator (CS) (Corwin & Schultz, 2012). For details regarding the standardization procedures, refer to the online appendix of Karnaukh et al. (2015). To construct the low-frequency liquidity risk factor, I follow the methodology of Mancini et al. (2013). At the end of each month t, currencies are sorted on their systematic LF liquidity measures. A long position is taken in the two most illiquid currencies ($P5$), and a short position is taken in the two most liquid currencies ($P1$). The resulting long-short portfolio captures the return differential between illiquid and liquid currencies and is denoted as IML (illiquid minus liquid), following the notation in Mancini et al. (2013). Data are from WM/Reuters accessed via LSEG Datastream.

Short-Term Momentum (MOM3). Following the methodology of Asness et al. (2013) and Menkhoff et al. (2012b), short-term momentum portfolios are constructed at each month t using excess returns realized over the last three-month period. Note that following Asness et al. (2013), the most recent one-month period is skipped to avoid short-term reversals. Specifically, currencies are sorted on their past cumulative excess returns. Each currency is then classified as a "winner" if its cumulative return exceeds the cross-sectional median, or as a "loser" if it falls below the median. The momentum portfolio return is computed by taking a long position in the winner currencies and a short position in the loser currencies. Portfolios are rebalanced monthly, and the sample period spans from May 1999 to January 2024. Data are from WM/Reuters accessed via LSEG Datastream.

Long-Term Momentum (MOM12). The construction of the long-term momentum portfolio closely follows that of the short-term momentum portfolio, with the primary difference being the length of the lookback period. Specifically, the long-term momentum strategy is based on the cumulative excess returns of each currency over the preceding 12 months. Note that following Asness et al. (2013), the most recent one-month period is skipped to avoid short-term reversals. Then, each currency is sorted into the two groups of "winners or losers" based on their relative performance compared to the median value. Portfolios are rebalanced at a monthly frequency, and the sample period spans from January 1998 to January 2024. Data are from WM/Reuters accessed via LSEG Datastream.

Net Foreign Asset Ratio (NFA). Following Corte et al. (2016), at each month t, currencies are allocated into portfolios according to the ratio between the foreign country's net foreign assets (NFA) and the country's gross domestic product (GDP) over the last month, both denominated in U.S. dollars. Hence, $P1$ includes creditor currencies, e.g., those with the highest NFA to GDP ratios, whereas $P5$ includes debtor currencies, e.g., those with the lowest NFA to GDP ratios. Portfolios are rebalanced monthly, and the sample is quarterly data and collected from LSEG, covering the period from January 1999 to January 2024.

Net external U.S. dollar foreign debt holdings (NDT). As documented by Liao & Zhang (2025), dollar imbalances are more accurately measured by the net external U.S. dollar debt position (ndt), defined as the difference between the external debt assets denominated in U.S. dollars (as a share of GDP) and external debt liabilities in U.S. dollars (as a share of GDP), than net foreign asset ratios. Even if Liao & Zhang (2025) do not directly purse using ndt as a risk factor, I construct a factor-mimicking portfolio by allocating currencies into portfolios sorted on the as ndt shares similar properties with nfa. Hence, $P1$ includes dollar creditor currencies, e.g., those with the highest

ndt, whereas $P5$ includes dollar debtor currencies, e.g., those with the lowest ndt. Portfolios are rebalanced monthly, and the sample is quarterly data covering the period from January 1999 to December 2020. I thank Federico Nucera (Nucera et al., 2024) for kindly sharing the data.

Term Spread (TER). At each month t, I sort currencies into portfolios according to the foreign country's term spread over that last month, defined as long- minus short-term rates, measured with the 10-year and 3-month government bank bill rates ($i^{10y} - i^{3m}$), respectively. I allocate to $P1$ countries with the highest term spread, and conversely to $P5$ countries with the lowest term spread. The portfolios are rebalanced every month and the sample runs from January 1999 to January 2024. Data are from LSEG datastream.

Currency Value (VAL). At each month t, currencies are allocated to portfolios based on the lagged 5-year currency value (real exchange rate returns) (Asness et al., 2013; Menkhoff et al., 2017). Following Asness et al. (2013), the currency value is calculated as the negative of the 5-year return on the exchange rate, measured as the log of the average spot exchange rate from 4.5 to 5.5 years ago divided by the spot exchange rate today minus the log difference in the change in CPI in the foreign country relative to the U.S. over the same period. The currency value measure is therefore the 5-year change in purchasing power parity. Then I sort the currency into 5 portfolios based on their currency values where $P1$ contains currencies with the highest lagged real exchange rate returns, and $P5$ contains those with lowest lagged real exchange rate returns. Value portfolios are rebalanced every month. The sample runs from January 1994 to January 2024. Real exchange rates are calculated by using Consumer Price Index data from LSEG datastream.

Implied volatility of S&P 500 (VIX). Brunnermeier et al. (2008) document that documents that carry traders are subject to crash risk. Currency crashes are positively correlated with increases in two funding liquidity measurements, namely, implied stock market volatility (VIX) and the TED spread. Therefore, I also include VIX as a risk factor that is potentially correlated with cross-currency basis. The monthly VIX data is collected from the Federal Reserve Bank of St. Louis, spanning from January 1999 to January 2024.

Global Volatility (VOL). Following the methodology of Menkhoff et al. (2012a), the global FX volatility proxy is constructed based on the equally weighted absolute level of realized returns of individual currencies. Volatility innovations are then obtained by computing the first differences of this global volatility measure. To construct the volatility factor-mimicking portfolio, each currency is sorted each period according to the magnitude of their volatility innovations. Portfolios are formed such that $P1$ contains the currencies with the lowest volatility innovations, while $P5$ includes those with the

highest. The return on the volatility factor-mimicking portfolio (VOL) is computed as the difference between the average returns of $P5$ and $P1$, corresponding to a long position in the most volatile currencies and a short position in the least volatile ones. Data are accessed via LSEG datastream.

D. Transaction Costs

In the main text analysis, transaction costs are not considered to avoid the influence of bid-ask spreads on the estimated results, and due to the unavailability of bid and ask quotes for risk-free interest rates in cash markets. However, bid and ask exchange rates are readily available in swap markets, making it possible to conduct a robustness check that incorporates transaction costs. By accounting for bid-ask spreads in both spot and forward contracts, I compute realized currency excess returns net of transaction costs. Specifically, in the context of the swap market, the net log excess return for an investor taking a long position in the foreign currency is defined as follows:

$$rx^l_{t+1} = f^b_t - s^a_{t+1}. \tag{A9}$$

The investor buys the foreign currency or equivalently sells the dollar forward at the bid price f^b_t in period t, and sells the foreign currency or equivalently buys dollars at the ask price in the spot market in period $t+1$. Similarly, for an investor who goes short in foreign currency (thus long in the dollar) is expressed as:

$$rx^s_{t+1} = -f^a_t + s^b_{t+1} \tag{A10}$$

A currency that enters a portfolio but stays in the portfolio at the end of the month has a net excess return of $r^l_{t+1} = f^b_t - s_{t+1}$ for a long position and $r^s_{t+1} = -f^a_t + s_{t+1}$ for a short position, whereas a currency that exits a portfolio at the end of month t but already was in the current portfolio the month before (t-1) has an excess return of $r^l_{t+1} = f_t - s^a_{t+1}$ for a long position and $r^s_{t+1} = -f_t + s^b_{t+1}$ for a short position. To assess the robustness of the pricing power of HML_x in the presence of transaction costs, I conduct benchmark cross-sectional asset pricing tests incorporating bid-ask spreads in swap markets. The results for both the full sample and the post-GFC subsample are reported in Table OA9 of the online Appendix. Panel A employs the full set of 30 currency strategy portfolios as test assets, while Panel B reports out-of-sample results using a reduced test asset set that excludes basis- and carry-sorted portfolios.

In Panel A, the results remain qualitatively consistent with those reported in Table 3, where transaction costs are not considered. The estimated price of risk for HML_x remains robust at 0.40% per month (4.8% per annum) and is statistically significant across all model specifications. Importantly, consistent with prior findings, the significance of the carry trade factor (CAR) declines substantially once HML_x is included, especially in the postcrisis period—further confirming that HML_x subsumes the pricing power traditionally attributed to CAR.

Table OA10 presents horse race regressions between HML_x and three external imbalance measures—namely, IMB, NFA, and NDT with bid-ask spreads. Two sets of SDF specifications are examined. The first includes DOL, CAR, and one of the external imbalance measures; the second augments the benchmark specification by including HML_x. The results are again qualitatively in line with those reported without transaction costs. Specifically, the inclusion of HML_x leads to a substantial increase in the cross-sectional R^2, typically by more than 10%. Besides, it simultaneously renders the statistical significance of risk prices of both CAR and the external imbalance proxies decreases markedly or disappears, while HML_x consistently retains statistical significance across specifications.

These findings indicate that HML_x captures the pricing power embedded in both interest differentials and external dollar imbalances, but also reflects an additional, distinct source of priced risk not accounted for by either. Taken together, the results support the robustness of the pricing power of HML_x and the two main hypotheses of the paper, namely, that higher basis values are associated with higher expected excess returns, and that HML_x subsumes information contained in traditional pricing factors regardless of whether transaction costs are explicitly considered.

E. Figures and Tables

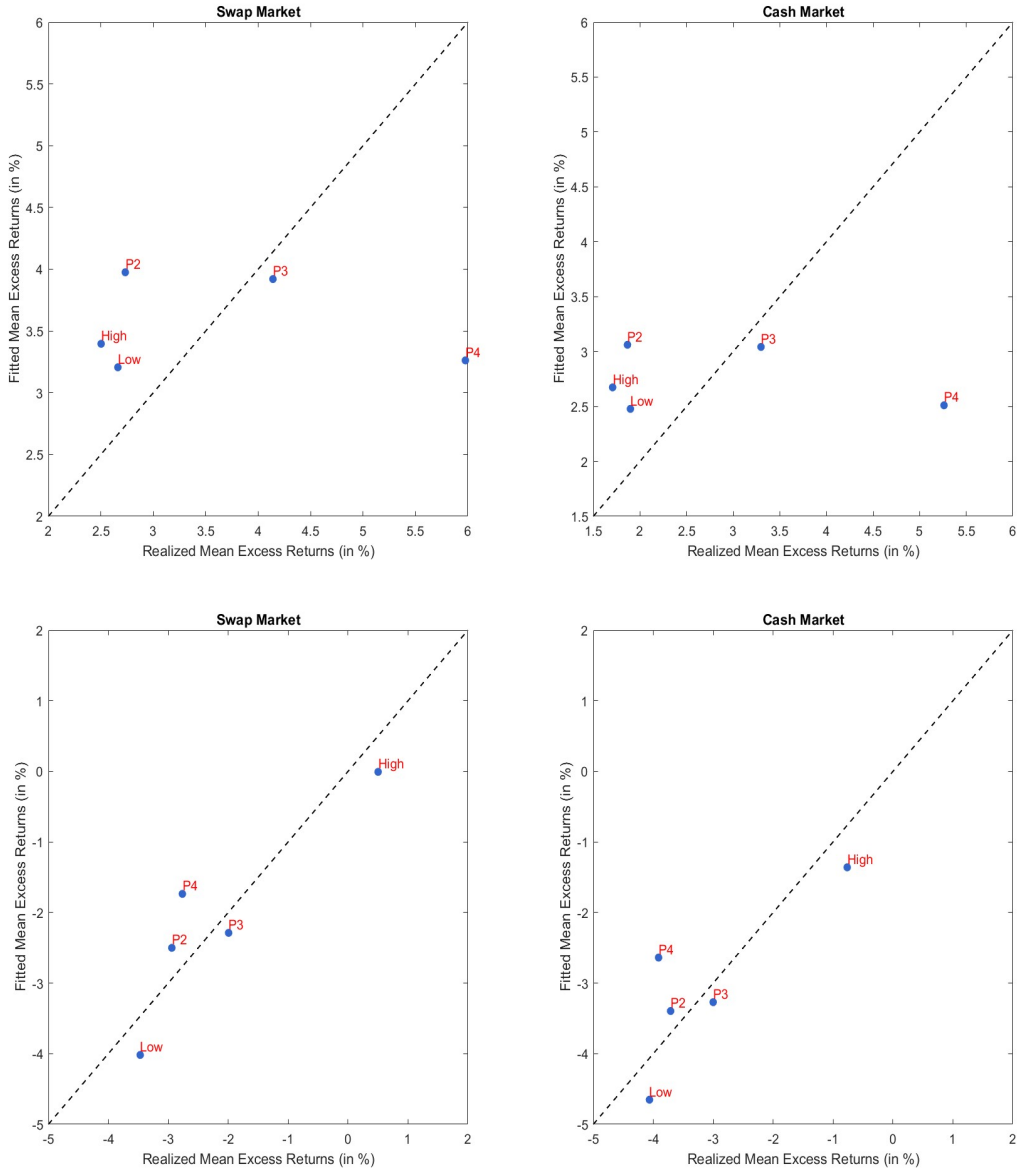


Figure OA1: **Pricing Error Plots in Pre- and Post-GFC.** The figure presents the pricing errors from a cross-sectional asset pricing model where the cross-currency basis (HML_x) and dollar factor (DOL) serve as common risk factors. The test assets are five currency portfolios sorted on the unconditional level of the cross-currency basis. The x-axis depicts the realized mean excess returns, while the y-axis displays the model-implied (fitted) mean excess returns for currency portfolios. Panel A shows results for precrisis period (from January 1999 to August 2008), while Panel B shows results for postcrisis period (from August 2009 to January 2024).

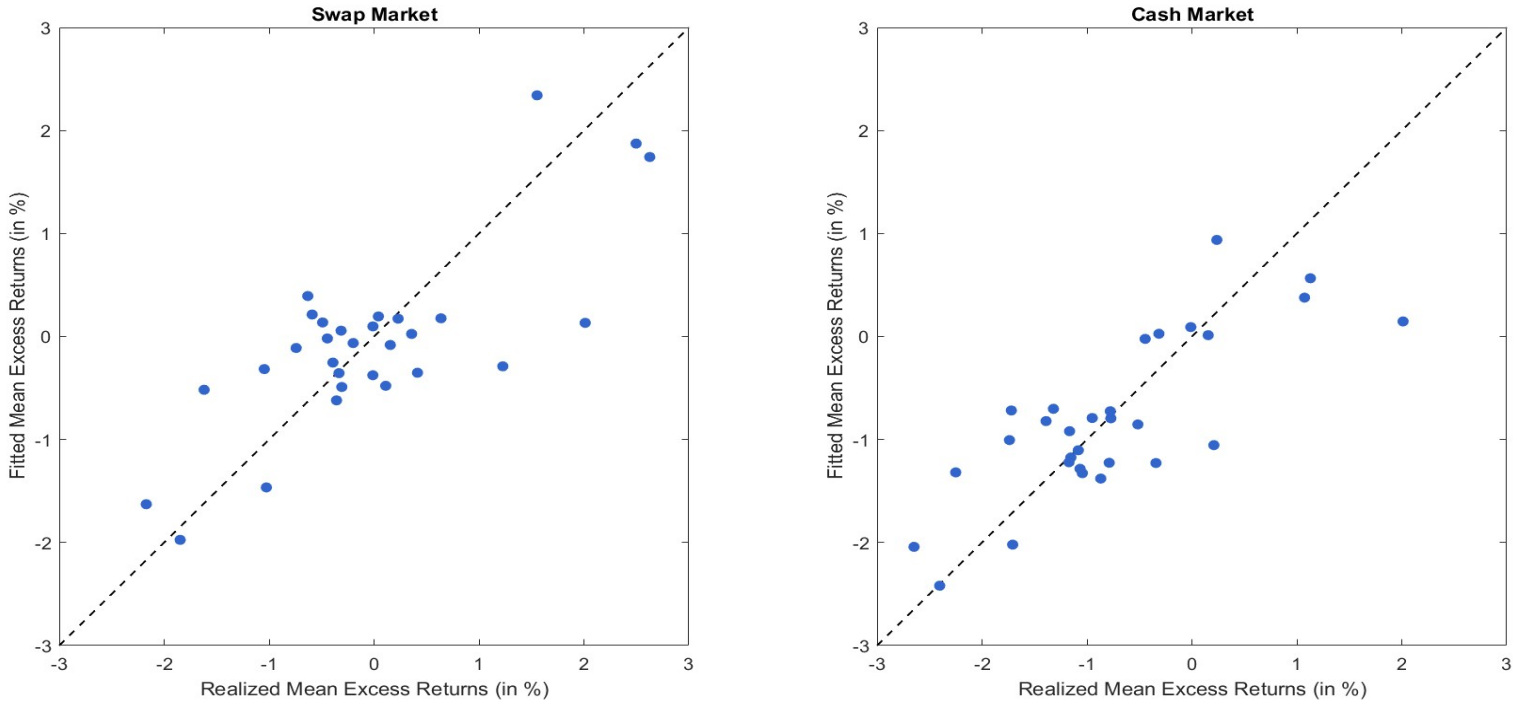


Figure OA2: **Pricing Error Plots of using Currency Strategy Portfolios as Test Assets.** The figure presents the pricing errors from a cross-sectional asset pricing model where the cross-currency basis (HML_x), carry trade (CAR), dollar factor (DOL) serve as common risk factors. The test assets are 30 currency portfolios sorted on interest rate differential, cross-currency basis, net foreign assets ratios, short-term momentum, currency value and global volatility, as well as risk factors. The x-axis depicts the realized mean excess returns, while the y-axis displays the model-implied (fitted) mean excess returns for currency portfolios. The left panel shows the results in swap markets and the right panel shows the results in cash markets.

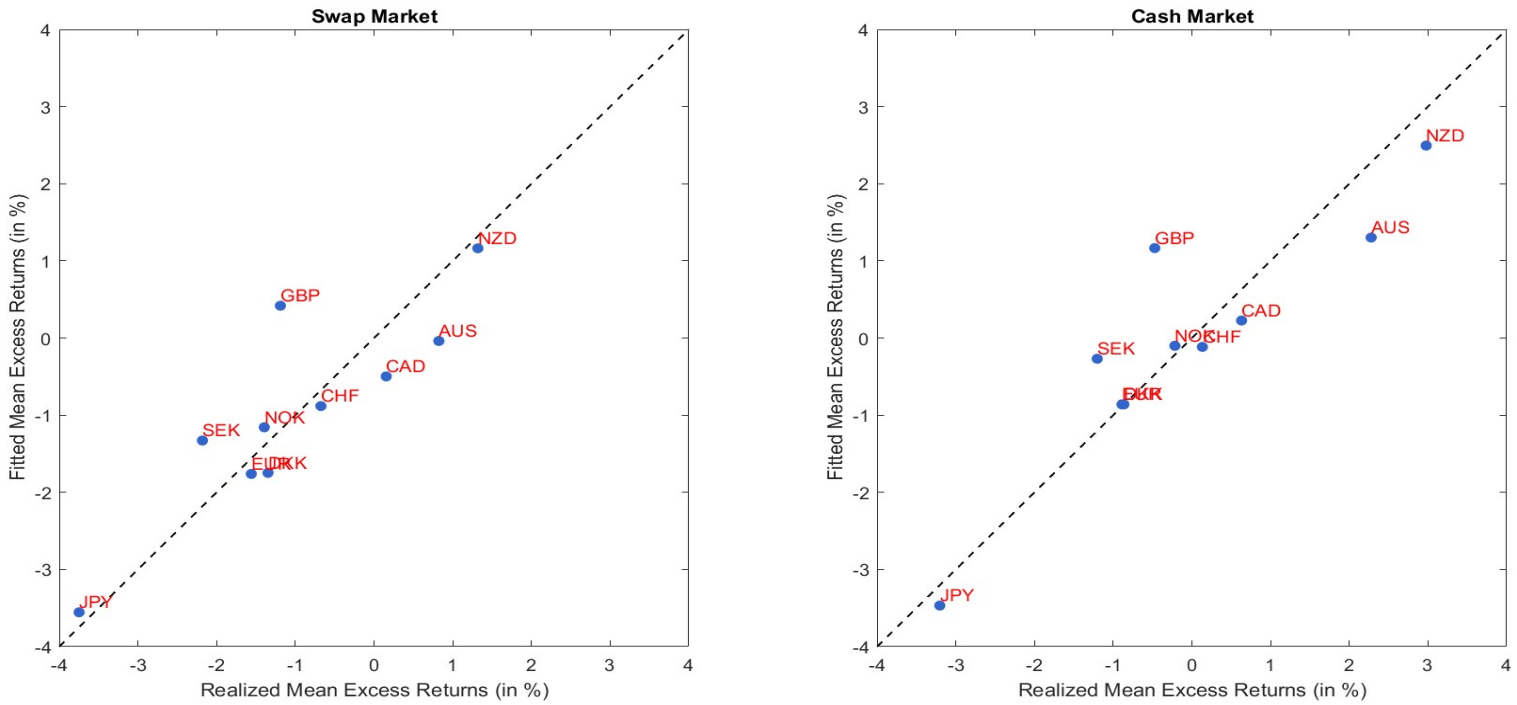


Figure OA3: **Currency-Level Pricing Error Plots.** The figure presents the pricing errors from a cross-sectional asset pricing model estimated at the currency level, where the cross-currency basis and the dollar factor serve as common risk factors. The x-axis depicts the realized mean excess returns, while the y-axis displays the model-implied (fitted) mean excess returns for currency portfolios. These portfolios are constructed conditional on the cross-currency basis falling within quintiles ranging from the lowest (most negative) to the highest (least negative) values of cross-currency basis. Panel (a) shows results for currency returns obtained from forward contracts on FX swap markets, while Panel (b) shows results for cash markets. The sample includes G10 currencies (developed economies) over the sample period from January 1999 to January 2024.

Table OA1: Correlation of Common FX Risk Factors on Swap Markets: Pre-and Post-GFC Period

This table reports the pairwise correlations of the high-minus low cross-currency basis factor (HML_x) and other common FX risk factors. The SDF(s) include: the global carry trade sorted on interest rate differential (Lustig et al., 2011), business gap (GAP) (Colacito et al., 2020), the carry trade sorted on forward discount (FDS) (Lustig et al., 2011), global imbalance risk (IMB) (Corte et al., 2016; Liao & Zhang, 2025), low-frequency systematic FX liquidity (IML) (Mancini et al., 2013; Karnaukh et al., 2015), short-term momentum (MOM3) (Menkhoff et al., 2012b; Asness et al., 2013), long-term momentum (MOM12) (Menkhoff et al., 2012b; Asness et al., 2013), net foreign asset (NFA) (Corte et al., 2016), term-spread (TER) (Ang & Chen, 2010; Lustig et al., 2019), currency value (VAL) (Asness et al., 2013; Menkhoff et al., 2017), the implied volatility of the S&P 500 (VIX) (Brunnermeier et al., 2008), and global volatility (VOL) (Menkhoff et al., 2012a). The sample covers the postcrisis period from August 2009 to January 2024. *, **, *** denotes significant correlations at the 90%, 95%, and 99% levels, respectively. Panel A reports the correlation coefficients for the precrisis sample period from January 1999 to August 2008. Panel B reports the results for the postcrisis period from August 2009 to January 2024.

Panel A: Pre-Global Financial Crisis period

	HML_x	CAR	FDS	GAP	IMB	IML	MOM3	MOM12	NDT	NFA	TER	VAL	VIX	VOL
HML_x	1.00													
CAR	0.43 ***	1.00												
FDS	0.44 ***	1.00 ***	1.00											
GAP	0.11	0.29 ***	0.29 ***	1.00										
IMB	0.43 ***	0.79 ***	0.78 ***	0.32 ***	1.00									
IML	-0.06	0.32 ***	0.32 ***	0.26 ***	0.15	1.00								
MOM3	0.10	0.03	0.03	-0.08	-0.05	-0.04	1.00							
MOM12	0.20 **	0.27 ***	0.27 ***	0.06	0.08	0.24 ***	0.27 ***	1.00						
NDT	0.31 ***	0.85 ***	0.84 ***	0.23 **	0.69 ***	0.18 *	0.04	0.08	1.00					
NFA	0.14	0.68 ***	0.68 ***	0.15	0.48 ***	0.13	-0.03	0.07	0.78 ***	1.00				
TER	0.62 ***	0.65 ***	0.65 ***	0.31 ***	0.64 ***	0.05	0.19 **	0.34 ***	0.55 ***	0.41 ***	1.00			
VAL	0.42 ***	0.16 *	0.15 *	0.11	0.19 **	-0.22 **	0.01	0.27 ***	0.03	0.01	0.54 ***	1.00		
VIX	0.08	-0.12	-0.12	0.13	-0.05	-0.16 *	0.03	-0.03	-0.14	-0.12	-0.02	-0.06	1.00	
VOL	0.03	-0.05	-0.04	0.01	-0.01	0.02	-0.03	0.04	-0.11	-0.10	0.04	0.17 *	-0.19 **	1.00

Panel B: Post-Global Financial Crisis

	HML_x	CAR	FDS	GAP	IMB	IML	MOM3	MOM12	NDT	NFA	TER	VAL	VIX	VOL
HML_x	1.00													
CAR	0.61 ***	1.00												
FDS	0.68 ***	0.96 ***	1.00											
GAP	0.12	0.13	0.15 *	1.00										
IMB	0.59 ***	0.70 ***	0.70 ***	0.04	1.00									
IML	-0.21 **	-0.48 ***	-0.47 ***	-0.24 ***	-0.27 ***	1.00								
MOM3	-0.10	-0.23 ***	-0.21 **	-0.03	-0.14 *	-0.04	1.00							
MOM12	-0.03	-0.18 **	-0.17 **	0.16 *	-0.23 ***	-0.20 **	0.53 ***	1.00						
NDT	0.61 ***	0.85 ***	0.85 ***	0.17 **	0.75 ***	-0.53 ***	-0.09	-0.04	1.00					
NFA	0.59 ***	0.72 ***	0.76 ***	-0.02	0.61 ***	-0.38 ***	-0.02	-0.03	0.79 ***	1.00				
TER	0.15 *	0.40 ***	0.40 ***	0.18 **	0.05	-0.28 ***	0.06	0.01	0.34 ***	0.39 ***	1.00			
VAL	-0.07	0.27 ***	0.25 ***	0.18 **	0.01	-0.45 ***	-0.07	-0.06	0.20 **	-0.09	0.18 **	1.00		
VIX	-0.06	-0.12	-0.13	-0.02	-0.15 *	-0.02	-0.04	-0.05	-0.02	0.08	0.12	-0.06	1.00	
VOL	0.09	0.02	0.03	0.03	-0.04	-0.07	0.03	-0.05	-0.11	-0.08	-0.08	0.04	-0.03	1.00

Table OA2: Correlation of Common FX Risk Factors on Cash Markets: Full Sample and Post-GFC Period

This table reports the pairwise correlations of the high-minus low cross-currency basis factor (HML_x) and other common FX risk factors. The SDF(s) include: the global carry trade sorted on interest rate differential (Lustig et al., 2011), business gap (GAP) (Colacito et al., 2020), the carry trade sorted on forward discount (FDS) (Lustig et al., 2011), global imbalance risk (IMB) (Corte et al., 2016; Liao & Zhang, 2025), low-frequency systematic FX liquidity (IML) (Mancini et al., 2013; Karnaukh et al., 2015), short-term momentum (MOM3) (Menkhoff et al., 2012b; Asness et al., 2013), long-term momentum (MOM12) (Menkhoff et al., 2012b; Asness et al., 2013), net foreign asset (NFA) (Corte et al., 2016), term-spread (TER) (Ang & Chen, 2010; Lustig et al., 2019), currency value (VAL) (Asness et al., 2013; Menkhoff et al., 2017), the implied volatility of the S&P 500 (VIX) (Brunnermeier et al., 2008), and global volatility (VOL) (Menkhoff et al., 2012a). The sample covers the postcrisis period from August 2009 to January 2024. *, **, *** denotes significant correlations at the 90%, 95%, and 99% levels, respectively. Panel A reports the correlation coefficients for the full sample period from January 1999 to January 2024. Panel B reports the results for the postcrisis period from August 2009 to January 2024.

Panel A: Full sample period

	HML_x	CAR	FDS	GAP	IMB	IML	MOM3	MOM12	NDT	NFA	TER	VAL	VOL	VIX
HML_x	1.00													
CAR	0.53 ***	1.00												
FDS	0.57 ***	0.98 ***	1.00											
GAP	0.09	0.15 **	0.15 **	1.00										
IMB	0.51 ***	0.79 ***	0.78 ***	0.00	1.00									
IML	-0.14 **	-0.08	-0.10	-0.09	-0.06	1.00								
MOM3	0.01	-0.20 ***	-0.17 ***	-0.17 ***	-0.19 ***	-0.08	1.00							
MOM12	0.02	-0.14 **	-0.13 **	0.11 *	-0.24 ***	-0.04	0.44 ***	1.00						
NDT	0.48 ***	0.87 ***	0.87 ***	0.10	0.78 ***	-0.16 **	-0.12 **	-0.15 **	1.00					
NFA	0.36 ***	0.71 ***	0.73 ***	0.09	0.59 ***	-0.09	-0.07	-0.08	0.80 ***	1.00				
TER	0.32 ***	0.46 ***	0.47 ***	0.32 ***	0.29 ***	-0.14 **	0.11 *	0.15 **	0.42 ***	0.41 ***	1.00			
VAL	0.11 *	0.11 *	0.11 *	0.23 ***	0.01	-0.33 ***	0.02	0.14 **	0.04	-0.07	0.30 ***	1.00		
VOL	-0.05	-0.21 ***	-0.18 ***	-0.01	-0.20 ***	-0.08	0.11 *	0.04	-0.13 **	-0.07	0.09	0.01	1.00	
VIX	0.10	0.15 **	0.15 **	-0.07	0.14 **	-0.01	-0.10 *	-0.16 ***	0.09	0.03	-0.03	0.04	-0.11 *	1.00

Panel B: Post-Global Financial Crisis

	HML_x	CAR	FDS	GAP	IMB	IML	MOM3	MOM12	NDT	NFA	TER	VAL	VIX	VOL
HML_x	1.00													
CAR	0.62 ***	1.00												
FDS	0.68 ***	0.96 ***	1.00											
GAP	0.16 *	0.31 ***	0.28 ***	1.00										
IMB	0.59 ***	0.70 ***	0.70 ***	-0.04	1.00									
IML	-0.21 **	-0.46 ***	-0.46 ***	-0.26 ***	-0.26 ***	1.00								
MOM3	-0.08	-0.20 **	-0.18 **	-0.29 ***	-0.11	-0.07	1.00							
MOM12	-0.00	-0.17 **	-0.16 *	-0.04	-0.21 **	-0.23 ***	0.52 ***	1.00						
NDT	0.61 ***	0.84 ***	0.85 ***	0.21 **	0.75 ***	-0.52 ***	-0.05	-0.01	1.00					
NFA	0.58 ***	0.71 ***	0.74 ***	0.04	0.60 ***	-0.37 ***	0.02	-0.01	0.78 ***	1.00				
TER	0.15 *	0.39 ***	0.39 ***	0.31 ***	0.05	-0.28 ***	0.08	0.02	0.35 ***	0.41 ***	1.00			
VAL	-0.07	0.26 ***	0.24 ***	0.29 ***	-0.00	-0.43 ***	-0.06	-0.05	0.19 **	-0.11	0.16 *	1.00		
VIX	-0.07	-0.14	-0.15 *	-0.07	-0.16 *	-0.02	-0.03	-0.04	-0.03	0.08	0.13	-0.09	1.00	
VOL	0.09	0.03	0.03	0.02	-0.03	-0.07	0.03	-0.03	-0.11	-0.07	-0.09	0.02	-0.04	1.00

Table OA3: Spanning Tests Results: Regressing SDFs on Basis Factor

The table presents time-series regression estimates for spanning tests. In this table, I employ two model specifications: the first specification regresses the various common FX factors' excess returns (SDF_t) on the global cross-currency basis *high-minus-low*'s excess returns (HML_x); the second specification extends this analysis by including the 12-month lag of the dependent variable as an additional control, reflecting external risk factor information updated once a year. These risk factors include: the carry trade factor sorted on the nominal interest rate (CAR) and forward discount (FDS), business gap (GAP) (Colacito et al., 2020), low-frequency FX systematic liquidity risk (IML) (Mancini et al., 2013; Karnaukh et al., 2015), short-term momentum (MOM3) and long-term momentum (MOM12) (Menkhoff et al., 2012b; Asness et al., 2013), net foreign asset positions (NFA) (Corte et al., 2016; Liao & Zhang,2025), term spread (TER) (Chen et al., 2013; Lustig et al., 2019), currency value (VAL) (Asness et al., 2013; Menkhoff et al., 2017), the implied volatility of the S&P 500 (VIX) (Brunnermeier et al., 2008), and global volatility (VOL) (Menkhoff et al., 2012a). Each of these common risk factors is constructed using our sample and following their respective methodology. Newey and West (1987) standard errors with Andrews (1991) optimal lag selection are reported below each estimated coefficient. The intercept (α) is reported in percentage points (%) and in monthly termss. The sample includes G10 currencies, covering the full sample period from January 1999 to January 2024 (Panel A) and postcrisis period from August 2009 to January 2024 (Panel B).

	Panel A: Full Sample									
	CAR	FDS	GAP	IMB	IML	MOM12	NDT	NFA	TER	VAL
$SDF_t = \alpha + \beta HML_{x,t} + \epsilon_t$										
alpha	0.11	0.15	-0.32	-0.01	0.09	-0.10	0.27	0.10	0.04	-0.08
s.e.	0.15	0.14	0.11	0.16	0.10	0.15	0.16	0.12	0.12	0.07
beta	0.65	0.70	0.06	0.62	-0.09	0.06	0.58	0.40	0.34	0.04
s.e.	0.07	0.07	0.07	0.06	0.06	0.11	0.08	0.09	0.09	0.06
R square	0.27	0.31	0.00	0.25	0.01	0.00	0.22	0.12	0.09	0.00
$SDF_t = \alpha + \beta HML_{x,t} + \gamma SDF_{t-12} + \epsilon_t$										
alpha	0.11	0.15	-0.37	-0.01	0.07	-0.08	0.21	0.07	0.01	-0.06
s.e.	0.15	0.14	0.12	0.17	0.10	0.14	0.16	0.13	0.12	0.07
beta	0.67	0.72	0.08	0.63	-0.07	0.07	0.62	0.45	0.36	0.03
s.e.	0.08	0.07	0.07	0.07	0.07	0.11	0.08	0.09	0.10	0.07
gamma	-0.10	-0.09	-0.03	-0.01	0.01	0.08	-0.05	-0.01	-0.11	-0.03
s.e.	0.04	0.04	0.07	0.05	0.05	0.06	0.05	0.04	0.06	0.03
R square	0.28	0.33	0.00	0.25	0.00	0.00	0.25	0.16	0.11	0.00
	Panel B: Post-Global Financial Crisis									
$SDF_t = \alpha + \beta HML_{x,t} + \epsilon_t$										
alpha	-0.05	-0.02	-0.26	-0.16	0.07	-0.10	0.15	0.02	-0.24	-0.10
s.e.	0.12	0.12	0.14	0.15	0.12	0.15	0.13	0.08	0.16	0.08
beta	0.68	0.76	0.11	0.67	-0.11	0.05	0.65	0.49	0.19	-0.10
s.e.	0.08	0.07	0.10	0.07	0.09	0.12	0.07	0.06	0.12	0.08
R square	0.35	0.44	0.01	0.35	0.01	0.00	0.37	0.29	0.03	0.01
$SDF_t = \alpha + \beta HML_{x,t} + \gamma SDF_{t-12} + \epsilon_t$										
alpha	-0.02	0.00	-0.27	-0.08	0.05	-0.11	0.16	0.01	-0.30	-0.07
s.e.	0.12	0.11	0.15	0.15	0.12	0.16	0.14	0.09	0.16	0.08
beta	0.64	0.74	0.08	0.64	-0.11	-0.02	0.60	0.51	0.25	-0.10
s.e.	0.08	0.08	0.11	0.08	0.10	0.13	0.07	0.06	0.12	0.09
gamma	-0.11	-0.06	-0.12	0.08	-0.04	0.14	0.08	-0.05	-0.15	0.08
s.e.	0.06	0.06	0.09	0.06	0.07	0.06	0.07	0.07	0.06	0.06
R square	0.32	0.41	0.01	0.31	0.00	0.01	0.33	0.28	0.07	0.01

Table OA4: Spanning Tests on Cash Markets

The table presents time-series regression estimates for spanning tests. In this table, I employ two model specifications: the first specification regresses the excess returns of the global *high-minus-low* cross-currency basis excess returns (HML_x) on the various SDFs; the second specification extends the analysis by adding the lagged 3-month HML_x as an additional explanatory variable, as CIP violations exhibit strong quarter-end effects. These SDFs include: the carry trade factor sorted on the forward discount (FDS), business gap (GAP) (Colacito et al., 2020), low-frequency FX systematic liquidity risk (IML) (Mancini et al., 2013; Karnaukh et al., 2015), short-term momentum (MOM3) and long-term momentum (MOM12) (Menkhoff et al., 2012b; Asness et al., 2013), net foreign asset positions (NFA) (Corte et al., 2016; Liao & Zhang,2025), term spread (TER) (Chen et al., 2013; Lustig et al., 2019), currency value (VAL) (Asness et al., 2013; Menkhoff et al., 2017), the implied volatility of the S&P 500 (VIX) (Brunnermeier et al., 2008), and global volatility (VOL) (Menkhoff et al., 2012a). Each of these common risk factors is constructed using our sample and following their respective methodology. Newey and West (1987) standard errors with Andrews (1991) optimal lag selection are reported below each estimated coefficient. The intercept (α) is reported in percentage points (%) and in monthly termss. The sample includes G10 currencies, covering the full sample period from January 1999 to January 2024 (Panel A) and postcrisis period from August 2009 to January 2024 (Panel B).

	Panel A: Full Sample									
	CAR	FDS	GAP	IMB	IML	MOM12	NDT	NFA	TER	VAL
$HML_{x,t} = \alpha + \beta SDF_t + \epsilon_t$										
alpha	0.16	0.13	0.30	0.20	0.29	0.29	0.10	0.22	0.24	0.29
s.e.	0.10	0.10	0.12	0.11	0.12	0.11	0.12	0.12	0.12	0.12
beta	0.41	0.45	-0.11	0.41	-0.10	0.04	0.38	0.31	0.29	0.07
s.e.	0.06	0.06	0.10	0.07	0.08	0.09	0.06	0.09	0.10	0.14
R square	0.27	0.31	0.01	0.26	0.01	0.00	0.22	0.12	0.10	0.00
$HML_{x,t} = \alpha + \beta SDF_t + \gamma HML_{x,t-3} + \epsilon_t$										
alpha	0.16	0.13	0.30	0.20	0.29	0.29	0.10	0.22	0.24	0.29
s.e.	0.10	0.10	0.12	0.11	0.12	0.11	0.12	0.12	0.12	0.12
beta	0.41	0.45	-0.11	0.41	-0.10	0.04	0.38	0.31	0.29	0.07
s.e.	0.06	0.06	0.10	0.07	0.08	0.09	0.06	0.09	0.10	0.14
R square	0.27	0.31	0.01	0.26	0.01	0.00	0.22	0.12	0.10	0.00
	Panel B: Post-Global Financial Crisis									
$HML_{x,t} = \alpha + \beta SDF_t + \epsilon_t$										
alpha	0.22	0.18	0.31	0.26	0.31	0.31	0.08	0.20	0.34	0.28
s.e.	0.11	0.10	0.13	0.14	0.14	0.13	0.15	0.12	0.12	0.14
beta	0.52	0.58	-0.18	0.53	-0.13	0.05	0.57	0.60	0.16	-0.20
s.e.	0.07	0.07	0.12	0.12	0.10	0.12	0.09	0.13	0.12	0.20
R square	0.35	0.44	0.03	0.35	0.01	0.00	0.37	0.29	0.03	0.02
$HML_{x,t} = \alpha + \beta SDF_t + \gamma HML_{x,t-3} + \epsilon_t$										
alpha	0.23	0.18	0.31	0.25	0.30	0.30	0.08	0.18	0.33	0.27
s.e.	0.11	0.11	0.13	0.14	0.13	0.13	0.16	0.12	0.12	0.14
beta	0.52	0.58	-0.18	0.53	-0.13	0.05	0.57	0.60	0.16	-0.19
s.e.	0.07	0.07	0.13	0.11	0.10	0.12	0.09	0.13	0.12	0.19
gamma	-0.01	0.01	0.00	0.02	0.03	0.03	0.00	0.06	0.02	0.02
s.e.	0.05	0.04	0.07	0.06	0.07	0.07	0.06	0.06	0.07	0.06
R square	0.35	0.44	0.03	0.35	0.02	0.00	0.37	0.30	0.03	0.02

Table OA5: Asset Pricing Results on Swap Markets: Country-Level Currency Excess Returns as Test Assets

The table reports the cross-sectional asset pricing results for currency strategies sorted on time $t-1$ information across G10 currency swap markets. The test assets are the country-level individual currency excess returns. Note that I also include the risk factors into test assets to ensure that the point estimates of factor prices equal to the expected returns of tradable risk factor. In addition to the high-minus-low cross-currency basis portfolios (HML_x), the set of pricing risk factors includes the dollar factor (DOL), carry trade sorted on interest rate differential (CAR), as well as three different measures of external imbalances ω, namely, the global imbalance portfolios of Corte et al. (2016) (IMB), the high-minus-low portfolio based on net USD debt holdings relative to GDP of Liao & Zhang (2025) (NDT), and the high-minus-low portfolio based on net foreign asset relative to GDP of Corte et al. (2016); Liao & Zhang (2025) (NFA). I report first-stage GMM estimates of the factor loadings (b_x), the market price of risk (λ_x), the cross-sectional R-square, and HJ-distance. Standard errors are computed using the heteroskedasticity and autocorrelation consistent estimator of Newey and West (1987), with optimal lag length determined according to Andrews (1991). The Hansen and Jagannathan (1997) distance (HJ-dist) is reported to assess the null hypothesis that the distance equals zero, with simulated p-values reported in parentheses. All moments are monthly and reported in percentage points (%). The portfolios are rebalanced monthly. Panel A presents results for the full sample spanning from January 1999 to January 2024 (from January 1999 to December 2020 for IMB and NDT portfolios due to data availability). Panel B summarizes results for the postcrisis period spanning from August 2009 to January 2024 (from August 2009 to December 2020 for IMB and NDT portfolios due to data availability).

	b_{DOL}	b_{CAR}	b_{IMB}	b_{NDT}	b_{NFA}	b_{HML_x}	λ_{DOL}	λ_{CAR}	λ_{IMB}	λ_{NDT}	λ_{NFA}	λ_{HML_x}	R-square	HJ-dist
Panel A: Full sample period														
coefficient	-0.01	0.08	-0.03				0.09	0.44	0.24				78.88%	0.11
s.e.	0.03	0.06	0.06				0.15	0.20	0.20					(0.99)
coefficient	0.00	0.07	-0.05			0.04	0.09	0.38	0.18			0.30	89.00%	0.09
s.e.	0.03	0.06	0.06			0.03	0.15	0.20	0.20			0.15		(0.99)
coefficient	-0.01	0.04		0.01			0.08	0.40		0.37			75.84%	0.12
s.e.	0.03	0.10		0.09			0.15	0.22		0.20				(0.98)
coefficient	-0.01	0.00		0.03		0.04	0.08	0.31		0.34		0.28	83.65%	0.11
s.e.	0.03	0.10		0.09		0.04	0.15	0.22		0.19		0.15		(0.99)
coefficient	-0.03	0.06			0.01		0.00	0.40			0.29		76.37%	0.14
s.e.	0.03	0.05			0.04		0.13	0.20			0.15			(0.91)
coefficient	0.03	0.05			0.02	0.06	0.13	0.18			0.25	0.32	89.38%	0.11
s.e.	-0.02	0.02			0.04	0.04	0.00	0.31			0.15	0.13		(0.97)
Panel B: Post-Global Financial Crisis														
coefficient	-0.03	0.11	-0.03				0.03	0.48	0.22				66.45%	0.21
s.e.	0.04	0.07	0.06				0.19	0.28	0.24					(0.91)
coefficient	-0.02	0.03	-0.04			0.08	0.03	0.27	0.13			0.38	81.23%	0.22
s.e.	0.04	0.07	0.06			0.05	0.19	0.26	0.24			0.21		(0.87)
coefficient	-0.04	0.01		0.07			0.03	0.38		0.43			66.53%	0.20
s.e.	0.04	0.10		0.10			0.19	0.27		0.25				(0.93)
coefficient	-0.02	-0.04		0.05		0.07	0.03	0.21		0.29		0.36	76.88%	0.21
s.e.	0.04	0.11		0.10		0.06	0.19	0.27		0.24		0.21		(0.90)
coefficient	-0.05	0.06			0.04		-0.10	0.39			0.31		68.16%	0.25
s.e.	0.04	0.06			0.07		0.17	0.23			0.16			(0.51)
coefficient	0.03	0.07			0.02	0.11	0.17	0.22			0.21	0.41	88.75%	0.25
s.e.	-0.04	-0.03			0.07	0.05	-0.10	0.16			0.15	0.16		(0.48)

Table OA6: Asset Pricing using DOL, HML_x, CAR and External Imbalances as Risk Factors: Cash Market

The table reports the cross-sectional asset pricing results for currency strategies sorted on time $t-1$ information across G10 currency swap markets. The test assets are 30 currency portfolios sorted on the cross-currency basis, interest rate differential, net foreign asset ratio, short-term momentum, currency value and global volatility. In addition to the high-minus-low cross-currency basis portfolios (HML_x), the set of pricing risk factors includes the dollar factor (DOL), carry trade sorted on interest rate differential (CAR), as well as three different measures of external imbalances ω, namely, the global imbalance portfolios of Corte et al. (2016) (IMB), the high-minus-low portfolio based on net USD debt holdings relative to GDP of Liao & Zhang (2025) (NDT), and the high-minus-low portfolio based on net foreign asset relative to GDP of Corte et al. (2016); Liao & Zhang (2025) (NFA). I report first-stage GMM estimates of the factor loadings (b_x), the market price of risk (λ_x), the cross-sectional R-square, and HJ-distance. Standard errors are computed using the heteroskedasticity and autocorrelation consistent estimator of Newey and West (1987), with optimal lag length determined according to Andrews (1991). The Hansen and Jagannathan (1997) distance (HJ-dist) is reported to assess the null hypothesis that the distance equals zero, with simulated p-values reported in parentheses. All moments are monthly and reported in percentage points (%). The portfolios are rebalanced monthly. Panel A presents results for the full sample spanning from January 1999 to January 2024 (from January 1999 to December 2020 for IMB and NDT portfolios due to data availability). Panel B summarizes results for the postcrisis period spanning from August 2009 to January 2024 (from August 2009 to December 2020 for IMB and NDT portfolios due to data availability).

	b_{DOL}	b_{CAR}	b_{IMB}	b_{NDT}	b_{NFA}	b_{HML_x}	λ_{DOL}	λ_{CAR}	λ_{IMB}	λ_{NDT}	λ_{NFA}	λ_{HML_x}	R-square	HJ-dist
Panel A: Full sample period														
coeff.	-0.01	0.05	0.00				0.09	0.37	0.28				55.14%	0.24
s.e.	0.03	0.05	0.06				0.15	0.19	0.22					0.73
coeff.	0.00	0.02	-0.02			0.07	0.08	0.29	0.20			0.37	69.19%	0.25
s.e.	0.03	0.05	0.06			0.04	0.15	0.19	0.22			0.15		0.80
coeff.	-0.01	0.09		-0.04			0.08	0.40		0.26			55.89%	0.24
s.e.	0.03	0.10		0.10			0.15	0.20		0.22				0.76
coeff.	0.00	0.00		0.01		0.07	0.08	0.28		0.27		0.38	68.64%	0.25
s.e.	0.03	0.09		0.09		0.04	0.15	0.19		0.22		0.15		0.77
coeff.	-0.03	0.05			0.01		0.00	0.36			0.25		53.49%	0.24
s.e.	0.03	0.04			0.04		0.13	0.17			0.15			0.59
coeff.	0.03	0.04			0.02	0.08	0.13	0.17			0.23	0.39	70.58%	0.24
s.e.	-0.02	-0.01			0.04	0.04	0.00	0.26			0.15	0.13		0.65
Panel B: Post-Global Financial Crisis														
coeff.	-0.03	0.08	-0.01				0.03	0.39	0.23				48.41%	0.32
s.e.	0.04	0.06	0.06				0.30	0.50	0.36					0.49
coeff.	-0.02	0.03	-0.04			0.09	0.03	0.27	0.11			0.39	66.09%	0.31
s.e.	0.04	0.06	0.06			0.06	0.45	1.19	0.93			0.82		0.84
coeff.	-0.03	-0.03		0.11			0.03	0.30		0.42			52.60%	0.28
s.e.	0.04	0.12		0.13			0.21	0.36		0.37				0.99
coeff.	-0.02	-0.08		0.10		0.07	0.03	0.19		0.36		0.39	66.32%	0.27
s.e.	0.04	0.10		0.12		0.06	0.34	0.29		0.55		0.57		0.94
coeff.	-0.05	0.04			0.06		-0.10	0.34			0.32		54.86%	0.32
s.e.	0.03	0.05			0.06		0.17	0.20			0.16			0.60
coeff.	0.03	0.06			0.03	0.09	0.17	0.20			0.25	0.39	68.50%	0.28
s.e.	-0.05	-0.01			0.06	0.05	-0.10	0.24			0.16	0.17		0.88

Table OA7: Asset Pricing Results on Cash Markets: Country-Level Currency Excess Returns as Test Assets

The table reports the cross-sectional asset pricing results for currency strategies sorted on time $t-1$ information across G10 currency swap markets. The test assets are the country-level individual currency excess returns. Note that the pricing factors are included into the test assets to ensure that the point estimates of factor prices equal to the expected returns of tradable risk factor. In addition to the high-minus-low cross-currency basis portfolios (HML_x), the set of pricing risk factors includes the dollar factor (DOL), carry trade sorted on interest rate differential (CAR), as well as three different measures of external imbalances ω, namely, the global imbalance portfolios of Corte et al. (2016) (IMB), the high-minus-low portfolio based on net USD debt holdings relative to GDP of Liao & Zhang (2025) (NDT), and the high-minus-low portfolio based on net foreign asset relative to GDP of Corte et al. (2016); Liao & Zhang (2025) (NFA). I report first-stage GMM estimates of the factor loadings (b_x), the market price of risk (λ_x), the cross-sectional R-square, and HJ-distance. Standard errors are computed using the heteroskedasticity and autocorrelation consistent estimator of Newey and West (1987), with optimal lag length determined according to Andrews (1991). The Hansen and Jagannathan (1997) distance (HJ-dist) is reported to assess the null hypothesis that the distance equals zero, with simulated p-values reported in parentheses. All moments are monthly and reported in percentage points (%). The portfolios are rebalanced monthly. Panel A presents results for the full sample spanning from January 1999 to January 2024 (from January 1999 to December 2020 for IMB and NDT portfolios due to data availability). Panel B summarizes results for the postcrisis period spanning from August 2009 to January 2024 (from August 2009 to December 2020 for IMB and NDT portfolios due to data availability).

	b_{DOL}	b_{CAR}	b_{IMB}	b_{NDT}	b_{NFA}	b_{HML_x}	λ_{DOL}	λ_{CAR}	λ_{IMB}	λ_{NDT}	λ_{NFA}	λ_{HML_x}	R-square	HJ-dist
Panel A: Full sample period														
coefficient	-0.02	0.07	-0.02				0.01	0.36	0.20				75.25%	0.23
s.e.	0.03	0.06	0.06				0.15	0.21	0.20					0.36
coefficient	-0.01	0.05	-0.04			0.05	0.01	0.30	0.14			0.29	90.92%	0.21
s.e.	0.03	0.06	0.06			0.03	0.15	0.20	0.20			0.15		0.47
coefficient	-0.02	0.04		0.02			0.01	0.33		0.31			74.20%	0.23
s.e.	0.03	0.09		0.09			0.15	0.22		0.20				0.39
coefficient	-0.02	-0.02		0.04		0.05	0.01	0.23		0.27		0.27	88.19%	0.21
s.e.	0.03	0.10		0.09		0.04	0.15	0.22		0.20		0.15		0.50
coefficient	-0.04	0.06			0.00		-0.08	0.36			0.23		74.06%	0.24
s.e.	0.03	0.04			0.04		0.14	0.20			0.15			0.18
coefficient	0.03	0.05			0.01	0.06	0.14	0.18			0.19	0.32	90.52%	0.21
s.e.	-0.04	0.02			0.04	0.03	-0.08	0.25			0.15	0.13		0.32
Panel B: Post-Global Financial Crisis														
coefficient	-0.03	0.06	-0.02				-0.04	0.28	0.13				58.30%	0.23
s.e.	0.04	0.05	0.05				0.19	0.24	0.23					0.91
coefficient	-0.03	0.01	-0.03			0.09	-0.04	0.17	0.09			0.35	85.07%	0.19
s.e.	0.04	0.05	0.05			0.05	0.19	0.23	0.23			0.21		0.98
coefficient	-0.04	-0.02		0.08			-0.04	0.20		0.29			62.89%	0.20
s.e.	0.04	0.09		0.10			0.19	0.23		0.25				0.97
coefficient	-0.03	-0.04		0.04		0.07	-0.04	0.12		0.19		0.32	80.17%	0.19
s.e.	0.04	0.09		0.10		0.05	0.19	0.23		0.25		0.21		0.99
coefficient	-0.06	0.04			0.04		-0.16	0.27			0.24		75.94%	0.39
s.e.	0.03	0.05			0.06		0.17	0.19			0.15			0.61
coefficient	0.03	0.05			0.02	0.11	0.17	0.19			0.20	0.39	92.72%	0.38
s.e.	-0.06	-0.02			0.06	0.05	-0.17	0.17			0.15	0.16		0.72

Table OA8: Horse Races between HML_x and Other Risk Factors in Post-GFC Period: Cash Markets

This table presents two sets of cross-sectional asset pricing results for the post-GFC period, evaluating the pricing performance of the global dollar funding pressure factor (HML_x) relative to a broad set of established risk factors on cash markets. The first specification includes the dollar risk factor (DOL) alongside various benchmark stochastic discount factors (SDFs). The second specification augments each benchmark model by additionally including HML_x, allowing for a direct comparison of its incremental explanatory power. The SDFs considered include the business cycle gap (GAP) (Colacito et al., 2020), low-frequency systematic FX liquidity (IML)(Mancini et al., 2013; Karnaukh et al., 2015), short-term momentum (MOM3) and long-term momentum (MOM12) (Menkhoff et al., 2012b; Asness et al., 2013), net foreign asset position (NFA) (Corte et al., 2016), term spread (TER) (Ang and Chen, 2010; Lustig et al., 2019), currency value (VAL) (Asness et al., 2013; Menkhoff et al., 2017), the VIX index (Brunnermeier et al., 2008), and global FX volatility (VOL) (Menkhoff et al., 2012a). All cross-sectional regressions are estimated using GMM. Standard errors for the estimated risk prices are reported in parentheses and are computed using the Newey and West (1987) heteroskedasticity- and autocorrelation-consistent procedure with optimal lag selection following Andrews (1991). Factor loadings for the dollar risk factor and each control SDF are denoted b_{DOL} and b_x, respectively, with corresponding risk prices λ_{DOL} and λ_x. For each specification, I also report the cross-sectional R^2, Hansen–Jagannathan (HJ) distance, and the simulated p-value for the test of zero pricing error. All moments are monthly and reported in percentage points (%). Panel A reports results using currency portfolios as test assets, while Panel B presents results using individual currency excess returns. The sample comprises G10 currencies and spans the postcrisis period from August 2009 to January 2024.

	Panel A: Currency portfolio as test assets								***Panel B: Individual currency as test assets***							
	b_dol	b_x	b_hml	λ_{DOL}	λ_x	λ_{HML_x}	R-square	HJ -distance	b_dol	b_x	b_hml	λ_{DOL}	λ_x	λ_{HML_x}	R-square	HJ -distance
GAP	-0.04	0.17		-0.13	0.56		7.81%	0.62	-0.07	0.34		-0.19	1.14		52.77%	0.22
	0.04	0.16		0.17	0.54			0.32	0.04	0.19		0.17	0.63			0.80
	-0.04	-0.18	0.10	-0.15	-0.57	0.31	76.74%	0.57	-0.07	0.14	0.07	-0.20	0.48	0.31	90.64%	0.18
	0.04	0.14	0.05	0.17	0.47	0.17		0.48	0.03	0.15	0.04	0.17	0.52	0.17		0.89
IML	-0.05	-0.10		-0.14	-0.37		12.45%	0.61	-0.08	-0.21		-0.19	-0.80		41.22%	0.27
	0.04	0.06		0.17	0.27			0.18	0.04	0.10		0.17	0.41			0.43
	-0.06	-0.03	0.08	-0.15	-0.11	0.32	72.95%	0.59	-0.08	-0.10	0.08	-0.21	-0.36	0.29	91.23%	0.20
	0.04	0.06	0.04	0.17	0.25	0.16		0.20	0.04	0.08	0.04	0.17	0.35	0.17		0.79
MOM3	-0.03	-0.12		-0.14	-0.66		6.33%	0.57	-0.04	-0.09		-0.18	-0.53		12.87%	0.26
	0.03	0.11		0.17	0.63			0.61	0.03	0.16		0.17	0.91			0.46
	-0.05	0.03	0.09	-0.14	0.15	0.33	72.29%	0.60	-0.06	0.10	0.09	-0.20	0.53	0.32	87.74%	0.18
	0.03	0.10	0.04	0.17	0.56	0.16		0.23	0.04	0.16	0.04	0.17	0.89	0.17		0.90
MOM12	0.01	0.27		-0.13	1.39		37.06%	0.66	0.00	0.24		-0.18	1.24		49.22%	0.21
	0.05	0.13		0.17	0.62			0.29	0.05	0.12		0.17	0.58			0.85
	-0.03	0.12	0.07	-0.14	0.65	0.34	77.11%	0.61	-0.04	0.12	0.07	-0.20	0.68	0.32	93.96%	0.17
	0.04	0.09	0.04	0.17	0.45	0.17		0.56	0.04	0.10	0.04	0.17	0.51	0.17		0.94
TER	-0.04	0.14		-0.14	0.76		31.52%	0.63	-0.05	0.10		-0.18	0.54		23.84%	0.26
	0.03	0.08		0.17	0.44			0.54	0.03	0.09		0.17	0.49			0.43
	-0.05	0.04	0.08	-0.15	0.23	0.32	73.44%	0.60	-0.06	-0.02	0.09	-0.20	-0.08	0.31	86.23%	0.19
	0.03	0.06	0.04	0.17	0.32	0.17		0.29	0.03	0.10	0.04	0.17	0.49	0.17		0.81
VAL	0.00	-0.12		-0.13	-0.28		20.91%	0.61	0.02	-0.24		-0.18	-0.53		53.16%	0.22
	0.04	0.07		0.18	0.15			0.12	0.05	0.13		0.18	0.27			0.68
	-0.05	0.01	0.09	-0.15	-0.08	0.33	72.12%	0.59	-0.06	0.00	0.09	-0.20	-0.11	0.31	85.80%	0.20
	0.04	0.06	0.04	0.17	0.12	0.16		0.19	0.05	0.13	0.05	0.17	0.25	0.17		0.78
VIX	-0.03	-0.02		-0.13	-0.70		2.67%	0.61	-0.05	-0.05		-0.18	-2.03		20.12%	0.29
	0.03	0.04		0.17	1.52			0.95	0.04	0.06		0.17	2.25			0.96
	-0.05	0.02	0.09	-0.15	0.87	0.33	73.14%	0.58	-0.06	0.00	0.08	-0.20	-0.14	0.31	85.85%	0.20
	0.03	0.03	0.04	0.17	1.41	0.16		0.98	0.03	0.05	0.04	0.17	2.06	0.17		0.88
VOL	-0.03	0.00		-0.13	-0.03		1.93%	0.59	-0.05	0.23		-0.18	1.19		16.92%	0.26
	0.03	0.03		0.17	0.17			0.02	0.04	0.24		0.17	1.25			0.62
	-0.05	-0.02	0.09	-0.15	-0.09	0.32	73.83%	0.59	-0.05	-0.13	0.09	-0.21	-0.65	0.28	87.36%	0.20
	0.03	0.03	0.04	0.17	0.17	0.16		0.19	0.04	0.24	0.04	0.17	1.21	0.17		0.85

Table OA9: Asset Pricing Tests Results: Transaction Costs

The table reports cross-sectional pricing results for the linear stochastic discount factor (SDF) model based on the dollar risk factor (DOL), traditional FX carry trade factor of Lustig et. al (2011) (CAR), and global "high-minus-low " cross-currency basis risk factor (HML_x) taking the transaction costs (bid-ask spreads) into account. The test assets in Panel A are the net excess returns to six equally-weighted currency strategy portfolios sorted by interest rate differential (Lustig et al., 2011), global volatility (Menkhoff et al., 2012a), three-month momentum (Menkhoff et al., 2012b; Asness et al., 2013), currency value (Asness et al., 2013; Menkhoff et al., 2017), net foreign asset ratios (Corte et al., 2016), and cross-currency basis. This results in 30 currency portfolios spanning the full sample period from January 1999 to January 2024. The Panel B conduct the cross-sectional out-of-sample tests in which the basis and carry portfolios are excluded from the test assets. The test assets only include currency value, momentum, volatility, and net foreign asset ratio portfolios. Note that the tradable pricing factors HML_x and CAR are included in test assets to ensure that the risk price is not estimated as a free parameter. This table shows coefficient estimates of SDF parameters b and factor risk prices λ obtained by the first-stage GMM. Standard errors (s.e.) of coefficient estimates are reported below the estimates and are obtained by the Newey and West (1987) procedure with the optimal lag selection according to Andrews (1991). I also report the cross-sectional R-square and the HJ distance (HJ dist), along with the (simulation-based) p-value for the test of whether the HJ distance is equal to zero. All moments are monthly and reported in percentage points (%). The detailed calculation procedure of currency excess returns with bid-ask spreads is elaborated in the online Appendix.

Panel A: Using currency strategy portfolios as tests assets

Post-GFC						Full sample					
GMM	DOL	HML_x	CAR	R^2	HJ dist	GMM	DOL	HML_x	CAR	R^2	HJ dist
b	-0.05	0.10		60.69%	1.01	b	-0.02	0.09		44.17%	0.98
s.e.	0.03	0.04			0.96	s.e.	0.03	0.03			0.94
λ	-0.10	0.40				λ	-0.01	0.39			
s.e.	0.17	0.18				s.e.	0.13	0.15			
b	-0.05		0.08	52.93%	1.00	b	-0.03		0.05	35.89%	0.97
s.e.	0.04		0.04		0.96	s.e.	0.03		0.03		0.95
λ	-0.10		0.36			λ	-0.01		0.34		
s.e.	0.17		0.19			s.e.	0.13		0.16		
b	-0.05	0.10	0.00	60.70%	1.01	b	-0.02	0.07	0.01	44.96%	0.98
s.e.	0.03	0.06	0.05		0.98	s.e.	0.03	0.03	0.03		0.96
λ	-0.10	0.40	0.26			λ	-0.01	0.35	0.28		
s.e.	0.17	0.17	0.19			s.e.	0.13	0.13	0.16		

Panel B: Out-of-sample currency portfolios as tests assets

Post-GFC						Full sample					
GMM	DOL	HML_x	CAR	R^2	HJ dist	GMM	DOL	HML_x	CAR	R^2	HJ dist
b	-0.05	0.10		75.77%	0.97	b	-0.02	0.08		54.45%	0.95
s.e.	0.03	0.04			0.95	s.e.	0.02	0.03			0.91
λ	-0.10	0.38				λ	-0.01	0.37			
s.e.	0.17	0.17				s.e.	0.13	0.14			
b	-0.05		0.08	69.88%	0.97	b	-0.03		0.06	53.88%	0.94
s.e.	0.03		0.04		0.95	s.e.	0.03		0.03		0.93
λ	-0.10		0.36			λ	-0.02		0.37		
s.e.	0.17		0.19			s.e.	0.13		0.16		
b	-0.05	0.08	0.02	76.17%	0.97	b	-0.03	0.05	0.03	59.32%	0.94
s.e.	0.03	0.05	0.04		0.97	s.e.	0.03	0.03	0.03		0.95
λ	-0.10	0.35	0.28			λ	-0.02	0.29	0.32		
s.e.	0.17	0.16	0.18			s.e.	0.13	0.13	0.15		

Table OA10: Asset Pricing Results with Transaction Costs: Country-Level Currency Excess Returns as Test Assets

The table reports the cross-sectional asset pricing results for currency strategies sorted on time $t-1$ information across G10 currency swap markets with considerations of bid-ask spreads. The test assets are 30 currency portfolios sorted on interest rate differential, basis, value, momentum, and volatility (in Panel A). The test assets are the country-level individual currency net excess returns (in Panel B). Note that I also include the risk factors in test assets to ensure that the point estimates of factor prices equal to the expected returns of the tradable risk factor. In addition to the high-minus-low cross-currency basis portfolios (HML_x), the set of pricing risk factors includes the dollar factor (DOL), carry trade sorted on interest rate differential (CAR), as well as three different measures of external imbalances ω, namely, as well as three different measures of external imbalances ω, namely, the global imbalance portfolios of Corte et al. (2016) (IMB), the high-minus-low portfolio based on net USD debt holdings relative to GDP of Liao & Zhang (2025) (NDT), and the high-minus-low portfolio based on net foreign asset relative to GDP of Corte et al. (2016); Liao & Zhang (2025) (NFA). I report first-stage GMM estimates of the factor loadings (b_x), the market price of risk (λ_x), the cross-sectional R-square, and HJ-distance. Standard errors are computed using the heteroskedasticity and autocorrelation consistent estimator of Newey and West (1987), with optimal lag length determined according to Andrews (1991). The Hansen and Jagannathan (1997) distance (HJ-dist) is reported to assess the null hypothesis that the distance equals zero, with simulated p-values reported in parentheses. All moments are monthly and reported in percentage points (%). The portfolios are rebalanced monthly. The left panel presents results for the full sample spanning from January 1999 to January 2024 (from January 1999 to December 2020 for IMB and NDT portfolios due to data availability). The right summarizes results for the postcrisis period spanning from August 2009 to January 2024 (from August 2009 to December 2020 for IMB and NDT portfolios due to data availability).

	b_{DOL}	b_{CAR}	b_{IMB}	b_{NDT}	b_{NFA}	b_{HML_x}	λ_{DOL}	λ_{CAR}	λ_{IMB}	λ_{NDT}	λ_{NFA}	λ_{HML_x}	R-square	HJ-dist
							Panel A: Full sample period							
coeff.	0.00	0.06	-0.02				0.09	0.36	0.22				75.22%	0.15
s.e.	0.03	0.05	0.05				0.15	0.18	0.20					0.94
coeff.	0.00	0.05	-0.04			0.05	0.09	0.32	0.16			0.30	88.18%	0.13
s.e.	0.03	0.05	0.05			0.03	0.15	0.18	0.20			0.15		0.98
coeff.	-0.01	0.01		0.04			0.08	0.33		0.36			75.74%	0.14
s.e.	0.03	0.07		0.07			0.15	0.18		0.20				0.97
coeff.	-0.01	-0.01		0.04		0.04	0.08	0.29		0.33		0.28	85.36%	0.11
s.e.	0.03	0.07		0.07		0.03	0.15	0.18		0.20		0.15		0.99
coeff.	-0.02	0.04			0.01		0.00	0.34			0.27		78.18%	0.15
s.e.	0.03	0.04			0.04		0.13	0.16			0.15			0.88
coeff.	0.03	0.04			0.02	0.06	0.13	0.16			0.24	0.33	91.40%	0.11
s.e.	-0.02	0.01			0.04	0.03	0.00	0.29			0.15	0.13		0.98
							Panel B: Post-Global Financial Crisis							
coeff.	-0.03	0.06	-0.02				-0.01	0.27	0.12				49.06%	0.31
s.e.	0.04	0.06	0.05				0.19	0.24	0.24					0.43
coeff.	-0.02	0.01	-0.04			0.10	-0.01	0.15	0.05			0.36	83.57%	0.29
s.e.	0.04	0.05	0.05			0.05	0.19	0.23	0.24			0.21		0.61
coeff.	-0.03	-0.03		0.09			-0.02	0.22		0.33			55.64%	0.27
s.e.	0.04	0.08		0.09			0.19	0.23		0.24				0.70
coeff.	-0.02	-0.04		0.04		0.08	-0.02	0.13		0.20		0.35	76.62%	0.26
s.e.	0.04	0.09		0.10		0.05	0.19	0.23		0.24		0.21		0.75
coeff.	-0.05	0.04			0.04		-0.13	0.27			0.24		66.58%	0.29
s.e.	0.04	0.05			0.06		0.17	0.19			0.16			0.30
coeff.	0.04	0.05			0.01	0.11	0.17	0.19			0.17	0.39	90.78%	0.26
s.e.	-0.05	-0.02			0.07	0.05	-0.14	0.15			0.16	0.17		0.50