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

Yirong Wang*

Abstract

This paper examines the relationship between dollar hedge funding pressure and the cross-section of currency risk premium. Motivated by the currency hedging channel proposed by Liao & Zhang (2025), I use the deviations of Covered Interest Rate Parity (CIP) as a measure of imbalances between excessive dollar hedging demand and constrained funding supply with financial intermediation costs. Using G10 currency data, I show that currencies with less negative or positive basis values offer significantly higher excess returns as compensation for holding currencies with higher dollar funding 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 and explains a large variation in cross-sectional variation in currency returns, particularly during the postcrisis period. This basis factor also subsumes information embedded in nominal interest rate (carry trade) and global imbalances in trade and capital flows in postcrisis period.
keywords: international finance, covered interest rate parity, cross-currency basis, dollar hedging, currency risk premia

*Email: yirong.wang@bristol.ac.uk, University of Bristol, School of Economics, Finance, and Management

1 Introduction

The U.S. dollar is the dominant global currency, serving as the primary medium for reserves, borrowing, and trade. A large portion of dollar-denominated assets and liabilities is held by non-U.S. banks, creating persistent hedging demand for dollars. Large global banks intermediate this demand by providing dollar liquidity and hedging services through FX swap and forward markets. However, post-Global Financial Crisis (GFC) regulatory reforms introduce balance sheet constraints on banks, straining dollar funding markets and driving persistent deviations from the Covered Interest Parity (CIP). This paper examines the asset pricing implications of the CIP deviations by estimating the impact of dollar funding risk, as proxied by the unconditional cross-currency basis, on the cross-section of currency risk premia.

The CIP condition, a fundamental no-arbitrage condition in international finance, posits that investors should earn identical risk-free returns by either investing in U.S. dollars at the U.S. risk-free rate or converting dollars into a foreign currency, earning the foreign risk-free rate, locking in the future exchange rate through a forward contract, and subsequently converting the proceeds back into U.S. dollars. However, persistent and systematic deviations from CIP have been widely documented since the GFC (e.g., Du et al., 2018; Cerutti et al., 2021; Keller, 2024). A growing body of literature has sought to explain the drivers of these deviations.[1] While these mechanisms differ in form, they all point to a common theme: CIP deviations arise from the interaction of market intermediary constraints, regulatory barriers, and global demand imbalances. As documented in the seminal work of Du et al. (2018), the cross-currency basis is largely driven by two key forces: the rising cost of financial intermediation in the post-crisis environment and persistent international imbalances in investment demand and funding supply.

Despite the growing literature on the drivers of CIP deviations, there remains limited research on their asset pricing implications. For example, Du et al. (2023), who use changes in the absolute magnitude of the cross-currency basis as a proxy for the costs of constrained financial intermediation. They construct a "forward CIP trading strategy" and demonstrate that this strategy earns a significant risk premium, thereby confirming that financial intermediary constraints are a priced factor in currency markets. However, their measure of intermediary risk—based solely on the absolute magnitude of the cross-currency basis—does not account for the underlying imbalances between dollar hedging

[1] The factors that drive the CIP deviations can see, for example, regulatory capital constraints (Ivashina et al., 2015), funding liquidity frictions (Mancini-Griffoli & Ranaldo, 2011), balance sheet costs for global banks (Avdjiev et al., 2019), segmentation and fragmentation in USD funding markets (Rime et al., 2022), market power and markups in FX swaps (Wallen, 2020), and macroeconomic imbalances such as safe asset scarcity and concentrated dollar demand (Moskowitz et al., 2024).

demand and funding supply.

In this paper, I argue that the unconditional cross-currency basis serves as a direct, market-based measure of a country's dollar funding pressure. This pressure arises from an imbalance between a country's structural dollar hedging demand and the constrained supply of dollar liquidity provided by financial intermediaries. The level of the cross-currency basis reflects this imbalance: currencies with higher basis values (less negative or positive) indicate lower dollar funding pressures, while those with lower basis values (more negative) indicate higher pressures.

This mechanism is motivated by the hedging channel proposed by Liao & Zhang (2025) where the cross-currency basis is jointly determined by two forces: the country's hedging demand, driven by exogenous external imbalances, and the marginal cost of supplying dollar liquidity, determined by the balance sheet constraints faced by financial intermediaries. On the demand side, non-U.S. banks and institutions hedge the currency risk arising from their U.S. dollar-denominated assets and liabilities by trading dollars forward in FX swap markets with intermediaries such as swap dealers. These institutions often lack direct access to dollar funding in cash markets, as documented by Du & Schreger (2022). On the supply side, swap dealers accommodate hedging demand by borrowing dollars in cash markets from cash-rich lenders (such as U.S. households and corporates) and replicating synthetic forward contracts in FX markets.[2] On the supply side, swap dealers therefore accommodate the investors' hedging demand and hedge against FX risk by, i.e., borrowing in U.S. dollars in cash markets from cash-rich lenders (such as households and corporate depositors) and replicating the synthetic forward contracts. The profit per unit earned by global banks—arising from the difference between the interest rate paid on dollar loans in the cash market and the return from providing liquidity in the FX swap market—corresponds to the deviation from CIP, as measured by the cross-currency basis. Therefore, the product of the swap dealers' liquidity provision position and the profit per unit must be non-negative to incentivize their continued provision of dollar liquidity in FX swap markets.

The cross-currency basis has been systematically negative in the post-GFC, reflecting the tightening of banking regulations such as Basel III. These regulations impose strict balance sheet constraints on global banks, including leverage ratio requirements, which raise the marginal cost of providing dollar liquidity. As a result, the supply curve for dollar funding has become upward sloping, contrasting with the near-elastic supply before the crisis. Intermediaries face higher costs for using scarce balance sheet capacity, which limits their ability to meet global dollar hedging demand. Despite rising intermediation

[2]The internal investors (i.e., non U.S. banks) borrow dollars in the FX swap market as opposed to directly borrowing in the cash market because they usually face barriers to get access to dollar cash funding markets (Du & Schreger, 2022).

costs, demand for dollar hedging remains strong, as documented by Puriya & Bräuning (2021). Major banking sectors outside the United States continue to hold sizable dollar funding gaps, with a large share of dollar-denominated assets not matched by on-balance-sheet dollar liabilities. Therefore, during periods of dollar funding strain, countries with greater hedging demand in purchasing dollars and selling domestic currencies in FX forward markets, face higher dollar funding pressure by exacerbating dollar scarcity, as reflected in higher (less negative or positive) cross-currency basis levels.

The underlying logic is that countries with negative external dollar imbalances tend to purchase dollars and sell domestic currencies in FX swap markets to hedge their FX risk. This increased demand raises dollar scarcity, requiring arbitrageurs to supply dollar liquidity by borrowing dollars in cash markets and replicating synthetic forwards. The cross-currency basis must be positive to compensate intermediaries for their liquidity provision and ensure non-negative profits. Conversely, countries with positive external dollar imbalances hedge by selling dollars and buying domestic currencies in forward markets, which alleviates dollar scarcity and results in lower dollar funding pressure, as reflected in a lower (more negative) cross-currency basis. The economic intuition behind this regime is similar as Keller (2024) who shows that the sign and magnitude of the cross-currency basis reflect relative scarcity. A negative cross-currency basis indicates dollar scarcity, where the market prefers to borrow rather than lend. For countries with positive dollar imbalances, they sell dollars and buy domestic currencies in swap markets, thus facing lower risk from dollar scarcity.

This economic mechanism yields a direct asset pricing implication: currencies with higher cross-currency basis values command higher risk premiums, as investors require compensation for greater exposure to dollar funding risk. In contrast, currencies with lower (more negative) basis values are perceived as safer, with lower exposure to dollar funding risk, and thus offer lower expected returns. Therefore, the first hypothesis tested in this paper is that the currency risk premium increases with the cross-currency basis.

The cross-currency basis, as driven by dollar hedging demand, is expected to capture information embedded in external imbalances. Three empirical measures are used to proxy a country's external dollar imbalances: the net foreign asset (NFA) ratio (Corte et al., 2016; Liao & Zhang, 2025), the net U.S. dollar debt holding ratio (NDT) (Liao & Zhang, 2025), and the global imbalance portfolio (IMB) from Corte et al. (2016), which is double-sorted by NFA and the share of external liabilities denominated in domestic currency (LDC). Beyond dollar funding pressure and external imbalances, the second hypothesis tested in this paper is that the cross-currency basis also contains information about nominal interest rate differentials, consistent with the carry trade factor documented by Lustig et al. (2011), which involves selling currencies with low interest rates and buying those with high rates. Both Du et al. (2018) and Liao & Zhang (2025) provide supporting evidence. Du et al. (2018) empirically show that the cross-currency basis is strongly positively correlated with interest rate differentials: lower foreign interest rates relative to the U.S. rate increase demand for U.S. dollar-denominated assets, creating hedging demand to sell dollars and buy foreign currencies, and resulting in a more negative basis as compensation for balance sheet costs. Liao & Zhang (2025) theoretically demonstrate that both dollar hedging demand and a country's external imbalances (and thus the basis) enter the determination of spot exchange rates. They show that currencies with low (or high) basis values tend to appreciate (or depreciate) during periods of financial stress, consistent with the logic of the carry trade.

However, before the GFC, financial intermediaries (i.e., large global banks) operated under minimal regulatory constraints and ample balance sheet capacity. This unconstrained environment enabled them to channel global dollar supply efficiently, absorbing strong demand for dollars in the FX swap market and allowing intermediaries to provide forward dollars at negligible cost, regardless of the quantity demanded (Du & Schreger, 2022). Therefore, given the global dollar hedging demands, the supply curve of dollar funding is perfectly elastic to accommodate their hedging services needs, so the CIP condition is mainly held or only violated in small magnitudes. Even if the deviation of CIP condition can exist temporarily due to market frictions, market power possessed by the financial intermediary institutions,[3] or temporary imbalances between dollar hedging demand and funding supply, they did not translate into persistent or economically significant currency risk premia as investors are largely unaware of dollar funding risk under the unrestricted dollar supply environments.

The first hypothesis tested in this paper is that dollar funding risk, as measured by the unconditional cross-currency basis, is priced in the cross-section of currency excess returns. A factor-mimicking portfolio that buys currencies with the highest basis and sells those with the lowest should yield a positive and significant risk premium. This hypothesis is tested in both forward and cash markets, separately.[4]

Using the most liquid G10 currencies in FX markets with the sample period from January 1999 to January 2025, I sort currencies based on their exposure to the dollar funding pressure risk, namely their respective cross-currency basis, from the most negative

[3]Basis spreads can still be non-zero even when intermediary costs are low, as swap dealers may possess market power. Wallen (2020) examines such markups in FX forward markets as a potential contributor to CIP deviations.

[4]I do not consider arbitraging profits arising from CIP, because the arbitraging activities are operated under strict restrictions due to market segemenation and regulations, and also a significant part of CIP arbitrage profit would be eroded by the higher funding cost, so I only consider the currency risk premium obtained directly via the synthetic FX forward contracts on swap markets and cash deposits obtained on money markets.

to the least negative (or positive). The cross-sectional asset pricing test results show that, over the full sample period, the cross-currency basis risk factor yields a positive and statistically significant risk premium of approximately between 3.8% to 4.6% per annum on swap markets based on different test assets and between 3% to 3.6% per annum on cash markets, and explains a large portion of cross-sectional currency risk premium. By analyzing the subsample of pre-and postcrisis period, the pricing power of the basis factor is predominantly coming from the post-GFC period, the risk price of basis factor is insignificantly priced in the pre-crisis period, as theoretically expected.

Besides, I also show that, in post-GFC, the basis factor captures the information embedded in the nominal interest rate (i.e., carry trade of Lustig et al. (2011)) and three different measures of external dollar imbalances by subsuming the pricing power of these factors in horse races. Via a spanning test, I find that the basis factor is not spanned by other well-established FX risk factors, including 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) (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), by generatig significant and positive alphas.

The remainder of the paper is organized as follows. Section 2 explains reviews the CIP condition and explanis the theoretical framework and research hypothesis of this study. Section 3 describes the data and basis-sorted currency porfolios constructions. Section 5 examins whether the dollar funding pressure risk is priced in the cross-sectional of asset prices. Section 6 examines the relationship between basis risk factor and other FX risk factors, paricularly carry trade and external imbalances. Section 7 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 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 cross-currency basis $x^{i}_{t,t+n}$ (or the CIP deviation) in log forms 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:

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

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.

Hedging demand: In period 1, it is assumed that the representative investor in a country i has an exogenous pre-existing net external position of ω^i in U.S. dollar-denominated debt that matures in period 2 and earns the return y^i. When $\omega^i > 0$, it means that this country has a positive external imbalance (i.e., holding net USD assets), while a country with $\omega^i < 0$ means that this country has a negative external imbalance (i.e., holding net USD liabilities). In either case, the investor faces exchange rate risk and can hedge their exchange rate exposure by trading dollars in the forward market. 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].[5] The derivation of equation (4) is reported in the Online Appendix.

Supply of forwards: Currency forward traders (or FX swap dealers) act as financial intermediaries, providing liquidity in forward currency markets. Letting q^i denote the forward trader's position in dollars taken in period 1 to provide liquidity for the country-i investor. The forward trader ultimately earns a following profit from liquidity provision:

[5]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). $\gamma S_1 y^i \operatorname{Var}[S_2/S_1] \geqslant \frac{E[S_2/S_1]-(F/S_1)}{\omega^i}$. The first assumption requires that the expected currency return is positive for funding (investment) countries with positive (negative) external imbalances. The expected currency return is negative for funding (investment) countries with negative (positive) external imbalances, which is consistent 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.

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

Forward traders only provide liquidity in forward markets under the condition: $q^i x^i \geqslant 0$, so the sign of q^i and x^i must align in the same direction and must be opposite with the sign of ω^i. This relationship can be explained in the following example: consider a country i characterized by a positive net external imbalance ($\omega^i > 0$). The representative investor hedges the FX risk by selling U.S. dollars and purchasing currency i in the forward markets against forward traders. In response, forward traders provide liquidity and hedge FX risks by replicating the forward contract. Specifically, they borrow U.S. dollars ($q^i < 0$) in cash markets and buy currency i in the spot market in period 1 and subsequently earn an interest return of y^i. In period 2, the forward traders deliver currency i to the country i's investors and receive in exchange dollars at the forward price of F. Then the traders must repay $q^i(1+y^{\$})$ as costs for their initial dollar loans. Finally, the traders earn a profit of dollars from such transactions to incentivize their liquidity provision, thus implying a negative basis ($x^i < 0$). Therefore, a negative basis can be viewed as an intermediation fee charged by large global banks to compensate for their swap provision activities.

Following Garleanu & Pedersen (2011), it is assumed that forward traders are required to set aside a haircut of $\kappa H(q^i)$ when supplying q^i dollars to forward markets, where κ is a positive constant intermediation costs parameter. After providing liquidity, the forward traders leave with $\pi = W - \kappa \sum_i H(q^i)$ dollars to an alternative investment, generating profit functions of $G(\pi)$.[6] Upon solving the forward traders' profit maximization problem, the traders' first order condition (F.O.C) determines the cross-currency basis endogenously as follows:[7]

$$x^i = \kappa G' \left(W - \kappa \sum_j H(q^j) \right) H'(q^i). \tag{6}$$

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

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

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

given and respond by supplying dollars in the forward market:

$$q^i = -h^i \omega^i. \tag{7}$$

Market clearing conditions define the cross-currency basis as a function of hedge ratio and external imbalances:

$$x^i = \kappa G' \left(W - \kappa \sum_m H(-h^j \omega^j) \right) H'(-h^i \omega^i). \tag{8}$$

This equation implies that the cross-currency basis is jointly determined by *two* forces: (i) the average financial intermediary costs of supplying dollar funding and (ii) the investors' hedge demand as driven by external imbalances.[8] To some extent, this framework is consistent with Du et al. (2018), who pinpoint the financial intermediary constraints and international imbalances in investment demand and funding supply as two drivers of CIP deviations.

In the pre-crisis period, financial intermediaries face unconstrained balance sheet capacities, allowing them to provide dollar hedging and funding services at negligible cost, regardless of the quantity demanded (Du & Schreger, 2022). Therefore, the CIP condition is held and the deviations from CIP are typically small in magnitude, short-lived, can be quickly arbitraged away (e.g., Akram et al., 2008; Du et al., 2018). While basis spreads could arise temporarily due to market frictions, they did not translate into persistent or economically significant currency risk premia.

In the wake of the GFC, financial intermediaries have faced significantly tighter operating environments following post-crisis regulatory reforms, which introduced leverage ratio requirements and other balance sheet constraints to the large banks. These constraints raise costs for banks to use precious balance sheet capacity, limiting their abilities to engage in cross-border arbitrage and to provide dollar funding and hedging services in the FX swap market to meet global hedging demand for U.S. dollars. As a result, financial intermediaries require compensation for supplying FX dollar forward contracts, leading to an upward-sloping supply curve of dollar funding and the emergence of persistent, large, and systematic deviations from the CIP. Therefore, as shown in equation (6), the unconditional cross-currency basis can be understood as a mismatch between excessive dollar hedge demand and restricted dollar funding supply, with the presence of financial

[8] 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, $\kappa = 0$.

intermediation costs.[9] A higher level of the cross-currency basis therefore signals a more severe imbalance between dollar hedge demand and constrained dollar funding supply, and greater exposure to dollar funding pressure.

That is, the currencies of countries exhibiting greater hedging demands in purchasing dollars on forward markets (i.e., ω is more negative) face a more severe imbalance between their dollar hedge demand under the global dollar funding shortage environments. This imbalance is reflected by a positive cross-currency basis, as swap dealers provide hedging services by lending in dollars ($q > 0$). Such currencies are considered riskier, as currencies are exposed to higher dollar funding pressures by demanding dollars and exacerbating dollar funding scarcity, and must therefore be compensated with higher expected excess returns. In contrast, currencies of countries with less dollar hedge demand in purchasing dollars or even selling dollars on forwards (i.e., $\omega>0$), face less dollar funding risk by reducing dollar scarcity, as reflected in a more negative basis. These currencies are perceived as safe havens with lower exposure to the dollar funding shortages and offer lower risk premiums. Based on this economic rationale, I propose the following hypothesis:

Hypothesis 1: *Currency risk premia increase with the the cross-currency basis. That is, currencies with a less negative (or positive) cross-currency basis yield higher expected excess returns, while currencies with a more negative basis yield lower expected excess returns.*

This hypothesis is tested in the following ways. First, I form portfolios sorted by the unconditional cross-currency basis, as defined in Equation (2), and compute the average currency excess returns for each portfolio. If currency risk premia increase with the cross-currency basis, the return spread between currencies with less negative (or positive) basis and those with more negative basis should be statistically significant and positive. Second, I construct a long-short trading strategy, termed the "*global high-minus-low cross-currency basis*" strategy, which involves shorting currencies with the most negative basis and going long in currencies with positive basis. Then I examine whether this tradable cross-currency basis factor is priced in the cross-section of currency excess returns, with the control of traditional carry and dollar risk factor, by estimating its price of risk. If the dollar funding pressure is indeed a priced risk, it is expected that the high-minus-low basis trading strategy to earn significantly positive excess returns on average, as a risk premium to compensate investors for bearing the systematic risk exposure to variations in the dollar funding pressure.

[9]As shown by Du et al. (2018), hedge demand for dollar funding remains robust even in the postcrisis period, as the U.S. dollar remains as the global reserve currency and ultra-low interest rates persist in Europe and Japan. Thus, dollar hedge demand does not decline significantly despite rising funding costs, exacerbating the imbalance between hedge demand and constrained funding supply.

Since the cross-currency basis is jointly determined by supply-side intermediation costs and demand-side dollar hedging pressures, 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.

By taking the derivative of $Var(S)$ with respect to S, it can be shown that currencies of countries with negative basis (positive external imbalances) tend to appreciate during periods of financial distress, while currencies of countries with positive basis (negative imbalances) tend to depreciate.[10] This economic mechanism is closely related to the well-documented economic phenomenon, failure of Uncovered Interest Rate Parity (UIP), which shows that currencies with higher interest rates tend to depreciate during episodes of heightened volatility and deliver higher expected excess returns, while lower interest rate currencies tend to appreciate during market stress and yield lower returns (e.g., Hansen & Hodrick, 1980; Fama, 1984). This mechanism maps naturally into our framework. The basket of currencies from creditor countries, typically characterized by negative basis values and lower interest rates, are viewed as safe-haven currencies with lower expected returns. Conversely, the currencies of debtor countries, associated with positive basis and higher interest rates, are perceived as riskier assets that compensate investors with higher risk premia. This classification is consistent with our earlier interpretation of currency risk and is directly aligned with the design of the traditional FX carry trade strategy, in which investors short the basket of low interest rate currencies and long the basket of high interest rate ones. 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*

[10]The derivation of derivatives is provided in the online Appendix.

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.[11] 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:

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

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

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:[12]

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

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 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

[12] 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.

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 sterling (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 2025, 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 1 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 (13). I use one-step GMM approach to address the estimation uncertainty (i.e., 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.[13] 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).

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 as comparison. The pricing kernel of our basic analysis is thus express as the following parametric form:

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

Our test assets are the five cross-currency basis-sorted currency portfolios as described in Section 3. Table 2 presents the cross-sectional asset pricing results with five portfolios as test assets. However, Lewellen et al. (2010) show that a strong factor structure in test asset returns can give rise to misleading results in empirical work. If the risk factor has a small (but nonzero) correlation with the "true" factor, the cross-sectional R^2 could still be high, suggesting an impressive model fit. This is particularly problematic in small

[13]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).

cross-sections. Therefore, I expand the test assets to larger sets of test portfolios which include portfolios sorted by interest rate differential (Lustig et al., 2011), global volatility (Menkhoff et al., 2012a), 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 2025. The detailed construction methodology for the portfolios and corresponding risk factors is provided in the online Appendix. Since 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. When the test assets include the global cross-currency basis portfolios, this problem does not arise. Therefore, I follow the suggestion of Lewellen et al. (2010) to include the pricing factors as one of the test assets (Panel A of Table 3) and also exclude them (Panel B of Table 3). In this part of larger set of test assets test, I conduct asset pricing tests using GMM for three different SDF 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);[14] and (iii) a three-factor model that includes three risk factor 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. 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 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

[14]Due to violations of CIP condition, the carry trade portfolios sorted based 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.

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 support 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 quite well, both in swap and cash markets. Overall, these results support our hypothesis 1.

[Figure 2 about here]

Panel A of Table 3 presents the cross-sectional asset pricing results using a large set of test assets, including global cross-currency basis and carry trade portfolios. This setup effectively constrains the price of risk for HML_x and CAR to equal the mean return of their respective traded portfolios. The results are qualitatively consistent with those reported in Table 2. Specifically, the risk price estimate of λ_{HMLx} is positive and statistically significant at 0.40% and 0.32% per month (4.8% and 3.8% per annum) in the swap and cash market respectively, across all stochastic discount factor (SDF) specifications, regardless of whether the CAR factor is included. Furthermore, the HJ distance is statistically insignificant across all models, confirming a good model fit. These findings suggest that the global dollar funding risk proxied by the cross-currency basis is priced in the cross-section of currency returns, consistent with Hypothesis 1. It is also noteworthy that although λ_{CAR} is statistically significant when only DOL and CAR are included in the model, the explanatory power of CAR alone is limited, with a cross-sectional R^2 of only 36%. Once HML_X is added to the model, the significance of the CAR factor disappears, indicating that the pricing information in CAR is largely subsumed by HML_x. The cross-sectional R^2 rises to 53.3% in the two-factor SDF (DOL and HML_x) and only marginally increase to 53.5% in the three-factor model (DOL, CAR, and HML_x). This result supports Hypothesis 2, suggesting that the global cross-currency basis factor captures information about interest rate differentials and subsumes the traditional carry trade factor.

Panel B of Table 3 reports results excluding both carry trade and global cross-currency basis portfolios from the test assets, reducing the number of portfolios to 25. This specification provides an out-of-sample test of whether the pricing power of HML_x and CAR extends beyond the portfolios from which they are constructed. Following Corte et al. (2016), HML_x and CAR risk factors are included test assets to ensure arbitrage-free pricing. The results are qualitatively similar to those in Panel A: the significance of λ_{HML_x} remains robust across different SDF specifications, indicating that the pricing power of HML_x earlier recorded is not driven by its ability to price global basis and carry portfolios, but it extends to other currency portfolios. However, the significance of λ_{CAR} diminishes when global dollar funding risk factor is included. This result further confirms the conclusion that the global cross-currency basis factor contains independent pricing information, beyond nominal interest rate differentials, related to global dollar funding pressure, thus supporting Hypothesis 2.

These results demonstrate that the global cross-currency basis enters the regression with a statistically significant coefficient and the expected sign, consistent with the theoretical framework: a more negative basis is associated with lower interest rates and lower currency risk premia. In essence, the global cross-currency basis captures not only information related to interest rate differentials but also independent pricing information linked to dollar funding pressures. This finding highlights that deviations from CIP reflect systematic risk that is priced in the cross-section of currency returns.

[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 (i.e., insurance against global dollar funding risk) yields a significantly lower return than does buying currencies with a high beta (i.e., 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, using characteristic-sorted portfolios as test assets tends to bias asset pricing tests toward identifying risk factors constructed from the same characteristics used in portfolio formation (Harvey & Liu, 2021). Moreover, 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.

Table 5 presents the results of the country-level cross-sectional asset pricing tests. Despite variation in estimated factor loadings across individual currencies, 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 OA2 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

As documented by studies such as Du et al. (2018) and Cerutti et al. (2021), the CIP condition held closely prior to the GFC, with only negligible and short-lived deviations among G10 currencies. Significant and persistent CIP deviations emerged only in the post-GFC period. 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 exhibits structural shifts around the GFC. 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 September 2009 to January 2025. Within each subperiod, I sort currencies into five portfolios based on their exposure to the cross-currency basis, following the portfolio formation procedure described earlier.

Table 6 presents summary statistics for each currency portfolios across the two subperiods. Prior to the crisis, the average cross-currency basis was relatively narrow at –5.5 bps, with a standard deviation of 9.39%. In contrast, post-crisis basis spreads widened substantially to –27.39 bps on average, with a standard deviation of 26.29%. Notably, both the forward discount and nominal interest rate differential exhibit monotonic increases across basis-sorted portfolios in both periods, suggesting that fluctuations in cross-currency basis are closely aligned with nominal rate differentials, consistent with the findings of Du et al. (2018); Du & Schreger (2022).

In the pre-GFC period, the excess returns and Sharpe ratios in both forward and cash markets generally increase from $P1$ (most negative basis) to $P3$ (near-zero basis), but decline thereafter. This non-monotonic pattern results in a positive but statistically insignificant high-minus-low (HML) spread, with t-statistics of 1.29 and 1.16 in swap and cash markets, respectively. The relationship between basis and external imbalances is not linear either. At first glance, this appears inconsistent with the hypothesis that dollar funding pressure risk is priced in currency returns. However, as elaborated in the theoretical section, prior to the crisis, the supply of dollar liquidity was effectively elastic, and the market did not exhibit persistent dollar scarcity, so the CIP deviation is only short-lived and small in magnitude, largely reflecting transient microstructure noise rather than hedge demand driven by external imbalances. As a result, dollar funding pressure did not translate into a significant risk premium.

In contrast, during the post-GFC period, the overall results remain qualitatively consistent 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 3 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 3 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 various currency portfolios sorted by interest rate differentials, cross-currency basis, global volatility, currency value, short-term momentum, and net foreign asset ratios as test assets. Panel B presents results of using country-level individual currency excess returns as test assets directly. Note that following the suggestions of Lewellen et al. (2010), I include risk factors in test assets to ensure that the point estimates of factor prices equal to the expected returns of tradable factors. 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 post-crisis 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, i.e.,), 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, these findings highlight that the pricing power of the basis factor is primarily driven by the post-GFC period. Only after the crisis does it emerge as a significant and systematically priced risk component and is able to absorb the pricing power of traditional carry trade, reflecting heightened investor awareness of structural imbalances between dollar hedge demand and liquidity provision, driven by rising balance sheet costs under a tighter regulatory regime. In this environment, currencies more exposed to funding pressures earn higher risk premia, consistent with theoretical predictions.

[Table 7 about here]

5 Dollar Funding Risk and Other Risk Factors

This section focuses on a comprehensive comparative analysis between HML_x and a set of well-established SDF in the FX literature. In particular, I evaluate whether HML_x captures systematic variation in currency excess returns beyond that explained by established SDFs in the FX literature. In particular, I test hypothesis 2 by examining the theoretically-related CAR factor of Lustig et al. (2011) and the global imbalance factors (IMB) of Corte et al. (2016).

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

As outlined in the theoretical framework of Liao & Zhang (2025), the cross-currency basis embeds overlapping information on a country's nominal interest rates and reflects hedge demand pressures driven by external imbalances. Empirically, Table 1 shows that sorting currencies by their basis yields portfolios with systematically increasing interest rate differentials (or forward discounts) and decreasing net external imbalances. This pattern raises some important questions: Does HML_x capture distinct sources of economic risk beyond those accounted for by traditional carry trade and global imbalance strategies, which primarily reflect interest rate differentials and global imbalances in capital flows and international trades, respectively? Is HML_x a novel risk factor that is not spanned by existing risk factors?

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 based 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) (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).[15] The construction details of each factor (or corresponding factor-mimicking portfolios) are pro-

[15]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 post-crisis correlation drops to 0.97.

vided 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.[16] 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 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 (i.e., 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 Spanning Tests

Next, I conduct spanning tests by regressing the HML_x factor on the risk factors with a significant correlation with HML_x along with a constant term; in an additional regression, I also control for the three-month lag of the dependent variable to account for potential serial correlation in the basis factor, as CIP deviations exhibit strong quarter-end effects (Du et al., 2018). The results from both regression specifications in full sample and post-GFC periods are reported in Table 9. Results indicate that only two carry trade and external imbalance risk factors play a significant role in explaining HML_x, as evidenced by statistically significant slope coefficients (β). However, their R^2 values are all below 45% and the beta coefficients are far from one. Besides, constant terms (α) of HML_x are positive and significantly different from zero in all specifications, with the only exception of NDT yielding an insignificant alpha but still with a relatively low R^2 less

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

than 40%. This result implies that the basis factor is very unlikely to be fully explained by external imbalances or interest rate differentials.

[Table 9 about here]

5.3 Horse Races

5.3.1 Dollar Funding Factor vs. External Imbalances Factor

Following theoretical predictions, I have shown that HML_x is significantly correlated with both the carry trade and external imbalance risk factors but is unlikely to be fully spanned by them. In Section 3, I have demonstrated that HML_x is a priced risk factor over the full sample period and absorbs the explanatory power of the traditional carry trade factor, particularly in the post-crisis period. Since dollar funding risk is primarily driven by hedging demand, which is largely determined by external imbalances, this subsection tests whether HML_x provides incremental pricing power beyond existing external imbalance portfolios. Table 10 presents two sets of SDF specifications. The first set includes the risk factors DOL, CAR, and one of the external imbalances measures, either IMB, NDT or NFA. The second set augments these models by adding HML_x. Panel A reports results for the full sample, while Panel B focuses on the post-crisis period. The test assets are currency portfolios as previously described.

Overall, including HML_x significantly improves R^2 values by at least 13% across all specifications, in both the full sample and post-crisis period, indicating a substantial incremental pricing power beyond not only CAR but also various proxies for external imbalances. In Panel A, for the full sample period, λ_{HML_x} is economically meaningful at 0.37% per month, remains stable in magnitude, and is consistently significant across all specifications. Another important finding is that, when HML_x is excluded, CAR remains consistently significant across all specifications that include any one of the three external imbalance proxies, and NFA is also significantly priced. However, both both CAR and NFA lose their pricing power entirely, once HML_x is included, while NDT and IMB remain consistently insignificant.

In Panel B, the estimate for λ_{HMLx} remains qualitatively similar to the full sample result, at 0.39% per month (4.7% per annum) across all specifications. However, it is insignificantly priced when using IMB as an external imbalance proxy and only weakly significant when using NDT. This does not imply, however, that the pricing power of HML_x is absorbed by IMB, NDT, or CAR, as none of these factors are significant. These results may be partially attributable to the smaller post-crisis sample size, but are more likely driven by the use of currency portfolios as test assets. As discussed earlier, Ang et al. (2020) highlight that while using currency portfolios as test assets reduces idiosyncratic volatility and enables more precise estimation of factor loadings and risk premia, it also destroys the information by shrinking the dispersion of betas and increasing standard errors. Thus, a trade-off exists between precise point estimates and the efficiency of standard errors. To mitigate this issue, I follow Lewellen et al. (2010) and additionally include the risk factors when using country-level individual currency excess returns as test assets. The results, reported in the online Appendix, show that the point estimates of λ_{HMLx}, range from 0.36% to 0.41% per month, are qualitatively similar to the currency portfolio results, but the estimated standard errors decrease substantially in the post-crisis period. This leads to significant estimates of λ_{HMLx}, while other factors remain insignificant. The R^2 values of model specifications also increase significantly by nearly 20% with the inclusion of HML_x, consistent with currency portfolios results. The asset pricing results on the cash market are reported in the online Appendix, delivering similar results with swap markets.

To summarize, there are two key takeaways. First, HML_x provides significant incremental pricing power beyond both carry trade and external imbalances and is economically distinct from them, in both the full sample and post-crisis period. Second, the pricing power of HML_x cannot be subsumed by carry or any proxy of external imbalances; rather, the inclusion of HML_x renders the pricing of carry and external imbalances factors insignificant. These conclusions support my hypothesis 2.

[Table 10 about here]

5.3.2 The Pricing Power of Basis Factor in Postcrisis Period

To further assess the pricing power of the cross-currency basis risk factor HML_x and the traditional carry trade factor in the postcrisis period, Table 11 presents the results of GMM cross-sectional asset pricing tests for two distinct model specifications. Panel A includes risk factors DOL and HML_x, with an additional control of various well-established SDF(s) from the literature, while Panel B reports the results of a model with the currency market factor, the traditional carry trade factor (CAR), and the same set of control SDFs as in Panel A.[17] The additional SDF controls include: the business cycle gap (GAP), low-frequency FX liquidity (IML), short-term momentum (MOM3), long-term momentum (MOM12), net foreign asset position (NFA), TED spread (TED),

[17]Since the two carry trade factors based on forward discount and interest rate differential yield qualitatively identical results, only CAR is included for parsimony in the analysis.

term spread (TER), currency value (VAL), and global volatility (VOL). [18]

There are two key findings in this table. First, the results in Panel A show that the model incorporating HML_x delivers significantly higher R^2 values, typically exceeding 85%, compared to the model in Panel B, which uses CAR as a risk factor. The R^2 values in Panel B are generally in the range of 40% to 60%, suggesting that the HML_x offers superior explanatory power in accounting for the cross-sectional variation in currency excess returns. Second, the estimated risk price associated with HML_x is consistently statistically significant for all specifications, providing strong evidence that basis risk is systematically priced in the postcrisis FX markets, even when controlling for other common risk factors. In contrast, the models based on the CAR factor yield insignificant factor loadings and factor prices, reinforcing the conclusion that the carry factor has lost its pricing power following the crisis.

Taken together, the results presented thus far highlight a substantial post-crisis failure of the traditional carry trade factor, which was once a central risk factor to asset pricing in the foreign exchange market. In contrast, after the financial crisis, the cross-currency basis factor HML_x is systematically priced in the cross-sectional currency premia and serves as a good replacement for the carry trade factor, in terms of its superior pricing power in explaining over 80% of the variation in cross-sectional currency returns. Furthermore, we show that, while HML_x shares common information with interest rate differentials and global imbalances in capital flows and international trade, it also captures unique information beyond these variables. The HML_x portfolio generates exceptional excess returns, and these returns cannot be spanned by existing common FX risk factors, confirming the distinct role of basis factor in the postcrisis period.

[Table 11 about here]

6 Conclusion

This paper investigates the asset pricing implications of the cross-currency basis as a measure of dollar funding pressure in global FX markets. Empirically, I show that the basis risk factor is significantly priced in the cross-section of currency excess returns by generating an annual risk premium of approximately 4%, particularly in the post-crisis period. The basis factor explains a substantial portion of the variation in currency risk

[18] The global imbalance portfolio (IMB) excluded for two reasons: first, the underlying LDC data, which serves as the foundation for constructing the IMB, is not updated beyond December 2017, limiting its applicability for the postcrisis period under study; second, GMM tests conducted for the post-crisis period, incorporating the IMB factor from August 2009 to December 2017, yielded results that were qualitatively similar to those obtained with the net foreign asset (NFA) factor.

premia across both forward and cash markets and subsumes the explanatory power of established FX risk factors, including carry trade, external imbalances, and liquidity-based factors. These findings highlight the importance of incorporating dollar funding risk into global currency pricing models and suggest that the cross-currency basis is a key indicator of global funding pressures. By linking market-based measures of the basis to external imbalances and financial intermediary constraints, this paper provides new insights into the pricing of global currency risk premia in a post-crisis world.

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Figures and Tables

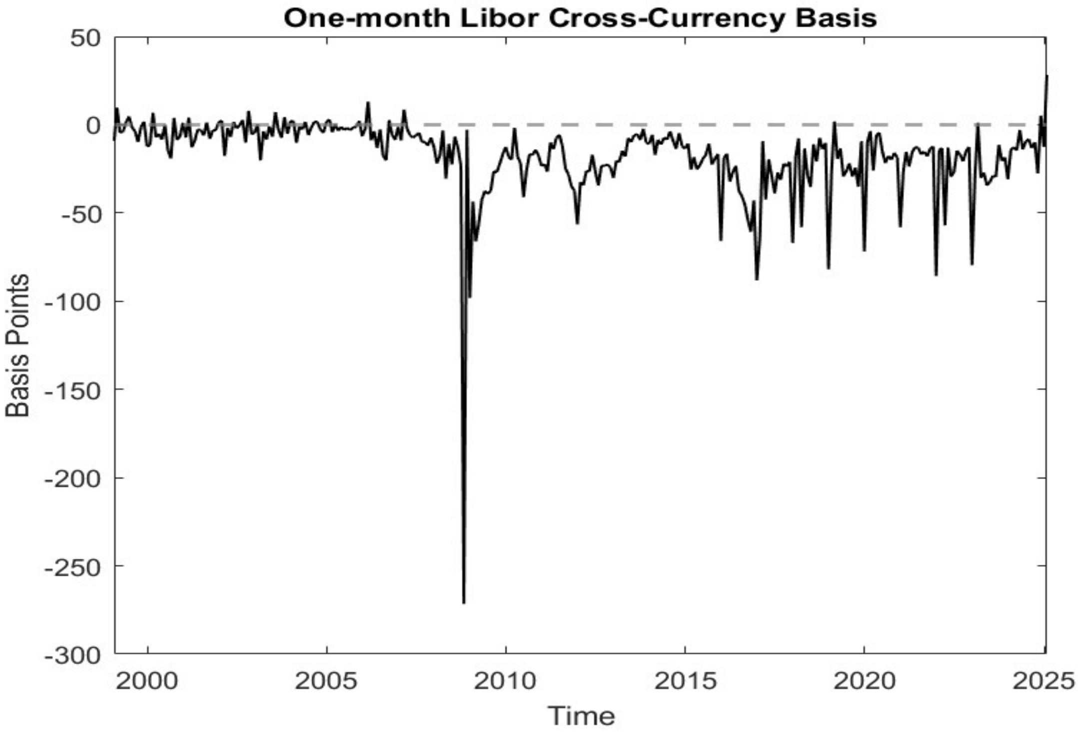

Figure 1: **Average Short-Term Libor-Based Deviations from Covered Interest Rate Parity (CIP).** This figure plots the equally-weighted average one-month Libor cross-currency basis for G10 currencies, measured in basis points. One-hundred basis points equal one percent. The Libor basis is equal to $x_{t,t+n} = y^{\$,Libor}_{t,t+n} - (y^{Libor}_{t,t+n} - \rho_{t,t+n})$, where n = one month, $y^{\$,Libor}_{t,t+n}$ and $y^{Libor}_{t,t+n}$ 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 01/1999 to 01/2025.

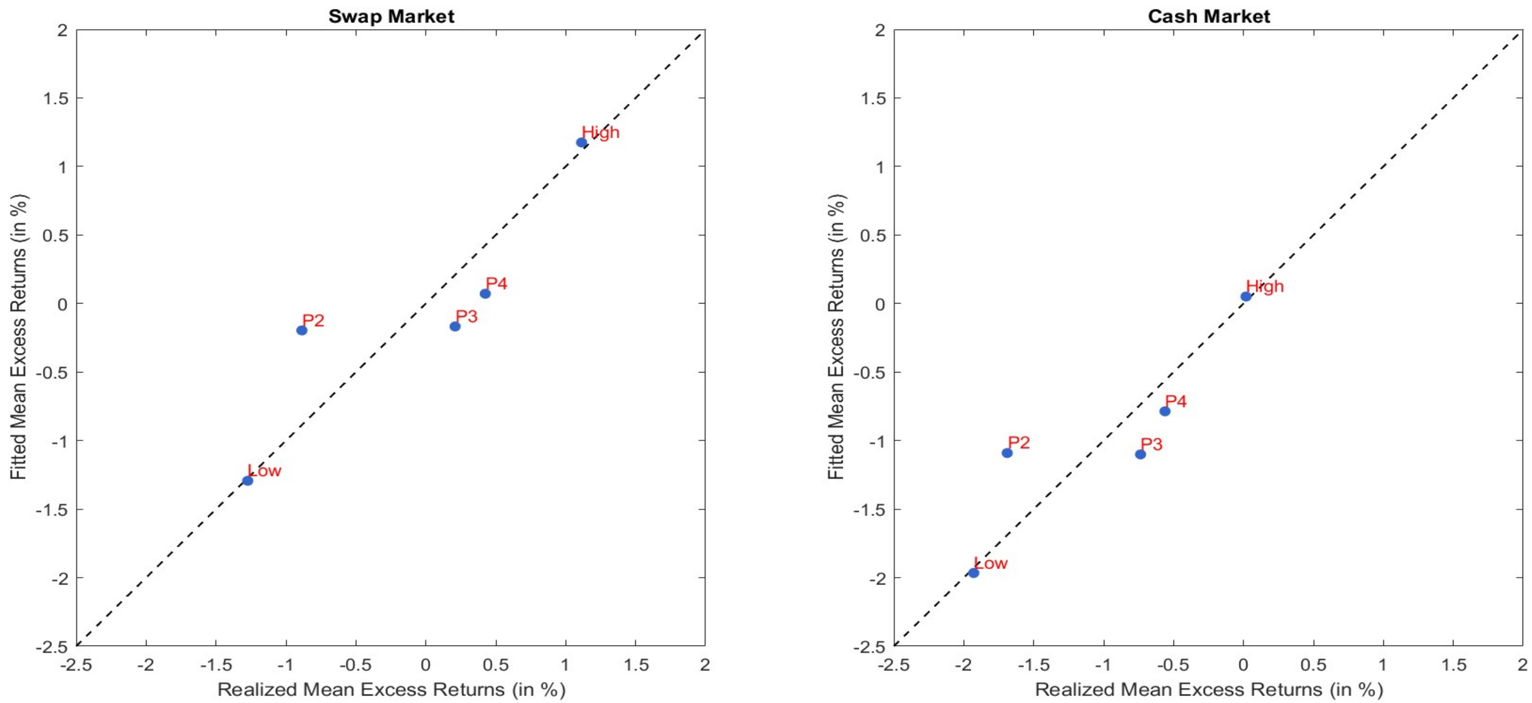

Figure 2: **Pricing Error Plots.** The figure presents the pricing errors from a cross-sectional asset pricing model estimated at the portfolio level, where the cross-currency basis and the dollar factor serve as common risk factors. The x-axis depicts the realized mean excess returns, while the y-axis 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 01/1999 to 01/2025.

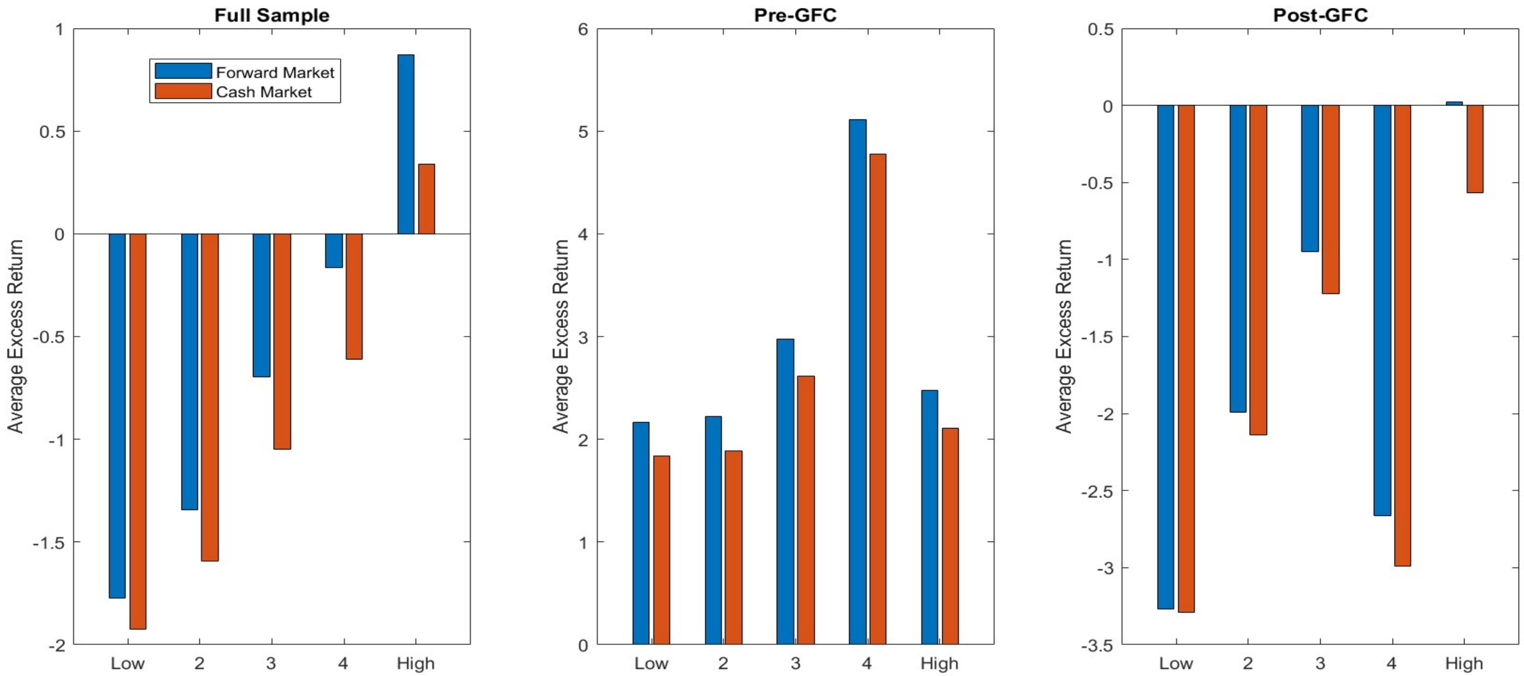

Figure 3: **Pre and post GFC Average Excess Returns and Cross-Currency Basis** The figure reports the mean excess returns of currency portfolios sorted by the cross-currency basis, categorized into quintiles based on the distribution of the basis across the sample. The x-axis in each panel represents 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 Jan 1999 to Jan 2025. Panel (b) displays results for precrisis period from Jan 1999 to Aug 2008. Panel (c) displays results for postcrisis period from Sept 2009 to Jan 2025.

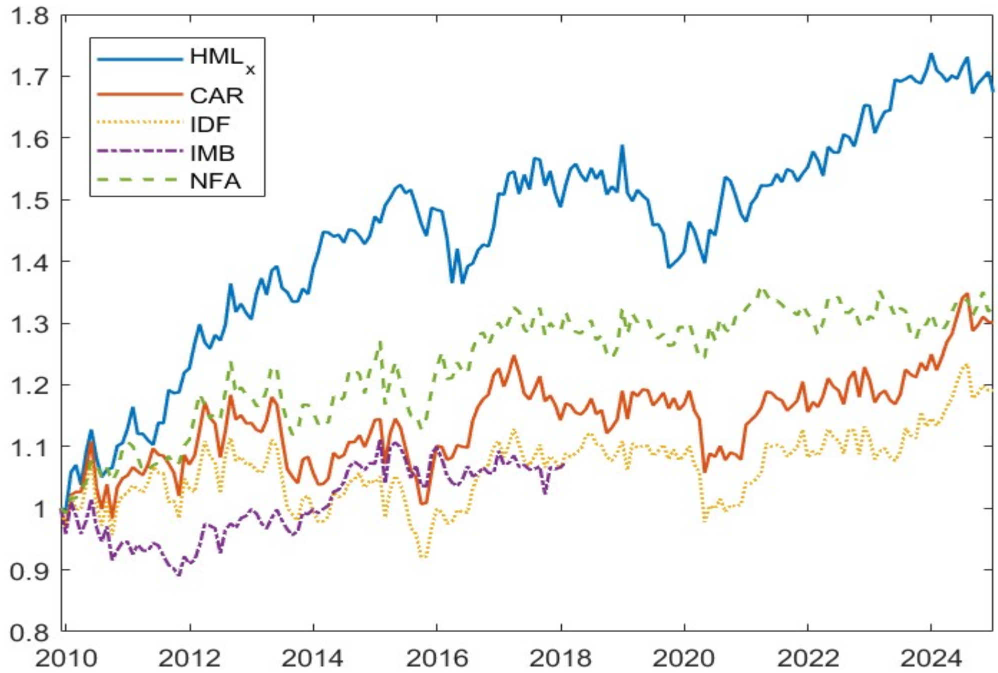

Figure 4: **Cumulative Excess Returns of Currency Investment Strategies** This figure plots the cumulative monthly returns of different currency investment portfolios in percent. I consider six investment strategies: cross-currency basis (HML_x), carry based on forward discount (CAR), carry based on interest rate differential (IDF), global imbalance trade and capital flows (IMB) and net foreign assets (NFA). See Internet Appendix for a detailed description of the strategies. The sample spans the Dec 2009 to Jan 2025 period at a monthly frequency.

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 01/1999–01/2025.

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 excess returns to 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 HJ 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. The sample includes G10 currencies and the sample period is from January 1999 to January 2025.

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
lambda	-0.01	0.28			lambda	-0.08	0.21		
s.e.	0.13	0.12			s.e.	0.14	0.12		
FMB	DOL	HML_x	x2̂ SH	x2̂ NW	FMB	DOL	HML_x	x2̂ SH	x2̂ NW
lambda	-0.01	0.28	0.61	0.60	lambda	-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				
Porfolio	α	DOL	HML_x	R^2	Porfolio	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: Cross-Sectional Asset Pricing Tests: Currency Strategies

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 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 2025. 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. Panel A employs 30 portfolios as test assets with the sample from Jan 1999 to Jan 2025. Panel B employs 20 portfolios as test assets with the same sample, as we exclude the five carry trade and five global cross-currency basis portfolios.

Panel A: Including carry trade and global cross-currency basis portfolios as test assets											
Forward Market						Cash Market					
GMM	DOL	HML_x	CAR	R$\hat{2}$	HJ dist	GMM	DOL	HML_x	CAR	R$\hat{2}$	HJ dist
b	-0.02	0.09		53.33%	0.27	b	-0.03	0.07		59.13%	0.26
s.e.	0.03	0.03			0.91	s.e.	0.02	0.03			0.86
lambda	-0.01	0.40				lambda	-0.08	0.32			
s.e.	0.13	0.15				s.e.	0.14	0.15			
b	-0.02		0.05	36.61%	0.27	b	-0.03		0.04	49.05%	0.25
s.e.	0.03		0.03		0.80	s.e.	0.03		0.03		0.81
lambda	-0.01		0.32			lambda	-0.08		0.24		
s.e.	0.13		0.17			s.e.	0.14		0.17		
b	-0.02	0.08	0.01	53.55%	0.27	b	-0.03	0.06	0.01	59.52%	0.25
s.e.	0.03	0.05	0.04		0.76	s.e.	0.03	0.04	0.04		0.94
lambda	-0.01	0.38	0.25			lambda	-0.08	0.30	0.19		
s.e.	0.13	0.16	0.18			s.e.	0.14	0.15	0.18		
Panel B: Excluding carry trade and global cross-currency basis portfolios as test assets											
Forward Market						Cash Market					
GMM	DOL	HML_x	CAR	R$\hat{2}$	HJ dist	GMM	DOL	HML_x	CAR	R$\hat{2}$	HJ dist
b	-0.02	0.08		60.81%	0.26	b	-0.03	0.07		66.60%	0.22
s.e.	0.03	0.03			0.69	s.e.	0.02	0.03			0.81
lambda	0.00	0.37				lambda	-0.08	0.30			
s.e.	0.14	0.14				s.e.	0.14	0.14			
b	-0.02		0.05	49.37%	0.26	b	-0.04		0.05	61.61%	0.22
s.e.	0.03		0.03		0.47	s.e.	0.03		0.03		0.88
lambda	-0.01		0.34			lambda	-0.08		0.27		
s.e.	0.14		0.16			s.e.	0.14		0.16		
b	-0.02	0.06	0.02	63.37%	0.25	b	-0.03	0.05	0.02	69.48%	0.21
s.e.	0.03	0.04	0.03		0.78	s.e.	0.03	0.04	0.03		0.91
lambda	-0.01	0.32	0.27			lambda	-0.08	0.25	0.22		
s.e.	0.13	0.13	0.16			s.e.	0.14	0.13	0.17		

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 βs. $P5$ contains currencies with the highest βs. 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. For excess returns, the table also reports 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 2025.

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 HJ 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 report 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. The sample includes G10 currencies and the sample period is from January 1999 to January 2025.

Panel A: Factor Prices									
Forward Market					Cash Market				
GMM	DOL	HML_x	R2̂	HJ dist	GMM	DOL	HML_x	R2̂	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
lambda	-0.01	0.88			lambda	-0.08	0.60		
s.e.	0.13	0.39			s.e.	0.14	0.26		
FMB	DOL	HML_x	x2̂ SH	x2̂ NW	FMB	DOL	HML_x	x2̂ SH	x2̂ NW
lambda	-0.01	0.88	3.05	3.13	lambda	-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	\alpha	DOL	HML_X	R2̂	Porfolio	\alpha	DOL	HML_X	R2̂
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 01/1999 to 01/2025 into two subsamples based on the global financial crisis in 2008 where Panel A reports statistics of the sample period from 01/1999–08/2008 (pre-GFC) and the Panel B reports the results of the sample period from 09/2009 to 01/2025 (post-GFC).

Panel A: Pre-Global Financial Crisis (2008)

Portfolio	1	2	3	4	5	HML	Avg.
Cross-currency basis							
Mean	-22.70	-10.42	-5.17	0.37	10.44	33.14	-5.50
SD	14.93	10.99	9.30	8.23	10.82	15.88	9.39
Excess returns on forward markets							
Mean	0.49	2.63	5.72	2.56	3.54	3.05	2.99
t-statistics	0.17	0.84	2.21	0.86	1.27	1.29	1.15
SD	7.83	9.23	8.02	7.74	8.24	7.73	7.13
Sharp ratio	0.06	0.29	0.71	0.33	0.43	0.39	0.42
Excess returns on cash markets							
Mean	0.28	2.27	5.42	2.20	3.04	2.76	2.64
t-statistics	0.10	0.72	2.11	0.74	1.09	1.16	1.02
SD	7.84	9.20	7.94	7.72	8.23	7.76	7.10
Sharp ratio	0.04	0.25	0.68	0.28	0.37	0.36	0.37
Spot change							
Mean	-1.64	-2.72	-5.74	-2.33	-2.71	-1.08	-3.03
SD	0.02	0.03	0.02	0.02	0.02	0.02	0.02
Forward discount (f-s)							
Mean	-1.15	-0.09	-0.02	0.23	0.83	1.98	-0.04
SD	2.34	2.01	1.72	1.71	2.34	3.27	1.51
Interest rate differential							
Mean	-0.91	0.03	0.05	0.25	0.75	1.65	0.04
SD	2.31	1.97	1.69	1.67	2.29	3.22	1.47
Net foreign assets ratio (nfa)							
Mean	5.94	-5.54	-4.11	-8.68	5.49	-0.45	-1.38
SD	33.50	32.86	32.09	29.91	46.05	70.05	3.69
USD net debt holding ratio (ndt)							
Mean	5.26	-1.87	-2.29	-3.30	4.68	-0.58	0.50
SD	12.46	11.77	11.40	11.48	14.41	24.20	3.36

Panel B: Post-Global Financial Crisis (2008)

Portfolio	1	2	3	4	5	HML	Avg.
Cross-currency basis							
Mean	-58.96	-38.93	-27.05	-16.14	4.14	63.11	-27.39
SD	45.72	35.42	25.50	21.46	17.05	44.10	26.29
Excess returns on forward markets							
Mean	-3.66	-3.32	-2.46	-2.99	0.26	3.92	-2.43
t-statistics	-1.62	-1.44	-0.96	-1.43	0.10	2.18	-1.17
SD	9.12	9.11	9.62	10.29	10.67	7.55	8.64
Sharp ratio	-0.40	-0.36	-0.26	-0.29	0.02	0.52	-0.28
Excess returns on cash markets(without b-a)							
Mean	-3.71	-3.52	-2.79	-3.49	-0.36	3.34	-2.78
t-statistics	-1.63	-1.51	-1.08	-1.65	-0.15	1.84	-1.32
SD	9.19	9.19	9.68	10.39	10.72	7.61	8.70
Sharp ratio	-0.40	-0.38	-0.29	-0.34	-0.03	0.44	-0.32
Spot change							
Mean	2.77	2.62	1.97	2.63	0.44	-2.33	2.08
SD	0.03	0.03	0.03	0.03	0.03	0.02	0.02
Forward discount (f-s)							
Mean	-0.97	-0.74	-0.50	-0.35	0.77	1.74	-0.36
SD	1.47	1.38	1.25	1.31	1.71	1.60	1.19
Interest rate differential							
Mean	-0.39	-0.35	-0.22	-0.19	0.73	1.12	-0.08
SD	1.42	1.28	1.24	1.28	1.66	1.46	1.16
Net foreign assets ratio (nfa)							
Mean	43.52	41.03	40.63	33.76	-27.72	-71.24	26.24
SD	30.28	47.47	51.36	59.18	54.33	67.00	13.45
USD net debt holding ratio (ndt)							
Mean	13.58	14.03	14.73	15.59	-12.19	-25.76	9.15
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 report the test results using country-level individual currency excess returns as test assets. Note that I also include risk factor to ensure that the point estimate of factor price equal 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. The full sample period is from Jan 1999 to Jan 2025. The post-Global Financial Crisis (GFC) period refers to the period from Aug 2009 to Jan 2025.

Panel A: Currency portfolios as test assets

Pre-Global Financial Crisis

	Swap Market					Cash Market				
GMM	DOL	HML_x	CAR	$R\hat{2}$	HJ dist	DOL	HML_x	CAR	$R\hat{2}$	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
lambda	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
lambda	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
lambda	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	$R\hat{2}$	HJ dist	DOL	HML_x	CAR	$R\hat{2}$	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
lambda	-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
lambda	-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
lambda	-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	$R\hat{2}$	HJ dist	DOL	HML_x	CAR	$R\hat{2}$	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
lambda	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
lambda	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
lambda	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	$R\hat{2}$	HJ dist	DOL	HML_x	CAR	$R\hat{2}$	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
lambda	-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
lambda	-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
lambda	-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 based 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) (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 full period from Jan 1999 to Jan 2025. *, **, *** denotes significant correlations at the 90%, 95%, and 99% levels, respectively.

	HML_x	CAR	FDS	GAP	IMB	IML	$MOM3$	$MOM12$	NFA	NDT	TER	VAL	VIX	VOL
HML_x	1.00													
CAR	0.52 ***	1.00												
FDS	0.56 ***	0.98 ***	1.00											
GAP	-0.09	-0.15 **	-0.14 **	1.00										
IMB	0.51 ***	0.78 ***	0.78 ***	-0.01	1.00									
IML	-0.14 **	-0.10	-0.11 *	0.09	-0.08	1.00								
MOM3	-0.00	-0.21 ***	-0.19 ***	0.18 ***	-0.19 ***	-0.05	1.00							
MOM12	0.02	-0.14 **	-0.13 **	-0.11 *	-0.23 ***	-0.01	0.43 ***	1.00						
NDT	0.47 ***	0.87 ***	0.87 ***	-0.10	0.77 ***	-0.17 ***	-0.14 **	-0.16 ***	1.00					
NFA	0.36 ***	0.71 ***	0.73 ***	-0.09	0.58 ***	-0.11 *	-0.08	-0.09	0.80 ***	1.00				
TER	0.32 ***	0.46 ***	0.47 ***	-0.32 ***	0.29 ***	-0.14 **	0.09	0.15 **	0.41 ***	0.39 ***	1.00			
VAL	0.11 *	0.13 **	0.12 **	-0.23 ***	0.04	-0.34 ***	-0.00	0.12 **	0.06	-0.05	0.31 ***	1.00		
VIX	-0.02	-0.19 ***	-0.16 ***	0.01	-0.18 ***	-0.08	0.10 *	0.02	-0.11 *	-0.05	0.08	-0.00	1.00	
VOL	0.10	0.14 **	0.14 **	0.08	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 based 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) (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). 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 termss. The sample includes G10 currencies, covering the full sample period from Jan 1999 to Jan 2025 (Panel A) and postcrisis period from Aug 2009 to Jan 2025 (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	0.10	0.22	0.24	0.29	0.29
se	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
se	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
se	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
se	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
se	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
se	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
se	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
se	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
se	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
se	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: Asset Pricing using 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 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. The portfolios are rebalanced monthly. Panel A presents results for the full sample spanning from Jan 1999 to Jan 2025 (from Jan 1999 to Dec 2020 for IMB and NDT portfolios due to data availability). Panel B summarizes results for the postcrisis period spanning from Aug 2009 to Jan 2025 (from Aug 2009 to Dec 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
se	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
se	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
se	0.03	0.10		0.10			0.15	0.19		0.22				(0.82)
coeff.	0.00	-0.01		0.02		0.07	0.08	0.27		0.28		0.37	68.87%	0.25
se	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
se	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
se	-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
se	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
se	0.04	0.06	0.06			0.06	0.24	0.29	0.37			0.33		(0.69)
coeff.	-0.03	-0.04		0.12			0.03	0.29		0.43			52.92%	0.26
se	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
se	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
se	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
se	-0.05	-0.01			0.07	0.05	-0.10	0.24			0.16	0.17		(0.88)

Table 11: Cross-sectional Asset Pricing Results: HML_x and Other Factors (post-GFC)

The table reports cross-sectional pricing results for the two groups of linear factor model specifications. In the first group, we include the dollar risk factor (DOL), cross-currency basis risk (HML_x), and different SDFs and the results are reported in the Panle A. For the second group, we include the dollar risk factor (DOL), carry factor based on the forward discount (CAR) and different SDFs and the results are reported in Panel B, where SDFs includes: business gap (GAP) (Colacito et al., 2020), 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), TED spread (TED) (Menkhoff et al., 2012a), term-spread (TER) (Ang & Chen, 2010; Lustig et al., 2019), currency value (VAL) (Asness et al., 2013; Menkhoff et al., 2017), and global volatility (VOL) (Menkhoff et al., 2012a). We use first-stage GMM. Standard errors of estimated coefficients are reported below each estimate and are obtained by the Newey and West (1987) procedure with an optimal lag selection according to Andrews (1991). The factor loadings (beta coefficients) of different SDF factors are denoted as β_x, and their respective factor prices are denoted as λ_x. We also report the cross-sectional R-square and the HJ distance (HJ-dist) along with the simulated p-value for the test of whether the HJ distance is equal to zero in parenthesis. Excess returns in G10 countries used as test assets. The sample includes G10 currencies, covering the postcrisis period from Aug 2009 to Jan 2025.

Panel A: Cross-Currency Basis Risk Factor and other SDF (post-GFC)

	β_{DOL}	β_{HML_x}	β_x	λ_{DOL}	λ_{HML_x}	λ_x	R-square	HJ-dist
GAP	-0.07	0.13	-0.12	-0.16	0.51	-0.45	95.00%	0.21
	0.04	0.07	0.12	0.17	0.24	0.43		(0.68)
IML	-0.06	0.15	-0.03	-0.16	0.55	-0.10	84.44%	0.25
	0.04	0.06	0.15	0.17	0.26	1.31		(0.37)
MOM3	-0.06	0.16	0.33	-0.16	0.58	0.15	89.02%	0.25
	0.04	0.07	0.53	0.17	0.25	0.24		(0.38)
MOM12	-0.06	0.12	0.37	-0.16	0.51	0.20	91.98%	0.23
	0.04	0.09	0.57	0.17	0.27	0.25		(0.51)
NFA	-0.06	0.16	0.00	-0.16	0.58	0.20	84.04%	0.26
	0.03	0.09	0.06	0.17	0.27	0.15		(0.36)
TED	-0.02	0.12	2.98	-0.17	0.61	0.16	95.32%	0.26
	0.05	0.08	2.86	0.17	0.28	0.18		(0.34)
TER	-0.06	0.15	0.02	-0.16	0.56	0.10	84.41%	0.25
	0.04	0.07	0.09	0.17	0.24	0.48		(0.38)
VAL	-0.07	0.17	0.05	-0.17	0.59	-0.09	85.12%	0.25
	0.06	0.09	0.15	0.17	0.26	0.26		(0.40)
VOL	-0.08	0.16	0.17	-0.16	0.66	0.92	86.78%	0.27
	0.05	0.08	0.35	0.17	0.35	1.83		(0.37)

Panel B: Carry Trade Factor and other SDF (post-GFC)

	β_{DOL}	β_{CAR}	β_x	λ_{DOL}	λ_{CAR}	λ_x	R-square	HJ-dist
GAP	-0.08	0.05	-0.15	-0.16	0.38	-0.61	59.61%	0.21
	0.04	0.04	0.12	0.17	0.22	0.44		(0.67)
IML	-0.08	0.08	-0.14	-0.17	0.28	-1.11	53.10%	0.23
	0.05	0.04	0.17	0.17	0.21	1.42		(0.69)
MOM3	-0.06	0.07	0.11	-0.16	0.32	0.06	41.39%	0.26
	0.04	0.04	0.50	0.17	0.20	0.23		(0.28)
MOM12	-0.05	0.04	0.64	-0.16	0.34	0.31	67.04%	0.23
	0.04	0.05	0.54	0.17	0.22	0.24		(0.54)
NFA	-0.06	0.06	0.01	-0.16	0.30	0.21	41.34%	0.26
	0.04	0.06	0.07	0.17	0.21	0.15		(0.29)
TED	-0.01	0.05	4.19	-0.17	0.22	0.22	62.96%	0.27
	0.06	0.06	3.44	0.18	0.26	0.22		(0.23)
TER	-0.06	0.09	-0.08	-0.16	0.24	-0.25	47.63%	0.27
	0.04	0.05	0.12	0.17	0.21	0.58		(0.25)
VAL	-0.03	0.06	-0.12	-0.16	0.24	-0.28	52.40%	0.27
	0.05	0.04	0.12	0.17	0.22	0.23		(0.23)
VOL	-0.04	0.07	-0.14	-0.16	0.31	-0.75	43.01%	0.25
	0.06	0.04	0.33	0.17	0.21	1.73		(0.43)

Appendix

A. Theoretical Proof

Supply side: 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:

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

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

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

Rearranging the equation and normalizing the exchange rates by dividing the initial values $S1$, we can obtain the final form as shown in the main text equation (4):

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

Demand side: 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:

$$\max_{q^i} \sum x^i q^i + G\left(W - \kappa \sum_i H(q^i)\right), \tag{A4}$$

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 as equation 6 in the main text:

$$\frac{\partial}{\partial q}\left(\sum xq + G\left(W - \kappa \sum H(q)\right)\right) = x - G'\left(W - \kappa \sum_j H(q^j)\right)(-\kappa H'(q)) = 0,$$

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

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}:

$$E\left\{[1 - b'(\Phi_{t+1} - \mu)]Rx^j_{t+1}\right\} = 0. \tag{A5}$$

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

$$g(z_t, \theta) = \begin{bmatrix} [1 - b'(\Phi_t - \mu)]Rx_t \\ \Phi_t - \mu \\ \text{vec}((\Phi_t - \mu)(\Phi_t - \mu)') - \text{vec}(\Sigma_{\Phi\Phi}) \end{bmatrix}, \tag{A6}$$

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 (A6), 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 (i.e., 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, i.e., $GAP_{t-1} - GAP_{t-1}^{US}$. $P5$ 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 Jan 1999 to Jan 2025. 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 Jan 1999 to Jan 2025. 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 Dec 2020, so the IMB portfolio returns run from Jan 1999 to Dec 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 based 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 based 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 2025. 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 extends from February 2000 to January 2025. 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, i.e., those with the highest NFA to GDP ratios, whereas $P5$ includes debtor currencies, i.e., 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 Jan 1999 to

Jan 2025.

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, i.e., those with the highest ndt, whereas $P5$ includes dollar debtor currencies, i.e., those with the lowest ndt. Portfolios are rebalanced monthly, and the sample is quarterly data covering the period from Jan 1999 to Dec 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 Jan 1999 to Jan 2025. 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 Jan 1994 to Jan 2025. 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 Jan 1999 to Jan

2025.

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 analysis, transaction costs are not considered due to the unavailability of bid and ask quotes for risk-free rates in cash markets. However, bid and ask exchange rates in swap markets can be easily collected, allowing a robustness check that incorporates transaction costs. By accounting for bid-ask spreads in both spot and forward contracts, I compute the realized currency excess returns net of transaction costs. Specifically, in the swap market, the net log excess return for an investor who takes a long position in the foreign currency is given by:

$$rx^l_{t+1} = f^b_t - s^a_{t+1}. \tag{A7}$$

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:

$$rx^s_{t+1} = -f^a_t + s^b_{t+1} \tag{A8}$$

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.

E. Figures and Tables

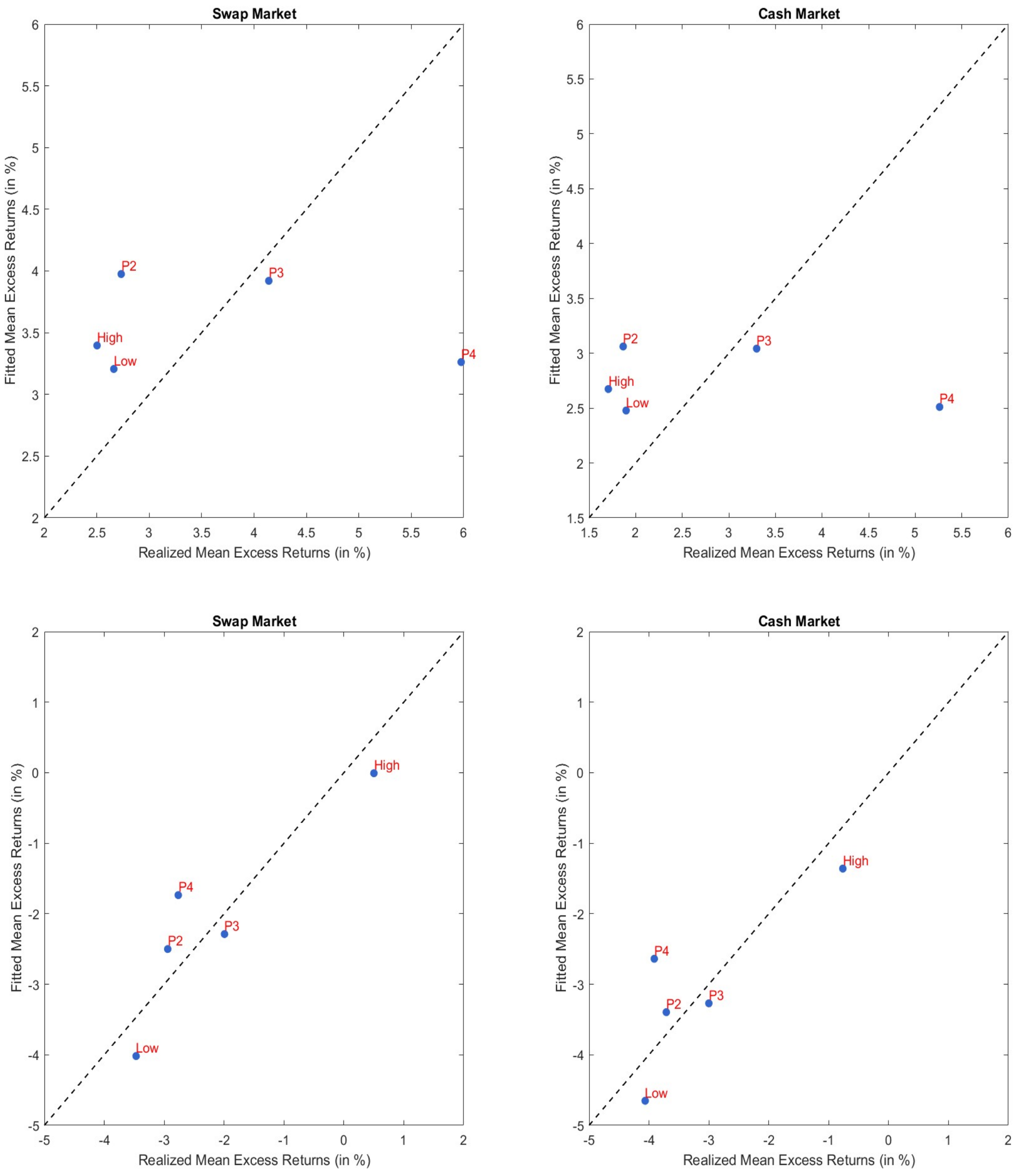

Figure OA1: **Pre- and Post-GFC Average Excess Returns and Cross-Currency Basis.** The figure shows mean excess returns for currency portfolios conditional on a cross-currency basis being within the lowest to highest quartile of its sample distribution (five categories from "lowest" to "highest" shown on the x-axis of each panel). The bars show average excess returns for being long in portfolio 5 (highest cross-currency basis) and short in portfolio 1 (lowest cross-currency basis). Panel A shows results for precrisis period (from Jan 1999 to Aug 2008), while Panel B shows results for postcrisis period (from Aug 2009 to Jan 2025).

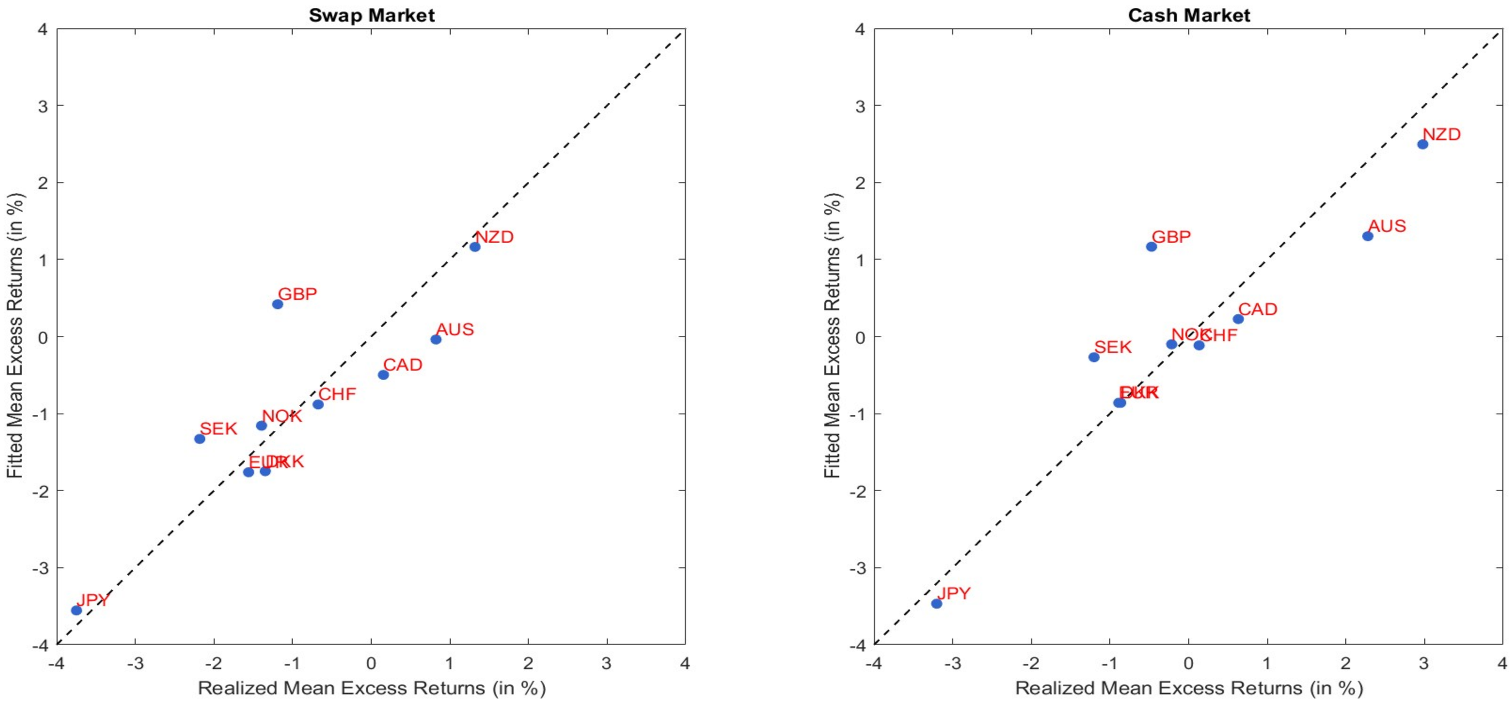

Figure OA2: **Currency-Level Pricing Error Plots.** The figure presents the pricing errors from a cross-sectional asset pricing model estimated at the currency level, where the cross-currency basis and the dollar factor serve as common risk factors. The x-axis depicts the realized mean excess returns, 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 01/1999 to 01/2025.

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 Aug 2009 to Jan 2025. *, **, *** denotes significant correlations at the 90%, 95%, and 99% levels, respectively. Panel A reports the correlation coefficients for the precrisis sample period from Jan 1999 to Aug 2008. Panel B reports the results for the postcrisis period from Aug 2009 to Jan 2025.

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	-0.16 *	-0.25 ***	-0.25 ***	1.00										
IMB	0.43 ***	0.79 ***	0.78 ***	-0.30 ***	1.00									
IML	-0.06	0.32 ***	0.32 ***	-0.14	0.15	1.00								
MOM3	0.10	0.03	0.03	0.17 *	-0.05	-0.04	1.00							
MOM12	0.20 **	0.27 ***	0.27 ***	-0.08	0.08	0.24 ***	0.27 ***	1.00						
NDT	0.31 ***	0.85 ***	0.84 ***	-0.21 **	0.69 ***	0.18 *	0.04	0.08	1.00					
NFA	0.14	0.68 ***	0.68 ***	-0.24 **	0.48 ***	0.13	-0.03	0.07	0.78 ***	1.00				
TER	0.62 ***	0.65 ***	0.65 ***	-0.28 ***	0.64 ***	0.05	0.19 **	0.34 ***	0.55 ***	0.41 ***	1.00			
VAL	0.42 ***	0.16 *	0.15 *	-0.13	0.19 **	-0.22 **	0.01	0.27 ***	0.03	0.01	0.54 ***	1.00		
VIX	0.08	-0.12	-0.12	-0.11	-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	-0.15 *	-0.31 ***	-0.28 ***	1.00										
IMB	0.59 ***	0.70 ***	0.70 ***	0.05	1.00									
IML	-0.21 **	-0.48 ***	-0.47 ***	0.26 ***	-0.27 ***	1.00								
MOM3	-0.10	-0.23 ***	-0.21 **	0.28 ***	-0.14 *	-0.04	1.00							
MOM12	-0.03	-0.18 **	-0.17 **	0.03	-0.23 ***	-0.20 **	0.53 ***	1.00						
NDT	0.61 ***	0.85 ***	0.85 ***	-0.20 **	0.75 ***	-0.53 ***	-0.09	-0.04	1.00					
NFA	0.59 ***	0.72 ***	0.76 ***	-0.05	0.61 ***	-0.38 ***	-0.02	-0.03	0.79 ***	1.00				
TER	0.15 *	0.40 ***	0.40 ***	-0.32 ***	0.05	-0.28 ***	0.06	0.01	0.34 ***	0.39 ***	1.00			
VAL	-0.07	0.27 ***	0.25 ***	-0.29 ***	0.01	-0.45 ***	-0.07	-0.06	0.20 **	-0.09	0.18 **	1.00		
VIX	-0.06	-0.12	-0.13	0.06	-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 Aug 2009 to Jan 2025. *, **, *** denotes significant correlations at the 90%, 95%, and 99% levels, respectively. Panel A reports the correlation coefficients for the full sample period from Jan 1999 to Jan 2025. Panel B reports the results for the postcrisis period from Aug 2009 to Jan 2025.

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 based 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) (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). 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 termss. The sample includes G10 currencies, covering the full sample period from Jan 1999 to Jan 2025 (Panel A) and postcrisis period from Aug 2009 to Jan 2025 (Panel B).

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

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 based 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) (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). 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 termss. The sample includes G10 currencies, covering the full sample period from Jan 1999 to Jan 2025 (Panel A) and postcrisis period from Aug 2009 to Jan 2025 (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
se	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
se	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
se	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
se	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
se	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
se	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
se	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
se	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
se	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 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. The portfolios are rebalanced monthly. Panel A presents results for the full sample spanning from Jan 1999 to Jan 2025 (from Jan 1999 to Dec 2020 for IMB and NDT portfolios due to data availability). Panel B summarizes results for the postcrisis period spanning from Aug 2009 to Jan 2025 (from Aug 2009 to Dec 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
se	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
se	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
se	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
se	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
se	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
se	-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
se	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
se	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
se	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
se	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
se	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
se	-0.05	-0.01			0.06	0.05	-0.10	0.24			0.16	0.17		0.88

Table OA6: 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. The portfolios are rebalanced monthly. Panel A presents results for the full sample spanning from Jan 1999 to Jan 2025 (from Jan 1999 to Dec 2020 for IMB and NDT portfolios due to data availability). Panel B summarizes results for the postcrisis period spanning from Aug 2009 to Jan 2025 (from Aug 2009 to Dec 2020 for IMB and NDT portfolios due to data availability).

Panel A: Full sample period

	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
coefficient	-0.01	0.08	-0.03				0.09	0.44	0.24				78.88%	0.11
se	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
se	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
se	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
se	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
se	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
se	-0.02	0.02			0.04	0.04	0.00	0.31			0.15	0.13		(0.97)

Panel B: Post-Global Financial Crisis

	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
coefficient	-0.03	0.11	-0.03				0.03	0.48	0.22				66.45%	0.21
se	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
se	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
se	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
se	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
se	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
se	-0.04	-0.03			0.07	0.05	-0.10	0.16			0.15	0.16		(0.48)

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 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. The portfolios are rebalanced monthly. Panel A presents results for the full sample spanning from Jan 1999 to Jan 2025 (from Jan 1999 to Dec 2020 for IMB and NDT portfolios due to data availability). Panel B summarizes results for the postcrisis period spanning from Aug 2009 to Jan 2025 (from Aug 2009 to Dec 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
se	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
se	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
se	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
se	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
se	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
se	-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
se	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
se	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
se	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
se	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
se	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
se	-0.06	-0.02			0.06	0.05	-0.17	0.17			0.15	0.16		0.72

Table OA8: Cross-Sectional Asset Pricing Tests: Extended Sample Analysis

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 excess returns to 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). The factor prices panel 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 HJ 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). The factor beta panel 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. The sample period is from January 1999 to January 2025. Panel A: All currencies; Panel B: Currencies from developing economies.

Panel A: All Economies									
Factor Prices									
Forward Market					Cash Market				
GMM	DOL	HML_x	$R\hat{2}$	HJ-dist	GMM	DOL	HML_x	$R\hat{2}$	HJ-dist
b	0.02	0.14	82.45%	0.17	b	0.00	0.05	42.60%	0.18
s.e.	0.03	0.03		0.06	s.e.	0.03	0.03		0.02
lambda	0.04	0.56			lambda	-0.02	0.18		
s.e.	0.12	0.13			s.e.	0.12	0.10		
FMB	DOL	HML_x	$x\hat{2}$ SH	$x\hat{2}$ NW	FMB	DOL	HML_x	$x\hat{2}$ SH	$x\hat{2}$ NW
lambda	0.04	0.56	3.87	5.02	lambda	-0.02	0.18	5.67	2.00
Sh	0.13	0.13	0.57	0.41	Sh	0.11	0.10	0.34	0.85
Nw	0.13	0.16			Nw	0.12	0.10		
Factor Betas									
Forward Market					Cash Market				
Porfolio	α	DOL	HML_x	$R\hat{2}$	Porfolio	α	DOL	HML_x	$R\hat{2}$
1	0.01	0.99	-0.47	89.49%	1	0.00	0.99	-0.55	93.34%
	0.08	0.05	0.08			0.04	0.02	0.05	
2	-0.20	0.97	-0.01	85.27%	2	-0.12	1.00	-0.03	87.64%
	0.07	0.03	0.04			0.04	0.02	0.04	
3	-0.09	1.00	0.03	85.04%	3	-0.01	1.03	0.06	86.05%
	0.05	0.03	0.04			0.04	0.03	0.03	
4	0.00	0.96	0.10	84.36%	4	0.09	0.99	0.15	85.76%
	0.06	0.03	0.05			0.05	0.03	0.03	
5	0.01	0.99	0.53	88.82%	5	0.00	0.99	0.45	91.94%
	0.08	0.05	0.08			0.04	0.02	0.05	
Panel B: Developing Economies									
Factor Prices									
Forward Market					Cash Market				
GMM	DOL	HML_x	$R\hat{2}$	HJ-dist	GMM	DOL	HML_x	$R\hat{2}$	HJ-dist
b	0.04	0.10	98.86%	0.08	b	0.03	0.05	60.57%	0.11
s.e.	0.04	0.02		0.54	s.e.	0.04	0.02		0.31
lambda	0.19	1.23			lambda	0.04	0.24		
s.e.	0.14	0.74			s.e.	0.09	0.13		
FMB	DOL	HML_x	$x\hat{2}$ SH	$x\hat{2}$ NW	FMB	DOL	HML_x	$x\hat{2}$ SH	$x\hat{2}$ NW
lambda	0.19	1.23	1.70	2.80	lambda	0.04	0.24	3.42	3.31
Sh	0.12	0.25	0.89	0.73	Sh	0.09	0.13	0.64	0.65
Nw	0.12	0.39			Nw	0.10	0.14		
Factor Betas									
Forward Market					Cash Market				
Porfolio	α	DOL	HML_x	$R\hat{2}$	Porfolio	α	DOL	HML_x	$R\hat{2}$
1	0.04	1.22	-0.37	88.33%	1	-0.04	1.08	-0.52	88.00%
	0.06	0.05	0.06			0.04	0.04	0.05	
2	-0.08	0.76	-0.07	56.79%	2	-0.08	0.82	-0.01	60.33%
	0.07	0.07	0.04			0.07	0.07	0.04	
3	-0.01	0.86	-0.03	56.17%	3	0.03	0.98	0.06	63.26%
	0.07	0.06	0.04			0.06	0.06	0.04	
4	0.04	0.85	0.02	57.51%	4	0.10	0.96	0.13	60.51%
	0.08	0.08	0.04			0.08	0.09	0.03	
5	0.04	1.22	0.63	93.69%	5	-0.04	1.08	0.48	84.29%
	0.06	0.05	0.06			0.04	0.04	0.05	

Table OA9: Pre- and Post-GFC Analysis: Extended Sample

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 excess returns to 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). The factor prices panel 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 HJ 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). The factor beta panel 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. The preGFC period is defined as the sample period from 01/1999–08/2008 and the post-GFC is defined as the sample period from 09/2008 to 01/2025. Panel A: All currencies; Panel B: Currencies from developing economies.

Panel A: All economies

Pre-Global Financial Crisis

Forward Market					Cash market				
GMM	DOL	HML_x	R^2	HJ dist	GMM	DOL	HML_x	R^2	HJ dist
b	0.04	0.25	94.11%	0.32	b	0.08	0.11	31.14%	0.32
s.e.	0.06	0.06		0.01	s.e.	0.06	0.07		0.01
λ	0.53	1.60			λ	0.27	0.28		
s.e.	0.28	0.99			s.e.	0.16	0.14		
FMB	DOL	HML_x	χ^2_{SH}	χ^2_{NW}	FMB	DOL	HML_x	χ^2_{SH}	χ^2_{NW}
λ	0.53	1.60	5.57	11.03	λ	0.27	0.28	18.95	14.36
Sh	0.33	0.47	0.35	0.05	Sh	0.19	0.17	0.00	0.01
Nw	0.22	0.49			NW	0.18	0.13		

Post-Global Financial Crisis

Forward Market					Cash Market				
GMM	DOL	HML_x	R^2	HJ dist	GMM	DOL	HML_x	R^2	HJ dist
b	-0.01	0.13	54.91%	0.20	b	-0.03	0.06	0.31	0.18
s.e.	0.03	0.06		0.06	s.e.	0.03	0.05		0.11
λ	-0.10	0.28			λ	-0.17	0.15		
s.e.	0.14	0.10			s.e.	0.14	0.09		
FMB	DOL	HML_x	χ^2_{SH}	χ^2_{NW}	FMB	DOL	HML_x	χ^2_{SH}	χ^2_{NW}
λ	-0.10	0.28	7.06	5.41	λ	-0.17	0.15	6.54	2.27
Sh	0.16	0.11	0.22	0.37	Sh	0.16	0.12	0.26	0.81
Nw	0.15	0.12			Nw	0.16	0.12		

Panel B: Developing economies

Pre-Global Financial Crisis

Forward Market					Cash market				
GMM	DOL	HML_x	R^2	HJ dist	GMM	DOL	HML_x	R^2	HJ dist
b	0.14	0.10	0.99	0.20	b	0.12	0.05	0.52	0.25
s.e.	0.08	0.03		0.21	s.e.	0.08	0.03		0.06
λ	0.67	3.00			λ	0.20	0.48		
s.e.	0.22	1.21			s.e.	0.11	0.26		
FMB	DOL	HML_x	χ^2_{SH}	χ^2_{NW}	FMB	DOL	HML_x	χ^2_{SH}	χ^2_{NW}
λ	0.67	3.00	3.48	6.92	λ	0.20	0.48	6.84	8.36
Sh	0.30	0.99	0.63	0.23	Sh	0.12	0.28	0.23	0.14
Nw	0.24	0.96			NW	0.12	0.27		

Post-Global Financial Crisis

Forward Market					Cash Market				
GMM	DOL	HML_x	R^2	HJ dist	GMM	DOL	HML_x	R^2	HJ dist
b	0.02	0.07	0.60	0.10	b	-0.02	0.02	0.59	0.05
s.e.	0.04	0.05		0.56	s.e.	0.04	0.04		0.91
λ	-0.02	0.20			λ	-0.08	0.09		
s.e.	0.11	0.12			s.e.	0.12	0.12		
FMB	DOL	HML_x	x$^2 SH$	x$^2 NW$	FMB	DOL	HML_x	x$^2 SH$	x$^2 NW$
λ	-0.02	0.20	2.13	1.63	λ	-0.08	0.09	0.69	0.40
Sh	0.13	0.13	0.83	0.90	Sh	0.13	0.14	0.98	1.00
Nw	0.13	0.14			Nw	0.13	0.14		