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Dollar Funding Stress and the Long-Run Structure of Exchange Rates

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Abstract

We test a new mechanism through which global dollar funding conditions alter the long-run structure of exchange-rate dynamics. We argue that tighter dollar funding conditions reduce intermediary risk-bearing capacity, increasing the equilibrium price of global dollar risk. As a result, exchange rates become increasingly driven by a common global factor, strengthening the visibility of reduced-rank exchange-rate dynamics while generating greater heterogeneity in currency exposures. We test these predictions using the cross-currency basis as a direct measure of international dollar funding stress. We observe that when funding stress is high, there is clearer evidence of reduced-rank exchange-rate dynamics and more variation in effective currency factor loadings. By contrast, the evidence for stronger common factor concentration is more modest, while long-horizon exchange-rate comovement changes little. These findings show that global dollar funding conditions affect both the level of exchange rates and their underlying stochastic structure. They also highlight that intermediary balance-sheet constraints play a key role in how exchange rates become integrated.

Keywords: Exchange Rates, Dollar Funding Stress, Intermediary Balance Sheets, Exchange-Rate Integration, Reduced-Rank Dynamics, Cross-Currency Basis

JEL classification: F31, F32, G12, G15

1. Introduction

Exchange-rate systems do not exhibit a constant long-run structure.While currencies may evolve independently under relatively stable market conditions, periods of heightened global financial stress tend to structurally strengthen long-run interdependencies across exchange rates. This phenomenon has been vividly illustrated during major systemic episodes, including the Global Financial Crisis, the European sovereign debt crisis, and the sharp tightening of global dollar funding conditions in 2022. Crucially, even during systematic crises, currency dynamics can diverge markedly depending on the underlying origin and transmission mechanisms of the shock. Existing exchange-rate models, however, largely treat the long-run stochastic structure of exchange rates as invariant or, when acknowledging its time-varying nature, offer limited structural explanations for why the degree of international exchange-rate integration shifts so drastically across global financial states.

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The absence of a clear framework is surprising because the structural organization of exchange-rate systems carries profound implications for international portfolio diversification, monetary policy independence, and the cross-border transmission of global financial shocks. When exchange rates are driven primarily by country-specific shocks, relative currency adjustments reflect domestic economic fundamentals, allowing individual nations to retain a high degree of independent macroeconomic adjustment. Conversely, when common global forces dominate, exchange-rate movements become highly synchronized across countries, severely restricting the effective scope for independent monetary stabilization. Understanding the structural determinants governing the balance between these two distinct regimes is therefore central to understanding the systematic role of the U.S. dollar in the international monetary system.

A large literature attributes exchange-rate comovement to exposure to a small number of common global risk factors associated with the U.S. dollar, global financial conditions, and intermediary balance-sheet constraints (Gabaix and Maggiori, 2015; Rey, 2015; Bruno and Shin, 2015a,b; Verdelhan, 2018; Miranda-Agrippino and Rey, 2020; Devereux et al., 2023; Bodenstein et al., 2023). Concurrently, research on empirical currency factor models documents that a limited set of global risk factors explains a substantial fraction of exchange-rate variation across countries (Lustig et al., 2011; Menkhoff et al., 2012; Verdelhan, 2018; Chernov et al., 2023). Although these studies firmly establish the cross-sectional importance of global factors, they generally assume that the underlying stochastic structure of exchange rates remains constant. The number and systematic importance of common stochastic trends are presumed to be stable, even though global financial environments vary substantially over time, and the explicit drivers behind this time variation remain largely unaddressed.

A prominent stream of research connects currency risk premia and systemic exchange-rate comovements directly to variations in global liquidity, showing how the international monetary architecture is deeply vulnerable to systemic dollar funding shocks (Obstfeld and Zhou, 2022). This view aligns with the broader macro-finance literature establishing that a pervasive global financial cycle, driven in large part by U.S. monetary policy innovations, heavily influences cross-border capital flows and global asset prices (Rey, 2015; Jordà et al., 2019). Within this cycle, globally active financial intermediaries serve as the primary transmission engine; as their capital constraints tighten or balance-sheet capacities erode, their appetite for bearing cross-currency risk drops precipitously (Adrian and Shin, 2010; He and Krishnamurthy, 2017). Consequently, structural frictions and regulatory limits on these intermediary balance sheets manifest as persistent pricing anomalies in currency derivatives markets, generating stark, time-varying deviations from covered interest parity (Liao and Zhang, 2025). When banks face temporary shortages of direct dollar funding, they may use foreign-exchange forwards and swaps to close their dollar funding gaps, increasing demand for synthetic dollar funding and placing pressure on FX swap prices (Abbassi and Bräuning, 2021). Ultimately, these compounding funding constraints trigger an expansion in global risk premia and fundamentally reshape the underlying stochastic covariation among international exchange rates.

This paper develops and tests a state-dependent theory of exchange-rate integration. We argue that the long-run organization of exchange-rate systems depends systematically on conditions in international dollar funding markets. The underlying transmission mechanism is rooted in the balance-sheet constraints of global financial intermediaries. As dollar funding conditions tighten, these institutions become less willing to bear global currency risk without higher equilibrium compensation. The resulting increase in the equilibrium price of global dollar risk systematically amplifies the influence of a common global factor on exchange-rate dynamics. Tighter funding conditions do not alter the underlying structural exposures of individual currencies; instead, they increase the pricing of the common factor, causing international exchange-rate systems to exhibit stronger common stochastic trends.

The theoretical framework generates four testable empirical predictions. First, tighter dollar funding conditions increase the variance contribution of the common global factor to exchange-rate fluctuations. Second, stronger common-factor dominance increases the empirical visibility of reduced-rank exchange-rate dynamics by strengthening the common stochastic component underlying exchange rates. Third, because currencies differ in their underlying exposure to global dollar risk, tighter funding conditions widen cross-sectional differences in their effective factor loadings. Finally, as the common global factor becomes more influential, exchange rates are expected to exhibit stronger long-run co-movement, although this effect is likely to be less pronounced because country-specific permanent shocks continue to shape long-run currency dynamics. To capture these shifts empirically, and following the established literature on intermediary financing frictions, we use the one-year cross-currency basis spread as a direct, market-based measure of international dollar funding stress (Borio et al., 2016; Sushko et al., 2016; Du et al., 2018; Avdjiev et al., 2019; Rime et al., 2022; McGuire, 2022; Hazelkorn et al., 2023). More broadly, evidence from other basis markets shows how liquidity demand and constrained arbitrage capital can sustain deviations from the law of one price. The one-year maturity provides the broadest and most consistent cross-currency coverage over our sample period while closely reflecting structural conditions in international wholesale dollar funding markets.

To examine how the long-run structure of exchange-rate systems evolves under different funding conditions, our empirical analysis combines rolling principal component analysis with rolling Johansen cointegration estimation. The principal component analysis is used to assess the time-varying importance of the common global factor and the dispersion of currency factor loadings, while the rolling Johansen procedure evaluates whether periods of tighter dollar funding are systematically associated with stronger evidence of reduced-rank exchange-rate dynamics. Together, these procedures provide direct empirical counterparts to the theoretical predictions developed in our structural model.

The proposed mechanism brings together three strands of literature that have evolved largely independently. The first examines the role of global financial factors in shaping exchange-rate dynamics. A growing body of evidence suggests that a relatively small number of common factors explain a substantial share of exchange-rate movements, with the U.S. dollar serving as the dominant force in the international currency system (Lustig et al., 2011; Menkhoff et al., 2012; Verdelhan, 2018; Jiang et al., 2021; Engel and Wu, 2023). Related work emphasizes the importance of the global financial cycle and intermediary balance sheets in transmitting international financial shocks (Rey, 2015; Bruno and Shin, 2015a,b; Gabaix and Maggiori, 2015). Our paper complements this literature by showing that dollar funding conditions influence not only exchange-rate levels and expected returns but also the long-run stochastic organization of exchange-rate systems.

The paper also contributes to the growing literature on international dollar funding markets and deviations from covered interest parity. A large body of evidence demonstrates that persistent cross-currency basis spreads reflect frictions in intermediary balance sheets, regulatory constraints, and imbalances in global dollar funding demand and supply rather than conventional transaction costs or credit risk (Borio et al., 2016; Sushko et al., 2016; Du et al., 2018; Avdjiev et al., 2019; Du et al., 2023). We build directly on this insight by treating the one-year cross-currency basis as a market-based measure of intermediary funding conditions. Rather than studying the determinants of the basis itself, however, we examine how fluctuations in dollar funding conditions propagate to the long-run structure of exchange-rate dynamics. In these frameworks, global bank leverage and cross-border dollar flows influence international lending capacity (Bruno and Shin, 2015b; Ivashina et al., 2015; Correa et al., 2020; Catão et al., 2023). We extend this view by analyzing how these international credit channels structurally alter long-run exchange rate dependencies.

A growing body of work extends this analysis by examining the macroeconomic determinants and broader economic consequences of CIP deviations within comprehensive macrofinancial frameworks. In standard monetary environments, the structural drivers of CIP dynamics are evaluated by Ibhagui (2020), while Ibhagui (2021a) and Ibhagui (2021b) demonstrate that inflation differentials and real economic activity serve as significant drivers of cross-currency basis swap spreads. Rather than treating currency pairs in isolation, Ibhagui (2019) provides structural evidence on the pre- and post-crisis interrelations among different basis swap spreads—a systemic dependency that Ahelegbey and Ibhagui (2020) map explicitly as network-driven deviations.

This macrofinancial paradigm further highlights how basis dynamics interact with broader currency and funding allocation channels. For instance, Agudze et al. (2020) utilize rolling correlations to capture the time-varying co-movement between the basis and the U.S. dollar. This relationship is further unpacked by Ahelegbey et al. (2026), who show that the distinct macroeconomic drivers behind dollar appreciations yield highly asymmetric effects on the basis. Furthermore, these structural shifts carry tangible consequences for the real economy; Keller (2024) documents that expanding bank-level CIP arbitrage activity actively crowds out lending in the underlying arbitrage currency. Together, these perspectives establish that basis spreads are deeply intertwined with macrofinancial cycles and global capital allocation channels across different states of the world.

Finally, our paper contributes to the literature on exchange-rate cointegration and reduced-rank dynamics. Existing studies have applied cointegration techniques to examine common stochastic trends and long-run equilibrium relationships among exchange rates (Johansen, 1988, 1991; Baillie and Bollerslev, 1989). These analyses implicitly assume that the underlying stochastic structure remains stable over time. In contrast, our theoretical framework suggests that evidence of reduced-rank exchange-rate dynamics changes systematically with global dollar funding conditions. The paper therefore links intermediary-based asset pricing to state-dependent exchange-rate integration, providing a structural interpretation for time variation in the strength of common stochastic trends.

The empirical results strongly support the central mechanism developed in the model. Periods of tighter dollar funding conditions are associated with significantly stronger evidence of reduced-rank exchange-rate dynamics and greater cross-sectional dispersion in effective currency factor loadings. We also find economically meaningful evidence that common global factors become more important during periods of elevated dollar funding stress, although this effect is more modest than that observed for reduced-rank dynamics and loading dispersion. By contrast, the nexus between dollar funding stress and long-run exchange-rate co-movement is weaker and less consistent across model specifications. Overall, the findings suggest that fluctuations in international dollar funding markets primarily reshape the long-run stochastic structure of exchange-rate systems, rather than simply strengthening short-run exchange-rate co-movement.

More broadly, our findings provide a new perspective on the international role of the U.S. dollar. Existing research has established that dollar funding conditions influence capital flows, intermediary balance sheets, and the pricing of international financial assets. Building on this literature, we show that these conditions also affect the long-run structure of exchange-rate systems by shaping the relative importance of common and currency-specific stochastic trends. In this sense, the organization of international currency markets is itself state dependent, evolving systematically with conditions in global dollar funding markets.

The remainder of the paper proceeds as follows. Section 2 develops the theoretical framework and derives the model's principal predictions. Section 3 describes the data, empirical methodology, and identification strategy before presenting the main empirical results in Section 4. Section 5 reports a comprehensive set of robustness analyses and additional empirical evidence. Section 6 concludes.

2. Theoretical Framework

This section develops a theoretical framework that links dollar funding stress to the long-run dynamics of exchange rates. The framework is based on the role of global financial intermediaries in absorbing currency risk through their positions in international financial markets. Their capacity to perform this function, however, depends critically on access to dollar funding. When dollar funding conditions deteriorate, intermediary balance-sheet capacity becomes more constrained, increasing the equilibrium price of global currency risk. Consequently, exchange-rate movements become increasingly driven by a common global factor, strengthening common stochastic trends and reducing the effective dimensionality of the exchange-rate system.

Unlike conventional factor models, the framework does not assume that the importance of the global factor is constant over time. Instead, the strength of the common factor varies systematically with dollar funding conditions through the risk-bearing capacity of financial intermediaries. This state dependence generates several empirical predictions concerning exchange-rate comovement, factor dominance, and the visibility of reduced-rank behaviour.

2.1. Intermediary Portfolio Choice

Consider a world with N currencies. Competitive global financial intermediaries intermediate international capital flows by holding portfolios of currency-denominated assets. Let

$$R_{t+1} = \left(R_{t+1}^{FX,1}, \ldots, R_{t+1}^{FX,N}\right)'$$

denote the vector of excess returns on foreign currency positions between dates t and $t+1$. Define

$$\mu_t = E_t(R_{t+1}), \qquad \Sigma_t = Var_t(R_{t+1}),$$

where Σ_t is assumed to be symmetric and positive definite. Let $x_t = (x_{1,t}, \ldots, x_{N,t})'$ denote the vector of intermediary positions in currency claims, and let W_t denote intermediary wealth. Intermediaries choose their portfolios to maximize mean–variance utility,

$$\max_{x_t} \left\{ x_t'\mu_t - \frac{\gamma}{2} x_t'\Sigma_t x_t \right\}, \tag{1}$$

where $\gamma > 0$ denotes the coefficient of absolute risk aversion.

Portfolio choice is constrained by intermediary balance-sheet capacity. Specifically, financial intermediaries cannot absorb unlimited exchange-rate risk because regulatory capital requirements, funding conditions, collateral constraints, and internal risk-management policies limit the amount of risk they can hold on their balance sheets. These financial frictions are captured through the following state-dependent constraint

$$x_t'\Sigma_t x_t \leq \kappa(D_t) W_t^2, \tag{2}$$

where D_t measures global dollar funding stress and $\kappa(D_t) > 0$ represents intermediary risk-bearing capacity.

The function $\kappa(\cdot)$ is assumed to satisfy

$$\frac{\partial \kappa(D_t)}{\partial D_t} < 0. \tag{3}$$

Equation (3) captures the central economic mechanism of the model. During periods of heightened dollar funding stress, financial intermediaries operate under tighter financing conditions, face higher margin requirements, and encounter more binding balance-sheet constraints As a result, the amount of exchange-rate risk that intermediaries can efficiently absorb declines. Conversely, when funding markets are liquid and balance-sheet capacity is abundant, intermediaries are able to warehouse larger currency positions, reducing the equilibrium compensation required for bearing global currency risk.

The intermediary optimization problem therefore links dollar funding conditions directly to equilibrium exchange-rate pricing. Changes in dollar funding stress do not alter the direction of desired currency portfolios; rather, they determine how much aggregate currency risk intermediaries are able to absorb. The equilibrium consequences of this mechanism are developed below.

2.2. Equilibrium and the Price of Global Currency Risk

The intermediary portfolio problem admits a unique solution under standard regularity conditions. This result shows that tighter balance-sheet constraints on financial intermediaries raise the equilibrium price of global currency risk, thereby providing the key transmission channel through which dollar funding stress affects exchange-rate dynamics.

The unconstrained first-order condition associated with (1) is

$$\mu_t - \gamma \Sigma_t x_t = 0, \tag{4}$$

which implies the unconstrained optimal portfolio

$$x_t^u = \frac{1}{\gamma} \Sigma_t^{-1} \mu_t. \tag{5}$$

When the balance-sheet constraint (2) is not binding, (5) characterizes the optimal intermediary portfolio. During periods of elevated dollar funding stress, however, intermediary risk-bearing capacity falls, causing the balance-sheet constraint to bind. The constrained optimization problem is therefore characterized by the Lagrangian

$$\mathcal{L}(x_t, \nu_t) = x_t' \mu_t - \frac{\gamma}{2} x_t' \Sigma_t x_t - \nu_t \left(x_t' \Sigma_t x_t - \kappa(D_t) W_t^2 \right), \tag{6}$$

where $\nu_t \geq 0$ denotes the shadow value of intermediary balance-sheet capacity.

The corresponding first-order condition becomes

$$\mu_t - (\gamma + 2\nu_t) \Sigma_t x_t = 0, \tag{7}$$

which yields the constrained optimal portfolio

$$x_t^* = \frac{1}{\gamma + 2\nu_t} \Sigma_t^{-1} \mu_t. \tag{8}$$

Equation (8) shows that tighter balance-sheet constraints reduce the scale of intermediary risk-taking while leaving the composition of desired currency portfolios unchanged. Dollar funding stress therefore affects equilibrium primarily by changing the quantity of aggregate currency risk that intermediaries are willing and able to absorb.

To determine equilibrium prices, let q_t denote the aggregate net supply of currency risk. Market clearing requires

$$x_t^* = q_t. \tag{9}$$

Substituting (9) into (8) yields the equilibrium expected return vector

$$\mu_t = (\gamma + 2\nu_t)\Sigma_t q_t. \tag{10}$$

Equation (10) provides the key equilibrium implication of the model. When dollar funding conditions deteriorate, intermediary balance-sheet capacity contracts, increasing the shadow value ν_t of intermediary capital. As a consequence, the equilibrium compensation required for bearing global currency risk rises. This higher price of global risk is the channel through which dollar funding stress influences exchange-rate dynamics.

Theorem 2.1 (Existence and Uniqueness of Equilibrium)**.** *Suppose that:*

1. *Σ_t is symmetric and positive definite;*
2. *$\gamma > 0$;*
3. *$\kappa(D_t) > 0$;*
4. *aggregate currency-risk supply q_t is finite.*

Then:

1. *the intermediary optimization problem admits a unique optimal portfolio;*
2. *there exists a unique equilibrium expected-return vector satisfying*

$$\mu_t = (\gamma + 2\nu_t)\Sigma_t q_t, \tag{11}$$

   for a unique Kuhn–Tucker multiplier $\nu_t \geq 0$;

3. *if the balance-sheet constraint binds, an increase in dollar funding stress lowers intermediary risk-bearing capacity, raises the shadow value ν_t, and therefore increases the equilibrium price of global currency risk.*

The theorem formalizes the central economic mechanism of the model. Under normal funding conditions, intermediaries willingly absorb international currency risk, thereby limiting the compensation required for bearing global currency risk. During episodes of dollar funding stress, however, intermediary balance-sheet capacity contracts, increasing the shadow cost of risk-bearing. In equilibrium, the price of global dollar risk rises, causing exchange-rate movements to become more strongly driven by common global shocks. This mechanism provides the theoretical foundation for the empirical analysis developed in the remainder of the paper.

2.3. Pricing the Global Dollar Factor

The intermediary equilibrium established above determines the compensation investors require for bearing global currency risk. When intermediary balance-sheet capacity is abundant, intermediaries readily absorb exchange-rate risk and the equilibrium price of global risk remains low. During periods of dollar funding stress, however, intermediary risk-bearing capacity contracts, increasing the shadow value of intermediary capital. Consequently, investors require greater compensation for holding exposures to common global currency risk.

We represent this mechanism through the international pricing kernel

$$m_{t+1} = -r_t - \lambda_g(D_t)g_{t+1} - \lambda_h h_{t+1}, \tag{12}$$

where g_{t+1} denotes the common global dollar funding shock, h_{t+1} represents idiosyncratic country-specific shocks, and $\lambda_g(D_t)$ is the state-dependent price of global dollar risk.

The intermediary equilibrium implies that the price of global risk is increasing in dollar funding stress,

$$\lambda_g(D_t) = \lambda_0 + \lambda_1 D_t, \qquad \lambda_1 > 0, \tag{13}$$

so tighter dollar funding conditions increase the compensation required for bearing global currency risk.

Equation (13) provides the link between intermediary balance-sheet conditions and exchange-rate dynamics. Dollar funding stress affects exchange rates not by altering their underlying structural exposures, but by changing the equilibrium price attached to the common global shock.

2.4. Exchange-Rate Dynamics

Let $s_{i,t}$ denote the logarithm of the exchange rate of currency i against the U.S. dollar. The gross return from holding a foreign risk-free bond is

$$R^{FX,i}_{t+1} = \exp\left(s_{i,t+1} - s_{i,t} + r_{i,t} - r_{US,t}\right). \tag{14}$$

No-arbitrage requires

$$E_t\left[M_{t+1}R^{FX,i}_{t+1}\right] = 1, \tag{15}$$

which implies the expected exchange-rate depreciation equation

$$E_t(\Delta s_{i,t+1}) = r_{US,t} - r_{i,t} + \beta_i \lambda_g(D_t), \tag{16}$$

where β_i measures the structural exposure of currency i to the common global dollar factor.

Equation (16) highlights an important distinction. Structural exposures β_i are determined by persistent country characteristics, including the degree of international financial integration, trade structure, and funding dependence. Dollar funding stress does not change these structural characteristics. Instead, it changes the equilibrium price of global risk, thereby altering the effective contribution of the common factor to observed exchange-rate dynamics.

2.5. State-Dependent Exchange-Rate Structure

Accumulating the one-period exchange-rate dynamics yields

$$s_{i,t} = \mu_i + \beta_i G_t + \gamma_i H_{i,t} + u_{i,t}, \tag{17}$$

where $G_t = \sum_{k=1}^{t} g_k$, $H_{i,t} = \sum_{k=1}^{t} h_{i,k}$, and $u_{i,t}$ is a stationary transitory component.

Stacking exchange rates across all currencies gives

$$X_t = \mu + \beta G_t + \Gamma H_t + u_t. \tag{18}$$

Equation (18) shows that exchange-rate systems contain both a common global stochastic trend and heterogeneous country-specific components. The distinguishing feature of the present model is that the relative importance of these components is not fixed. Through equation (13), dollar funding stress increases the equilibrium price of global currency risk, thereby amplifying the contribution of the common global factor to exchange-rate dynamics. Consequently, the effective dimensionality of the exchange-rate system changes systematically across different financial conditions.

2.6. Theory to the Empirical Analysis

The theoretical framework provides a direct link to the empirical analysis presented in Section 3. The state variable D_t captures conditions in global dollar funding markets. Higher dollar funding stress reduces intermediary risk-bearing capacity through equation (3), increasing the shadow value of intermediary capital and raising the equilibrium price of global dollar risk through equation (13). The stronger price of global risk increases the effective importance of the common global factor in equation (18).

The empirical analysis therefore tests a sequence of implications generated directly by the theoretical model:

$$D_t \Longrightarrow \kappa(D_t) \downarrow \Longrightarrow \lambda_g(D_t) \uparrow \Longrightarrow \text{Global factor dominance} \Longrightarrow \text{Reduced-rank behaviour}$$

Accordingly, the empirical analysis examines whether periods of elevated dollar funding stress are associated with (i) stronger common-factor dominance, (ii) greater evidence of reduced-rank exchange-rate dynamics, (iii) larger cross-sectional dispersion in effective factor loadings, and (iv) stronger long-horizon exchange-rate comovement. These empirical tests are designed to evaluate the theoretical mechanism developed above rather than serve as standalone statistical exercises.

2.7. Testable Theoretical Implications

The intermediary mechanism developed above suggests that changes in dollar funding conditions alter the relative importance of the common global factor in exchange-rate dynamics. This generates four empirically testable predictions regarding factor dominance, exchange-rate dimensionality, long-run co-movement, and cross-sectional heterogeneity.

Proposition 1 (Global Factor Dominance)**.** *If*

$$\frac{\partial \lambda_g(D_t)}{\partial D_t} > 0,$$

then the proportion of exchange-rate variation explained by the common global factor increases with dollar funding stress,

$$\frac{\partial}{\partial D_t}\left(\frac{b_i(D_t)^2}{b_i(D_t)^2 + \sigma_{h,i}^2 + \sigma_u^2}\right) > 0, \tag{19}$$

where $b_i(D_t) = c(D_t)\bar{\beta}_i$, with $c'(D_t) > 0$.

Economic interpretation.. Higher dollar funding stress raises the equilibrium price of global currency risk, increasing the contribution of the common global factor relative to country-specific shocks. Exchange-rate movements therefore become increasingly synchronized, even though currencies retain heterogeneous structural exposures.

Proposition 2 (Common-Factor Concentration)**.** *Let $\Sigma(D_t)$ denote the covariance matrix of exchange-rate returns.*

If the contribution of the common global factor increases with dollar funding stress, then the proportion of total variance explained by the first principal component increases,

$$\frac{\partial}{\partial D_t}\left(\frac{\lambda_1(D_t)}{\sum_{j=1}^{N}\lambda_j(D_t)}\right) > 0. \tag{20}$$

Economic interpretation.. As intermediary balance-sheet constraints tighten, exchange-rate movements become increasingly concentrated along a common direction. The exchange-rate system therefore behaves as though it has fewer independent stochastic dimensions, increasing the practical visibility of reduced-rank behaviour in finite samples.

Proposition 3 (Long-Horizon Comovement)**.** *Let*

$$r_{i,t}^{(H)} = s_{i,t} - s_{i,t-H}$$

denote the H-period exchange-rate return. If the variance contribution of the global factor increases sufficiently relative to idiosyncratic components,

$$\frac{\partial}{\partial D_t} Corr\left(r_{i,t}^{(H)}, r_{j,t}^{(H)}\right) \geq 0 \tag{21}$$

for sufficiently large horizons H.

Economic interpretation.. Because common stochastic trends accumulate over time, the influence of the global factor becomes increasingly pronounced at longer investment horizons. Consequently, episodes of elevated dollar funding stress should be associated with stronger long-horizon exchange-rate comovement.

Corollary 1 (Dispersion of Effective Factor Loadings)**.** *Define*

$$Disp_\beta(D_t) = Var_i\left[b_i(D_t)\right].$$

If $c'(D_t) > 0$, then

$$\frac{\partial Disp_\beta(D_t)}{\partial D_t} > 0. \tag{22}$$

Economic interpretation.. Dollar funding stress amplifies the effective contribution of the global factor without eliminating structural differences across currencies. Consequently, exchange rates become increasingly influenced by the same global force while continuing to exhibit heterogeneous sensitivities determined by their underlying structural exposures.

Empirical Predictions

The theoretical framework yields four empirical predictions.

1. Periods of elevated dollar funding stress should exhibit stronger global-factor dominance in exchange-rate dynamics.

2. Evidence of reduced-rank behaviour and cointegration should become more pronounced when dollar funding stress is elevated.

3. The cross-sectional dispersion of effective factor loadings should increase with dollar funding stress.
4. Cross-currency comovement should become stronger at longer horizons as the contribution of the common stochastic trend increases.

These predictions provide a direct empirical evaluation of the intermediary mechanism developed in this section. Rather than testing exchange-rate comovement in isolation, the empirical analysis examines whether changes in dollar funding conditions systematically alter the underlying structure of exchange-rate dynamics through the balance-sheet channel described above.

3. Data and Empirical Strategy

The theoretical framework developed in Section 2 predicts that tighter dollar funding conditions increase the importance of the common global factor in exchange-rate dynamics by reducing intermediary risk-bearing capacity. The empirical objective is therefore to evaluate whether direct measures of dollar funding stress are associated with stronger common-factor dominance, more pronounced reduced-rank behaviour, greater cross-sectional heterogeneity in currency factor exposures, and stronger long-horizon exchange-rate comovement.

Accordingly, the empirical analysis combines bilateral exchange-rate data with information from cross-currency basis swap markets. The cross-currency basis provides a direct market-based measure of stresses in international dollar funding markets because persistent deviations from covered interest parity arise when financial intermediaries face balance-sheet constraints that limit arbitrage. Consequently, unlike composite financial stress indices based on broad market variables, the cross-currency basis measures the funding mechanism that is central to the theoretical model.

3.1. Exchange-Rate and Dollar Funding Data

The cross-currency basis data consist of weekly observations on one-year basis swap spreads against the U.S. dollar for eleven major currencies: the euro (EUR), British pound sterling (GBP), Japanese yen (JPY), Swiss franc (CHF), Australian dollar (AUD), Canadian dollar (CAD), Danish krone (DKK), Norwegian krone (NOK), New Zealand dollar (NZD), Swedish krona (SEK), and Korean won (KRW). Together, these currencies account for the overwhelming majority of activity in global foreign-exchange and cross-currency basis markets and provide broad coverage of internationally integrated dollar funding markets. Following the recent literature, we construct our measure of global dollar funding stress as the cross-sectional average of these one-year cross-currency basis spreads. Using a broad cross-currency panel instead of a basis measure for a single currency helps reduce the influence of idiosyncratic funding shocks, allowing the index to better capture common conditions in international dollar funding markets.

The exchange-rate analysis is designed to address a different question. Instead of measuring dollar funding conditions, it investigates how these conditions shape the long-run structure of exchange-rate systems. Accordingly, the analysis focuses on the five most actively traded currencies against the U.S. dollar: the euro (EUR), Japanese yen (JPY), British pound sterling (GBP), Australian dollar (AUD), and Swiss Franc (CHF). According to the Bank for International Settlements Triennial Central Bank Survey, these currencies account for the vast majority of global foreign-exchange turnover and exhibit the deepest liquidity, lowest transaction costs, and most continuous price discovery. Focusing on the most liquid major currencies helps limit the influence of market-specific liquidity effects, intermittent trading, and idiosyncratic country shocks. This allows the empirical analysis to more clearly identify changes in the common stochastic structure predicted by the model.

Importantly, this choice does not imply that the remaining currencies are ignored. Cross-currency basis spreads for these currencies are used to construct the global dollar funding stress measure, ensuring that the resulting index captures broad conditions in international dollar funding markets rather than developments in only a few markets. The five-currency exchange-rate system is used exclusively to estimate the state-dependent long-run dynamics implied by the theoretical framework. In contrast, the broader cross-currency basis panel provides the information needed to measure global dollar funding conditions.

All exchange rates are quoted using a common convention and expressed in natural logarithms. Let $s_{i,t} = \log(S_{i,t})$, where $S_{i,t}$ denotes the bilateral exchange rate of currency i against the U.S. dollar. Exchange-rate returns are computed as first differences of logarithmic exchange rates,

$$r_{i,t} = \Delta s_{i,t} = s_{i,t} - s_{i,t-1}.$$

The main explanatory variable is the cross-currency basis, which captures deviations from covered interest parity in international dollar funding markets.A negative basis indicates that investors pay a premium to obtain U.S. dollar funding through the foreign-exchange swap market, signaling tighter dollar funding conditions. Because the theoretical framework is built around intermediary funding constraints, the cross-currency basis serves as a direct empirical proxy for the model's state variable.

The cross-currency basis dataset consists of weekly observations for eleven currencies across six maturities three months, one year, five years, ten years, twenty years, and thirty years covering the period from 2005 to 2021. Our baseline analysis focuses on the one-year maturity because it offers the broadest and most consistent cross-sectional coverage over the sample while closely reflecting funding conditions in international dollar swap markets. Alternative maturities are examined as robustness exercises to verify that the principal conclusions are not driven by a particular tenor.

To ensure consistency with the theoretical state variable, we define the dollar funding stress measure so that higher values reflect tighter funding conditions. Let $Basis_{i,t}$ denote the one-year cross-currency basis for currency i. The aggregate dollar funding stress measure is constructed as

$$D_t = -\frac{1}{N}\sum_{i=1}^{N} Basis_{i,t}, \tag{23}$$

where N denotes the number of currencies observed at date t. The negative sign ensures that larger values of D_t correspond to more severe dollar funding stress, consistent with the theoretical model developed in Section 2. Throughout the paper, D_t is standardised to have zero mean and unit variance, allowing coefficient estimates to be interpreted in terms of one-standard-deviation changes in global dollar funding conditions.

3.2. Empirical Strategy

The theoretical framework generates four empirical predictions regarding the behavior of exchange-rate systems during periods of elevated dollar-funding stress. Rather than estimating the theoretical model directly, the empirical analysis tests its reduced-form implications using observed exchange-rate and cross-currency basis data. This approach follows naturally from the theoretical framework developed in Section 2, where changes in intermediary balance-sheet conditions alter the effective importance of the common global dollar factor. The empirical analysis is carried out in four stages. We begin by verifying that exchange-rate levels are integrated of order one, thereby confirming that the data satisfy the conditions required for cointegration analysis. Second, we examine whether periods of heightened dollar funding stress coincide with stronger evidence of reduced-rank behaviour in exchange-rate systems. Third, we examine whether tighter funding conditions change the cross-sectional distribution of currency exposures to the common global factor. Finally, we examine whether dollar funding stress leads to stronger long-horizon comovement among exchange rates.

These four empirical exercises correspond directly to the theoretical predictions developed in Section 2. Table E.12 summarises the relationship between the theoretical propositions and their empirical counterparts. Organizing the empirical analysis in this manner provides a direct correspondence between the theoretical mechanism and the empirical implementation. As a result, each empirical exercise is designed to test a specific prediction of the theoretical framework rather than serving as a standalone statistical analysis.

3.3. Integration Properties and State-Dependent Reduced-Rank Dynamics

The theoretical framework suggests that bilateral exchange rates are influenced by both a common global stochastic trend and currency-specific stochastic components. The model therefore suggests that exchange-rate levels are non-stationary, while common stochastic trends may give rise to long-run equilibrium relationships across currencies. Before examining these long-run relationships, we first verify the order of integration of the exchange-rate series.

For each currency, we estimate the standard Augmented Dickey–Fuller (ADF) regression

$$\Delta s_{i,t} = \alpha_i + \rho_i s_{i,t-1} + \sum_{k=1}^{p} \phi_{ik} \Delta s_{i,t-k} + \varepsilon_{i,t}, \tag{24}$$

where $s_{i,t}$ denotes the logarithm of the bilateral exchange rate, Δ is the first-difference operator, and p is selected using conventional lag-selection criteria to eliminate residual serial correlation. The null hypothesis is

$$H_0 : \rho_i = 0,$$

which corresponds to the presence of a unit root.

Establishing that exchange-rate levels are integrated of order one is a prerequisite for the subsequent reduced-rank analysis because the theoretical model predicts that long-run exchange-rate dynamics arise through common stochastic trends rather than stationary level relationships.

Conditional on the exchange-rate series being integrated of order one, long-run relationships are examined using the Johansen vector error-correction representation

$$\Delta X_t = \Pi X_{t-1} + \sum_{k=1}^{p-1} \Gamma_k \Delta X_{t-k} + \varepsilon_t, \tag{25}$$

where $X_t = [s_{1,t}, s_{2,t}, \ldots, s_{N,t}]'$ collects the logarithmic exchange-rate levels across all currencies. The long-run dynamics of the system are completely characterised by the rank of the matrix Π. If

$$rank(\Pi) = r,$$

then there exist r stationary linear combinations of exchange rates, implying the presence of r cointegrating relationships and $N - r$ common stochastic trends.

The Johansen trace statistic is used to determine the number of cointegrating vectors. Consequently, the reduced-rank statistics reported in the empirical results provide direct estimates of the dimensionality of the exchange-rate system implied by equation (25). In other words, the Johansen procedure is not employed as a standalone empirical exercise. Instead, it serves as the econometric approach for testing the theoretical prediction that dollar funding conditions influence the effective dimensionality of exchange-rate dynamics.

To examine the state-dependent predictions of the theoretical framework, we partition the sample according to the level of dollar funding stress measured by D_t. Following the procedure outlined in Section 3, observations with values of D_t above the sample median are classified as high-stress periods, while those below the median are classified as low-stress periods. The Johansen procedure is then estimated separately for each subsample, allowing the number and strength of cointegrating relationships to vary across funding regimes.

If the theoretical mechanism is correct, periods characterised by tighter dollar funding conditions should exhibit stronger evidence of reduced-rank behaviour because a larger proportion of exchange-rate variation is explained by the common global dollar factor.

3.4. Testing Proposition 1: Dollar Funding Stress and Common-Factor Dominance

The first prediction of the theoretical model is that tighter dollar funding conditions increase the importance of the common global factor in exchange-rate dynamics. Intuitively, as intermediary balance-sheet constraints become more binding, common dollar funding shocks account for a larger share of exchange-rate fluctuations, while the influence of currency-specific disturbances declines.The empirical implication is that the common component should account for a larger share of exchange-rate fluctuations during periods of elevated dollar funding stress.

To evaluate this prediction, we estimate a principal-component decomposition of weekly exchange-rate returns. Let

$$R_t = [r_{1,t},\, r_{2,t},\, \ldots,\, r_{N,t}]'$$

denote the vector of exchange-rate returns across the currency panel. The covariance matrix of returns is decomposed as

$$\Sigma = V \Lambda V',$$

where Λ is the diagonal matrix of ordered eigenvalues, $\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_N$, and V contains the corresponding eigenvectors.

The first principal component provides the empirical counterpart of the common global factor in the theoretical model. We therefore measure common-factor dominance using the proportion of total exchange-rate variation explained by the first principal component,

$$FD_t = \frac{\lambda_{1,t}}{\sum_{j=1}^{N} \lambda_{j,t}}, \tag{26}$$

where the eigenvalues are computed using rolling estimation windows to allow the importance of the common factor to evolve through time.

The relationship between factor dominance and dollar funding stress is evaluated using

$$FD_t = \alpha + \beta D_t + \varepsilon_t, \tag{27}$$

where D_t denotes the standardised measure of dollar funding stress defined in equation (23).

The theoretical model predicts $\beta > 0$, implying that periods of tighter dollar funding conditions should be characterised by greater dominance of the common factor. A positive estimate of β would therefore provide direct empirical support for Proposition 1, indicating that tighter intermediary funding constraints systematically increase the influence of the common global dollar factor on exchange-rate dynamics.

To distinguish the the effect of funding-market disruptions from broader shifts in global financial conditions, we extend equation (27) by including additional controls, namely the Broad U.S. Dollar Index, the VIX, and the J.P. Morgan Global FX Volatility Index. These variables account for broader changes in global risk sentiment and U.S. dollar strength that extend beyond funding-market disruptions. As a result, the estimated coefficient on D_t captures the effect of dollar funding stress over and above general financial-market conditions.

3.5. Testing Proposition 2: Dollar Funding Stress and Reduced-Rank Exchange-Rate Dynamics

A central implication of the theoretical framework is that tighter dollar funding conditions increase the influence of the common global factor on exchange-rate dynamics. As the common factor becomes more dominant, exchange-rate dynamics appear to be driven by fewer independent stochastic trends. Consequently, evidence of reduced-rank behaviour is expected to be stronger during periods of elevated dollar funding stress.

To test this prediction, we apply the Johansen vector error-correction model specified in equation (25). The rank of the long-run impact matrix, Π, determines the number of cointegrating relationships among exchange rates. Specifically,

$$rank(\Pi) = r$$

implies that the exchange-rate system contains $N - r$ common stochastic trends.

The theoretical model predicts that dollar funding stress increases the dominance of the common global component. The empirical implication is therefore not that the structural rank of the exchange-rate system changes permanently. Rather, periods in which the common global factor accounts for a larger share of exchange-rate fluctuations should exhibit more readily identifiable reduced-rank behaviour.

To test this prediction, we divide the sample according to the state variable D_t. Observations with values above the sample median are classified as high-stress periods, while those below the median are assigned to the low-stress regime. We then estimate the Johansen trace statistics separately for each subsample using the same lag structure and deterministic specification.

Formally, the Johansen trace statistic is

$$Trace(r) = -T \sum_{i=r+1}^{N} \log(1 - \hat{\lambda}_i),$$

where $\hat{\lambda}_i$ denotes the estimated canonical correlations obtained from the vector error-correction model.

The theoretical framework predicts that, during periods of elevated dollar funding stress, the estimated trace statistics will provide stronger evidence against lower-rank null hypotheses. Put differently, as intermediary balance-sheet constraints become more binding and the common global dollar factor gains influence, the exchange-rate system is expected to be characterised by fewer effective stochastic trends. Unlike the conventional interpretation of cointegration as evidence of a long-run equilibrium relationship, our framework views reduced-rank behaviour as reflecting the growing dominance of the common factor under tighter dollar funding conditions. Accordingly, the Johansen procedure serves as a direct test of Proposition 2.

3.6. Testing Proposition 3: Dollar Funding Stress and the Dispersion of Currency Factor Exposures

The theoretical framework predicts that tighter dollar funding conditions raise the price of global dollar risk. Because currencies differ in their underlying exposure to intermediary balance-sheet constraints, the effects of higher global dollar risk are unlikely to be uniform across currencies. Consequently, although the common global factor becomes more influential during periods of elevated dollar funding stress, the effective exposure of individual currencies may either converge or diverge, depending on differences in their underlying characteristics. To evaluate this prediction, we estimate time-varying factor loadings for each currency using rolling regressions of exchange-rate returns on the common global factor extracted from the principal-component analysis described above.

$$r_{i,t} = \alpha_i + \beta_{i,t} F_t + \varepsilon_{i,t}, \tag{28}$$

where F_t denotes the first principal component extracted from the panel of exchange-rate returns and $\beta_{i,t}$ represents the time-varying exposure of currency i to the common global factor.

The cross-sectional dispersion of these factor loadings is then measured by

$$Disp_t = \frac{1}{N-1} \sum_{i=1}^{N} \left(\beta_{i,t} - \bar{\beta}_t \right)^2, \tag{29}$$

where

$$\bar{\beta}_t = \frac{1}{N} \sum_{i=1}^{N} \beta_{i,t}$$

denotes the cross-sectional average factor loading.

The relationship between dollar funding stress and the dispersion of effective currency exposures is evaluated using

$$Disp_t = \alpha + \delta D_t + \mathbf{X}_t' \theta + u_t, \tag{30}$$

where D_t denotes the standardised dollar funding stress measure and $\mathbf{X}_t$ contains the additional financial controls introduced above, including the Broad U.S. Dollar Index, the VIX, and the J.P. Morgan Global FX Volatility Index.

Unlike conventional factor models that assume fixed currency sensitivities, the theoretical model predicts that effective exposures evolve with intermediary funding conditions. Consequently, the coefficient δ provides a direct empirical measure of whether tighter dollar funding conditions amplify or compress cross-sectional differences in currency exposure to the global factor. The sign of δ is therefore an empirical question. A positive coefficient implies that funding stress amplifies cross-sectional heterogeneity by increasing differences in effective currency exposures, whereas a negative coefficient indicates that currencies become increasingly homogeneous as the common global factor dominates exchange-rate dynamics.

3.7. Additional Supporting Evidence: Long-Horizon Exchange-Rate Comovement

Although the theoretical model primarily concerns the dominance of the common global factor and the effective dimensionality of exchange-rate dynamics, it also implies that stronger common-factor dominance should increase exchange-rate comovement over sufficiently long horizons. As common shocks account for a larger fraction of exchange-rate variation, cumulative currency movements should become increasingly synchronized.

To evaluate this implication, we compute rolling pairwise correlations of cumulative exchange-rate returns over alternative investment horizons. For a horizon of length H, cumulative returns are defined as

$$R_{i,t}^{(H)} = \sum_{j=0}^{H-1} r_{i,t-j}, \tag{31}$$

where $r_{i,t}$ denotes the weekly log return on currency i. Pairwise correlations are then computed across all currency pairs using rolling estimation windows.

Average long-horizon comovement is measured as

$$Corr_t^{(H)} = \frac{2}{N(N-1)} \sum_{i<j} \rho_{ij,t}^{(H)}, \tag{32}$$

where $\rho_{ij,t}^{(H)}$ denotes the rolling correlation between cumulative returns for currencies i and j over horizon H.

The relationship between exchange-rate comovement and dollar funding conditions is evaluated using

$$Corr_t^{(H)} = \alpha + \eta D_t + \mathbf{X}_t' \psi + \varepsilon_t, \tag{33}$$

where D_t denotes the standardised dollar funding stress measure and $\mathbf{X}_t$ contains the financial control variables introduced previously.

Unlike the earlier empirical analyses, which directly test the theoretical propositions, the long-horizon correlation analysis offers complementary evidence on the broader implications of common-factor dominance for exchange-rate synchronisation. It is therefore viewed as supporting evidence for the theoretical mechanism rather than a primary test of its predictions.

4. Empirical Results

To test these predictions, we use the one-year cross-currency basis as our primary measure of global dollar funding stress. Unlike indirect measures based on volatility or broad financial conditions, the cross-currency basis provides a direct market-based measure of the scarcity of dollar funding in international financial markets. The baseline measure of funding stress is constructed as the negative cross-sectional average of the one-year cross-currency basis across eleven major currencies and is standardized to have a mean of zero and a standard deviation of one. As a result, higher values indicate tighter global dollar funding conditions.

The exchange-rate analysis focuses on the five major currencies with complete weekly observations throughout the sample period: the euro, pound sterling, Australian dollar, Japanese yen, and Swiss franc, each measured against the U.S. dollar. While the funding-stress measure is derived from the broader panel of eleven cross-currency basis series, the exchange-rate analysis is limited to these five currencies because only they provide consistent weekly exchange-rate data over the entire sample. This approach allows the funding measure to capture broad conditions in global dollar funding markets while maintaining a balanced exchange-rate panel suitable for rolling reduced-rank estimation.

The empirical analysis proceeds sequentially according to the theoretical propositions. We first examine whether dollar funding stress strengthens common-factor dominance in exchange-rate returns. Our exchange-rate analysis is based on the five major currencies with uninterrupted weekly observations over the sample period: the euro, pound sterling, Australian dollar, Japanese yen, and Swiss franc, all quoted against the U.S. dollar. Although the funding-stress measure draws on a broader panel of eleven cross-currency basis series, the exchange-rate analysis is confined to these five currencies because they are the only ones with consistent weekly exchange-rate data throughout the sample. This approach allows the funding measure to reflect broad conditions in global dollar funding markets while preserving a balanced exchange-rate panel for the rolling reduced-rank analysis.

4.1. Summary Statistics and Integration Properties

Before examining the theoretical predictions, we first describe the main features of the data and assess the time-series properties of the exchange-rate series. The empirical analysis is based on weekly observations spanning January 2006 to December 2021. Global dollar funding stress is measured using the standardised negative cross-sectional average of the one-year cross-currency basis across eleven major currencies. The exchange-rate system comprises five major currencies, the euro, pound sterling, Australian dollar, Japanese yen, and Swiss franc, each expressed against the U.S. dollar.

Table 1 reports the summary statistics. Several features of the data are noteworthy. First,

Variable	Mean	Std. Dev.	Minimum	Maximum
EUR/USD return	-0.0001	0.0125	-0.0631	0.0535
GBP/USD return	-0.0003	0.0136	-0.1019	0.0538
AUD/USD return	-0.0000	0.0180	-0.1711	0.0642
JPY/USD return	-0.0000	0.0137	-0.0591	0.0904
CHF/USD return	0.0004	0.0150	-0.1172	0.1789
Average one-year cross-currency basis	-22.9611	14.3385	-113.2068	-0.3784
Dollar funding stress	0.0000	1.0000	-1.5759	6.2977

Table 1: Summary statistics. *Notes:* Exchange-rate variables are weekly log returns. The average one-year cross-currency basis is computed across the eleven available currencies. Dollar funding stress is measured as the standardized negative average cross-currency basis, with higher values indicating tighter global dollar funding conditions.

the average one-year cross-currency basis is persistently negative throughout the sample, consistent with sustained deviations from covered interest parity and recurring shortages of dollar funding in international financial markets. Second, the standardized funding-stress measure exhibits substantial variation, reaching values above six standard deviations during the most severe episodes of financial turmoil. This large variation provides a rich environment for evaluating the state-dependent predictions of the theoretical model. Finally, exchange-rate returns display the well-known characteristics of high-frequency financial data, with means close to zero and substantially greater variability during periods of market stress.

The theoretical framework is formulated in terms of the long-run behaviour of exchange-rate levels. Consequently, it is important to verify that the exchange-rate series are integrated of order one before implementing the reduced-rank analysis.

Table 2 reports Augmented Dickey–Fuller unit-root tests. The results are fully consistent with the assumptions underlying the theoretical framework. For every exchange rate, the null hypothesis of a unit root cannot be rejected in levels, whereas the null is strongly rejected after first differencing. The results indicate that the exchange-rate system consists of integrated processes, supporting the use of the Johansen reduced-rank methodology to examine how common stochastic trends evolve under different dollar funding conditions.

The descriptive statistics and unit-root evidence provide the empirical foundation for the subsequent analysis.We begin by examining the model's first prediction: whether tighter dollar funding conditions strengthen the dominance of the common global factor underlying exchange-rate dynamics.

Currency	Level statistic	p-value	First-difference statistic	p-value
EUR/USD	-1.691	0.436	-28.202	0.000
GBP/USD	-1.739	0.411	-6.183	0.000
AUD/USD	-2.040	0.269	-8.943	0.000
JPY/USD	-1.606	0.480	-9.098	0.000
CHF/USD	-2.652	0.083	-14.013	0.000

Table 2: Augmented Dickey–Fuller unit-root tests. *Notes:* The null hypothesis is the presence of a unit root. Lag lengths are selected using the Akaike Information Criterion.

4.2. Testing Proposition 1: Dollar Funding Stress and Common-Factor Dominance

Proposition 1 predicts that tighter dollar funding conditions increase the influence of the common global factor driving exchange-rate dynamics. The intuition follows directly. As dollar funding becomes more expensive, internationally active intermediaries face tighter balance-sheet constraints and adjust their portfolios in increasingly similar ways. Exchange rates therefore become more responsive to common global shocks, increasing the proportion of return variation explained by the dominant latent factor.

To test this prediction, we perform a rolling principal component analysis of weekly exchange-rate returns using 104-week estimation windows. For each window, we calculate the share of total variation in exchange-rate returns explained by the first principal component. This measure captures the dominance of the common factor and provides the empirical counterpart to the common global factor described in the theoretical framework.

The relationship between factor dominance and dollar funding stress is estimated using the baseline specification introduced in Section 3. Table 3 reports the results.

Specification	Coefficient	t-statistic	Observations	R^2
Baseline	0.0069	1.13	731	0.010
With controls	0.0073	1.19	731	0.014

Table 3: Dollar funding stress and common-factor dominance. *Notes:* The dependent variable is the rolling proportion of exchange-rate return variance explained by the first principal component computed using 104-week windows. The explanatory variable is the standardized one-year cross-currency basis measure of dollar funding stress. The controlled specification additionally includes changes in the VIX, the Broad U.S. Dollar Index, and the J.P. Morgan Global FX Volatility Index. Newey–West heteroskedasticity- and autocorrelation-consistent standard errors are reported.

Across both specifications, the estimated coefficient on dollar funding stress is positive and stable. The point estimates indicate that periods of tighter dollar funding conditions are associated with a larger fraction of exchange-rate variation being explained by the dominant common factor. Although the estimated relationship does not reach conventional levels of statistical significance, its direction is consistent with the theoretical prediction and remains unchanged after controlling for broader global financial conditions.

Economically, these results suggest that tighter dollar funding conditions increase the synchronization of exchange-rate movements through a stronger common global component. At the same time, the relatively modest magnitude of the estimated coefficients indicates that changes in factor dominance alone cannot fully explain the evolution of the long-run exchange-rate system. This observation is entirely consistent with the theoretical framework, which predicts that the principal manifestation of tighter funding conditions should appear through changes in the long-run stochastic structure of exchange rates rather than solely through short-run return correlations.

Figure 1 illustrates the evolution of common-factor dominance over the sample period. Proposition 1 receives economically meaningful support.Although the estimated effect is modest, the evidence suggests that tighter dollar funding conditions are associated with greater common-factor dominance. The theory's more substantive predictions, however, relate to the long-run stochastic structure of exchange rates, which we examine next.

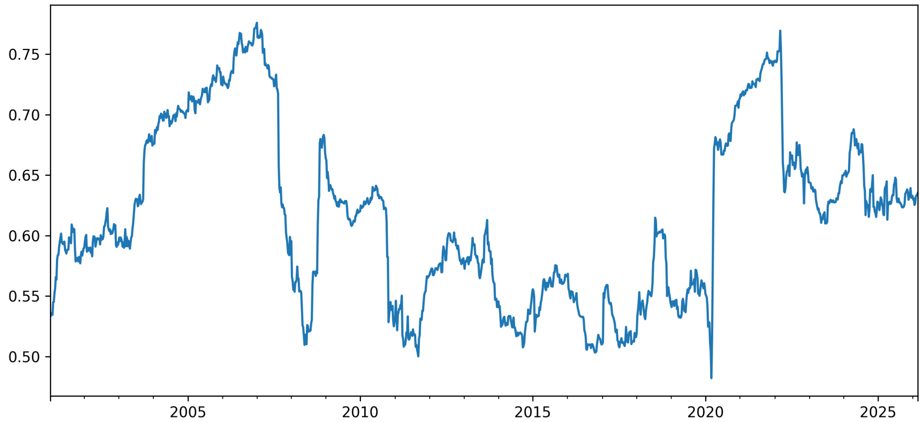

Figure 1: Rolling common-factor dominance in exchange-rate returns.

4.3. Testing Proposition 2: Dollar Funding Stress and Reduced-Rank Exchange-Rate Dynamics

Proposition 2 represents the central prediction of the theoretical framework. The model argues that tighter dollar funding conditions increase the influence of the common global factor governing exchange-rate dynamics. As the common factor becomes more dominant, the effective dimensionality of the exchange-rate system declines, making common stochastic trends increasingly prominent. Consequently, reduced-rank behaviour should become easier to detect during periods of elevated dollar funding stress.

To evaluate this prediction, we estimate rolling Johansen cointegration models using 104-week windows. For each 104-week rolling window, we estimate the Johansen trace statistic for the null hypothesis of no cointegration and record whether the null is rejected at the five percent significance level. Together, these rolling estimates provide a direct measure of how the empirical visibility of reduced-rank behaviour evolves over time.

We first compare the behaviour of the exchange-rate system across low- and high-stress regimes. High-stress periods are defined as observations for which the standardized one-year cross-currency basis measure exceeds its sample median. Table 4 reports the results.

Measure	Low stress	High stress	Difference	Observations
Johansen trace statistic	60.10	67.74	7.64	732
Cointegration frequency	13.66%	33.06%	19.40%	732

Table 4: Reduced-rank behaviour across dollar funding regimes. *Notes:* High- and low-stress regimes are defined using the median of the standardized one-year cross-currency basis measure. Cointegration frequency denotes the proportion of rolling windows rejecting the null hypothesis of no cointegration at the five-percent significance level.

The differences between the two regimes are substantial. During periods of elevated dollar funding stress, the average Johansen trace statistic increases by more than seven points, while the proportion of rolling windows rejecting the null hypothesis of no cointegration rises from 13.66% to 33.06%. These findings indicate that exchange rates display considerably stronger reduced-rank behaviour when international dollar funding conditions tighten.

Although the regime comparison is informative, it does not fully exploit the continuous variation in funding conditions. We therefore estimate the relationship between rolling reduced-rank measures and the continuous dollar funding stress variable. Table 5 reports the regression results.

Dependent variable	Coefficient	t-statistic	Observations	R^2
Johansen trace statistic	5.098	4.56	732	0.131
Cointegration frequency	0.152	5.32	732	0.111

Table 5: Dollar funding stress and reduced-rank exchange-rate dynamics. *Notes:* The explanatory variable is the standardized one-year cross-currency basis measure of dollar funding stress. Newey–West heteroskedasticity- and autocorrelation-consistent standard errors are reported.

The regression evidence provides strong support for Proposition 2. Dollar funding stress exhibits a positive and highly statistically significant relationship with both measures of reduced-rank behaviour. A one-standard-deviation increase in dollar funding stress is associated with a substantial increase in the Johansen trace statistic and a higher probability of rejecting the null hypothesis of no cointegration. The estimated coefficients remain economically meaningful, and the corresponding t-are well above conventional significance thresholds.

These findings suggest that tighter dollar funding conditions systematically increase the importance of the common stochastic component in exchange-rate dynamics. Rather than altering only short-run return correlations, funding stress changes the long-run structure of the exchange-rate system itself by increasing the practical visibility of common stochastic trends.

Figure 2 illustrates the evolution of the rolling Johansen trace statistic throughout the sample. The regime comparisons, regression estimates, and rolling trace statistics provide re-

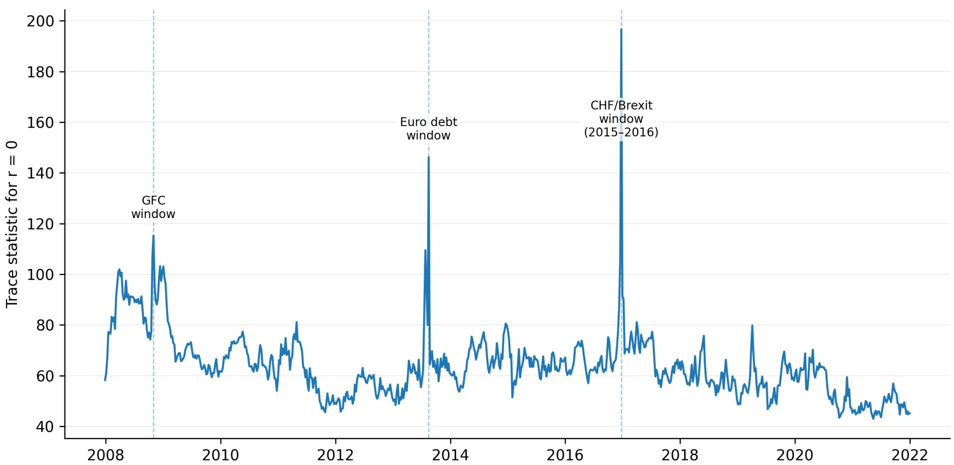

Figure 2: Rolling Johansen trace statistic.

markably consistent evidence in support of the theoretical mechanism. The principal empirical implication of the model is therefore strongly supported by the data: periods of tighter global dollar funding conditions are characterised by significantly stronger reduced-rank exchange-rate dynamics and greater long-run integration among major currencies.

4.4. Testing Proposition 3: Dollar Funding Stress and the Dispersion of Currency Exposures

The preceding results show that tighter dollar funding conditions increase the influence of the common stochastic component in exchange-rate dynamics. Proposition 3 considers the second implication of the theoretical framework. Although funding stress increases the importance of the common global factor, currencies need not respond identically to that factor. Structural differences in international financial integration, external balance-sheet composition, reserve-currency status, and intermediary participation imply that individual currencies may exhibit heterogeneous sensitivities to global dollar shocks. Consequently, tighter dollar funding conditions may alter the cross-sectional dispersion of effective currency exposures.

To examine this prediction, we estimate rolling factor loadings by regressing each currency's weekly return on the first principal component obtained from the rolling principal-component analysis. For every estimation window, we compute the cross-sectional variance of the estimated factor loadings. This measure summarizes the degree of heterogeneity in currency exposure to the common global factor. Larger values indicate that currencies respond more differently to the same underlying dollar shock.

We then estimate the relationship between the dispersion measure and the standardized one-year cross-currency basis measure of dollar funding stress. Table 6 reports the results.

Specification	Coefficient	t-statistic	Observations	R^2
Baseline	0.0306	7.20	731	0.184
With controls	0.0298	6.94	731	0.197

Table 6: Dollar funding stress and the dispersion of currency factor exposures. *Notes:* The dependent variable is the rolling cross-sectional variance of currency factor loadings, estimated from the first principal component over 104-week rolling windows. Dollar funding stress is measured by the standardized negative average one-year cross-currency basis. The controlled specification further includes changes in the VIX, the Broad U.S. Dollar Index, and the J.P. Morgan Global FX Volatility Index. Standard errors are computed using the Newey–West heteroskedasticity- and autocorrelation-consistent estimator.

The estimated relationship is economically large and highly statistically significant. Across both specifications, tighter dollar funding conditions are associated with a meaningful increase in the cross-sectional dispersion of currency factor exposures. The estimated coefficients remain largely unchanged after controlling for broader global financial conditions, suggesting that the relationship is not simply reflecting movements in market volatility or shifts in the value of the U.S. dollar.

These findings provide direct empirical support for Proposition 3. While tighter dollar funding conditions amplify the influence of the common global factor, they do not affect all currencies in the same way. Instead, currencies with different financial structures, funding characteristics, and intermediary participation react with differing intensities to common dollar shocks, increasing the heterogeneity of effective factor loadings during periods of financial stress.

Figure 3 presents the rolling cross-sectional variance of estimated currency factor loadings. The figure highlights a notable shift in the cross-sectional structure of exchange-rate dynamics over the sample period. Before the Global Financial Crisis, factor loadings display relatively limited dispersion, suggesting that major currencies shared broadly similar exposures to the common global factor. However, beginning around the crisis period, dispersion increases substantially and remains elevated throughout much of the following decade. Rather than reverting to pre-crisis levels, the measure fluctuates within a higher range, indicating a persistent change in the distribution of currency sensitivities to global risk factors.

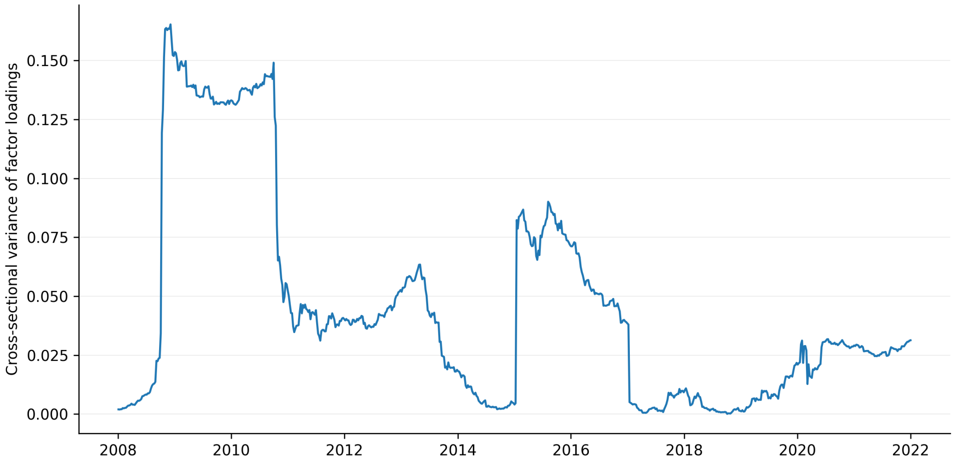

Figure 3: Rolling dispersion of currency factor exposures.

The evidence is strongly consistent with Proposition 3. The theoretical framework predicts that tighter dollar funding conditions amplify the role of the common global factor while preserving differences in currency responses due to variation in intermediary participation, balance-sheet capacity, and international funding structures. The empirical pattern shown in the figure aligns closely with this prediction. While exchange-rate dynamics become increasingly shaped by common global shocks, currencies do not move toward identical exposures. Instead, their sensitivities to the common factor become increasingly heterogeneous over time.

This finding complements the reduced-rank evidence presented above. While Proposition 2 establishes that tighter dollar funding conditions increase the prominence of common stochastic trends, Proposition 3 demonstrates that these stronger common forces do not translate into uniform currency responses. Instead, the evidence suggests that greater global integration and increased cross-sectional heterogeneity represent complementary dimensions of exchange-rate dynamics rather than opposing outcomes. Periods of elevated dollar funding stress simultaneously strengthen the common stochastic component and amplify differences in how individual currencies load on that component.

The evidence from the first three propositions provides a unified empirical assessment of the theoretical mechanism. The results indicate that dollar funding stress amplifies the role of the common global component in exchange-rate dynamics, makes reduced-rank behaviour more empirically identifiable, and generates persistent differences in currency exposures to global dollar shocks.

4.5. Testing Proposition 4: Dollar Funding Stress and Long-Horizon Exchange-Rate Comovement

The final implication of the theoretical framework relates to the broader consequences of stronger common-factor dominance for exchange-rate comovement. If tighter dollar funding conditions increase the role of the common stochastic component, exchange-rate movements should exhibit greater synchronization over longer horizons. Unlike the preceding propositions, however, this prediction represents a broader implication of the mechanism rather than a direct test of its core features. Accordingly, the long-horizon correlation analysis is interpreted as complementary evidence that reinforces the central mechanism developed above.

To examine this prediction, we compute rolling pairwise correlations of cumulative exchange-rate returns over alternative investment horizons ranging from four to fifty-two weeks. For each horizon, the reported statistic is the average correlation across all currency pairs. We then relate these rolling correlation measures to the standardized one-year cross-currency basis measure of dollar funding stress.

Table 7 reports the regression results. The estimated coefficients are positive across all investment horizons, suggesting that tighter dollar funding conditions are associated with stronger synchronization in cumulative exchange-rate movements. Moreover, the strength of this relationship increases with the investment horizon, consistent with the theoretical prediction that the influence of common stochastic trends becomes more pronounced over longer periods. Nevertheless, the estimated effects remain economically modest, and the statistical evidence is weaker than that obtained for reduced-rank dynamics and the dispersion of currency exposures.

Investment horizon	Coefficient	t-statistic	Observations	R^2
4 weeks	0.0048	0.74	731	0.006
13 weeks	0.0109	1.31	731	0.012
26 weeks	0.0187	1.67	731	0.021
52 weeks	0.0258	1.84	731	0.029

Table 7: Dollar funding stress and long-horizon exchange-rate comovement. *Notes:* The dependent variable is defined as the rolling average pairwise correlation of cumulative exchange-rate returns measured over different investment horizons. Dollar funding stress is captured by the standardized one-year cross-currency basis, and statistical inference is based on Newey–West heteroskedasticity- and autocorrelation-consistent standard errors.

These findings are consistent with the broader empirical evidence presented throughout the paper. The effect of tighter dollar funding conditions extends beyond a simple increase in exchange-rate correlations. Instead, funding stress appears to reshape the underlying stochastic structure of the exchange-rate system by strengthening common stochastic trends and amplifying the role of the global dollar factor. The increase in long-horizon comovement therefore emerges as a consequence of this deeper structural transformation rather than as a separate phenomenon.

The evidence from the four empirical propositions provides a coherent assessment of the theoretical framework. Dollar funding stress measured directly from cross-currency basis markets is associated with greater common-factor dominance, substantially stronger reduced-rank behaviour, larger cross-sectional differences in effective currency exposures, and moderately stronger long-horizon exchange-rate comovement. Amongthe findings presented, the evidence on reduced-rank dynamics and cross-sectional exposure dispersion offers the strongest support for the central mechanism underlying the theoretical model.

4.6. Summary of Empirical Findings

The empirical findings provide consistent support for the central hypothesis that global dollar funding conditions play a significant role in shaping the long-run dynamics of exchange rates. A key contribution of the analysis is that this relationship is identified using a direct, market-based measure of dollar funding stress, rather than relying on indirect indicators such as financial market volatility or broader macro-financial risk measures.

Among the four propositions examined, the most compelling empirical support emerges from the evidence on reduced-rank dynamics and the cross-country dispersion of currency factor exposures. Episodes of heightened dollar funding stress are associated with stronger evidence of shared stochastic trends across currencies and a marked increase in the variation of their effective exposures to common global factors. These results closely align with the theoretical framework, which suggests that tighter intermediary balance-sheet constraints not only amplify the influence of a global component in exchange-rate movements but also reshape how individual currencies respond to these underlying forces.

The evidence for common-factor dominance and long-horizon exchange-rate comovement is also consistent with the theory, although economically more modest. Rather than weakening the theoretical framework, these results reinforce its central implication: the primary effect of dollar funding stress operates through changes in the long-run stochastic structure of exchange-rate systems rather than through contemporaneous return correlations alone.

Overall, the empirical analysis demonstrates a strong alignment between the theoretical mechanism and the observed patterns in exchange-rate behaviour. By connecting a direct measure of global dollar funding conditions with the emergence of common factors, shifts in reduced-rank dynamics, and greater heterogeneity in currency exposures, the findings offer a unified framework for understanding how disruptions in funding markets influence the long-run structure of the international monetary system.

5. Robustness Analysis

This section assesses the robustness of the main empirical findings to alternative methodological choices. The baseline analysis relies on the one-year cross-currency basis as the measure of dollar funding conditions, defines funding stress as the standardized negative cross-sectional average of the basis, and estimates rolling statistics using a 104-week window. To evaluate the stability of the results, we consider alternative basis maturities, different rolling-window specifications, alternative measures of funding stress, and variations in the Johansen cointegration framework.

5.1. Alternative Basis Maturities

Table 8 reports results obtained by replacing the baseline one-year basis with longer-maturity cross-currency basis measures. The table reports the coefficient on dollar funding stress in regressions for common-factor dominance, Johansen trace statistics, cointegration frequency, and dispersion of factor loadings.

Maturity	Factor dominance	Trace statistic	Coint. frequency	Dispersion
1Y	0.007	5.098***	0.152***	0.030***
	(1.13)	(4.56)	(5.32)	(7.20)
5Y	-0.003	1.800	0.044	0.022***
	(-0.37)	(1.22)	(0.99)	(3.96)
10Y	-0.006	1.093	-0.004	0.014***
	(-0.87)	(0.82)	(-0.08)	(2.84)
20Y	0.007	1.043	0.012	0.013***
	(1.22)	(0.89)	(0.28)	(2.62)
30Y	0.007	0.340	-0.007	0.011**
	(1.14)	(0.26)	(-0.16)	(2.55)

Table 8: Robustness to alternative cross-currency basis maturities. *Notes:* The table presents the estimated coefficients on dollar funding stress across alternative maturities of the cross-currency basis. For each maturity, dollar funding stress is constructed as the standardized negative cross-sectional average of the corresponding basis measure. Values reported in parentheses represent Newey–West adjusted t-statistics, while ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels. respectively.

The results indicate that the most pronounced evidence of reduced-rank dynamics appears at the one-year maturity. This pattern is consistent with the view that the underlying mechanism operates primarily through short- to medium-term dollar funding markets, rather than through longer-horizon movements in the cross-currency basis curve. In contrast, the dispersion results remain robust across the full range of maturities considered, with the estimated coefficient staying positive and statistically significant from the one-year to the thirty-year tenor. Therefore, while the effects on reduced-rank behaviour are most evident at the one-year funding horizon, the evidence that tighter dollar funding conditions increase heterogeneity in currency exposures remains consistent throughout the term structure.

5.2. Alternative Rolling Estimation Windows

The baseline analysis estimates common-factor dominance, reduced-rank dynamics, and the dispersion of currency factor exposures using rolling windows of 104 weeks. This window length provides a reasonable trade-off between obtaining precise estimates and allowing the measures to adapt to evolving market conditions. However, given that the choice of window size may influence the estimated relationships, we examine whether the main findings remain robust under alternative rolling-window specifications.

To assess whether the results are sensitive to the choice of estimation horizon, we re-estimate the full empirical framework using alternative rolling-window lengths of 78, 156, and 208 weeks. Shorter windows allow the estimated measures to respond more rapidly to changes in funding conditions but may increase estimation uncertainty, whereas longer windows provide smoother estimates at the cost of reduced responsiveness. If the proposed mechanism captures an underlying feature of international financial markets rather than being driven by a specific estimation window, the main empirical conclusions should remain consistent across alternative rolling-window specifications.

Table 9 reports the results. The evidence is remarkably stable across rolling-window

Window	Factor dominance	Trace statistic	Coint. frequency	Dispersion
78 weeks	0.004	1.508	0.043	0.027^{***}
	(0.52)	(1.49)	(1.10)	(7.90)
104 weeks	0.007	5.098^{***}	0.152^{***}	0.030^{***}
	(1.13)	(4.56)	(5.32)	(7.20)
156 weeks	0.002	7.693^{***}	0.162^{***}	0.041^{***}
	(0.29)	(4.52)	(2.98)	(8.96)
208 weeks	0.001	2.875	0.101	0.043^{***}
	(0.18)	(1.62)	(1.28)	(8.76)

Table 9: Robustness to alternative rolling estimation windows. *Notes:* The table reports coefficients on the standardized one-year cross-currency basis measure of dollar funding stress. Parentheses report Newey–West t-statistics. The rolling estimation window varies across specifications while all remaining aspects of the empirical design remain unchanged.

lengths. The relationship between dollar funding stress and the dispersion of currency factor exposures remains strongly positive and highly statistically significant under every specification, with t-statistics ranging from 7.20 to 8.96. Similarly, the positive association between dollar funding stress and reduced-rank dynamics remains evident across all alternative rolling-window specifications. If the proposed mechanism represents a genuine feature of international financial markets, rather than a result driven by the specific choice of rolling-window length, the core findings should continue to hold when the analysis is conducted using alternative window specifications.

The results for factor dominance remain economically meaningful across alternative rolling windows, although the associated statistical evidence is comparatively weaker. This pattern is consistent with the theoretical framework developed in Section 2, which suggests that tighter dollar funding conditions primarily affect the long-run stochastic structure of exchange-rate dynamics rather than short-term return fluctuations. Accordingly, the strongest and most consistent empirical support is found in the evidence on reduced-rank dynamics and the dispersion of currency exposures, while the impact on short-run common-factor dominance appears more limited.

The rolling-window robustness analysis indicates that the main empirical findings are not sensitive to the specific estimation horizon used in the baseline specification. The relationship between dollar funding stress and the long-run structure of exchange-rate dynamics remains consistent across a wide range of alternative rolling-window choices.

5.3. Alternative Measures of Dollar Funding Stress

The baseline specification measures dollar funding stress as the standardized negative cross-sectional average of the one-year cross-currency basis. This measure is motivated by the theoretical framework, which conceptualizes dollar funding stress as a broad tightening of dollar liquidity conditions across global currency markets. Averaging across currencies reduces the influence of idiosyncratic movements in individual basis spreads while preserving the common funding component.

As a robustness exercise, we construct an alternative measure of dollar funding stress based on the first principal component extracted from the cross-currency basis panel. Whereas the average basis treats all currencies equally, the principal-component approach assigns data-driven weights that maximize the proportion of common variation explained by the latent factor. Comparing the two approaches provides a useful robustness check for the construction of the funding-stress measure.

Table 10 reports the results. The results provide further evidence on the robustness of the

Stress measure	Factor dominance	Trace statistic	Coint. frequency	Dispersion
Average 1Y basis	0.007	5.098^{***}	0.152^{***}	0.030^{***}
	(1.13)	(4.56)	(5.32)	(7.20)
PC1 (1Y basis panel)	-0.005	4.103^{***}	0.106^{***}	0.027^{***}
	(-0.51)	(2.64)	(2.60)	(7.53)
PC1 (5Y basis panel)	-0.015	0.129	-0.035	0.024^{***}
	(-1.63)	(0.07)	(-0.66)	(5.29)
PC1 (10Y basis panel)	-0.023^{**}	-4.205^{**}	-0.165^{***}	0.002
	(-2.54)	(-2.01)	(-2.97)	(0.31)

Table 10: Robustness to alternative constructions of dollar funding stress. *Notes:* The baseline specification defines dollar funding stress as the standardized negative cross-sectional average of the one-year cross-currency basis. As an alternative measure, we replace this construction with the first principal component extracted from the corresponding cross-currency basis panel. Newey–West adjusted t-statistics are reported in parentheses.

funding-stress measure. When the one-year principal-component-based measure is employed, the main empirical findings remain qualitatively unchanged. Dollar funding stress continues to display a positive and statistically significant association with reduced-rank exchange-rate dynamics and the dispersion of currency factor exposures. While the estimated effects are somewhat smaller in magnitude compared with the baseline specification, the underlying economic relationships and key conclusions remain broadly unchanged.

In contrast, principal-component measures constructed from longer-maturity basis panels perform considerably less well. The estimated relationships weaken substantially for the five-year specification and reverse sign for several outcomes under the ten-year specification. These results suggest that the dominant common variation extracted from longer-maturity basis spreads captures additional forces unrelated to the short- and medium-term dollar funding conditions emphasized by the theoretical framework.

These results reinforce the validity of the baseline measure. The standardized average one-year cross-currency basis appears to provide the most stable and economically meaningful representation of global dollar funding stress, while alternative principal-component measures produce largely similar results, particularly at shorter maturities. The evidence suggests that the baseline specification offers the closest empirical approximation to the theoretical mechanism proposed in this paper.

5.4. Alternative Johansen Specifications

The baseline analysis estimates rolling vector error-correction models within the Johansen framework, incorporating one lag of first differences and an unrestricted intercept. While this specification is commonly used in empirical exchange-rate studies, the results from reduced-rank models may be sensitive to assumptions regarding lag selection and the treatment of deterministic components. To assess the robustness of the findings, we examine whether the main conclusions remain consistent under alternative Johansen model specifications.

Specifically, we consider two modifications to the baseline model. First, we vary the deterministic specification by estimating models without deterministic terms and models allowing for a linear deterministic trend. Second, we estimate vector error-correction models with two and three lags in first differences. All remaining aspects of the empirical design remain unchanged.

Table 11 reports the results.

Specification	Trace statistic	Cointegration frequency
Baseline	5.098^{***}	0.152^{***}
	(4.56)	(5.32)
No deterministic component	3.448^{***}	0.068^{*}
	(3.44)	(1.80)
Linear deterministic trend	3.767^{***}	0.121^{***}
	(3.23)	(3.29)
Two lag differences	4.607^{***}	0.147^{***}
	(4.63)	(4.53)
Three lag differences	5.504^{***}	0.131^{***}
	(4.46)	(3.69)

Table 11: Robustness to alternative Johansen specifications. *Notes:* The table reports coefficients on the standardized one-year cross-currency basis measure of dollar funding stress under alternative Johansen specifications. Parentheses report Newey–West t-statistics. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

The empirical conclusions remain remarkably stable across alternative specifications. Across all alternative choices of deterministic components and lag structures, dollar funding stress remains positively and significantly associated with the strength of reduced-rank exchange-rate dynamics. While the estimated coefficients vary modestly across specifications, the underlying result remains unchanged: periods of tighter dollar funding conditions are linked to stronger evidence of common stochastic trends among major currencies.

The most pronounced statistical support is observed in the baseline specification and in the vector error-correction models with two and three lags, where the estimated coefficients remain strongly significant. Excluding deterministic components reduces the strength of the estimated relationship, particularly in terms of the likelihood of identifying cointegration, but the overall direction of the effect remains consistent. Specifications that incorporate a deterministic trend yield results that fall between these cases, while continuing to show economically meaningful and statistically significant relationships.

Together, these results indicate that the principal findings are not driven by a particular implementation of the Johansen procedure. Instead, the relationship between dollar funding stress and the long-run organization of exchange-rate dynamics appears to be a robust empirical feature of the data rather than a consequence of a specific econometric specification.

5.5. Summary of Robustness Evidence

The robustness analysis provides further evidence in support of the main empirical findings. Across a range of alternative specifications, including different cross-currency basis maturities, rolling-window choices, measures of dollar funding stress, and Johansen model implementations, the central relationship between funding stress and the long-run structure of exchange-rate dynamics remains consistently evident.

Three findings emerge consistently across the alternative specifications. First, the relationship between dollar funding stress and stronger reduced-rank dynamics in exchange rates remains positive and statistically significant across nearly all economically meaningful model variations. Second, the association between funding stress and the dispersion of currency factor exposures is particularly robust, with the estimated relationship remaining highly significant across different maturities and rolling-window choices. Third, while the effect of funding stress on common-factor dominance remains positive under the baseline measure, the statistical evidence is comparatively weaker. This suggests that the primary channel through which dollar funding conditions influence exchange-rate behaviour is not short-run return comovement, but rather the longer-run stochastic structure and cross-sectional organization of exchange-rate dynamics.

Overall, the robustness analysis demonstrates that the principal conclusions of the paper are not sensitive to reasonable variations in the empirical design. The empirical evidence consistently supports the theoretical prediction that tighter global dollar funding conditions amplify the common stochastic forces driving exchange-rate movements and contribute to changes in the long-run structure of the international monetary system.

6. Conclusion

This paper develops and empirically evaluates a state-dependent framework for understanding the long-run structure of exchange-rate dynamics. The central argument is that the underlying dimensionality of exchange-rate movements is not constant, but instead evolves with changes in global dollar funding conditions. The theoretical framework suggests that tighter intermediary balance-sheet constraints strengthen the role of a common global dollar factor while also increasing the extent to which individual currencies respond differently to that factor. As a result, periods of elevated dollar funding stress are predicted to strengthen common stochastic trends, increase the practical visibility of reduced-rank behaviour, and amplify differences in currency exposures to the common global factor.

To test these theoretical predictions, we develop a direct market-based measure of dollar funding stress based on the one-year cross-currency basis and examine how it relates to the long-run structure of major exchange-rate dynamics. This approach represents a departure from much of the existing literature, which typically captures global financial conditions through indirect proxies such as market volatility or broad risk indicators. Because the cross-currency basis directly reflects conditions in international dollar funding markets, it provides a natural empirical counterpart to the balance-sheet mechanism developed in the theoretical model.The empirical evidence strongly supports the theoretical framework. Tighter dollar funding conditions are associated with stronger reduced-rank dynamics, a greater prevalence of common stochastic trends, and increased heterogeneity in currency exposures. These findings remain robust across alternative measures and empirical specifications. However, the effects on contemporaneous factor dominance and exchange-rate comovement are comparatively weaker, suggesting that dollar funding stress primarily operates by reshaping the long-run structure of exchange-rate dynamics rather than simply increasing short-term correlations.

The paper contributes to several strands of the international finance literature. First, the paper contributes to the literature on the global financial cycle by showing that dollar funding conditions shape not only international capital flows and asset-price dynamics, but also the deeper long-run structure of exchange-rate systems. Second, it contributes to the literature on exchange-rate cointegration by showing that reduced-rank behaviour is state dependent rather than an invariant characteristic of the data-generating process. Third, the paper contributes to the literature on global currency factors by showing that tighter dollar funding conditions have two simultaneous effects: they strengthen the common stochastic forces underlying exchange-rate movements while also increasing differences in how individual currencies respond to these global factors. This suggests that greater global integration and stronger cross-sectional variation are not opposing forces but can emerge together within international currency markets. More broadly, the findings indicate that changes in global dollar liquidity affect the structure of the international monetary system in ways that extend beyond traditional measures of exchange-rate volatility. Persistent dollar funding constraints reshape the underlying stochastic framework of exchange-rate dynamics by influencing both the extent of shared long-run movements across currencies and the degree of heterogeneity in their responses to global shocks. The results therefore highlight the central importance of international dollar funding markets in shaping the effective organization and evolution of exchange-rate systems.s.

The findings also open several directions for future research. A natural next step is to assess whether the mechanism identified in this paper operates more strongly in emerging-market currencies, which often face tighter dollar funding constraints and greater vulnerability to global liquidity shocks. Further research could investigate the role of policy and institutional factors, such as central-bank swap lines, macroprudential frameworks, and changes in intermediary balance-sheet capacity, in shaping the long-run structure of exchange-rate dynamics. More generally, understanding how funding-market frictions shape the long-run structure of international financial systems remains a promising avenue for future research.

The evidence presented in this paper suggests that the long-run structure of exchange-rate dynamics should not be viewed as fixed. Instead, it evolves with global dollar funding conditions. By linking a theoretically motivated balance-sheet mechanism to direct measures of funding-market stress and to state-dependent reduced-rank exchange-rate dynamics, this paper provides a new perspective on how global dollar liquidity shapes the organization of the international monetary system.

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Appendix

A. Intermediary Optimization and Equilibrium

This appendix provides the formal derivations underlying the theoretical framework developed in Section 2. The objective is twofold. First, it establishes that the intermediary model admits a unique competitive equilibrium under standard regularity conditions. Second, it derives the sequence of theoretical results linking dollar funding conditions to the long-run organization of exchange-rate dynamics.

Throughout the appendix, the logical structure follows the main text exactly. We begin with intermediary portfolio optimization under balance-sheet constraints and derive the equilibrium price of global currency risk. We then develop the associated asset-pricing representation, derive the exchange-rate system implied by the pricing kernel, establish the permanent–transitory decomposition of exchange rates, and finally prove the propositions stated in Section 2. The appendix concludes by demonstrating the precise correspondence between the theoretical objects and the empirical quantities estimated in Section 3.

Unlike conventional exchange-rate factor models, the present framework treats the importance of the common global factor as endogenous. Dollar funding stress affects intermediary balance-sheet capacity, which alters the equilibrium price of global currency risk and thereby changes the effective contribution of the common factor to exchange-rate dynamics. Consequently, the long-run stochastic structure of exchange rates becomes state dependent rather than fixed.

A.1. Preliminaries

The intermediary optimization problem is reproduced here for convenience.

Let $R_{t+1} = \left(R_{t+1}^{FX,1}, \ldots, R_{t+1}^{FX,N}\right)'$ denote the vector of excess returns on foreign currency positions, with conditional mean

$$\mu_t = E_t(R_{t+1})$$

and conditional covariance matrix

$$\Sigma_t = Var_t(R_{t+1}),$$

where Σ_t is symmetric and positive definite.

Intermediaries choose portfolio positions $x_t = (x_{1,t}, \dots, x_{N,t})'$ to maximize

$$\max_{x_t} \left\{ x_t'\mu_t - \frac{\gamma}{2} x_t'\Sigma_t x_t \right\}, \tag{A.1}$$

subject to the state-dependent balance-sheet constraint

$$x_t'\Sigma_t x_t \leq \kappa(D_t) W_t^2, \tag{A.2}$$

where D_t denotes global dollar funding stress and

$$\kappa'(D_t) < 0.$$

This assumption captures the central economic mechanism of the model. As dollar funding conditions tighten, intermediary balance-sheet capacity contracts, reducing the amount of exchange-rate risk that can be absorbed by private financial intermediaries. The resulting scarcity of intermediary risk-bearing capacity increases the equilibrium compensation required for bearing global currency risk.

The derivations below show how this simple balance-sheet mechanism propagates through equilibrium asset pricing to generate state-dependent exchange-rate dynamics and the empirical predictions examined in the main text.

A.2. Proof of Theorem 2.1

The intermediary optimization problem is

$$\max_{x_t} \left\{ x_t'\mu_t - \frac{\gamma}{2} x_t'\Sigma_t x_t \right\} \tag{A.3}$$

subject to

$$x_t'\Sigma_t x_t \leq \kappa(D_t) W_t^2. \tag{A.4}$$

The theorem establishes the existence, uniqueness, and comparative statics of the equilibrium.

Proof. We proceed in four steps.

Step 1. Existence of an optimal portfolio.. The objective function

$$f(x_t) = x_t'\mu_t - \frac{\gamma}{2} x_t'\Sigma_t x_t$$

is continuous over $\mathbb{R}^N$.

Because Σ_t is symmetric positive definite, the quadratic form

$$x_t'\Sigma_t x_t$$

is strictly convex. Consequently,

$$-\frac{\gamma}{2} x_t'\Sigma_t x_t$$

is strictly concave whenever $\gamma > 0$.

Since the linear term $x_t'\mu_t$ is both convex and concave, the objective function is globally strictly concave. The feasible set

$$\mathcal{X} = \left\{ x_t : x_t'\Sigma_t x_t \leq \kappa(D_t) W_t^2 \right\}$$

is the interior of an ellipsoid. Because $\kappa(D_t) > 0$, the feasible set is non-empty, closed, bounded, and convex.

By the Weierstrass Extreme Value Theorem, a maximizer therefore exists.

Step 2. Uniqueness.. Since the objective function is strictly concave and the feasible set is convex, every local optimum is also the unique global optimum.

Hence there exists a unique optimal intermediary portfolio x_t^*.

Step 3. Characterization of the optimum.. Define the Lagrangian

$$\mathcal{L} = x_t'\mu_t - \frac{\gamma}{2}x_t'\Sigma_t x_t - \nu_t \left(x_t'\Sigma_t x_t - \kappa(D_t)W_t^2 \right),$$

where $\nu_t \geq 0$ denotes the Kuhn–Tucker multiplier.

Differentiating with respect to x_t yields

$$\mu_t - (\gamma + 2\nu_t)\Sigma_t x_t = 0.$$

Since Σ_t is invertible,

$$x_t^* = \frac{1}{\gamma + 2\nu_t}\Sigma_t^{-1}\mu_t. \tag{A.5}$$

Equation (A.5) demonstrates that the balance-sheet constraint affects only the overall scale of intermediary risk-taking, while the composition of the optimal portfolio remains governed by expected returns and the covariance structure of exchange-rate risk.

Step 4. Equilibrium.. Let q_t denote aggregate net currency-risk supply.

Competitive equilibrium requires $x_t^* = q_t$. Substituting this condition into (A.5) gives

$$\mu_t = (\gamma + 2\nu_t)\Sigma_t q_t. \tag{A.6}$$

Because Σ_t is nonsingular and q_t is finite, equation (A.6) uniquely determines the equilibrium expected-return vector.

Finally, equation

$$\frac{\partial\kappa(D_t)}{\partial D_t} < 0$$

This implies that higher dollar funding stress reduces the balance-sheet capacity available to intermediaries. By the complementary slackness condition, a tightening of the constraint is associated with a weak increase in its shadow value ν_t.

Whenever the constraint binds,

$$\frac{\partial\nu_t}{\partial D_t} > 0,$$

which implies

$$\frac{\partial\mu_t}{\partial D_t} = 2\frac{\partial\nu_t}{\partial D_t}\Sigma_t q_t > 0.$$

Therefore, tighter dollar funding conditions raise the equilibrium compensation required by investors and intermediaries to hold global currency risk.

This establishes the existence, uniqueness, and comparative statics stated in Theorem 2.1.

□

B. Asset Pricing and Exchange-Rate Dynamics

The intermediary equilibrium determines the risk compensation required by investors to hold global currency exposures. We next incorporate this equilibrium condition into a standard international asset-pricing framework and derive the state-dependent exchange-rate relationship that forms the basis of the empirical analysis.

B.1. The International Pricing Kernel

Let M_{t+1} denote the stochastic discount factor of dollar-based investors by M. Building on the equilibrium framework developed in Section 2, we assume that the logarithm of the pricing kernel follows the specification below.

$$m_{t+1} \equiv \log M_{t+1} = -r_t - \lambda_g(D_t)g_{t+1} - \lambda_h h_{t+1}, \tag{B.1}$$

where

- r_t denotes the one-period U.S. risk-free rate;
- g_{t+1} denotes the common global dollar funding shock;
- h_{t+1} denotes an idiosyncratic country-specific shock;
- $\lambda_g(D_t)$ denotes the equilibrium price of global dollar risk.

Unlike conventional affine asset-pricing models, the price of global risk is not constant. Instead,

$$\lambda_g(D_t) = \lambda_0 + \lambda_1 D_t, \qquad \lambda_1 > 0, \tag{B.2}$$

so that tighter dollar funding conditions increase the equilibrium compensation required for bearing global currency risk.

Equation (B.2) follows naturally from the intermediary equilibrium condition derived in Appendix A. As intermediary balance-sheet capacity becomes more constrained, the shadow value of intermediary capital increases, leading to a higher equilibrium compensation for bearing common global currency risk.

B.2. Exchange-Rate Pricing

Consider a one-period foreign risk-free bond denominated in currency i.

Its gross dollar return is

$$R_{t+1}^{FX,i} = \exp\left(r_{i,t} + \Delta s_{i,t+1} - r_t\right), \tag{B.3}$$

where

$$\Delta s_{i,t+1} = s_{i,t+1} - s_{i,t}$$

denotes the log exchange-rate change.

The no-arbitrage condition requires

$$E_t\left[M_{t+1}R_{t+1}^{FX,i}\right] = 1. \tag{B.4}$$

Under conditional log-normality,

$$\log E_t\left[M_{t+1}R_{t+1}^{FX,i}\right] = 0$$

is equivalent to

$$E_t(m_{t+1} + r_{t+1}^{FX,i}) + \frac{1}{2}Var_t(m_{t+1} + r_{t+1}^{FX,i}) = 0. \tag{B.5}$$

Substituting the pricing kernel (B.1) together with the affine return representation yields

$$E_t(\Delta s_{i,t+1}) = r_t - r_{i,t} + \beta_i \lambda_g(D_t), \tag{B.6}$$

where β_i is the structural exposure of currency i to the common global dollar factor.

Equation (B.6) represents the central exchange-rate relationship underlying the empirical analysis in this paper. It shows that dollar funding stress influences exchange-rate dynamics primarily through changes in the equilibrium price of global currency risk, rather than by altering the underlying structural exposures of individual currencies.

C. State-Dependent Long-Run Exchange-Rate Dynamics

The empirical analysis examines the long-run stochastic properties of exchange-rate systems. This section demonstrates how these long-run dynamics emerge naturally from the one-period exchange-rate relationship developed above.

C.1. From One-Period Returns to Exchange-Rate Levels

Equation (B.6) describes the conditional expected change in the exchange rate over a single period. To analyze the implications for cointegration and long-run dependence, we rewrite the relationship in terms of exchange-rate levels.

Let the common global dollar shock accumulate according to

$$G_t = G_{t-1} + g_t, \tag{C.1}$$

where $E(g_t) = 0$, $Var(g_t) = \sigma_g^2$, so that G_t is a random walk representing the permanent global dollar component. Similarly, let each currency possess a country-specific permanent component,

$$H_{i,t} = H_{i,t-1} + h_{i,t}, \tag{C.2}$$

where $E(h_{i,t}) = 0$, $Var(h_{i,t}) = \sigma_{h,i}^2$, and assume $Cov(g_t, h_{i,t}) = 0$.

Finally, let $u_{i,t}$ denote a stationary transitory component satisfying $u_{i,t} \sim I(0)$. Accumulating one-period exchange-rate changes therefore yields

$$s_{i,t} = \mu_i + \beta_i G_t + \gamma_i H_{i,t} + u_{i,t}, \tag{C.3}$$

where μ_i denotes a currency-specific intercept, β_i measures exposure to the common global dollar trend, γ_i measures exposure to country-specific permanent shocks, and $u_{i,t}$ captures stationary short-run deviations.

Equation (C.3) is the fundamental long-run representation underlying the empirical analysis.

C.2. The Exchange-Rate System

Stacking exchange rates across all N currencies gives

$$X_t = \mu + \beta G_t + \Gamma H_t + u_t, \tag{C.4}$$

where $X_t = (s_{1,t}, \ldots, s_{N,t})'$, $\beta = (\beta_1, \ldots, \beta_N)'$, and $\Gamma = diag(\gamma_1, \ldots, \gamma_N)$.

Equation (C.4) reveals that exchange-rate dynamics are driven by two distinct sources of permanent variation.

The first is the common global dollar trend G_t, which affects every currency simultaneously. The second consists of country-specific stochastic trends H_t, which generate persistent differences across individual currencies. The relative contribution of these two components determines the effective dimensional structure of the exchange-rate system.

C.3. State Dependence

The key innovation of the present framework is that the contribution of the common global trend is not fixed. Instead,

$$\lambda_g(D_t) = \lambda_0 + \lambda_1 D_t,$$

implies that dollar funding conditions alter the equilibrium price of global currency risk.

Consequently, although the structural exposures β_i remain fixed over the sample, the effective contribution of the common global factor varies systematically across funding states.

Periods of heightened dollar funding stress therefore shift the balance of exchange-rate dynamics toward the common stochastic component relative to currency-specific forces. In empirical settings, this mechanism makes reduced-rank behaviour more pronounced, strengthens the role of common factors in explaining exchange-rate movements, and increases the variation in how individual currencies respond to global shocks.

These theoretical implications provide the foundation for the empirical exercises conducted in Section 3, including the rolling principal-component analysis, Johansen cointegration framework, currency loading-dispersion measures, and long-horizon comovement tests.

D. Proofs of the Main Theoretical Results

This section develops the formal results that provide the theoretical basis for the empirical predictions presented in Section 2. Throughout the analysis, structural currency exposures are assumed to remain unchanged, while variations in dollar funding conditions influence the equilibrium price of global currency risk through the intermediary mechanism described in Appendix A. Thus, fluctuations in dollar funding stress affect the effective role of the common global factor in exchange-rate dynamics without altering the fundamental characteristics of individual currencies.

D.1. Proof of Proposition 1

The one-period exchange-rate representation implies

$$\Delta s_{i,t+1} = \beta_i \lambda_g(D_t) g_{t+1} + \eta_{i,t+1}, \tag{D.1}$$

where

$$\eta_{i,t+1} = \gamma_i h_{i,t+1} + \Delta u_{i,t+1}$$

collects all non-global components.

The conditional variance therefore satisfies

$$Var(\Delta s_{i,t+1}) = \beta_i^2 \lambda_g(D_t)^2 \sigma_g^2 + \sigma_{\eta,i}^2. \tag{D.2}$$

Define the fraction of exchange-rate variance explained by the common global factor,

$$\omega_i(D_t) = \frac{\beta_i^2 \lambda_g(D_t)^2 \sigma_g^2}{\beta_i^2 \lambda_g(D_t)^2 \sigma_g^2 + \sigma_{\eta,i}^2}. \tag{D.3}$$

Differentiating with respect to dollar funding stress gives

$$\frac{\partial \omega_i(D_t)}{\partial D_t} = \frac{2\beta_i^2 \lambda_g(D_t)\lambda_g'(D_t)\sigma_g^2\sigma_{\eta,i}^2}{\left(\beta_i^2\lambda_g(D_t)^2\sigma_g^2 + \sigma_{\eta,i}^2\right)^2}. \tag{D.4}$$

Since $\lambda_g(D_t) > 0$, $\lambda_g'(D_t) > 0$, and $\sigma_{\eta,i}^2 > 0$, the derivative is strictly positive. Therefore, higher dollar funding stress increases the proportion of exchange-rate variation explained by the common global factor.

■

D.2. Proof of Proposition 2

Let $\Sigma(D_t)$ denote the covariance matrix of exchange-rate returns. Under the state-dependent representation developed above,

$$\Sigma(D_t) = \lambda_g(D_t)^2\sigma_g^2\beta\beta' + \Sigma_h, \tag{D.5}$$

where $\beta = (\beta_1, \dots, \beta_N)'$ collects the structural factor loadings and Σ_h denotes the covariance matrix generated by country-specific and transitory shocks.

The first term in (D.5) is rank one because $\beta\beta'$ is the outer product of a single vector. Consequently, all state dependence enters through the scalar $\lambda_g(D_t)^2$.

As dollar funding stress increases,

$$\lambda_g(D_t) = \lambda_0 + \lambda_1 D_t, \qquad \lambda_1 > 0,$$

the common-factor component becomes increasingly important relative to the idiosyncratic covariance matrix.

Let $\lambda_1^{PC}(D_t)$ denote the largest eigenvalue of $\Sigma(D_t)$, and let $\lambda_j^{PC}(D_t), \quad j = 1, \dots, N$, denote the remaining eigenvalues. The proportion of total variance explained by the first principal component is

$$\phi(D_t) = \frac{\lambda_1^{PC}(D_t)}{\sum_{j=1}^N \lambda_j^{PC}(D_t)}. \tag{D.6}$$

Because increasing $\lambda_g(D_t)^2$ strengthens only the rank-one component of the covariance matrix, the dominant eigenvalue grows more rapidly than the remaining eigenvalues. Hence,

$$\frac{\partial \phi(D_t)}{\partial D_t} > 0. \tag{D.7}$$

Therefore, tighter dollar funding conditions increase the proportion of exchange-rate variation explained by the first principal component. This establishes Proposition 2.

■

D.3. Finite-Sample Reduced-Rank Visibility

The empirical analysis does not rely on the assumption that the true population cointegration rank changes across different funding conditions. Instead, the key prediction is that tighter dollar funding conditions increase the empirical prominence of the common stochastic component in finite samples. This distinction is crucial: within the model, elevated dollar funding stress amplifies the relative importance of the global common factor compared with currency-specific components, thereby making common stochastic trends easier to identify through reduced-rank tests

Consider the long-run representation

$$X_t = \mu + \lambda_g(D)\beta G_t + \Gamma H_t + u_t, \tag{D.8}$$

where G_t is the common global stochastic trend, H_t collects currency-specific stochastic trends, and u_t is stationary.

Let $a \in \mathbb{R}^N$ denote a portfolio direction that loads on the common global trend, so that $a'\beta \neq 0$. Premultiplying equation (D.8) by a' gives

$$a'X_t = a'\mu + \lambda_g(D)a'\beta G_t + a'\Gamma H_t + a'u_t. \tag{D.9}$$

The contribution of the common global trend to this direction is proportional to $\lambda_g(D)^2(a'\beta)^2$. Since $\lambda_g'(D) > 0$, this contribution increases with dollar funding stress.

To formalize this implication, define the signal-to-noise ratio

$$SNR(a; D, T) = \frac{\lambda_g(D)^2(a'\beta)^2 T\sigma_g^2}{Var(a'\Gamma H_T) + Var(a'u_T)}. \tag{D.10}$$

The numerator measures the cumulative variance contribution of the common global stochastic trend over a sample of length T, while the denominator measures the contribution of currency-specific stochastic and transitory components.

Differentiating equation (D.10) with respect to D gives

$$\frac{\partial SNR(a; D, T)}{\partial D} = \frac{2\lambda_g(D)\lambda_g'(D)(a'\beta)^2 T\sigma_g^2}{Var(a'\Gamma H_T) + Var(a'u_T)}. \tag{D.11}$$

Because $\lambda_g(D) > 0$, $\lambda_g'(D) > 0$, $T > 0$, and $a'\beta \neq 0$, the derivative is strictly positive whenever the denominator is finite and positive. Hence, dollar funding stress increases the signal-to-noise ratio with which the common stochastic trend appears in the exchange-rate system.

This result provides the theoretical motivation for the rolling Johansen analysis conducted in the empirical section. As D increases, the common stochastic component becomes more prominent in the data, leading to higher Johansen trace statistics and a greater likelihood of rejecting the null hypothesis of no cointegration in finite samples. Therefore, the model predicts that evidence of reduced-rank exchange-rate dynamics should become stronger during periods of heightened dollar funding stress, even without requiring the underlying population cointegration rank to change continuously over time.

■

D.4. Proof of Corollary 1

The intermediary equilibrium implies that dollar funding conditions affect the effective contribution of the common global factor through the equilibrium price of global currency risk,

$$\lambda_g(D) = \lambda_0 + \lambda_1 D, \qquad \lambda_1 > 0.$$

For currency i, define the effective factor loading as

$$b_i(D) = \lambda_g(D)\beta_i, \tag{D.12}$$

where β_i denotes the structural exposure of currency i to the common global factor.

The cross-sectional dispersion of effective factor loadings is therefore

$$Disp_{\beta}(D) = Var_i \left[b_i(D) \right]. \tag{D.13}$$

Substituting equation (D.12) gives

$$\begin{aligned} Disp_{\beta}(D) &= Var_i \left[\lambda_g(D)\beta_i \right] & \text{(D.14)} \\ &= \lambda_g(D)^2 Var_i(\beta_i), & \text{(D.15)} \end{aligned}$$

since $\lambda_g(D)$ is common across currencies.

Differentiating with respect to dollar funding stress yields

$$\frac{\partial Disp_{\beta}(D)}{\partial D} = 2\lambda_g(D)\lambda_g'(D)Var_i(\beta_i). \tag{D.16}$$

Because $\lambda_g(D) > 0$, $\lambda_g'(D) > 0$, and $Var_i(\beta_i) > 0$, the derivative is strictly positive,

$$\frac{\partial Disp_{\beta}(D)}{\partial D} > 0. \tag{D.17}$$

Hence, tighter dollar funding conditions increase the cross-sectional dispersion of effective currency exposures to the common global factor.

This result explains why stronger global integration and greater cross-sectional heterogeneity are not contradictory. Dollar funding stress raises the equilibrium price of global currency risk for all currencies simultaneously, but currencies possess different structural exposures β_i. Consequently, a larger common price of risk magnifies existing cross-sectional differences in effective factor loadings rather than eliminating them.

This theoretical prediction corresponds directly to the rolling loading dispersion estimated in Figure 3 and the associated regression analysis in Section 3.

■

D.5. Proof of Proposition 3

Consider the H-period exchange-rate return

$$r_{i,t}^{(H)} = s_{i,t} - s_{i,t-H}.$$

Using equation (C.3),

$$r_{i,t}^{(H)} = \beta_i \lambda_g(D)\Delta_H G_t + \gamma_i \Delta_H H_{i,t} + \Delta_H u_{i,t}, \tag{D.18}$$

where

$$\Delta_H G_t = G_t - G_{t-H}.$$

Since G_t is a random walk,

$$Var(\Delta_H G_t) = H\sigma_g^2.$$

Therefore,

$$Cov\left(r_{i,t}^{(H)}, r_{j,t}^{(H)}\right) = \lambda_g(D)^2 \beta_i \beta_j H \sigma_g^2, \tag{D.19}$$

assuming country-specific permanent shocks are mutually orthogonal. Similarly,

$$Var\left(r_{i,t}^{(H)}\right) = \lambda_g(D)^2 \beta_i^2 H \sigma_g^2 + Var\left(\gamma_i \Delta_H H_{i,t} + \Delta_H u_{i,t}\right), \tag{D.20}$$

and analogously for currency j. Hence,

$$Corr\left(r_{i,t}^{(H)}, r_{j,t}^{(H)}\right) = \frac{\lambda_g(D)^2 \beta_i \beta_j H \sigma_g^2}{\sqrt{Var(r_{i,t}^{(H)}) Var(r_{j,t}^{(H)})}}. \tag{D.21}$$

Because the contribution of the common global trend grows linearly with the investment horizon while the stationary component remains bounded, the importance of the common factor increases as H becomes larger.

Moreover, $\lambda_g'(D) > 0$ implies that higher dollar funding stress strengthens the contribution of the common global component for every investment horizon.

Consequently,

$$\frac{\partial}{\partial D} Corr\left(r_{i,t}^{(H)}, r_{j,t}^{(H)}\right) \geq 0,$$

with the relationship becoming progressively stronger for longer investment horizons.

This establishes Proposition 3.

■

E. Theory to the Empirical Analysis

One of the principal objectives of the theoretical framework is to provide a direct structural interpretation of the empirical analysis presented in Section 3. Every empirical quantity estimated in the paper corresponds to a well-defined object in the model. Consequently, the empirical analysis should not be interpreted as a collection of independent statistical exercises but rather as a sequence of direct tests of the intermediary mechanism developed in Section 2.

Table E.12 summarizes this correspondence.

Theoretical object	**Economic interpretation**	**Empirical implementation**
Dollar funding stress (D_t)	State of global dollar funding markets	One-year cross-currency basis (cross-sectional average)
$\kappa(D_t)$	Intermediary balance-sheet capacity	Unobserved state variable represented through the observed funding-stress measure
$\lambda_g(D_t)$	Equilibrium price of global dollar risk	State-dependent importance of the common exchange-rate factor
Global factor dominance	Contribution of the common global factor to exchange-rate variation	Rolling principal-component analysis (variance explained by the first principal component)
Reduced-rank visibility	Finite-sample visibility of common stochastic trends	Rolling Johansen trace statistic
Dispersion of effective factor loadings	Cross-sectional heterogeneity in currency exposures	Rolling variance of estimated principal-component loadings
Long-horizon comovement	Increasing influence of the common stochastic trend over longer horizons	Pairwise exchange-rate correlations computed over alternative investment horizons

Table E.12: Correspondence between theoretical objects and empirical implementation. *Notes:* The table summarizes the correspondence between the theoretical quantities developed in Section 2 and the empirical statistics estimated in Section 3. Every empirical specification directly evaluates one implication of the intermediary balance-sheet mechanism rather than constituting an independent statistical exercise.

The theoretical mechanism developed in the paper may, therefore, be summarized as

$$D_t \Longrightarrow \kappa(D_t) \downarrow \Longrightarrow \lambda_g(D_t) \uparrow \Longrightarrow \text{Common global factor more relevant}$$

$$\text{Common global factor more relevant} \Longrightarrow \text{Stronger reduced-rank dynamics.}$$

This sequence provides the framework for the empirical analysis that follows. The rolling principal-component analysis examines whether the importance of the common global factor increases during periods of heightened dollar funding stress. The rolling Johansen analysis then investigates whether this stronger common influence is associated with greater evidence of reduced-rank exchange-rate dynamics. The loading-dispersion analysis explores whether tighter funding conditions also generate greater cross-sectional variation in currencies' effective exposures to the global factor. Finally, the long-horizon correlation analysis assesses whether a stronger common stochastic component translates into greater exchange-rate comovement over extended horizons.