Not All Dollar Funding Is Equal: Uncovering Economic Exposures of Global FX Funding*

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Abstract

We revisit the question of U.S. dollar (USD) dominance by uncovering the economic exposures of global FX funding. Our analysis uses a proprietary dataset of daily FX-derivative positions for 60 investor groups. From outstanding FX forwards and swaps with precise remaining-maturity information, we estimate investors' direct exposures to FX funding at different horizons. We then link these exposures to the price of FX funding, measured by deviations from covered interest-rate parity (CIP). We show that global funding is not a single unified market. Instead, it is organized into distinct funding segments defined by mutually independent aggregate-demand shocks and mutually independent arbitrage-capacity shocks. Each segment captures a unique type of economic exposure to changing funding conditions. Two segments dominate: (i) a Dollar segment (USD funding vis-à-vis all others) and (ii) a Pan-European segment (EUR and GBP funding vis-à-vis all others). Three insights emerge. First, USD-based CIP deviations are in fact driven by movements in funding conditions in both funding segments. Second, large global banks supply substantial USD funding but diversify by splitting it across the two segments. Third, the relative importance of Pan-European grows at longer horizons. These results nuance the idea of USD dominance, as not all dollar funding entails the same economic exposure.

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1 Introduction

The U.S. dollar (USD) dominates global finance. One manifestation is the strong demand for temporary USD funding. Using foreign exchange (FX) derivatives such as forwards and swaps, non-U.S. investors convert local currencies into USD for the duration of the contract without exchange-rate risks. FX-based synthetic funding (henceforth FX funding) thus provides a critical channel for foreign investors to access USD assets. Not surprisingly, stable FX funding conditions are a priority for monetary authorities. During both the Global Financial Crisis of 2007-09 and the COVID-19 pandemic, the Federal Reserve intervened decisively in the FX funding markets, including by establishing central bank swap lines. The effectiveness of such policies depends crucially on the structure of these markets. Yet with many possible choices of currencies and tenors in FX derivatives, the workings of FX funding markets remain poorly understood.

This paper makes two contributions to understanding global FX funding. First, we develop a new measurement framework that uses outstanding FX swaps and forwards, together with precise remaining-maturity information, to construct investors' direct funding exposures over specific horizons. Applying this framework to a proprietary dataset of daily FX derivative positions from 60 distinct investor groups, we document new facts about global FX funding. Second, we translate these direct exposures into implied economic funding exposures, which we define as exposure to time-varying funding conditions. We do so by jointly considering direct exposures and the price of FX funding, captured by deviations from covered interest-rate parity (CIP): an FX swap effectively borrows one currency while using another as collateral, this hedges out exchange-rate risk, and CIP deviations measure the price of this synthetic funding arrangement relative to borrowing the first currency directly at the risk-free rate. The analysis reveals that global FX funding is not a single unified market but is organized into distinct funding segments defined by mutually independent aggregate-demand shocks and mutually independent arbitrage-capacity shocks. Two segments dominate: (i) a Dollar segment (USD vis-à-vis all others) and (ii) a Pan-European segment (EUR and GBP vis-à-vis all others), each representing a unique type of economic exposure. Our findings nuance the idea of USD dominance: while the dollar is central, not all USD funding entails the same economic exposure. Large banks respond to this segmentation by diversifying their substantial supply of USD FX funding across the two funding segments.

We begin by estimating investors' direct exposures to FX funding and introduce two measurement innovations to fully exploit our novel data. Our proprietary data contains end-of-day aggregates of outstanding FX swap and outright forward positions, disaggregated

by investor group, currency, and maturity bucket, together with the outstanding-amount-weighted average remaining maturity in each bucket. Our first innovation is to incorporate maturity information to construct, from all outstanding positions, the total quantity of currency-specific FX funding over specific horizons. For example, our 1-month USD measure aggregates (i) all 1-month positions, (ii) the full contribution of longer-maturity positions whose remaining life spans the next month, and (iii) the pro-rata share of shorter-maturity positions that overlap the month. This roll-down mapping recovers each investor's total balance-sheet exposure relevant for pricing at that horizon. Empirically, same-tenor positions contribute only about a quarter of the total exposure at a given horizon. Our second innovation is to include both FX forwards and swaps to estimate the total FX funding. Although end users may enter an outright forward (which specifies only an exchange at contract's expiration) to hedge or to speculate, the counterparty typically hedges the FX risk at initiation by combining the forward with an offsetting spot trade. This leaves the same net funding exposure as an otherwise identical swap. Hence, forwards, like swaps, add to direct FX-funding exposure, an implication formalized in recent models (Dao, Gourinchas, and Itskhoki, 2025; De Leo, Keller, and Zou, 2025). Empirically, forwards are sizable: notionals are roughly one quarter of swap notionals, and large global banks are especially active in FX forwards. Accordingly, our measure of direct FX funding exposure materially improves on approaches that count only same-tenor swaps.

An important insight from our direct measures of FX funding is that investors have preferred-habitats. For the average investor, a single "top" currency accounts for about 70% of total FX funding demand and about 80% of total FX funding supply. This pattern is true for both banks and customers and holds across funding horizons. Moreover, different investors demand and supply different currencies. Looking at each investor's modal currency, USD is the most demanded currency for about 75% of customers but only 25% of banks; on the supply side, USD is modal for about 20% of customers and 50% of banks. In short, most investors concentrate in one currency, but the identity of that currency varies systematically across investors and between the demand and supply sides.

Arbitrageurs must be active in global FX funding to reconcile the preferred-habitat patterns in direct exposure with the well-known co-movement in the relative price of USD funding, reflected in CIP deviations and measured by cross-currency basis. However, whereas the standard preferred-habitat framework (Vayanos and Vila, 2021) assumes that arbitrageurs jointly optimize across all habitats under a single pricing kernel, our data suggest possible segmentation even among arbitrageurs. Indeed, segmented funding exposures are observed among all investors, including banks, the key intermediaries and natural arbitrageurs in FX funding. More importantly, a principal component analysis (PCA) of cross-currency *changes*

in CIP deviations reveals economically meaningful components beyond the first. Differences in levels can be rationalized by differences in funding costs (Diamond and Van Tassel, 2024), but systematic differences in changes point to the presence of distinct drivers of funding conditions across currencies.

We argue that considerations for changing funding conditions are important determinants of FX funding supply and demand. Consider an investor who supplies 1-month USD funding against EUR via an FX swap today. She locks in an exchange rate determined by the USD risk-free rate and the contemporaneous USD/EUR cross-currency basis. Over the next month, however, the USD/EUR basis can move because of changes in aggregate demand for USD/EUR funding or in arbitrageurs' capacity to intermediate.[1] If the basis widens before maturity, the position suffers a mark-to-market loss even though the rate was locked in at inception, because the investor has forgone the opportunity to earn the now higher basis on her scarce dollar capacity. Consequently, time-varying funding conditions must be a first-order consideration when deciding whether to demand or supply funding. Consistent with this view, Du, Hébert, and Huber (2023) show that changing intermediary constraints, i.e., time-varying funding conditions, is a salient priced risk factor in the cross section of assets.

Our aim is to identify the independent funding segments of global FX that reflect distinct sources of variation in funding conditions and—crucially—constitute economic exposures that investors actually bear. A simple PCA of CIP deviations is insufficient, because its components may not correspond to funding conditions with meaningful investor exposure. For example, the second principal component from a simple PCA resembles a "carry trade" that uses AUD and NZD to synthetically fund USD (or vice versa). Yet our estimated direct-exposures show very limited demand and supply for such trades. This is intuitive: FX funding carries no exchange rate risks and therefore does not deliver carry-trade returns. The example underscores the need to incorporate direct exposures when identifying funding conditions that matter for investors. We therefore extend An and Huber (2025) by analyzing investors' direct FX-funding exposures jointly with the cross-section of CIP deviations. This combined price-and-quantity approach isolates the funding segments that investors actually demand and supply. By construction, these segments have mutually independent shocks to aggregate demand and mutually independent shocks to arbitrage capacity, so each segment represents a distinct exposure to time-varying funding conditions.

Empirically, two segments dominate: the Dollar (vis-à-via all others), and Pan-European (via-à-vis all others). The Dollar segment reflects broad USD-funding demand across cur-

[1] Arbitrageur capacity may be limited by regulation or fixed balance sheet size and changes with shifts in investment opportunities that draw on arbitrageurs' limited dollar supply.

rencies. The Pan-European segment reflects demands for EUR and GBP funding primarily against JPY, with a smaller USD contribution. Indeed, the EUR-JPY basis moves nearly one-for-one with this segment's price. Not only is a Carry-looking funding segment absent but Carry currencies also play little role in the two most important funding segments: changes in these currencies' CIP deviations have near-zero covariance with the two segments'. This absence suggests that the determinants of cross-sectional spot exchange rate movements can differ from those of global FX funding prices.

The decomposition of global FX funding into two independent funding segments provides three insights. First, we show that CIP deviations are not barometers of funding tightness in USD alone. Take the USD/EUR basis as an example, its movements in fact reflect funding condition changes in both the Dollar and Pan-European segments. At the 1-month horizon, movements in the USD/EUR basis are about 94% driven by the Dollar segment and 5% by the Pan-European segment. This split shifts to 77% vs. 18% at the 1-year horizon. Moreover, the USD/AUD basis reflects funding condition changes in neither segment. These patterns underscore that the economic forces driving CIP deviations are horizon dependent and segment specific.

Second, because the two funding segments face independent shocks to funding conditions, splitting exposure across the two segments delivers diversification, and global banks do so in practice. We find that the Dollar segment shows recurrent spikes at stress points and quarter-ends, whereas the Pan-European segment alternates between positive and negative phases, sometimes moving opposite to the Dollar segment at quarter-ends and sometimes in the same direction during global stress episodes such as early 2020. As such, although US-headquartered banks supply much of the USD funding demanded by other investors, they do not channel all of this activity through through the Dollar segment. Instead, they allocate part of their balance sheet to the Pan-European segment, thereby diversifying across segments whose shocks are uncorrelated. This diversification helps banks manage exposure to shifting funding conditions during periods of sustained, large, one-sided funding imbalances.

Finally, the two funding segments provide a clean gauge of the relative dominance of Dollar versus Pan-European funding demand. Comparing total economic exposures across all investors, the Dollar segment averages about 70% of combined activity. However, this dominance declines with funding horizons: roughly 75% at 1M and 3M, falling to around 65% at 6M and 1Y. There is also notable time-series variation, whereby dollar dominance dipped around 2016, possibly related to the U.S. money-market fund reform that tightened access to dollar funding. Taken together, our findings nuance the idea of dollar dominance. The dollar remains central to global funding, but it is also not just about demand for dollar funding. Global FX demand and supply operate through independent funding segments,

and investors' economic exposures depend on which segment they access.

This paper contributes to three related strands of the literature: (i) the study of FX funding and CIP deviations, (ii) the broader literature on global capital flows, and (iii) the inquiry into dollar dominance. The first strand concerns FX funding, particularly research on CIP deviations. Early studies document the post-2008 breakdown of CIP and link it to arbitrage constraints faced by intermediaries (e.g., Du, Tepper, and Verdelhan, 2018; Cenedese, Della Corte, and Wang, 2021). More recent work leverages granular quantity data to broaden the drivers of CIP deviations. For example, Kloks, Mattille, and Ranaldo (2024) show that demand for FX swaps at quarter-ends can be driven by regulation-induced substitution away from wholesale funding, which widens CIP deviations. Dao, Gourinchas, and Itskhoki (2025) and De Leo, Keller, and Zou (2025) show that speculative demand for FX forwards to harvest interest-rate carry also moves the cross-currency basis. Our contribution is twofold. First, we provide an improved measure of the quantity relevant for CIP deviations: investors' direct exposure to FX funding at a given horizon, which aggregates both forward and swap positions across maturities. Second, we link this direct exposure with CIP deviations to uncover the *economic exposures* investors bear in FX funding. This notion of economic exposure—measuring the amount of exposure to time-varying funding conditions in the sense of Du, Hébert, and Huber (2023)—is distinct from the bank-level risks in executing CIP arbitrage, such as maturity mismatches or risky-asset holdings, emphasized by Moskowitz, Ross, Ross, and Vasudevan (2025).

Beyond CIP deviations, this paper relates to the broader literature on global capital flows, such as Maggiori, Neiman, and Schreger (2020), Coppola, Maggiori, Neiman, and Schreger (2021), and Du, Fontana, Jakubik, Koijen, and Shin (2023). At a high level, cross-border capital flows take two forms: one involves direct currency exchange, which is exposed to exchange-rate risk; the other uses FX derivatives to obtain funding in one currency against another for a finite horizon, which by construction eliminates exchange-rate risk. The FX-hedged channel has grown increasingly important since the 2008 crisis (Du and Huber, 2025), and is the focus of this paper. Our results show that global capital flows are not solely USD-centric. Flows into and out of the Pan-European currencies constitute another key driver. This finding offers a new perspective on the international role of the euro (European Central Bank, 2025), highlighting its function not only in invoicing and reserves but also as a funding currency: together with GBP, it anchors a Pan-European funding segment that becomes especially important at longer horizons.

In so doing, we also connect to the inquiry into dollar dominance. The U.S. dollar is the predominant currency in trade invoicing (e.g., Gopinath, Boz, Casas, Díez, Gourinchas, and Plagborg-Møller, 2020) and in debt denomination (e.g., Coppola, Krishnamurthy, and

Xu, 2023), giving USD a unique role in the transmission of shocks (e.g., Miranda-Agrippino and Rey, 2020; An and Huber, 2025). We focus on the dollar's pre-eminence in FX-based synthetic funding, which is central to its role in both trade and finance. Our central result is that not all dollar funding entails the same economic exposure; rather, the global FX funding market comprises independent funding segments.[2] Our finding rationalizes global banks' large, sustained, and one-sided imbalances in USD funding: they diversify by participating in two independent funding segments.

The next section describes the data. Section 3 constructs measures of direct exposure, and Section 4 documents key facts about those measures. Section 5 combines direct exposures with price data to construct economic exposures via independent funding segments, and Section 6 presents the three main findings from these economic exposures. Section 7 concludes.

2 Data

We outline the data used to measure prices and quantities in global FX funding markets. Throughout, the U.S. dollar (USD) is the numeraire: exchange rates are expressed as number of foreign currencies per USD, and quantities are measured in USD.

2.1 Price Data

Consider an investor who needs funding in currency n at date t for τ months and uses USD as collateral. At t, she enters an FX swap: sell USD for n at the spot rate $S_{n,t}$ and agree to buy back USD by delivering n at $t+\tau$ at the forward rate $F_{n,t,t+\tau}$. Let $R_{\$,t,\tau}$ and $R_{n,t,\tau}$ denote gross risk-free rates in USD and n from time t to $t+\tau$. The annualized rate to synthetically borrow 1 unit of currency n using USD is

$$R^{\text{syn}}_{n,t,\tau} \;:=\; R_{\$,t,\tau}\left(\frac{F_{n,t,t+\tau}}{S_{n,t}}\right)^{12/\tau}, \tag{1}$$

where $12/\tau$ annualizes forward points. Covered interest-rate parity (CIP) deviations measure the price of synthetic funding $R^{\text{syn}}_{n,t,\tau}$ relative to borrowing currency n directly at the risk-free rate $R_{n,t,\tau}$, expressed in log differences:

$$P_{n,t,\tau} \;:=\; \ln R^{\text{syn}}_{n,t,\tau} - \ln R_{n,t,\tau}. \tag{2}$$

[2]Our segmented funding markets may seem reminiscent of Siriwardane, Sunderam, and Wallen (2025), who document low correlations across arbitrage spreads in equity, fixed-income, and FX markets. The key distinction is that segmentation in our setting arises from distinct economic exposures, not from frictions that limit arbitrage across equally profitable opportunities.

In a frictionless market satisfying CIP, $P_{n,t,\tau} = 0$, i.e., there is no markup of synthetic funding relative to direct funding. In the data, a negative $P_{n,t,\tau}$ means synthetically funding a foreign currency using USD is cheaper than directly borrowing that foreign currency, which reflects a "USD premium," as documented in post-crisis episodes (Du, Tepper, and Verdelhan, 2018).

Similarly, for any two non-USD currencies n and n', the price of demanding currency n funding and supplying currency n' funding is defined by the triangular arbitrage:

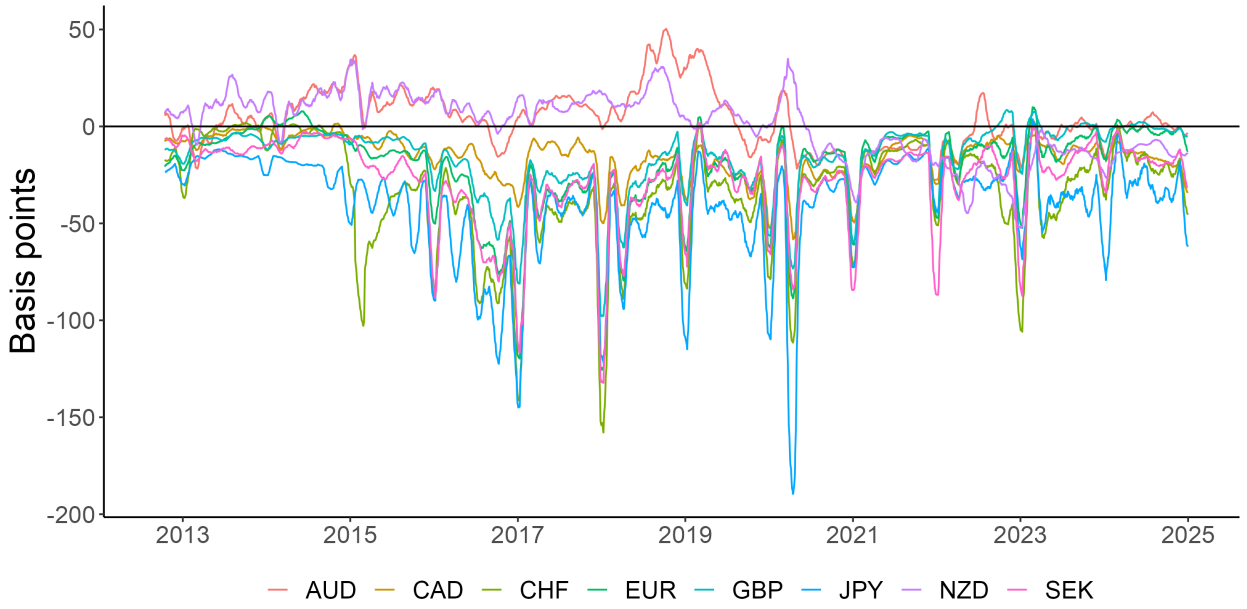
$$P_{n,n',t,\tau} = P_{n,t,\tau} - P_{n',t,\tau}. \tag{3}$$

We obtain spot and forward FX rates from Bloomberg. To measure risk-free discount rates we use Overnight Indexed Swap (OIS) rates, following Du, Hébert, and Huber (2023). OIS is the appropriate benchmark for CIP because it reflects collateralized overnight funding with minimal bank-credit and scarcity premia, whereas LIBOR embeds bank credit/liquidity risk (also discontinued around 2021) and Treasury yields can be distorted by specialness and regulatory demand. OIS quotes are available for the USD and eight non-USD currencies: Australian dollar (AUD), Canadian dollar (CAD), Swiss franc (CHF), euro (EUR), British pound (GBP), Japanese yen (JPY), New Zealand dollar (NZD), and Swedish krona (SEK).

A contribution of this paper is to construct a continuous OIS-based series of CIP deviations that spans the CHF and EUR reference-rate transitions. Because these transitions induce level shifts, many studies restrict CHF and EUR samples to single-reference subperiods. We instead splice the pre- and post-transition segments using the overlap window to align levels at each tenor, yielding a single continuous series.

Our sample runs from September 2012 through December 2024, with the start date dictated by the availability of the quantity data described below. To span short- and long-tenor funding, we study 1-month (1M), 3-month (3M), 6-month (6M), and 1-year (1Y) tenors. Figure 1 plots $P_{n,t,1\mathrm{M}}$, the 1M price of demand funding in currency n by supplying USD funding for each non-USD currency n, as defined in (2). To reduce high-frequency noise, the series are shown as 30-day moving averages. We observe pronounced comovement across currencies, consistent with tightly connected FX funding markets exposed to common supply- and demand-side shocks. Results for other tenors are similar and omitted for brevity.

Figure 1: Price of FX funding across currencies ($P_{n,t,1\text{M}}$) at 1-month tenor



Notes: This figure plots $P_{n,t,1\text{M}}$, the 1M price of obtaining funding in currency n by supplying USD funding for each non-USD currency n. Positive values indicate that borrowing USD synthetically via currency n is cheaper than direct USD funding; negative values indicate the reverse.

2.2 Quantity Data

Our quantity data come from the CLS Group (CLS), which settles FX trades for 72 settlement members, primarily large multinational banks.[3] As the largest single source of FX execution data, CLS covers over 50% of global FX volumes.

We use CLS daily aggregates of outstanding FX swap and forward positions; Section 2.3 shows why including forwards, rather than swaps alone, is essential. Each trading day, CLS reports end-of-day gross outstanding notional buys and sells by investor type and location (details on investor taxonomy below). Concretely, for each investor-type-location × currency pair × maturity bucket × trading day, we observe (i) the total outstanding notional on the buy and sell sides against all counterparties (including those in the same investor category) and (ii) the outstanding-amount-weighted average remaining maturity within that bucket.[4]

Tracking remaining maturity is essential for mapping outstanding quantities to direct ex-

[3] A list of settlement members is available at https://www.cls-group.com/communities/settlement-members/.

[4] CLS defines remaining maturity as the number of calendar days from the current date to the settlement date of the far leg, which is typically two business days after the contractual far date. The maturity buckets are: tomorrow-next and spot-next (overnight variants with remaining maturity ≤ 3 days), 1 week (4-9 days), 1 month (10-33 days), 3 months (34-94 days), 6 months (95-185 days), 1 year (186-368 days), and longer ($\geq$ 369 days).

posure to FX funding for a given funding horizon. For example, a six-month EUR borrowing via USD initiated at date t rolls down to a three-month exposure after three months and should load on the three-month rather than the six-month FX-funding price. In Section 3 we show that this roll-down of existing positions accounts for a sizable share of the total exposures.

The raw CLS panel spans 17 currencies from September 2012 to December 2024; for consistency with our price benchmarks, we restrict the analysis to the nine currencies with OIS curves.[5] We convert pair-level positions into currency-level funding demand and supply. Specifically, any position that borrows currency n against any currency n' is classified as demand for funding in n; the opposite direction is supply of n'. For example, positions in EUR/JPY or EUR/USD that borrow EUR are counted as demand for EUR funding; the offsetting legs supply JPY or USD, respectively. All quantities are expressed in USD billions using contemporaneous spot rates, consistent with our USD-numeraire convention.

We classify investors into three groups: (i) banks that settle with CLS, (ii) banks that do not settle with CLS, and (iii) customers. For CLS-settling banks, we observe both the physical location and the headquarter country, so we index groups by $Bank_{Loc}^{HQ}$, where $Loc, HQ \in \{US, EZ, UK, JP, AU, CH, CA, ROW\}$ corresponding to United States (US), Euro Zone (EZ), United Kingdom (UK), Japan (JP), Australia (AU), Switzerland (CH), Canada (CA), and Rest of World (ROW). For example, $Bank_{US}^{UK:HQ}$ denotes banks located in the United States but headquartered in the United Kingdom. For non-CLS-settling banks, headquarters is not observed, so we write $Bank_{Loc}^{other}$ (e.g., $Bank_{US}^{other}$). For customers, only location is observed, and we write $Customer_{Loc}$ (e.g., $Customer_{US}$).

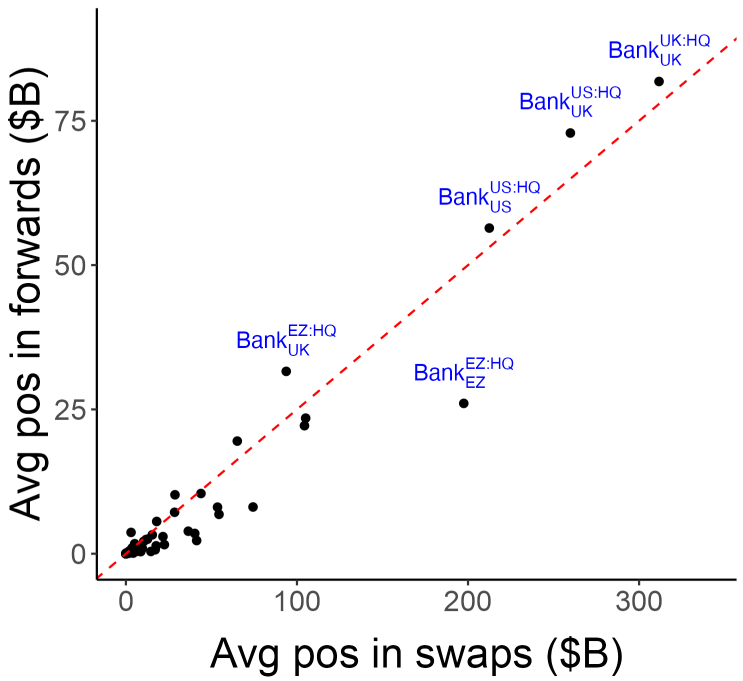
2.3 How Swaps and Forwards Contribute to FX Funding

This subsection explains why both FX swaps and outright forwards belong in our measure of FX funding, and measures their relative importance.

An FX swap consists of a near-date exchange of the two currencies at the spot rate together with a reverse exchange at $t+\tau$ at a forward rate fixed today. An outright forward has only the far leg: the two currencies are exchanged at $t+\tau$ at a rate agreed at t. Hence, an outright forward can be written as an FX swap plus an offsetting spot trade. The offsetting spot leg carries no funding over the horizon; the swap leg embodies the borrowing/lending between the two currencies. Therefore, a forward contributes to FX funding one-for-one with an otherwise identical swap of the same direction and horizon.

[5]The full CLS currency list comprises the nine OIS currencies plus Danish krone (DKK), Hong Kong dollar (HKD), Israeli new shekel (ILS), Korean won (KRW), Mexican peso (MXN), Norwegian krone (NOK), Singapore dollar (SGD), and South African rand (ZAR).

Figure 2: Swaps versus forwards by investor group and tenor



Notes: Each dot represents an investor-type-location group. The axes display the time-series mean of end-of-day outstanding gross notionals, with swaps on the x-axis and forwards on the y-axis, averaged across all currencies at the 1M tenor. Labeled points identify the largest groups by average notional.

One may argue that end-users may transact forwards to hedge or speculate rather than to obtain funding per se (e.g., exchange-rate appreciation/depreciation views; see Shin, Wooldridge, and Xia, 2025). However, the counterparty that intermediates the forward typically hedges FX risk with a spot trade, stripping out exchange-rate risk and leaving the same funding exposure as a swap. Consequently, from the perspective of direct balance-sheet exposures, forwards demand the same funding capacity as swaps.

To gauge the quantitative importance of swaps versus forwards, Figure 2 plots, for each investor-type-location group, the time-series average of end-of-day outstanding gross notionals in swaps (x-axis) and forwards (y-axis) at the 1M tenor. Results for other tenors are similar and omitted for brevity. Two facts emerge. First, larger investor groups use both instruments more, with points lying close to a line through the origin, showing that forward usage scales roughly proportionally with swap usage. Second, on average, about 80% of FX funding is executed via swaps and about 20% via forwards. Forwards therefore account for a material share of FX funding and should not be ignored by analyses that focus solely on swaps.

3 Constructing Direct Exposures

In this section, we map the raw outstanding positions into direct exposures to FX funding and document their time-series properties.

Our objective is to recover the exposures relevant for pricing at a given funding horizon. Positions at longer maturities continue to occupy balance-sheet capacity within shorter horizons as they roll down. Thus, even if an investor has no outstanding 1-month position today, a previously entered 3-month USD borrowing still spans the next month and contributes to the 1-month horizon during that window. Accordingly, our direct exposures over a funding horizon τ aggregates outstanding contracts across all remaining maturities, weighting each position by the share of its life that overlaps $[t, t+\tau]$. This roll-down mapping aligns quantities with the horizon-specific price $P_{n,t,\tau}$ and avoids the mismeasurement that would result from looking only at contracts with tenor τ.

For investor group i demanding funding in currency n on date t, the horizon-τ direct exposure is

$$\mathcal{E}^D_{i,n,t,\tau} := \sum_{m\in\{1\text{W},1\text{M},3\text{M},6\text{M},1\text{Y},\text{Longer}\}} O^D_{i,n,t,m}\,\mu^D_{i,n,t,m}(\tau), \quad \mu^D_{i,n,t,m}(\tau) := \frac{\min\{\tau,\, M^D_{i,n,t,m}\}}{\tau} \in [0,1], \tag{4}$$

where m indexes the maturity buckets, $O^D_{i,n,t,m}$ is the end-of-day outstanding total notional on the demand side in bucket m, and $M^D_{i,n,t,m}$ is the corresponding outstanding-amount-weighted remaining maturity. The weight $\mu^D_{i,n,t,m}(\tau)$ captures the share of each position's remaining life that overlaps the horizon $[t, t+\tau]$: it equals 1 when the remaining maturity exceeds τ and scales linearly otherwise. Intuitively, a 1-month contract contributes 1/12 to the 1-year direct exposure, whereas a 1-year contract contributes fully (weight 1) to the 1-month direct exposure. We construct the supply side exposure analogously, $\mathcal{E}^S_{i,n,t,\tau} = \sum_m O^S_{i,n,t,m}\,\mu^S_{i,n,t,m}(\tau)$; the net exposures are $\mathcal{E}_{i,n,t,\tau} = \mathcal{E}^D_{i,n,t,\tau} - \mathcal{E}^S_{i,n,t,\tau}$.

To quantify how maturity bucket m contributes to horizon-τ direct exposure, define the market-weighted share on the demand side:

$$\text{Share}_m(\tau) := \frac{\sum_{i,n,t} O^D_{i,n,t,m}\,\mu^D_{i,n,t,m}(\tau)}{\sum_{i,n,t} \mathcal{E}^D_{i,n,t,\tau}}. \tag{5}$$

The numerator aggregates, across investors i, currencies n, and dates t, the portion of horizon-τ demand exposure attributable to contracts in maturity bucket m; the denominator is total horizon-τ demand exposure. By market clearing, the corresponding supply-side shares are the same, so we report demand-based shares only. By construction, $\sum_m \text{Share}_m(\tau) =$

Table 1: Contribution of maturity buckets m to horizon-τ direct exposure

Maturity bracket	1M Funding	3M Funding	6M Funding	1Y Funding
1W	2%	1%	1%	1%
1M	26%	14%	11%	9%
3M	45%	44%	35%	29%
6M	14%	22%	24%	21%
1Y	9%	14%	21%	26%
longer	3%	5%	8%	14%

Notes: Rows are CLS maturity buckets $\{1\text{W}, 1\text{M}, 3\text{M}, 6\text{M}, 1\text{Y}, \text{Longer}\}$; columns are funding horizon $\{1\text{M}, 3\text{M}, 6\text{M}, 1\text{Y}\}$. Each cell is the market-weighted share (percent) of horizon-τ exposure accounted for by bucket m, aggregated over all investor groups i, currencies n, and dates t.

1.

Table 1 reports the market-weighted shares $\text{Share}_m(\tau)$ by maturity bucket m (rows) and funding horizon τ (columns). Two facts stand out. First, diagonal entries ($m = \tau$) are small—26% (1M), 44% (3M), 24% (6M), and 26% (1Y). Second, off-diagonal contributions are large; for example, the 3M bucket accounts for 45% of the 1M direct exposure. Thus, using only same-tenor contracts (e.g., 1M positions for 1M funding) misses more than half of the relevant quantity. Correct measurement requires the roll-down mapping in (4), which translates outstanding positions into horizon-τ exposures.

Next, we study what drives day-to-day changes in net direct exposure $\mathcal{E}_{i,n,t,\tau}$. These changes have two components: (i) the *aging* of existing positions as remaining maturities shorten, and (ii) *new* positions initiated between t and $t+1$ (the component typically observed in transaction-flow data). Empirically, new trading (ii) explains a substantial share of daily variation but not all—the remainder reflects the impact of aging. Therefore, the quantity relevant for horizon-τ pricing must track both components via our measure $\mathcal{E}_{i,n,t,\tau}$, rather than relying solely on transaction flows for new positions.

Define the counterfactual next-day net exposure if no new trades occur and all positions simply age by one day as

$$\widehat{\mathcal{E}}_{i,n,t+1|t,\tau} \;:=\; \sum_m O^D_{i,n,t,m}\,\mu^{D,\text{age}}_{i,n,t,m}(\tau) \;-\; \sum_m O^S_{i,n,t,m}\,\mu^{S,\text{age}}_{i,n,t,m}(\tau), \tag{6}$$

with aging weights

$$\mu^{D,\text{age}}_{i,n,t,m}(\tau) = \frac{\min\{\tau,\,(M^D_{i,n,t,m}-1)_+\}}{\tau}, \qquad \mu^{S,\text{age}}_{i,n,t,m}(\tau) = \frac{\min\{\tau,\,(M^S_{i,n,t,m}-1)_+\}}{\tau}, \tag{7}$$

where $(x)_+ = \max\{x, 0\}$ ensures positions that mature between t and $t+1$ contribute zero at $t+1$.

The aging and new components are then

$$\Delta\mathcal{E}^{\text{age}}_{i,n,t+1,\tau} := \widehat{\mathcal{E}}_{i,n,t+1|t,\tau} - \mathcal{E}_{i,n,t,\tau}, \tag{8}$$

$$\Delta\mathcal{E}^{\text{new}}_{i,n,t+1,\tau} := \mathcal{E}_{i,n,t+1,\tau} - \widehat{\mathcal{E}}_{i,n,t+1|t,\tau}, \tag{9}$$

so that the identity for day-to-day changes in net exposures

$$\mathcal{E}_{i,n,t+1,\tau} - \mathcal{E}_{i,n,t,\tau} = \Delta\mathcal{E}^{\text{net,age}}_{i,n,t+1,\tau} + \Delta\mathcal{E}^{\text{net,new}}_{i,n,t+1,\tau} \tag{10}$$

holds exactly by construction. We then estimate a pooled regression across all (i, n, t, τ):

$$\Delta\mathcal{E}^{\text{new}}_{i,n,t+1,\tau} = \alpha + \beta(\mathcal{E}_{i,n,t+1,\tau} - \mathcal{E}_{i,n,t,\tau}) + \epsilon_{i,n,t,\tau}. \tag{11}$$

The estimate is $\beta = 0.82$, implying that about 82% of the day-to-day change in net exposure is driven by new trades, while the remaining 18% reflects the aging of existing positions. Thus, relying only on transaction flows would miss roughly one-fifth of the relevant variation in direct exposures.

4 Facts about Direct Exposures

This section documents stylized facts about investors' direct exposure in FX funding. We identify the largest demanders and suppliers by currency and funding horizon, and show that activity is highly concentrated: most investors demand and supply FX funding in only a small number of currencies.

Figure 3 summarizes who supplies and demands FX funding at the 1-month tenor. For each currency $n \in \{\text{USD}, \text{EUR}, \text{JPY}\}$ and fixed $\tau = 1M$, we compute investor-group shares from the balance-sheet measures $\mathcal{E}^D_{i,n,t,\tau}$ and $\mathcal{E}^S_{i,n,t,\tau}$, average those shares over time t, identify the top three demanders and top three suppliers, and then plot their daily shares over the sample while keeping the investor identity fixed (shown in the legends). Three patterns emerge. (i) Concentration: in each currency, a small number of investor groups account for the bulk of supply and demand. (ii) Persistence: the composition of leaders is relatively stable over time. (iii) Geography: USD demand is led by Euro-area customers, EUR demand by U.S. customers, and JPY demand by Euro-area banks; on the supply side, USD supply is dominated by U.S. customers with notable contributions from UK banks, EUR supply by Euro-area customers and banks, and JPY supply by Japanese banks and Rest-of-World

customers. Results for 3M, 6M, and 1Y tenors are similar and omitted for brevity.

To quantify how concentrated an investor's activity is across currencies, define the top-currency share for demand and supply. For investor i on date t and funding horizon τ, let

$$\text{TopDemShare}_{i,t,\tau} := \frac{\mathcal{E}^D_{i,n^D(i,t,\tau),t,\tau}}{\sum_n \mathcal{E}^D_{i,n,t,\tau}}, \qquad n^D(i,t,\tau) \in \arg\max_n \mathcal{E}^D_{i,n,t,\tau}, \tag{12}$$

and define $\text{TopSupShare}_{i,t,\tau}$ analogously using $\mathcal{E}^S_{i,n,t,\tau}$. We then average these shares across investors and time, separately for banks and customers, for each funding horizon $\tau \in \{1\text{M}, 3\text{M}, 6\text{M}, 1\text{Y}\}$. Figure 4 plots the results.

Two patterns emerge. First, activity is highly concentrated: a single currency typically accounts for a majority of an investor's funding demand and supply at every horizon. Second, concentration is systematically higher on the supply side than on the demand side, and higher for customers than for banks. Concentration is fairly stable across horizons, with at most a mild increase at longer horizons. These facts align with a preferred-habitat view, where investors demand and supply FX funding via their preferred currencies.

Having measured how concentrated activity is, we next report which currency most often anchors investors' demand and supply. Using the same $n^D(i,t,\tau)$ and $n^S(i,t,\tau)$ defined above, we compute the fraction of investor-days on which each currency is the most demanded/supplied currency, again separately for banks and customers and for each funding horizon.

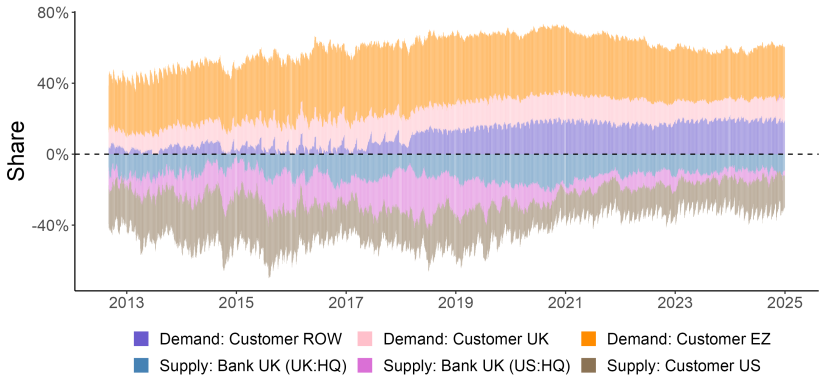
Figure 5 displays these distributions and reveals a clear asymmetry between investor types. On the demand side (top panel), banks are diversified across several currencies, whereas customers most often demand USD at every funding horizon. On the supply side (bottom panel), the pattern is largely the reverse: banks most frequently supply USD, while customers' modal supply currency is more often non-USD. The mirror-image structure points to the centrality of the dollar in global FX funding. USD dominates either as the final funding currency or as the bridge/vehicle currency to intermediate between two non-USD currencies.

5 Measure Economic Exposures via Independent Funding Segments

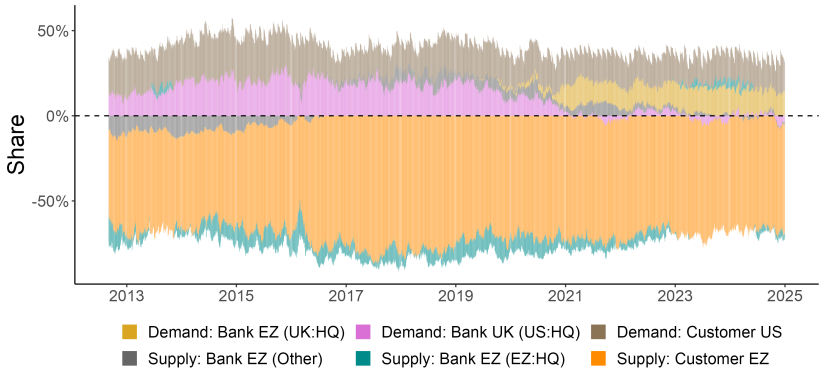
In this section we measure the economic exposures of FX funding by constructing independent funding segments. We first lay out the motivation and the theoretical framework, then show that the global FX funding universe is well summarized by two dominant, mutually independent segments: (i) a Dollar segment (USD funding vis-à-vis all others) and (ii) a Pan-European segment (EUR and GBP funding vis-à-vis all others).

Figure 3: Top 3 funding demanders and suppliers by currency

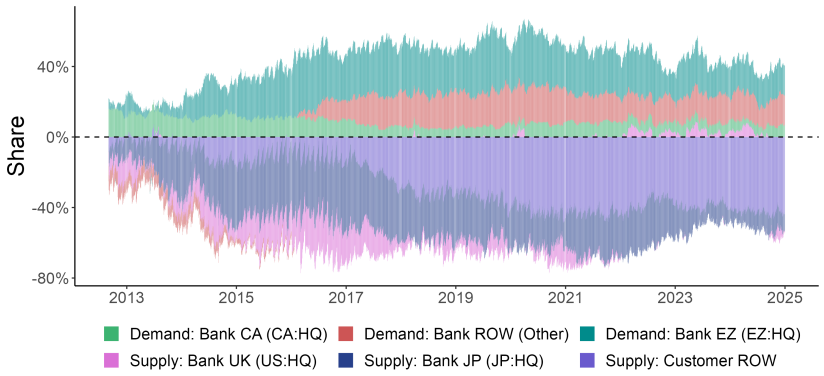
(a) USD



(b) EUR



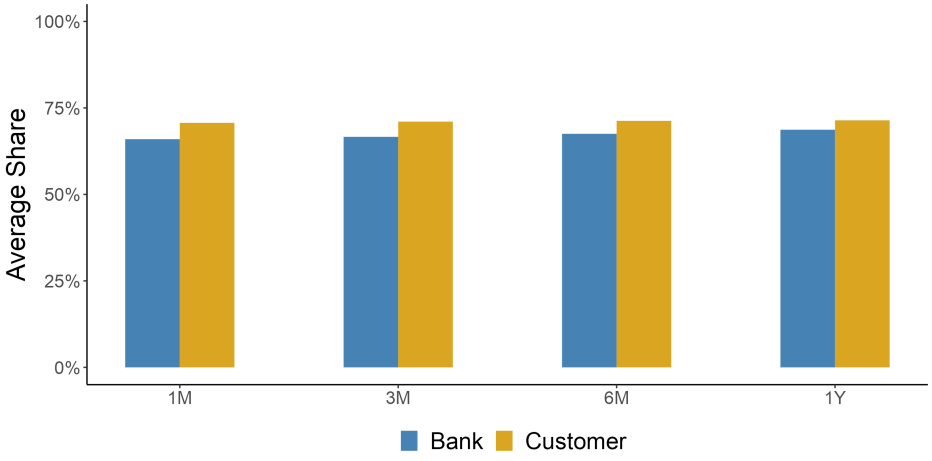
(c) JPY



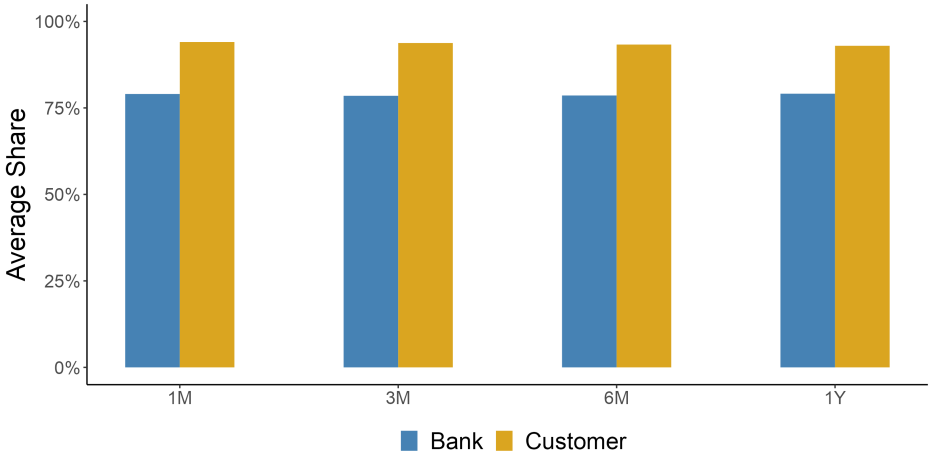
Notes: For each currency n with $\tau = 1\text{M}$, we compute investor-group shares from $\mathcal{E}^{D}_{i,n,t,\tau}$ (demand against all other currencies) and $\mathcal{E}^{S}_{i,n,t,\tau}$ (supply against all other currencies), rank groups by their time-averaged shares, fix the top three on each side, and plot their daily shares (positive for demand, negative for supply). Each group is represented by the same color across the panels.

Figure 4: Concentration in the top currency by funding horizon and investor type

(a) Demand



(b) Supply



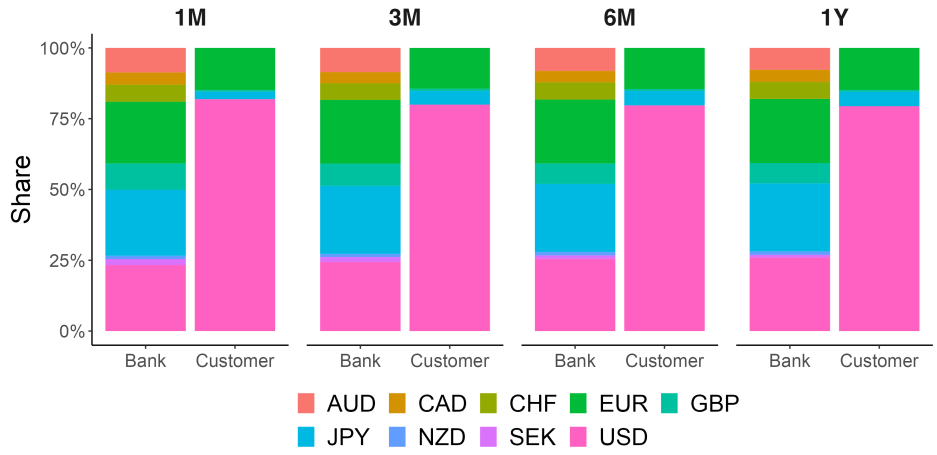
Notes: $\text{TopDemShare}_{i,t,\tau}$ ($\text{TopSupShare}_{i,t,\tau}$) is the share of investor i's total demand (supply) at horizon τ accounted for by the single currency with the largest $\mathcal{E}^{D}_{i,n,t,\tau}$ ($\mathcal{E}^{S}_{i,n,t,\tau}$). Bars report the averages of these shares across investors and time, separately for banks and customers, for each funding horizon $\tau \in \{1\text{M}, 3\text{M}, 6\text{M}, 1\text{Y}\}$.

5.1 Motivation

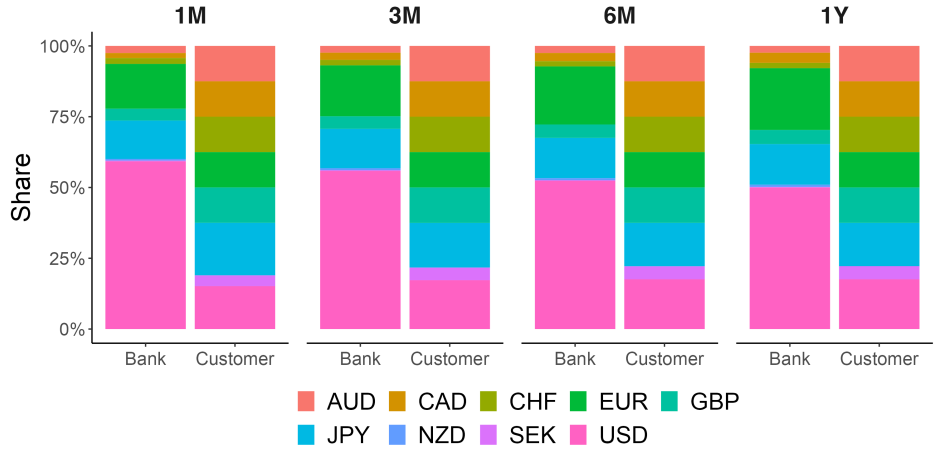
Section 4 shows highly concentrated trading, whereby most investor groups demand and supply FX funding in only a small set of currencies; such patterns are suggestive of segmentation. At the same time, Figure 1 reveals pronounced comovement in FX-funding prices across currencies, which suggestive of integration. To quantify the common price component,

Figure 5: Most demanded and most supplied currency by funding horizon and investor type

(a) Most demanded currency



(b) Most supplied currency



Notes: For each investor i and date t at horizon τ, $n^D(i,t,\tau)$ ($n^S(i,t,\tau)$) is the currency with the largest $\mathcal{E}^D_{i,n,t,\tau}$ ($\mathcal{E}^S_{i,n,t,\tau}$). Bars show, for each investor type and funding horizon, the share of investor-days on which a given currency is the most demanded/supplied currency.

we run a PCA on price changes. For horizon τ, define

$$\Sigma^P_\tau \;:=\; \mathrm{cov}_t\big(\Delta P_{n,t,\tau}\big), \qquad \Delta P_{n,t,\tau} := P_{n,t,\tau} - P_{n,t-1,\tau}, \tag{13}$$

and extract principal components across currencies n. Table 2 reports the results based on 1-month price change (other tenors are similar). The first component loads negatively on nearly all non-USD currencies, consistent with a dollar-centric factor, and explains 64.0% of the variation in $\Delta P_{n,t,1\mathrm{M}}$. However, substantial variation remains: PC2 and PC3 add 11.2% and 9.3%, respectively (top three total 84.5%), indicating meaningful structure beyond a

Table 2: PCA of changes in funding price

	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
AUD	-0.03	-0.35	0.45	0.22	-0.10	1.00	-0.56	0.09
CAD	-0.01	-0.01	0.02	0.15	-0.66	0.46	1.00	-0.35
CHF	-0.25	0.06	-0.27	1.00	0.48	0.15	0.26	0.11
EUR	-0.17	-0.02	-0.19	0.23	-0.48	-0.41	-0.64	-0.84
GBP	-0.11	-0.08	-0.13	0.15	-0.65	-0.38	-0.11	1.00
JPY	-0.26	0.20	1.00	-0.55	0.06	-0.04	0.11	0.03
NZD	0.01	-0.52	0.48	0.18	0.19	-0.73	0.38	-0.14
SEK	-0.19	-0.27	-0.78	-0.88	0.17	0.21	0.16	-0.02
USD	1.00	1.00	-0.59	-0.51	1.00	-0.27	-0.61	0.13
Var explained	64.0%	11.2%	9.3%	5.6%	3.7%	2.7%	2.2%	1.3%

Notes: PCA is applied to the cross-currency covariance matrix of price changes, $\Sigma_\tau^P = \text{cov}_t(\Delta P_{n,t,\tau})$, at $\tau =$ 1M. "Var explained" is the share of total cross-currency variance in $\Delta P_{n,t,1\text{M}}$ captured by each component.

single "USD factor." In particular, the second component assigns opposite-signed weights to USD versus the high-interest-rate currencies AUD and NZD, which is suggestive of a carry-like dimension.

At a high level, the evidence fits the preferred-habitat view of Vayanos and Vila (2021): investors operate mainly in select, preferred-habitat currencies, yielding segmented balance-sheet exposures; while arbitrageurs connect these habitats, producing strong common movements in prices. However, whereas the standard preferred-habitat framework assumes that these arbitrageurs jointly optimize across all habitats under a single pricing kernel, Figures 4 and 5 suggest possible segmentation even within arbitrageurs. Indeed, segmented funding exposures are observed among all investors, including banks, the key intermediaries and natural arbitrageurs in FX funding. More importantly, the PCA of changes in funding prices point to the presence of distinct drivers of funding conditions across currencies.

As argued in the introduction, time-varying funding conditions are first-order determinants of FX-funding supply and demand. We therefore combine our measures of direct exposures with the price of FX funding to recover each investor's economic exposure to distinct sources of variation in funding conditions. The idea is straightforward: direct exposures identify which currencies investors demand and supply, while prices translate those positions into the funding conditions they bear over time. For example, in Figure 1 the AUD and EUR funding prices move largely independently, which implies that demanding AUD funding loads on different conditions than demanding EUR funding.

In what follows, we use this insight to construct independent funding segments that

summarize the most important economic exposures in the data. By construction, these segments have mutually independent shocks to aggregate demand and mutually independent shocks to arbitrage capacity, so each segment represents a distinct exposure to time-varying funding conditions.

5.2 Theoretical Framework

In this subsection, we fix a tenor τ and suppress it in the notation. We denote the day-t change in investor i's net exposure in non-USD currency n by $\Delta\mathcal{E}_{i,n,t} := \mathcal{E}_{i,n,t} - \mathcal{E}_{i,n,t-1}$, and the corresponding change in the currency n-funding price by $\Delta P_{n,t} := P_{n,t} - P_{n,t-1}$.

Our goal is to identify K independent funding segments, indexed by $k = 1, \ldots, K$. Segment k is characterized by a vector of currency weights $w_{1,k}, w_{2,k}, \ldots, w_{N,k}$. The interpretation is that a \$1 position in segment k induces a position of $\$w_{n,k}$ in currency n, with the sign indicating demand (+) or supply (−) of funding in n. Hence, the net USD funding demand is $-\sum_{n=1}^{N} w_{n,k}$. Throughout we take USD as the numeraire; as shown by An and Huber (2025), the independent funding segments constructed below are invariant to the choice of numeraire.

Next, we posit a simple demand-supply system to pin down the currency weights $w_{n,k}$, and thus the funding segment. With $w_{n,k}$ the price of segment k satisfies the accounting identity

$$\Delta P^{\text{seg}}_{k,t} = \sum_{n=1}^{N} w_{n,k}\, \Delta P_{n,t}. \tag{14}$$

To obtain the exposures to segment k, we estimate

$$\Delta P_{n,t} = \sum_{k=1}^{K} \beta_{n,k}\, \Delta P^{\text{seg}}_{k,t} + \alpha_n + \epsilon_{n,t}, \tag{15}$$

where $\beta_{n,k}$ measures currency n's exposure to segment k: a \$1 position in currency n implies a $\$\beta_{n,k}$ exposure to segment k. This is the inverse mapping of the weights $w_{n,k}$: a \$1 position in segment k induces $\$w_{n,k}$ in currency n. The residual $\epsilon_{n,t}$ capturing idiosyncratic, currency-specific exposures. Using the estimated $\beta_{n,k}$, the change in investor i's net exposure to segment k is given by

$$\Delta\mathcal{E}^{\text{seg}}_{i,k,t} = \sum_{n=1}^{N} \beta_{n,k}\, \Delta\mathcal{E}_{i,n,t}. \tag{16}$$

We construct the funding segments to be independent in the sense that each investor's

change in exposure responds only to the price change of its own segment:

$$\Delta\mathcal{E}^{\text{seg}}_{i,k,t} = -\,\theta_{i,k}\Big(\Delta P^{\text{seg}}_{k,t} - \Delta\tilde{P}^{\text{seg}}_{k,t}\Big) + e_{i,k,t}. \tag{17}$$

This decomposes the equilibrium change in investor i's exposure to segment k into two parts. The first term, $-\theta_{i,k}\big(\Delta P^{\text{seg}}_{k,t} - \Delta\tilde{P}^{\text{seg}}_{k,t}\big)$, is the arbitrage response. Here, $\Delta\tilde{P}^{\text{seg}}_{k,t}$ is the counterfactual price change in the absence of demand shocks and captures shifts in arbitrageurs' capacity in providing FX funding. The parameter $\theta_{i,k} > 0$ is investor i's elasticity in segment k; it measures how active the investor is in that segment. When the observed price rises relative to the counterfactual, the minus sign implies that investor i supplies more funding to segment k, lowering $\Delta\mathcal{E}^{\text{seg}}_{i,k,t}$. The second term, $e_{i,k,t}$, is investor i's own demand shock for segment k at time t. This "own-price only" specification rules out cross-segment price effects by construction; the currency weights $w_{n,k}$ are chosen to deliver the desired independence.

Market clearing for segment k at time t requires

$$\sum_i \Delta\mathcal{E}^{\text{seg}}_{i,k,t} = 0. \tag{18}$$

Summing (17) over i then yields

$$\Delta P^{\text{seg}}_{k,t} = \Delta\tilde{P}^{\text{seg}}_{k,t} + \frac{\sum_i e_{i,k,t}}{\sum_i \theta_{i,k}}. \tag{19}$$

Equation (19) shows that the price change of segment k equals shocks to arbitrageurs' capacity of providing funding, $\Delta\tilde{P}^{\text{seg}}_{k,t}$, plus the aggregate demand shock $\sum_i e_{i,k,t}$ scaled by the aggregate elasticity $\sum_i \theta_{i,k}$. A larger $\sum_i \theta_{i,k}$ dampens the price impact of a given demand shock.

To ensure independence across funding segments, we choose currency weights $w_{n,k}$ so that, for all $k \neq l$,

$$\operatorname{cov}\big(\Delta\tilde{P}^{\text{seg}}_{k,t},\, \Delta\tilde{P}^{\text{seg}}_{l,t}\big) = 0, \tag{20}$$

$$\operatorname{cov}\Big(\sum_i e_{i,k,t},\, \sum_i e_{i,l,t}\Big) = 0. \tag{21}$$

The first condition requires that shocks to arbitrageurs' capacity of providing funding be uncorrelated across segments; the second requires that aggregate demand shocks be uncorrelated across segments. In short, the constructed funding segments are independent along both the arbitrage-capacity and aggregate-demand dimensions.

Empirically, neither shocks to arbitrageurs' capacity $\Delta\tilde{P}^{\text{seg}}_{k,t}$ nor aggregate demand shocks $\sum_i e_{i,k,t}$ are observed; we only observe equilibrium price changes and investor-level direct exposure changes. In Appendix A we show that, under additional technical assumptions, requiring arbitrage capacity and aggregate demand to be pairwise uncorrelated across segments is equivalent to simultaneously orthogonalizing equilibrium price and direct exposure changes:

$$\operatorname{cov}\left(\Delta P^{\text{seg}}_{k,t},\, \Delta P^{\text{seg}}_{l,t}\right) = 0, \tag{22}$$

$$\sum_i \operatorname{cov}\left(\Delta \mathcal{E}^{\text{seg}}_{i,k,t},\, \Delta \mathcal{E}^{\text{seg}}_{i,l,t}\right) = 0. \tag{23}$$

The direct exposure covariance is computed within investor: for each i we first compute $\operatorname{cov}(\Delta\mathcal{E}^{\text{seg}}_{i,k,t},\, \Delta\mathcal{E}^{\text{seg}}_{i,l,t})$ over t, and then aggregate across investors (summing, or equivalently up to a constant, averaging).

Note that the price orthogonality in (22) is exactly the moment condition that underlies a standard PCA on price changes; likewise, the exposure orthogonality in (23) corresponds to a standard PCA on direct exposure changes. Our identification of independent funding segments imposes both sets of conditions simultaneously; a single PCA that orthogonalizes only one set of series is therefore insufficient.[6]

An and Huber (2025) provide an explicit algorithm that constructs the currency weights $w_{n,k}$ satisfying (22) and (23), using covariance matrices estimated from price-change and exposure-change data. The resulting independent funding segments are generically unique up to scale. The share of total exposures explained by segment k is proportional to

$$\operatorname{var}\left(\Delta P^{\text{seg}}_{k,t}\right) \times \sum_i \operatorname{var}\left(\Delta \mathcal{E}^{\text{seg}}_{i,k,t}\right), \tag{24}$$

which is invariant to rescaling $w_{\cdot,k}$; selecting the top few segments by this criterion usually captures total exposures well.[7]

5.3 Empirical Findings

Table 3 reports the results of our procedure: the currency weights $w_{n,k}$ for each funding segment and the share of total exposure explained. We focus on 1M tenor here; results for other tenors are similar and omitted for brevity. Only the top two funding segments are

[6] Beyond zero cross-covariances, standard PCA selects eigenvectors via normalization and variance-maximization conventions. These are statistical choices without direct economic content. Our procedure does not rely on such additional identification restrictions.

[7] If all $w_{n,k}$ are multiplied by a constant, $\Delta P^{\text{seg}}_{k,t}$ scales proportionally while $\Delta\mathcal{E}^{\text{seg}}_{i,k,t}$ scales inversely by (14) and (16), leaving $\operatorname{var}(\Delta P^{\text{seg}}_{k,t}) \sum_i \operatorname{var}(\Delta\mathcal{E}^{\text{seg}}_{i,k,t})$ unchanged.

Table 3: Independent funding segments

	Seg 1	Seg 2	Seg 3	Seg 4	Seg 5	Seg 6	Seg 7	Seg 8
AUD	-0.01	-0.02	0.13	1.00	0.06	-0.03	-0.24	-0.74
CAD	-0.00	-0.01	0.04	0.04	-0.00	1.00	0.42	0.16
CHF	-0.05	0.02	-0.02	-0.02	1.00	0.05	-0.25	0.10
EUR	-0.56	1.00	-0.70	0.34	-0.88	0.07	-0.32	0.19
GBP	-0.17	0.43	1.00	-0.57	-0.15	-0.25	-0.49	-0.16
JPY	-0.18	-0.94	0.03	-0.07	-0.27	0.00	0.00	0.06
NZD	-0.01	-0.02	0.02	0.07	0.01	-0.03	0.11	1.00
SEK	-0.01	-0.01	0.01	0.02	0.03	-0.07	1.00	-0.14
USD	1.00	-0.45	-0.52	-0.81	0.19	-0.74	-0.25	-0.46
Var explained	83.0%	10.0%	3.0%	2.0%	1.0%	0.0%	0.0%	0.0%

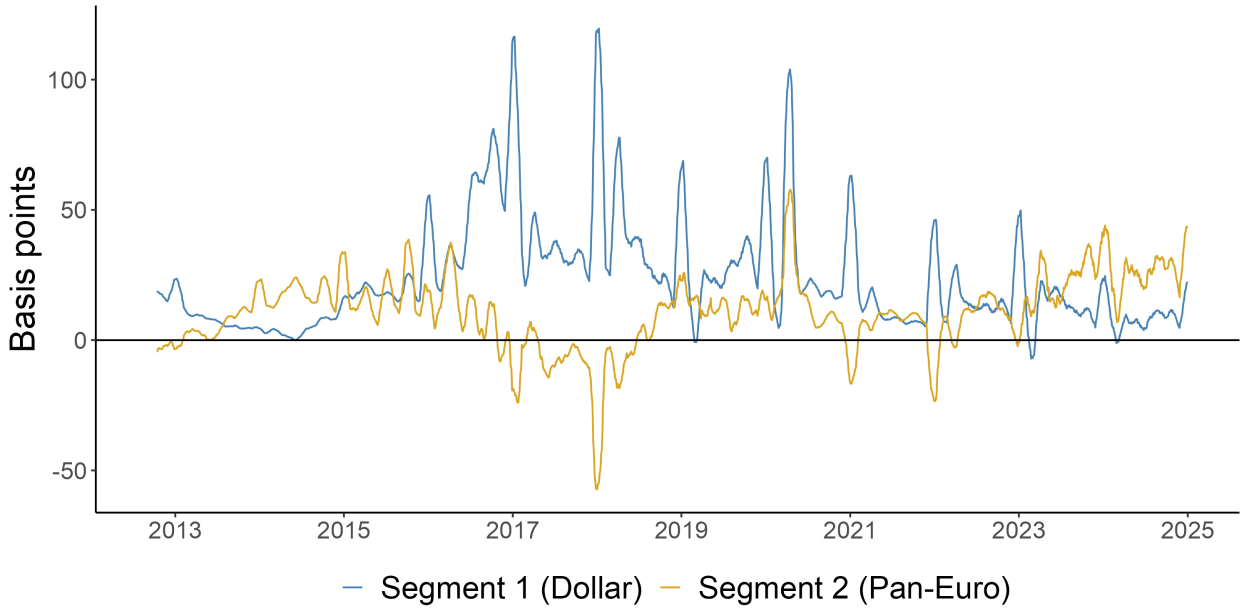
Notes: Currency weights are constructed to satisfy (22) and (23) and are sign/scale-normalized for interpretability (Segment 1: USD set to +1; Segment 2: EUR set to +1). "Var explained" is the share of total exposures explained by each segment.

quantitatively important: they explain 75% and 10% of the total exposure, respectively, while the third contributes only 3%.

Inspecting the weights, Segment 1 loads negatively on all non-USD currencies—with especially large magnitudes for EUR, GBP, and JPY—consistent with USD funding vis-à-vis all other currencies. For interpretation, we normalize the USD weight to +1, so a $1 position in Segment 1 corresponds to $1 of Dollar funding demand. Segment 2 features a large positive weight on Pan-European currencies (EUR and GBP) and a large negative weights on other major currencies (JPY and USD), consistent with EUR funding vis-à-vis all other currencies. Thus, we normalize the EUR weight to +1, so a $1 position in Segment 2 corresponds to $1 of EUR funding demand. These normalizations fix units and direction only; orthogonality and explanatory power are unchanged because weights are identified up to scale and sign.

We also note that in contrast to the first few price PCs (Table 2), neither of the two most important independent funding segments features the "carry" currencies (AUD, NZD). This is because there are limited direct funding exposures to these currencies. The logic is straightforward: the appeal of carry is the unhedged exposure, whereas FX funding hedges the FX leg and does not confer the high local-currency yield. For example, funding AUD neither takes FX risk nor earns the AUD carry, so the trade is simply less attractive. Put differently, that direct AUD funding is more expensive than synthetic AUD funding (a positive CIP deviation) likely reflects the limited appeal of the synthetic trade itself. Looking at prices alone might suggest this market is important; combining prices with direct exposures shows it is not.

Figure 6: Pricing of funding segments at 1-month tenor



Notes: Prices of funding segments are computed as $P^{\text{seg}}_{k,t} = \sum_n w_{n,k}\, P_{n,t}$ using the weights in Table 3. Series are shown as 30-day moving averages and reported in basis points.

Moreover, Appendix Table A1 reports a standard PCA on the direct exposure data. We find that the leading components align with the currency pairs that carry the largest outstanding positions (for example, EUR/USD, GBP/USD, and JPY/USD), which explain most of the variation in direct exposures. In other words, the PCA mainly summarizes concentration in large pairs rather than isolating distinct economic exposures to time-varying funding conditions, since it does not incorporate price changes.

Figure 6 plots the 1M-tenor price of the two funding segments $P^{\text{seg}}_{1,t}$ and $P^{\text{seg}}_{2,t}$. Each series is a portfolio-weighted aggregation of currency-level prices using the weights $w_{n,k}$ from Table 3. By construction, the changes in the two series are orthogonal, so the figure shows distinct dynamics: Segment 1 displays recurrent spikes around stress and quarter-ends, whereas Segment 2 alternates between positive and negative phases—sometimes moving in the opposite direction to Segment 1 (e.g., at quarter-ends) and sometimes in the same direction during global stress episodes (e.g., early 2020). Both series spend most of the sample above zero, indicating that, on average, obtaining FX funding for USD and EUR is more expensive than direct funding in the base currency. The separation underscores that tightening of funding conditions in one segment need not coincide with tightening in the other.

6 Findings on Economic Exposures

Having constructed and interpreted the two independent funding segments—Dollar funding and Pan-European funding—we use them to characterize the structure and dynamics of global synthetic funding. Three insights emerge. First, USD-based CIP deviations are in fact driven by movements in funding conditions in both funding segments. Second, large global banks supply substantial dollar funding but diversify by splitting it across the two segments. Third, the relative importance of Pan-European grows at longer horizons.

6.1 Decomposing CIP deviations

In this subsection, we use the independent funding segments to understand the cross-currency drivers of CIP deviations.

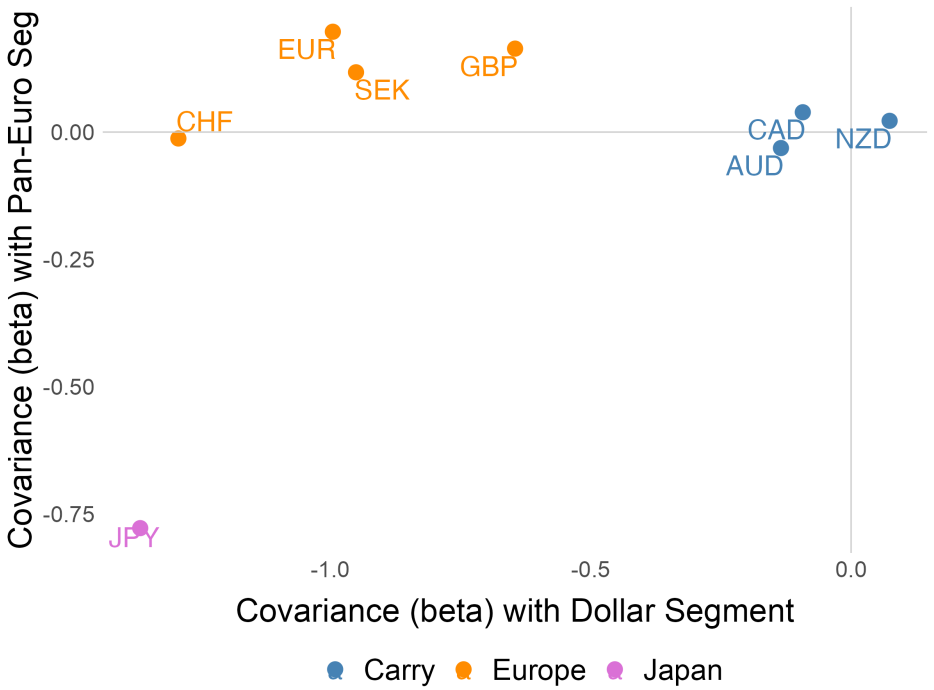
Specifically, Figure 7 plots the estimated coefficients $(\beta_{n,1}, \beta_{n,2})$ from (15) at 1M tenor, which measure how each currency's CIP price changes load on the two segments. Three groupings emerge. Pan-European currencies (CHF, EUR, GBP, SEK) lie close to $(-1, 0)$: they load roughly one-for-one on the Dollar segment and only weakly on the Pan-European segment. For example, EUR sits near $(-1, 0.25)$, so demanding \$1 of EUR funding against USD is equivalent to supplying \$1 in the Dollar segment and demanding about \$0.25 in the Pan-European segment in terms of exposure to time-varying funding conditions. JPY sits near $(-1, -1)$, indicating heavy exposure to both segments. By contrast, the carry currencies (AUD, CAD, NZD) cluster around $(0, 0)$, with little exposure to either segment.[8]

These results show that not all dollar funding is the same. For example, borrowing USD against AUD and borrowing USD against EUR both increase USD direct exposure. Yet the associated economic exposures differ sharply: the USD/AUD trade has little exposure to either funding segment, whereas the USD/EUR trade is heavily exposed to the Dollar segment and, to a lesser extent, to the Pan-European segment.

Figure 8 shows that even for a given currency, the relative contribution of the two segments varies systematically with the funding horizon. For EUR, movements in the USD/EUR basis at the 1-month horizon are about 94% attributable to the Dollar segment and 5% to the Pan-European segment; at the 1-year horizon the split shifts to roughly 77% versus 18%. For JPY, both segments contribute materially at all horizons, consistent with its strong loading on each segment. Together, these patterns underscore that the economic forces driving CIP deviations are horizon dependent and segment specific.

[8]The estimated β coefficients are stable over time. Appendix Figure A1 plots five-year rolling-window estimates that show only modest variation across windows.

Figure 7: Currency exposures to independent funding segments



Notes: Currency exposures $(\beta_{n,1}, \beta_{n,2})$ come from projecting each currency's price change onto the two funding segments at 1M tenor. The x-axis is exposure to Dollar segment; the y-axis is exposure to Pan-European segment.

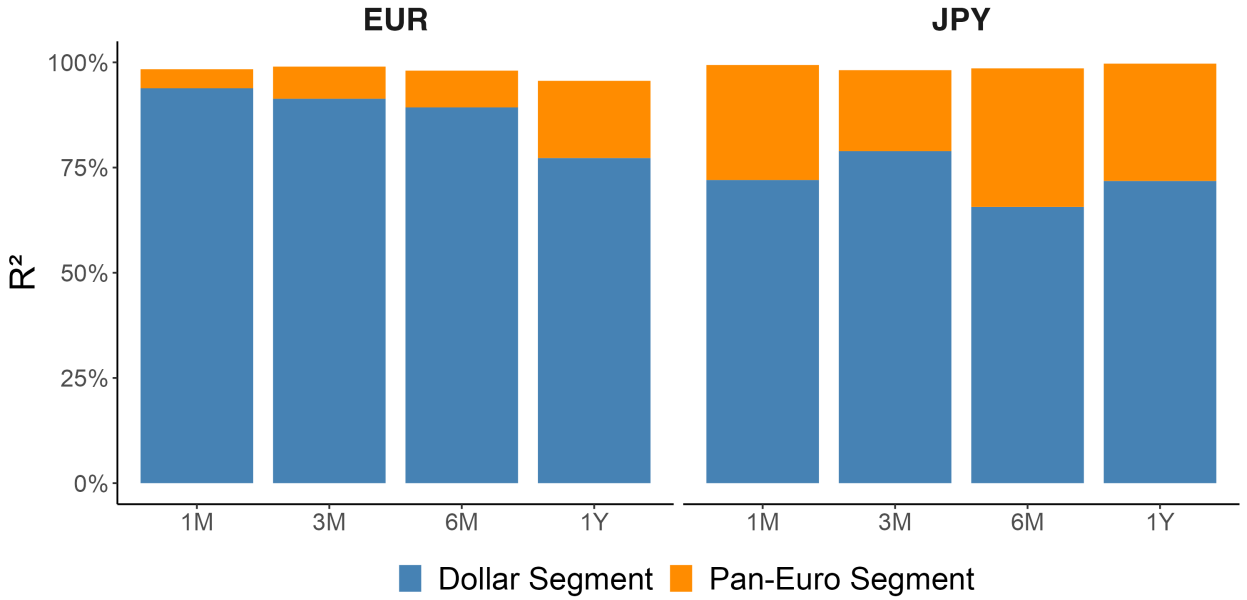
6.2 The Economic Exposure to each Funding Segment

This subsection documents investors' economic exposures to each funding segment.

We aggregate economic exposures $\mathcal{E}^{\text{seg}}_{i,k,t,\tau}$ across all banks and across all customers to compare who demands and who supplies funding in the two segments at the 1-month tenor. Figure 9 shows the resulting 90-day-smoothed series. In Segment 1 (Dollar funding), customers are persistent net demanders and banks are the mirror-image suppliers: customer demand rises from near zero in 2013 to a little over $1 trillion, while bank supply deepens to roughly -$1 trillion by 2022. In Segment 2 (Pan-European funding), positions are much smaller and switch sign over time: banks move from mild net demand pre-2018 to net supply after 2019, whereas customers transition from mild net supply to net demand; by 2024, customer demand is around $0.2 trillion and bank supply of similar magnitude. The picture is consistent with banks intermediating dollar funding to customers, while the Pan-European segment is closer to balanced and exhibits role reversals over time.

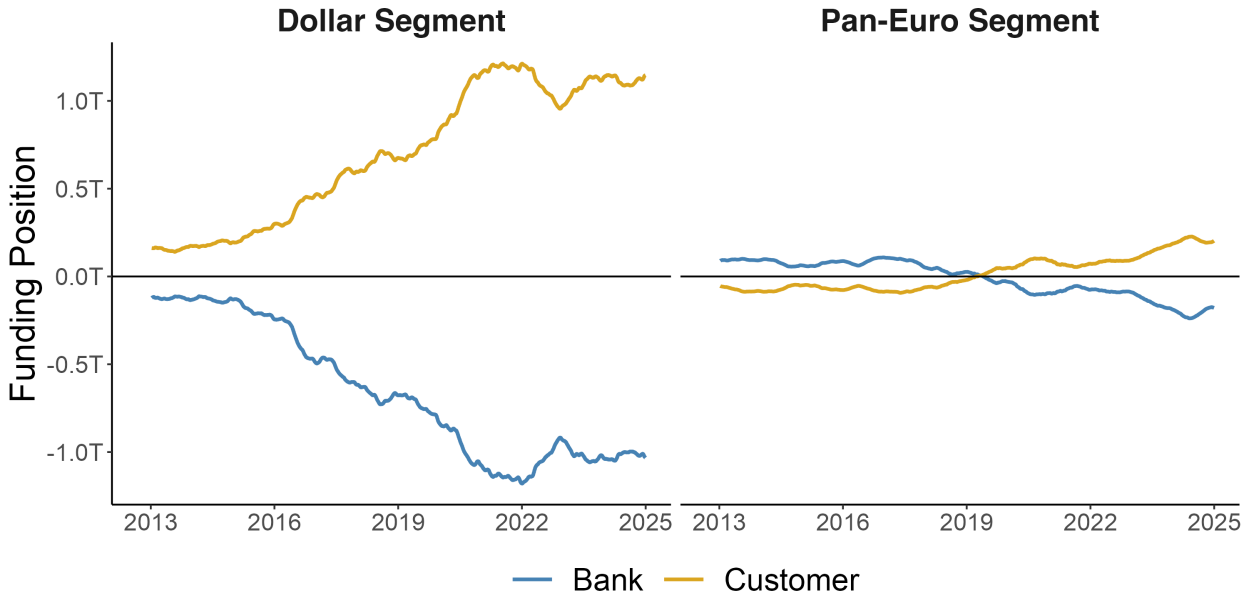
Figure 10 breaks out customers' economic exposures by geographic location and shows stark, systematic patterns across the two segments at 1M tenor. In Segment 1, euro-area (EZ) customers are the dominant net demanders: their dollar funding need rises from roughly

Figure 8: Segment contributions to currency-specific CIP deviations by tenor



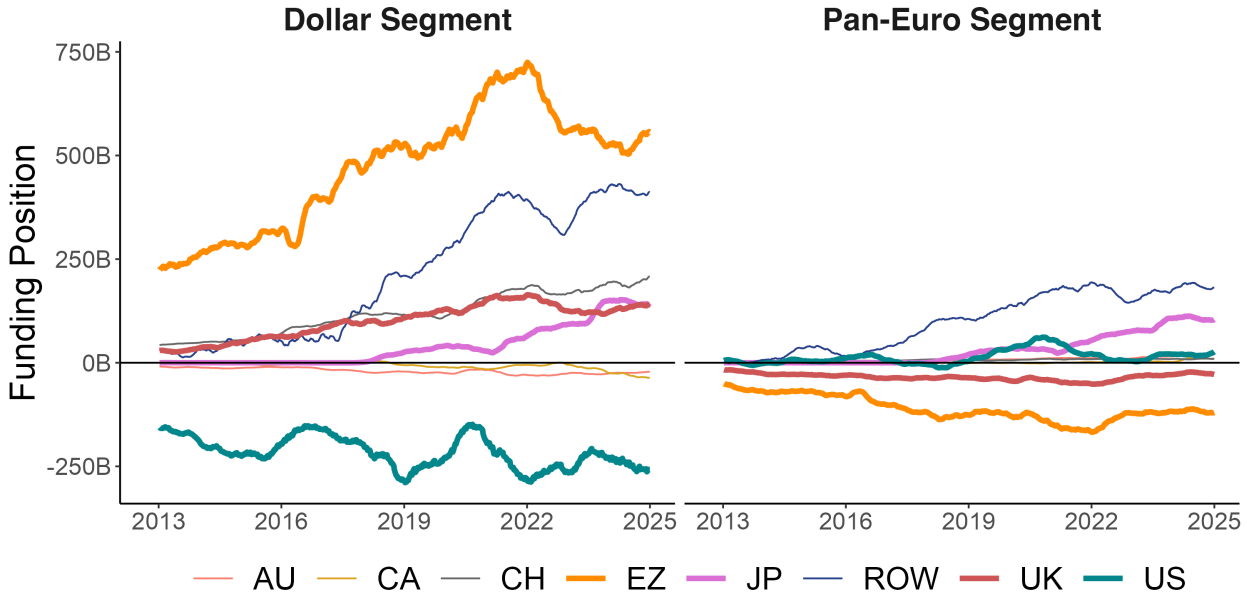
Notes: For each currency and tenor, the bars report the share of explained variation (R^2) in that currency's CIP deviation that is attributable to the Dollar and Pan-European segments, based on the exposure regression in (15). Results are shown for EUR and JPY at the 1M, 3M, 6M, and 1Y tenors.

Figure 9: Economic exposures: banks vs. customers



Notes: For each segment $k \in \{1, 2\}$ (Dollar, Pan-European) and $\tau = 1\text{M}$, we sum $\mathcal{E}^{\text{seg}}_{i,k,t,\tau}$ across all banks and across all customers. Positive values indicate net demand for the segment; negative values indicate net supply. Series are 90-day moving averages.

Figure 10: Economic exposures: Customers



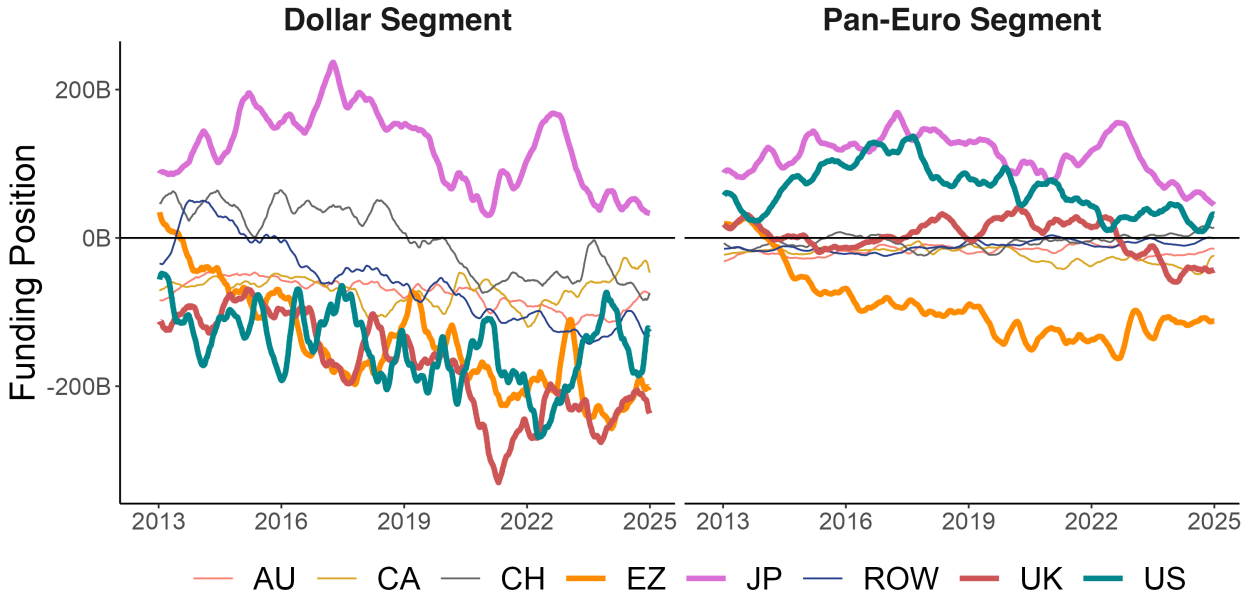
Notes: For each segment $k \in \{1, 2\}$ (Dollar, Pan-European) and $\tau = 1\text{M}$, we show $\mathcal{E}^{\text{seg}}_{i,k,t,\tau}$ for all customers. Positive values indicate net demand for the segment; negative values indicate net supply. Series are 90-day moving averages.

$250B in 2013 to a peak near $700B around 2020, and then settles in the $500B range by 2024. U.K., Swiss, and Japanese (UK, CH, JP) customers also post steadily growing dollar demand, each reaching on the order of $150B by the end of the sample. Customers from the Rest of World (ROW) become increasingly important demanders over time, climbing from near zero in 2013 to roughly $300B by 2024. By contrast, U.S. customers are consistently on the supply side, with a persistent negative position that is about $200B.

In Segment 2, the picture flips for several groups. EZ customers are net suppliers of Pan-European funding throughout, with positions generally about -$100B. ROW customers are the largest EUR demanders, rising steadily to around $200B by 2024. JP customers also demand EUR, trending up to roughly $100B in recent years. US customers are small net demanders on average—hovering around zero for much of the sample and turning modestly positive after 2020. Taken together, the panel highlights a clear division of roles: EZ customers demand dollars in Segment 1 and supply euros in Segment 2; ROW and JP customers increasingly demand funding on both fronts; and US customers most often supply dollars while demanding little euro overall.

Figure 11 breaks down the 1M-tenor economic exposures of CLS-settling banks by geographic location (non-settling banks are small and omitted). In Segment 1, JP banks are persistent net demanders of dollars, typically in the $100-$200B range, peaking a little above

Figure 11: Economic exposures: CLS-settling banks



Notes: For each segment $k \in \{1, 2\}$ (Dollar, Pan-European) and $\tau = 1\text{M}$, we show $\mathcal{E}^{\text{seg}}_{i,k,t,\tau}$ for all CLS-settling banks by geographic location. Positive values indicate net demand for the segment; negative values indicate net supply. Series are 90-day moving averages.

$200B in 2016-2018 and again around 2020-2021. By contrast, UK, US, and EZ banks are the main net suppliers: each around $100-200B on average. Other regions are small by comparison. In Segment 2, the signs flip. US and JP banks are net demanders of euro funding, on the order of $50 to $150B. EZ and UK banks are net suppliers: EZ banks provide roughly $100B, while UK banks move from near zero before 2021 to about $50B supply thereafter. Other regions are small by comparison.

Taken together, Dollar segment funding is largely intermediated by UK/US/EZ banks, whereas Pan-European Segment funding is sourced primarily in the euro area and supplemented by UK supply to meet demand from US and Japanese banks. These patterns also show that large global banks diversify across segments. For example, US banks supply funding in Segment 1 while demanding funding in Segment 2. Although both actions raise their direct exposure to dollar supply, this allocation spreads their economic exposure across segments whose price changes are orthogonal by construction.

6.3 Relative Dominance of Dollar vs. Pan-European Funding Across Horizons and Over Time

To compare the importance of Dollar vs. Pan-European funding across horizons and over time, we measure total economic exposures for each segment. Let

$$\sigma_k = \mathrm{sd}(\Delta P^{\mathrm{seg}}_{k,t}) \tag{25}$$

be the standard deviation of price changes in segment $k \in \{1, 2\}$. For date t and horizon τ, define the total economic exposures across all investors i of segment k as

$$A_{k,t,\tau} = \sigma_k \sum_i |\mathcal{E}^{\mathrm{seg}}_{i,k,t,\tau}|. \tag{26}$$

We take absolute values because market clearing implies that investor exposures sum to zero; $|\cdot|$ aggregates the gross amount of exposure. Multiplying by σ_k makes $A_{k,t,\tau}$ invariant to the arbitrary scaling of segment weights (since $|\mathcal{E}^{\mathrm{seg}}_{i,k,t,\tau}|$ scales inversely while $\Delta P^{\mathrm{seg}}_{k,t}$ scales proportionally). We then measure the relative dominance of the Dollar funding (Segment 1) vs. the Pan-European funding (Segment 2) as

$$\mathrm{DollarImportance}_{t,\tau} = \frac{A_{1,t,\tau}}{A_{1,t,\tau} + A_{2,t,\tau}}. \tag{27}$$

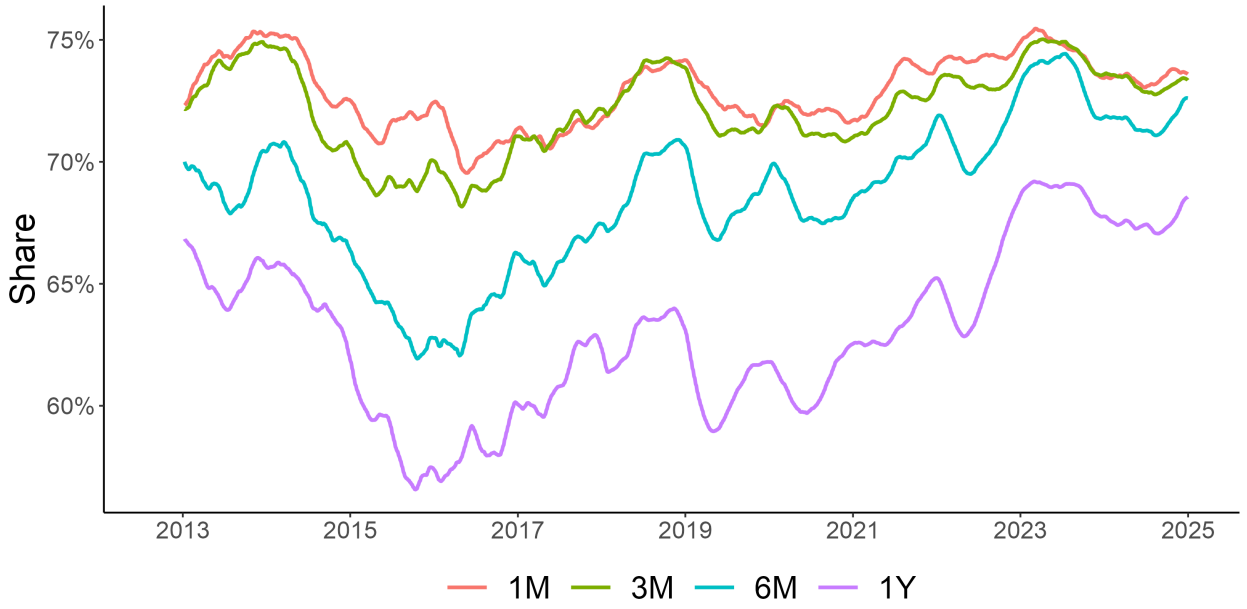
By construction, $\mathrm{DollarImportance}_{t,\tau} \in [0, 1]$; the complementary share $1-\mathrm{DollarImportance}_{t,\tau}$ is the EUR-funding dominance.

Figure 12 plots $\mathrm{DollarImportance}_{t,\tau}$ for $\tau \in \{1M, 3M, 6M, 1Y\}$. To reduce high-frequency noise, we display 90-day moving averages. Comparing total economic exposures across all investors, the Dollar segment averages about 70% of combined activity. However, this dominance declines with funding horizons: roughly 75% at 1M and 3M, falling to around 65% at 6M and 1Y. There is also notable time-series variation, whereby dollar dominance dipped around 2016, possibly related to the U.S. money-market fund reform that tightened access to dollar funding.

7 Conclusion

This paper revisits the question of U.S. dollar dominance by uncovering the economic, rather than purely accounting, exposures embedded in global FX funding. Using a proprietary daily panel of outstanding swaps and forwards for 60 investor groups, we construct tenor-specific balance-sheet exposures that roll positions down their remaining maturities and

Figure 12: Relative dominance of Dollar vs. Pan-European funding



Notes: The series plots $\text{DollarImportance}_{t,\tau}$ defined in (27) for each tenor τ. Curves are 90-day moving averages.

treat outright forwards on par with swaps. These measurement choices show that same-tenor trades capture only a fraction of the quantity relevant for pricing, and that forwards account for a material share of funding capacity. Linking these quantities to CIP deviations translates direct positions into exposure to time-varying funding conditions.

The core finding is that global FX funding is organized into independent segments with mutually independent shocks to aggregate demand and arbitrage capacity. Two segments dominate: a Dollar segment that reflects USD funding against other currencies, and a Pan-European segment that reflects EUR and GBP funding against others. Three insights emerge. First, USD-based CIP deviations are in fact driven by movements in funding conditions in both funding segments. Second, large global banks supply substantial USD funding but diversify by splitting it across the two segments. Third, the relative importance of Pan-European grows at longer horizons. Moreover, carry currencies play a limited role because FX funding hedges the FX return and does not deliver carry premia.

Read together, the evidence shows that not all dollar funding is equal. Prices and quantities align with a segmented market structure in which investors operate in preferred habitats and CIP deviations reflect distinct funding conditions across segments. Interpreting CIP through this lens nuances dollar dominance: the dollar remains central, but investors' economic exposures depend on which dollar market they access.

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A Technical Details for Identifying Independent Funding Segments

In this appendix, we show that—under additional technical assumptions—the cross-segment orthogonality of arbitrageur capacity and aggregate demands in (20) and (21) is equivalent to the simultaneous orthogonalization of equilibrium price changes and investor-level exposures changes in (22) and (23).

Note that (19) implies

$$\begin{aligned}\operatorname{cov}(\Delta P^{\text{seg}}_{k,t}, \Delta P^{\text{seg}}_{l,t}) = \operatorname{cov}(\Delta \tilde{P}^{\text{seg}}_{k,t}, \Delta \tilde{P}^{\text{seg}}_{l,t}) + \operatorname{cov}\left(\frac{\sum_i e_{i,k,t}}{\sum_i \theta_{i,k}}, \frac{\sum_i e_{i,l,t}}{\sum_i \theta_{i,l}}\right) \\ + \operatorname{cov}\left(\Delta \tilde{P}^{\text{seg}}_{k,t}, \frac{\sum_i e_{i,l,t}}{\sum_i \theta_{i,l}}\right) + \operatorname{cov}\left(\Delta \tilde{P}^{\text{seg}}_{l,t}, \frac{\sum_i e_{i,l,t}}{\sum_i \theta_{i,k}}\right). \qquad \text{(A1)}\end{aligned}$$

Assume that, for $k \neq l$,

$$\operatorname{cov}\left(\Delta \tilde{P}^{\text{seg}}_{k,t}, \sum_i e_{i,l,t}\right) = \operatorname{cov}\left(\Delta \tilde{P}^{\text{seg}}_{l,t}, \sum_i e_{i,k,t}\right) = 0, \qquad \text{(A2)}$$

i.e., the aggregate demand for one market is uncorrelated with the shocks to arbitrageur capacity of another. Hence,

$$\operatorname{cov}(\Delta P^{\text{seg}}_{k,t}, \Delta P^{\text{seg}}_{l,t}) = \operatorname{cov}(\Delta \tilde{P}^{\text{seg}}_{k,t}, \Delta \tilde{P}^{\text{seg}}_{l,t}) + \operatorname{cov}\left(\frac{\sum_i e_{i,k,t}}{\sum_i \theta_{i,k}}, \frac{\sum_i e_{i,l,t}}{\sum_i \theta_{i,l}}\right). \qquad \text{(A3)}$$

Using (17) and (19), for any investor j we have

$$\Delta \mathcal{E}^{\text{seg}}_{j,k,t} = -\psi_{j,k} \sum_i e_{i,k,t} + e_{j,k,t}, \qquad \psi_{j,k} := \frac{\theta_{j,k}}{\sum_i \theta_{i,k}}. \qquad \text{(A4)}$$

Hence,

$$\begin{aligned}\operatorname{cov}\left(\Delta \mathcal{E}^{\text{seg}}_{j,k,t}, \Delta \mathcal{E}^{\text{seg}}_{j,l,t}\right) = \operatorname{cov}\left(\psi_{j,k} \sum_i e_{i,k,t}, \psi_{j,l} \sum_i e_{i,l,t}\right) + \operatorname{cov}(e_{j,k,t}, e_{j,l,t}) \\ - \operatorname{cov}\left(\psi_{j,k} \sum_i e_{i,k,t}, e_{j,l,t}\right) - \operatorname{cov}\left(\psi_{j,l} \sum_i e_{i,l,t}, e_{j,k,t}\right). \qquad \text{(A5)}\end{aligned}$$

Summing across investors gives

$$\sum_i \operatorname{cov}(\Delta\mathcal{E}^{\text{seg}}_{i,k,t}, \Delta\mathcal{E}^{\text{seg}}_{i,l,t}) = \left(\sum_i \psi_{i,k}\psi_{i,l}\right) \operatorname{cov}\left(\sum_i e_{i,k,t}, \sum_i e_{i,l,t}\right) + \sum_i \operatorname{cov}(e_{i,k,t}, e_{i,l,t}) - \operatorname{cov}\left(\sum_i e_{i,k,t}, \sum_i \psi_{i,k} e_{i,l,t}\right) - \operatorname{cov}\left(\sum_i e_{i,l,t}, \sum_i \psi_{i,l} e_{i,k,t}\right). \tag{A6}$$

Assume $\operatorname{cov}(e_{i,k,t}, e_{j,l,t}) = 0$ for any $i \neq j$ and $k \neq l$ (two investors' demands for two different segments are uncorrelated). Then

$$\sum_i \operatorname{cov}(\Delta\mathcal{E}^{\text{seg}}_{i,k,t}, \Delta\mathcal{E}^{\text{seg}}_{i,l,t}) = \left(\sum_i \psi_{i,k}\psi_{i,l} + 1\right) \sum_i \operatorname{cov}(e_{i,k,t}, e_{i,l,t}) - \sum_i (\psi_{i,k} + \psi_{i,l}) \operatorname{cov}(e_{i,k,t}, e_{i,l,t}). \tag{A7}$$

Using $\sum_i \psi_{i,k} = 1$ and treating the investor weights as weakly related to $\operatorname{cov}(e_{i,k,t}, e_{i,l,t})$ (so that $\sum_i (\psi_{i,k} + \psi_{i,l}) \operatorname{cov}(\cdot) \approx \frac{2}{I} \sum_i \operatorname{cov}(\cdot)$, with I the number of investors), we obtain the approximation

$$\begin{aligned} \sum_i \operatorname{cov}(\Delta\mathcal{E}^{\text{seg}}_{i,k,t}, \Delta\mathcal{E}^{\text{seg}}_{i,l,t}) &\approx \left(\sum_i \psi_{i,k}\psi_{i,l} + 1 - \frac{2}{I}\right) \sum_i \operatorname{cov}(e_{i,k,t}, e_{i,l,t}) \\ &= \left(\sum_i \psi_{i,k}\psi_{i,l} + 1 - \frac{2}{I}\right) \operatorname{cov}\left(\sum_i e_{i,k,t}, \sum_i e_{i,l,t}\right). \end{aligned} \tag{A8}$$

Together with (A3), this shows that conditions (20) and (21) hold if and only if (22) and (23) hold.

B Additional Empirical Results

Table A1 runs a PCA on changes in net exposures, $\Delta\mathcal{E}_{i,n,t,\tau} := \mathcal{E}_{i,n,t,\tau} - \mathcal{E}_{i,n,t-1,\tau}$. Fix a tenor τ. For each investor i, compute the time-series covariance of the currency vector $\Delta\mathcal{E}_{i,\cdot,t,\tau}$ across n, and then average across investors:

$$\Sigma^{\mathcal{E}}_{\tau} \;=\; \frac{1}{I} \sum_{i=1}^{I} \operatorname{cov}_t\big(\Delta\mathcal{E}_{i,\cdot,t,\tau}\big). \tag{A9}$$

By market clearing, $\sum_n \Delta\mathcal{E}_{i,n,t,\tau} = 0$; we therefore drop USD when estimating $\Sigma^{\mathcal{E}}_{\tau}$, compute principal components on the remaining currencies, and recover the USD loading in each component as the negative sum of the non-USD loadings.

Table A1: PCA of changes in net exposure

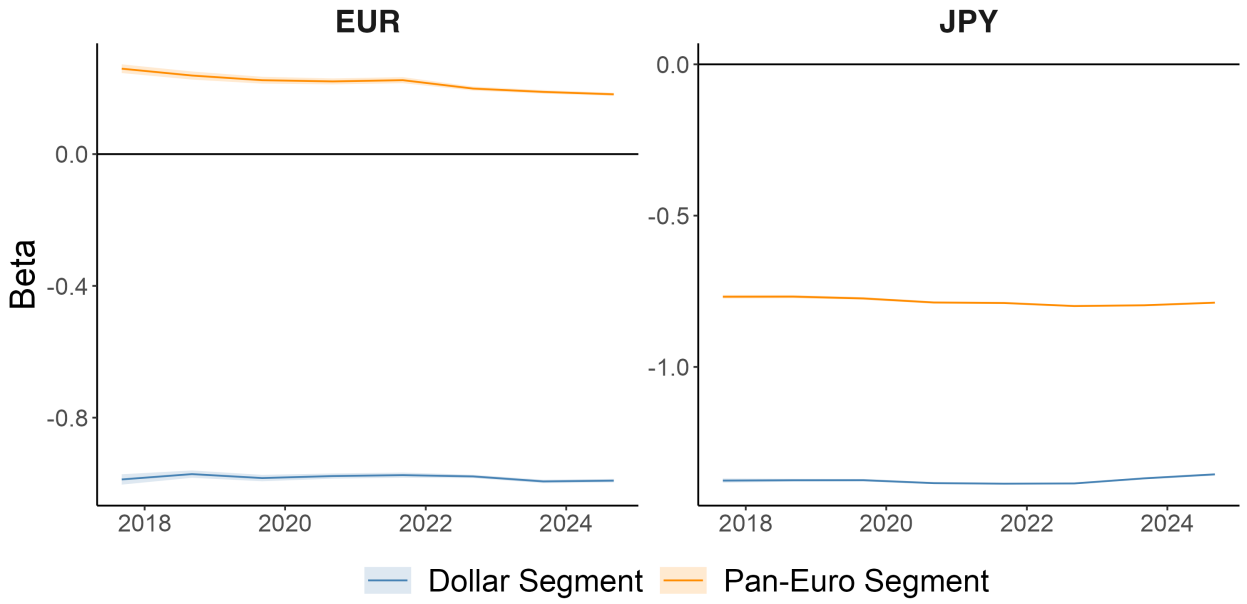
	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
AUD	0.00	-0.02	-0.02	-1.00	0.13	0.05	0.01	0.02
CAD	0.01	0.00	-0.02	-0.06	-0.07	-1.00	0.01	0.00
CHF	-0.03	-0.02	-0.02	-0.12	-1.00	0.08	0.02	0.01
EUR	-1.00	0.12	0.02	0.00	0.02	-0.01	0.00	0.00
GBP	-0.12	-1.00	-0.06	0.02	0.02	0.00	0.01	0.00
JPY	-0.01	0.06	-1.00	0.02	0.02	0.02	0.02	0.02
NZD	0.00	0.00	-0.02	-0.03	-0.01	0.00	-0.15	-1.00
SEK	-0.01	0.00	-0.02	-0.01	-0.01	-0.01	-1.00	0.15
USD	1.17	0.85	1.13	1.18	0.92	0.87	1.07	0.79
Var explained	55.4%	21.5%	13.4%	3.9%	3.0%	2.2%	0.4%	0.2%

Notes: PCA is applied to the investor-averaged within-investor covariance matrix $\Sigma_\tau^{\mathcal{E}}$ at $\tau = 1\text{M}$ horizon. "Var explained" is the fraction of the average within-investor covariance of ΔB captured by each PC.

Table A1 reports the 1M results; other tenors are similar and omitted for brevity. The first three PCs explain $55.4\% + 21.5\% + 13.4\% \approx 90.3\%$ of the average within-investor covariance in changes of net exposures. Each leading PC is essentially one currency against USD: PC1 aligns with EUR/USD, PC2 with GBP/USD, PC3 with JPY/USD; subsequent PCs line up with AUD/USD, CHF/USD, CAD/USD, SEK/USD, and NZD/USD.

Figure A1 plots five-year rolling-window estimates of the β coefficients from regression (15). We advance the window in one-year steps and report the resulting coefficient paths for each currency at the 1M tenor. The estimates exhibit only modest variation across windows, indicating stable segment loadings over time.

Figure A1: Five-year rolling estimates of segment loadings β



Notes: For each currency, we estimate the β loadings in (15) at the 1M tenor over rolling five-year windows and plot the resulting loadings on the two independent funding segments. Windows advance in one-year steps.