

Term Funding and the Long-Dated Cross-Currency Basis

PRELIMINARY*

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Abstract

At long maturities, deviations from covered interest parity (CIP) are measured against interest-rate swap (IRS) curves, and the resulting cross-currency basis has been large and persistent since the global financial crisis. We show that the quoted basis is a relative price between two curves and should not be read directly as an arbitrage return: at the 2022 benchmark transition, the same five-year swap was quoted with a basis of -24 basis points under one floating-rate convention and $+6$ basis points under another. We argue that relative term-funding costs are an important component of the long-dated cross-currency price. The five-year forward premium is closely aligned with cross-currency differences in same-issuer term-funding rates. In the common monthly sample, the mean absolute residual is 24.9 basis points using IRS rates and 10.9 basis points using same-issuer bond yields. The same-issuer residual is approximately invariant to the benchmark transition. Across seventeen independently quoted currency pairs, a currency-level representation accounts for 99.95 percent of the cross-sectional sum of squares at five years. Funded returns at observed dealer borrowing costs are negative in every period and tenor.

Keywords: Covered Interest Parity, Cross-Currency Basis, Term Funding, Funds Transfer Pricing, Dealer Intermediation

JEL Classification: F31, G15, G12, E43

1 Introduction

The covered interest parity (CIP) condition links the forward premium to an interest-rate differential. An investor who borrows in one currency, invests in another, and hedges the exchange-rate risk in the forward market should not earn a risk-free return. At short maturities, the interest rates in this comparison can be tied to actual borrowing and lending rates. At long maturities, the cross-currency basis is quoted against interest-rate swap (IRS) curves. Measured this way, the basis has been substantially different from zero since the global financial crisis, which in turn has been interpreted as evidence of violations of CIP. This interpretation assumes that the IRS curve is the relevant interest-rate input when measuring deviations from CIP.

To illustrate why the interest-rate input matters when evaluating the CIP condition, the discontinuation of Libor in 2022 is a useful example. Before 2022, Libor was the main benchmark for interest-rate swaps and therefore also entered the quoted cross-currency basis. In 2022, SOFR replaced Libor as the underlying U.S. benchmark. When the benchmark changed, the quoted basis changed as well. Changing the benchmark changes the spread needed to quote the same cross-currency transaction because the spread is measured relative to a different interest-rate curve. The benchmark transition therefore shows that the measured CIP deviation depends on the interest-rate benchmark used in the calculation.

Since the conventional cross-currency basis is quoted as a spread relative to a pair of floating-rate benchmarks, a change in the benchmarks changes the spread. While this is not surprising, it has important implications. A measure of arbitrage, or of the shadow cost of intermediary balance sheet, should not depend mechanically on which floating rate the market happens to reference. The cross-currency basis is a relative price between two interest rate curves. The question is therefore which interest-rate curve is economically relevant for the long-dated exchange of currencies.

In this paper, we argue that relative costs of locking in longer term funding are an important component of the long-dated cross-currency price, and that the conventional IRS basis should not be interpreted as CIP deviations. The IRS curve is a derivative price reflecting the

expected path of short-term benchmark rates. The actual cost of locking in longer-term funding is different from the IRS rate and can vary across currencies for the same issuer. Dealers must internalize differences in the cost of term funding in order to avoid one-sided order-flow and are incentivised to do so through the internal cost of capital within the bank.

The starting point for our argument is that a cross-currency swap reallocates funding across currencies, but it does not create funding in either currency. A bank that raises euros and swaps them into dollars receives dollars from a counterparty that already has them. These dollars have an opportunity cost for the counterparty. Hence, if term funding becomes cheaper in euros while the cost of dollar funding is unchanged, trading in the swap market cannot eliminate the underlying funding-cost difference. However, the price at which euros are exchanged for dollars over the relevant tenor can adjust. Funding conditions can differ across currencies because banks have different access to deposits, wholesale funding markets, and central-bank liquidity and such differences affect the internal cost assigned to dealers for long-dated currency positions.

As long as the relative term funding is an important component of the cross-currency price, the interest-rate differential implied by the forward premium should be close to the differential between the term-funding rates of the same borrower in the two currencies. Consequently, we compare bonds issued by the same borrower in different currencies, keeping the legal entity and seniority fixed. Under our decomposition, the common issuer credit component drops out of the cross-currency difference. What remains is the relative term-funding component, together with bond-specific liquidity and other currency related effects for that issuer. Across our main USD sample, the same-issuer bond differential is much closer to the interest-rate differential implied by the cross-currency market than the IRS differential. In the common monthly sample, the mean absolute residual is 24.9 basis points using IRS rates and 10.9 basis points using same-issuer bond yields. After 2021, the same-issuer residual is the smallest in absolute value for all five USD pairs. Importantly, the same-issuer residual changes little at the 2022 benchmark transition, while the quoted basis changes substantially. The bond-based residual therefore does not show an unusual break when the quoting convention changes.

Du et al. (2018b) construct issuer-specific cross-currency bases for multi-currency issuers, while Liao (2020) shows that cross-currency differences in corporate credit spreads are closely aligned with long-term CIP deviations and that issuance responds to differences in hedged borrowing costs. We take this relation as our starting point. Our contribution is to characterize the economic object underlying the long-dated cross-currency quote and to provide evidence that relative term-funding costs are an important component of it.

Our analysis has three main parts. First, we separate the quoted basis from the underlying cross-currency interest-rate differential. The 2022 benchmark transition shows that the quoted spread can change substantially when the floating-rate convention changes even though the underlying currency exchange is unchanged. The forward-implied interest-rate differential is approximately invariant to this change in quoting convention.

Second, we investigate which traded interest-rate differential is closest to this forward-implied differential. Same-issuer term-funding differentials are substantially closer in levels than IRS or government-rate differentials. Importantly, the difference between the various interest-rate inputs is mainly in levels rather than time-series comovement: IRS, government and same-issuer funding differentials all move closely with the forward-implied differential due to the fact that they share a large common component, but the same-issuer residual is much smaller.

Third, we use closed currency triangles to characterize the structure of the long-dated basis. A component that is specific to a currency enters all pairs involving that currency and cancels when basis quotes are combined around a closed triangle. The remaining triangular deviation therefore identifies pair-specific pricing. Across seventeen independently quoted currency pairs, these deviations are very small. At five years, the triangular deviations are negligible suggesting that the quoted cross currency basis is predominantly currency specific rather than pair specific.

Dealer price setting provides a channel through which relative funding costs can enter the cross currency swap quote. Consider the same borrower paying 50 basis points over the IRS curve when issuing a five-year bond in dollars and 20 basis points when issuing in euros.

At a zero basis, issuing in euros and swapping the proceeds into dollars is 30 basis points cheaper than issuing directly in dollars. This creates demand to issue in euros and swap the proceeds into dollars. If the quote is too favorable to one side, order flow becomes one-sided and dealer inventories build. The basis then adjusts against that flow.

A dealer can in principle finance a dollar position by rolling short-term dollar funding and hedging the benchmark interest-rate exposure with an IRS. But the IRS does not hedge the bank's funding spread or the cost of repeatedly refinancing its dollar liabilities. The bank remains exposed to these funding costs for the life of the position. Banks typically assign this exposure an internal funding price through funds transfer pricing (FTP), which Treasury applies to the trading desk (Cadamagnani et al., 2015; Grant, 2011). Even if the bank ultimately rolls short-term liabilities, the desk is charged for committing the bank to carry the dollar funding exposure for five years. The dealer therefore has to take the relative internal price of dollar and euro funding into account when setting the basis at which it is willing to intermediate the trade. The issuer and the dealer are exposed to the same type of cross-currency funding difference, one when choosing where to issue and the other when pricing the swap.

We do not expect the bond differential to match the basis exactly. The bond yield is an observed market funding rate, while the dealer sets its quote against the internal marginal cost of carrying the position. Treasury assigns this cost to the trading desk through FTP, and the internal price can differ from the observed bond yield because of liquidity, refinancing risk, balance-sheet costs, and other bank-specific considerations. We do not observe dealer FTP curves or dealer-specific order flow, so the bond and dealer evidence tests implications of this mechanism rather than directly identifying the quote-setting rule.

A further implication of the funding interpretation is that a large part of the relative funding-cost differential should be common across institutions. Treasury may assign very different absolute funding costs to different banks because their credit quality differs. But these level differences need not translate into equally large differences in the relative cost of funding in dollars rather than foreign currencies. Issuer credit quality explains very little of the cross-currency funding differential: the implied gap between an AA and a BBB issuer is below

one basis point. Within a currency-month, the cross-dealer standard deviation of funding spreads is 41.2 basis points; within a pair-month, the standard deviation of cross-currency differentials is 23.3 basis points. Dealer heterogeneity therefore remains economically relevant, but it is much smaller for relative funding costs than for funding levels.

The choice of interest-rate input also changes the interpretation of the measured cross-currency basis. IRS rates are derivative prices rather than direct measures of dealer term-funding costs. The swap literature shows that they can move relative to cash-market rates because of end-user demand, dealer positions, and balance-sheet constraints ([Feldhütter and Lando, 2008](#); [Klingler and Sundaresan, 2019](#); [Boyarchenko et al., 2018](#); [Jermann, 2020](#)). Government and corporate bond yields in turn contain different liquidity, credit, collateral, and convenience components. Holding the forward premium fixed, changing the interest-rate curve therefore changes the economic object being measured. If the same-issuer funding residual is small, the conventional IRS residual measures the cross-currency difference between swap rates and term-funding rates rather than a directly available arbitrage return. A government-bond residual similarly reflects the cross-currency difference between government yields and term-funding rates.

We finally assess whether the conventional IRS residual can be reaped as an arbitrage. We consider two distinct tests. First, following [Rime et al. \(2022\)](#), we compare the hedged safe investment return with the dealer’s observed borrowing cost. This extends their cash-flow approach to long maturities, where replacing term funding with a short-term benchmark introduces roll-over risk. Mean funded returns are negative in every sample period and at every tenor. Second, we test whether bilateral prices are inconsistent across currency triangles. Across seventeen independently quoted currency pairs the currency-level representation accounts for 99.95 percent of the cross-sectional sum of squares at five years, and the root mean square triangular remainder is 0.60 basis points against 26.47 basis points for the bilateral basis. Where two-sided quotes are available, the direct and indirect currency routes are consistent within quoted bid-ask spreads on at least 97 percent of days for every triangle. The large IRS basis therefore does not translate into a positive return at observed dealer funding costs and usually cannot be avoided by trading through a third currency.

The balance-sheet literature links an important part of the short-dated basis to regulatory constraints around quarter-end and year-end reporting dates. We find the same pattern at short maturities (Appendix F). At three months, the basis widens by 4 to 5 basis points into quarter-ends and by 9 to 11 basis points for contracts that span year-end. At five years, the corresponding initiation-date effects are very small, as expected since every five-year contract spans several reporting dates. This does not imply that intermediary balance-sheet constraints are irrelevant at long maturities. [Du et al. \(2023\)](#) and [Fleckenstein and Longstaff \(2020\)](#) interpret the basis as compensation for intermediary balance-sheet use, and [Siriwardane et al. \(2025\)](#) show that arbitrage is segmented because different trades rely on different funding sources and intermediary balance sheets.

The close match between the basis and relative term-funding costs is an average relationship rather than an exact identity. During market stress, the link can weaken. The fit also weakens at longer tenors for several currency pairs. Bond liquidity, evaluated-price measurement, issuer–currency effects, and differences between observed funding rates and the dealer’s marginal cost of carrying the position can all contribute. Relative term funding therefore provides an important anchor for the long-dated basis without implying that the two prices should coincide exactly.

The paper proceeds as follows. Section 2 sets out the framework and the data. Section 3 shows how the quoted basis depends on the floating-rate benchmark and compares the forward-implied differential with swap, government, and same-issuer funding differentials. Section 4 examines the cross-sectional structure of term-funding differentials. Section 5 examines funded and triangular arbitrage. Section 6 concludes.

1.1 Related literature

The paper is related to four parts of the literature. The first studies CIP deviations and limits to arbitrage. Early evidence includes [Akram et al. \(2009\)](#), [Baba et al. \(2009\)](#), [Mancini Griffoli and Ranaldo \(2010\)](#), and [Coffey et al. \(2009\)](#). The large post-crisis deviations documented by [Du et al. \(2018b\)](#) shifted attention to regulation, dealer balance sheets, and intermediary constraints. Related work includes [He et al. \(2017\)](#), [Cenedese et al. \(2021\)](#), [Avdjiev et al.](#)

(2019), Bahaj and Reis (2022), and Correa et al. (2025). Du et al. (2023), Siriwardane et al. (2025), and Fleckenstein and Longstaff (2020) treat the basis as compensation for intermediary balance sheet. Augustin et al. (2024) study the term structure of CIP deviations, and Diamond and Van Tassel (2026) study convenience yields across currencies. We focus on the term-funding component of the long-dated basis.

The second literature concerns the interest rates used to measure long-dated CIP. Du et al. (2018b) use IRS and OIS rates and also construct issuer-specific cross-currency bases from bonds issued by the same borrower, matched on maturity and seniority. Du et al. (2026) distinguish CIP measures based on bank benchmark rates from those based on government bond yields and show that benchmark reform materially changes the former while leaving government-bond measures comparatively stable. Our question is different. We recover the interest-rate differential implied by the same cross-currency market price and ask which traded interest-rate differential is closest to it. The 2022 transition provides a useful test because the same economic exchange was quoted under different floating-rate conventions. The quoted basis changes with the convention, while the recovered forward-implied differential and the same-issuer funding residual are approximately invariant. We use this observation to separate the quoting convention from the economic interest-rate differential and then compare that differential with observed term-funding rates. Du et al. (2018a) use government bonds and interpret the resulting wedge as a Treasury premium.

The third literature studies funding costs and cross-currency pricing. Liao (2020) documents that cross-currency corporate credit-spread differentials move closely with long-term CIP deviations and that firms adjust the currency composition of issuance in response to hedged borrowing-cost differences. We take this equilibrium relation as given and study the structure of the common component. In particular, we ask whether it is consistent with a currency-level term-funding component that is largely common across issuers and enters the funding costs relevant for dealers. Rime et al. (2022) provide the closest comparison for the arbitrage interpretation. At short maturities, they show that conventional CIP deviations can differ substantially from the arbitrage return available to an institution once its actual marginal funding cost is used. We apply the same principle at long maturities, where using short-term

funding instead of term funding introduces roll-over risk. Our funded-return test therefore compares the hedged investment return with the dealer’s observed term-funding cost.

[Andersen et al. \(2019\)](#) study the shareholder value of debt-financed dealer positions. Their funding value adjustment provides a separate reason why funding conditions can enter dealer quotes, but it is distinct from the cash-flow return in [Rime et al. \(2022\)](#) and from the currency-specific term-funding component studied here. [Liao and Zhang \(2025\)](#) and [Kloks et al. \(2023\)](#) study hedging demand and swap-market liquidity, while [Ivashina et al. \(2015\)](#) and [Borio et al. \(2016\)](#) document dollar funding conditions for non-U.S. banks. [Bahaj and Reis \(2022\)](#) show that central-bank swap lines cap the short-dated basis.

The fourth literature studies the pricing of interest-rate swaps. [Feldhütter and Lando \(2008\)](#), [Klingler and Sundaresan \(2019\)](#), [Boyarchenko et al. \(2018\)](#), [Jermann \(2020\)](#), and [Hanson et al. \(2024\)](#) show that duration demand, dealer intermediation, and balance-sheet constraints can move swap rates relative to cash-market rates. This matters because the conventional long-dated CIP measure uses the fixed rate on an interest-rate swap. Triangular restrictions have been used in spot FX markets by [Somogyi \(2026\)](#) and [Huang et al. \(2025\)](#). We use them to measure the pair-specific part of the long-dated basis.

2 Framework and data

We begin with the relation between the conventional cross currency basis and the implied interest rate differential from the forward premium. We then define the return on a funded trade, describe dealer price setting and internal funding costs, and set out the triangular restriction. The final part of the framework shows how the interpretation of the cross currency basis depends on the interest rates used in the calculation and describes the data.

2.1 The forward premium and the conventional basis

Exchange rates are quoted in market convention. $S_t^{i/j}$ is the price of one unit of currency i in units of currency j , and $F_{t,N}^{i/j}$ is the corresponding forward rate. A standard covered trade

gives

$$(1 + r_{t,N}^i) = (1 + r_{t,N}^j) \times \frac{S_t^{i/j}}{F_{t,N}^{i/j}}. \quad (1)$$

Writing the forward premium on currency i as $\rho_{t,N}^{i/j} \equiv f_{t,N}^{i/j} - s_t^{i/j}$ and using log rates gives

$$r_{t,N}^i - r_{t,N}^j = -\rho_{t,N}^{i/j}. \quad (2)$$

We define the interest-rate differential implied by the forward as

$$d_{t,N}^{F,i/j} \equiv -\rho_{t,N}^{i/j}. \quad (3)$$

For long maturities, the conventional CIP measure (the cross currency basis swap) uses interest-rate swap rates, following [Du et al. \(2018b\)](#):

$$x_{t,N}^{i/j} = (y_{t,N}^{\text{IRS},i} - y_{t,N}^{\text{IRS},j}) - d_{t,N}^{F,i/j}. \quad (4)$$

At five years there is no liquid outright forward quote. The forward-implied differential is obtained from the cross-currency basis swap and the two swap curves. Equation (4) is therefore the quoted basis written as a residual. The empirical analysis compares $d_{t,N}^{F,i/j}$ with alternative traded interest-rate differentials.

2.2 Funded arbitrage

A cross-currency swap exchanges notionals at inception and maturity. Customer trades can arrive on either side of the market, and dealers quote both directions. When order flow is not balanced, the dealer temporarily carries a funding position by currency. Collateral protects the replacement value of the derivative, but it does not supply the cash notional or remove the cost of carrying this inventory.

A positive IRS residual is not enough to establish a funded arbitrage. The institution must be able to borrow the funding currency at its own cost, invest in the other currency, hedge the exchange rate, and still earn a positive return. To separate the funding comparison from

the return calculation, suppose the same issuer raises five-year funding in currencies i and j . Define the same-issuer residual as

$$\text{LOOP}_{t,N}^{i/j} = (y_{t,N}^{\text{bond},i} - y_{t,N}^{\text{bond},j}) - d_{t,N}^{F,i/j} = y_{t,N}^{\text{bond},i} - [y_{t,N}^{\text{bond},j} - \rho_{t,N}^{i/j}]. \quad (5)$$

A value close to zero means that the issuer's funding-rate differential is close to the differential implied by the forward. This compares two funding prices. Importantly, even a positive LOOP does not by itself imply an arbitrage that benefits the issuer's shareholders. [Andersen et al. \(2019\)](#) show in their CIP example that a law-of-one-price deviation must be sufficiently large relative to the dealer's credit spread for the trade to increase shareholder value. In our setting, the corresponding condition is that LOOP must exceed the issuer's funding spread over the safe asset. We look at funded return below.

The return from borrowing in currency j , swapping into currency i , and investing in a safe asset in currency i is

$$\Pi_{t,N}^{i/j} = \text{LOOP}_{t,N}^{i/j} - (y_{t,N}^{\text{bond},i} - r_{t,N}^{\text{safe},i}) = r_{t,N}^{\text{safe},i} - [y_{t,N}^{\text{bond},j} - \rho_{t,N}^{i/j}]. \quad (6)$$

The same-issuer residual can therefore be small while the funded return is negative. The difference is the issuer's funding spread over the safe asset.

Equation (6) is the term version of the cash-flow calculation in [Rime et al. \(2022\)](#). They use the institution's actual borrowing rate on the funding leg and a safe rate on the investment leg. A positive value of Π means that the safe hedged payoff exceeds the institution's promised funding payment. Under the assumptions of this calculation, the trade is then profitable to the institution and beneficial to its shareholders. There is no additional FVA adjustment to subtract from this return.¹ A negative value shows that there is no funded arbitrage of this form at the observed borrowing rate. However, it does not measure the full shareholder value of intermediating a client trade.

¹Note that for banks/dealers, additional balance sheet costs such as the cost of leverage can imply that even small positive values are not profitable.

2.3 Triangular consistency

The conventional long-dated basis is quoted separately for each currency pair, but this does not imply that the underlying price is pair specific. We analyze how much of the basis is common to all swaps involving a given currency and how much is specific to a particular currency pair. Following [Georgievska \(2026\)](#), we use closed currency triangles to separate these two components.

Write the basis for currencies i and j as

$$x_{t,N}^{i/j} = \delta_{t,N}^{i/j} + \pi_{t,N}^{i/j}, \quad \delta_{t,N}^{i/j} = \delta_{t,N}^i - \delta_{t,N}^j. \quad (7)$$

Here, $\delta_{t,N}^i$ is a currency-level component and $\pi_{t,N}^{i/j}$ is a pair-specific remainder. A currency-level component enters every basis involving that currency. A pair-specific component enters only the corresponding currency pair.

Closed currency triangles allow us to distinguish between these two types of variation. For three currencies i , j , and k ,

$$\Delta_{t,N}^{i,j,k} = x_{t,N}^{i/j} + x_{t,N}^{j/k} - x_{t,N}^{i/k} = \pi_{t,N}^{i/j} + \pi_{t,N}^{j/k} - \pi_{t,N}^{i/k}. \quad (8)$$

The currency-level components cancel from this expression. If the bases are entirely organised by currency, the triangular sum is zero regardless of the size of the individual bilateral bases. A non-zero triangular sum therefore measures the part of the quotes that cannot be represented by currency-level differences.

This result does not require any assumption about the economic source of the currency-level component. The observed triangular sums themselves provide a direct test of how close the basis is to a currency-level representation. [Section 5.2](#) shows that these sums are very small relative to the bilateral bases.

The triangular sums do not, however, uniquely determine how a given deviation should be allocated across the bilateral pairs. To report separate currency-level and pair-level

components for each quote, we therefore use a minimum-norm decomposition. This assigns any component that is common to all swaps involving a currency to δ , while π contains only the remaining pair-specific variation. Appendix A gives the matrix representation and the closed-form solution.

This allocation rule affects the exact values of the individual δ and π components, but it does not affect the observed triangular sums. Hence, the finding that triangular deviations are small is independent of the decomposition rule.

Finally, the triangular analysis identifies a currency-level component but does not determine what that component represents economically. A funding cost that is common to all positions in a currency, a currency-specific balance-sheet cost, or another currency-level price can all generate the same structure. Our interpretation of the currency-level component as being related to relative term-funding costs therefore comes from the same-issuer funding evidence in Section 3 and the dealer evidence in Section 4, not from the triangular decomposition itself.

2.4 Dealer pricing, order flow, and internal funding prices

The long-dated cross-currency market is intermediated by dealers. Issuers generate flow when they raise funds in one currency and swap into another. Investors generate flow when they hedge foreign-currency assets. Dealers quote both sides of the market, and the basis is part of the price that allocates these flows.

Dealers adjust their quotes as order flow changes. If the basis makes one direction too attractive relative to the cost of intermediating it, customers or other dealers trade in that direction and inventory starts to build. The quote then moves against that flow. If the price moves too far, flow shifts in the other direction. At the equilibrium quote, expected marginal order flow is balanced given funding, inventory, and other intermediation costs. Individual dealers can still carry temporary positions.

Relative funding costs are one part of these costs. When a dealer provides five-year dollars and receives five-year euros, Treasury charges the desk for the dollar funding exposure and

credits it for the euro funding exposure. Banks implement these charges through funds transfer pricing. [Cadamagnani et al. \(2015\)](#) describe the practice at major UK banks: for a given currency, Treasury assigns a curve that gives the transfer price at each maturity. The marginal funding cost behind this curve has two parts. The first is a reference rate, typically the swap rate at the relevant tenor, which hedges the interest-rate risk. The second is an additional funding premium, which embeds the bank’s own credit risk and the liquidity premium for term funding. [Grant \(2011\)](#) reports the same construction from a supervisory survey of 38 large banks in nine countries, where the spread between the swap curve and the bank’s marginal cost of funds curve is referred to as the term liquidity premium. Equation (9) below follows this decomposition.

The bank can issue term debt or roll shorter liabilities. Rolling changes how the position is financed, but it does not remove exposure to future funding conditions and the corresponding maturity mismatch in the funding currency, and internal prices are meant to reflect this. The U.S. interagency guidance gives the example of a five-year loan with a rate that resets every three months. The interest-rate component of the transfer price is set at the three-month horizon, while the liquidity component is set at the five-year horizon ([Board of Governors of the Federal Reserve System et al., 2016](#)). Hence, hedging the benchmark rate with an IRS leaves the term-funding charge in place. Post-crisis regulation also requires liquidity costs to enter internal pricing, with processes tailored to individual currencies.²

We do not observe internal FTP curves. However, banks have traditionally built them from their marginal senior unsecured wholesale funding curve, in part because this curve is observable in market prices and can be updated frequently ([Cadamagnani et al., 2015](#)). The Bank of England uses secondary-market yields on five-year senior unsecured bonds as its own indicative measure of banks’ long-term funding costs. We therefore use senior bond yields to construct a market-based measure of the relative term-funding component that should enter FTP. The measure is not exact. The supervisory review reported in [Cadamagnani et al.](#)

²[European Parliament and Council \(2009\)](#), Annex V, point 14, requires liquidity strategies and processes to be tailored to business lines, currencies and entities, and to include mechanisms for allocating liquidity costs, benefits and risks. See also [Committee of European Banking Supervisors \(2010\)](#) and Principle 4 of [Basel Committee on Banking Supervision \(2008\)](#). [Board of Governors of the Federal Reserve System et al. \(2016\)](#) list illiquid currencies and trapped liquidity among the conditions that transfer prices should reflect.

(2015) finds that approaches to the marginal funding curve differ considerably across banks, and that some banks blend wholesale and deposit funding costs. Such differences enter the issuer–currency term η in Equation (9). If relative term-funding costs are primarily currency-specific, they should also help determine the quote that balances customer order flow. The same cross-currency funding differential that enters the dealer’s internal transfer price affects the relative attractiveness of trading in one direction rather than the other. In this case, the order-flow-balancing quote and the quote implied by relative FTP should be close.

For issuer m , write the term funding rate in currency k as

$$y_{t,N}^{\text{fund},k,m} = y_{t,N}^{\text{IRS},k} + c_{t,N}^m + \lambda_{t,N}^k + \eta_{t,N}^{k,m}, \quad (9)$$

where $c_{t,N}^m$ is a common issuer credit component, $\lambda_{t,N}^k$ is a currency-level term-funding component, the term funding risk premium of currency k , and $\eta_{t,N}^{k,m}$ contains issuer–currency differences and bond-market measurement. The assumption is that the common credit component is the same across currencies for the same legal entity and seniority. It therefore drops out of the cross-currency difference:

$$\left(y_{t,N}^{\text{fund},i,m} - y_{t,N}^{\text{IRS},i}\right) - \left(y_{t,N}^{\text{fund},j,m} - y_{t,N}^{\text{IRS},j}\right) = \lambda_{t,N}^i - \lambda_{t,N}^j + \eta_{t,N}^{i,m} - \eta_{t,N}^{j,m}. \quad (10)$$

Consider the marginal cost of accommodating an order that requires the dealer to provide currency i and receive currency j . Ignoring other intermediation costs for the moment, a funding-consistent quote satisfies

$$y_{t,N}^{\text{fund},i,d} - \left(y_{t,N}^{\text{fund},j,d} - \rho_{t,N}^{i/j}\right) = 0. \quad (11)$$

The opposite order reverses the sign of the same relative funding cost. If the quoted basis is away from this level, one direction becomes relatively more attractive and generates pressure on the quote. Using Equation (9), the funding component of the market-clearing basis is

$$x_{t,N}^{i/j} = \left(\lambda_{t,N}^j - \lambda_{t,N}^i\right) + \left(\eta_{t,N}^{j,d} - \eta_{t,N}^{i,d}\right). \quad (12)$$

The dealer’s common credit component cancels from this difference. Dealers can therefore have very different absolute funding spreads and still face similar relative costs across currencies. The η term allows these relative costs to differ across institutions. Other inventory and intermediation costs can also affect the quote; Equation (12) isolates the funding component studied in the empirical analysis.

This gives several implications that can be tested without observing internal FTP. First, if relative term-funding costs are an important component of the dealer’s internal funding price, the same-issuer funding differential across currencies should be closely related to the interest-rate differential implied by the cross-currency basis. The relationship need not be exact because bond yields are market funding rates rather than internal FTP rates. Furthermore, within the same pair and month, issuer credit quality should explain little of the cross-currency funding differential if the common credit component has been removed. Finally, among dealers, dealer identity should explain less variation in cross-currency funding differentials than in absolute funding levels if a large part of the relative funding cost is common across institutions. None of these implications requires the funding differential to be identical across institutions.

Maturity matters for this argument. At short horizons, some institutions can fund through deposits, money markets, or repo. At five years, the dealer can issue term debt or roll shorter liabilities, but there is no five-year risk-free borrowing rate available to the bank. Rolling short-term funding leaves the bank exposed to future funding spreads and roll-over risk. Funding conditions can also differ by currency because a bank has access to central bank funding facilities its home currency and, absent swap lines, not in a foreign currency (Bahaj and Reis, 2022). Banks also typically have better access to deposits in their home currency, which for some types of deposits (e.g. insured call deposits) are regarded as long-term funding. This is especially relevant where central banks have conducted large-scale asset purchases.

The funding interpretation also has an implication for the time series. Grant (2011) documents that before 2007 some banks charged users of funds at the swap curve only, with no spread for term liquidity, and that the larger banks could obtain long-term funding at

only slight margins above swap rates. In terms of Equation (9), λ was close to zero in every currency, and the IRS differential was then a reasonable measure of the relative cost of term funding. Cadamagnani et al. (2015) report that banks started to include a funding premium in their transfer prices during the crisis. The long-dated basis opened up over the same period (Du et al., 2018b). This timing is in line with the view that the post-crisis basis reflects term-funding premia which differ across currencies and now enter internal prices. It does not speak against a role for balance-sheet constraints, which tightened over the same years.

2.5 The interest-rate input and the meaning of the residual

The forward-implied differential does not determine which interest rate should be used in the comparison. A government yield is the return on a government security and includes liquidity, collateral, and convenience services. An OIS or IRS rate is the fixed rate on a derivative. A corporate bond yield is an observable market measure of term funding, but it also contains credit, liquidity, and investor-demand components. These rates are prices of different objects.

Let $z_{t,N}^k$ denote any candidate five-year rate in currency k and define

$$e_{t,N}^{z,i/j} = (z_{t,N}^i - z_{t,N}^j) - d_{t,N}^{F,i/j}. \quad (13)$$

For the same issuer m , $e_{t,N}^{\text{fund},i/j,m} = \text{LOOP}_{t,N}^{i/j,m}$. The two residuals satisfy

$$e_{t,N}^{z,i/j} = e_{t,N}^{\text{fund},i/j,m} + (z_{t,N}^i - y_{t,N}^{\text{fund},i,m}) - (z_{t,N}^j - y_{t,N}^{\text{fund},j,m}). \quad (14)$$

If the funding residual is close to zero, a residual calculated from another curve is approximately the cross-currency difference between that curve and the term-funding curve. An IRS residual then measures a cross-currency swap-to-funding difference. A government-bond residual measures the corresponding government-to-funding difference. The interest-rate input therefore determines what the residual measures.

For two candidate curves z and q ,

$$e_{t,N}^{z,i/j} - e_{t,N}^{q,i/j} = (z_{t,N}^i - q_{t,N}^i) - (z_{t,N}^j - q_{t,N}^j). \quad (15)$$

The common forward premium cancels. This identity is useful for interpreting [Du et al. \(2026\)](#). Their government-bond and swap-based measures use the same forward premium. The difference between the two measures is therefore the cross-currency difference in government–swap spreads. This is the object they use to study the decoupling of Treasury and dollar convenience. Our analysis is complementary: it keeps the forward premium fixed and compares it separately with funding, government, and swap rates.

For the bond comparison, define $\text{ASW}_{t,N}^k = y_{t,N}^{\text{bond},k} - y_{t,N}^{\text{IRS},k}$ and

$$\text{BB}_{t,N}^{i/j} = \text{ASW}_{t,N}^j - \text{ASW}_{t,N}^i. \quad (16)$$

Then

$$x_{t,N}^{i/j} = \text{LOOP}_{t,N}^{i/j} + \text{BB}_{t,N}^{i/j}. \quad (17)$$

This is an accounting identity. We refer to BB as the asset-swap differential; whether it measures a term-funding component is what the empirical analysis examines. A small same-issuer residual means that the forward-implied differential is close to the funding differential of the same borrower. The identity does not explain why the relation holds. Issuer choice, investor substitution, and dealer pricing can all contribute.

Government bonds illustrate why a non-funding residual can remain large. A hedged foreign government bond need not provide the same liquidity, collateral value, regulatory treatment, or safe-asset services as the domestic government bond. Under the near-default-free comparison in [Du et al. \(2018a\)](#), this difference is interpreted as relative convenience. In our framework, if the funding residual is small, the government residual measures how government yields differ from term-funding rates across currencies. It is not itself the return on a dealer-funded arbitrage.

2.6 Data

2.6.1 Cross-currency swap data

Our primary swap dataset contains daily cross-currency basis quotes from Bloomberg from January 2002 to June 2026. The triangular analysis uses ten currencies: USD, EUR, JPY, GBP, CHF, CAD, AUD, NZD, SEK, and NOK. Seventeen bilateral pairs are independently quoted, nine against the dollar and eight against the euro. We exclude pairs that Bloomberg constructs mechanically from a hub currency, since they carry no independent pricing information. Quotes are available at the 1, 2, 5, 10, and 20 year tenors. The main analysis uses five years. The calendar test also uses three-month measures constructed from government and OIS rates.

Each basis series is kept on a consistent floating-rate convention over time because the quoted basis depends on the reference rate. At the benchmark transition, we splice the old IBOR-based quote to its risk-free-rate successor. We do this on 31 December 2021 and, for CAD, again when CDOR ended on 28 June 2024. For euro crosses that continue to use Euribor while the alternative quote uses ESTR, we convert the quote to the ESTR convention using the contemporaneous difference between the two swap curves.

We exclude CHF observations from September 2011 to January 2015, when the Swiss National Bank maintained an exchange-rate floor. The EUR/CHF series starts in December 2009, when continuous quotes become available. EUR/AUD and EUR/CAD have no successor quotes and therefore end at the 2021 transition.

2.6.2 Matched-issuer bond data

The bond tests use constituent-level bond index data from the Intercontinental Exchange (ICE). [Kelly et al. \(2023\)](#) describe these data as the “gold standard for corporate bond data.” The sample contains investment-grade bonds with at least USD 500 million equivalent outstanding and four to six years of remaining maturity. The data are monthly from January 2006 through December 2023. We use the ICE asset-swap spread for each bond as the main measure of its spread over the swap curve.

We match bonds issued by the same entity in USD and one foreign currency. Matched bonds must have the same ICE type and composite rating. We retain the closest-maturity pair for each issuer, month, and currency pair and exclude observations when either price or asset-swap spread is unchanged for at least three consecutive monthly files. The main bond sample contains USD/EUR, USD/JPY, USD/GBP, USD/AUD, and USD/CAD. We do not use non-USD bond pairs in the main comparison. Those markets are thinner, and small differences in bond liquidity and benchmark conventions make the comparison less clean. Non-USD pairs remain in the swap-only triangular analysis. Appendix D reports the coverage.

The local ICE archive does not contain issue dates, a verified ultimate-parent identifier, or a fixed-rate bullet flag. Appendix C describes the resulting proxies and construction checks. Dealer banks are identified as a fixed group of global dealers. Other issuers are classified once as other banks, non-financial corporates, or supranationals and agencies. Bank domicile is assigned at the legal-entity level.

2.6.3 Benchmark harmonisation

The swap and bond measures must use consistent floating-rate conventions. We record the benchmark used for each cross-currency swap series and for the ICE asset-swap curves in each period. The 2022 transition is useful because old and new conventions can be compared directly. Section 3.1 and Appendix E show that the observed re-quotes are close to the changes implied by contemporaneous term swap curves.

3 Interest-rate inputs and the forward premium

3.1 The conventional IRS basis and the underlying floating rate

The conventional basis is quoted as a spread relative to a pair of floating-rate benchmarks. Its level therefore depends on the benchmarks. The 2022 transition from IBOR to overnight rates makes this dependence observable, because old and new quotes coexisted for several weeks in a number of currencies. Under LIBOR, the floating leg in each currency carried

the 3-month bank funding premium. The LIBOR basis hence embedded only the part of the relative funding differential not already contained in the expected path of these 3-month premia in the two currencies. Under overnight benchmarks, the floating legs carry essentially no bank funding premium, and the full differential has to appear in the quoted basis. The re-quote at the transition is therefore the market’s five-year valuation of the 3-month bank funding premium, in both currencies where both legs change and in dollars alone where only the USD leg changes.

[Du et al. \(2026\)](#) also study how the transition from IBOR to alternative benchmark rates affects measured CIP deviations. They show substantial level differences between CIP measures based on the old and new benchmark rates. We use the transition for a different purpose. Because old and new cross-currency swap conventions were quoted simultaneously, we can ask whether they recover the same underlying forward-implied interest-rate differential. We then use the same transition to test whether the residual based on same-issuer term-funding rates is invariant to the quoting convention.

Before the Libor discontinuation, 3-month Libor served as the underlying floating rate, while after the benchmark reform the underlying benchmark is SOFR. The 2022 benchmark transition makes this dependence clear. Under the ISDA fallback protocol, legacy IBOR contracts moved to overnight benchmarks plus fixed spread adjustments. When the floating-rate benchmarks changed, dealers expressed the same all-in cross-currency swap price using a different quoted spread. The resulting change in the reported basis need not reflect a change in the economic cost of exchanging funding across currencies.

For several weeks, CAD/USD was quoted under two conventions. The five-year CDOR/SOFR basis was -23.72 basis points and the CORRA/SOFR basis was $+6.28$ basis points. The difference is about 30 basis points. [Table 1](#) uses the benchmark transition to investigate whether changes in the quoted basis can be explained by changes in the interest-rate curves against which the basis is quoted. Around the transition, both the old and the new interest-rate swap curves were observable in the market. These two curves generally had different levels. Because the cross-currency basis is quoted as a spread relative to these curves, moving from the old benchmark curve to the new one should mechanically change the quoted basis

even if the all-in price of the cross-currency transaction is unchanged.

We therefore use the contemporaneous difference between the old and new swap curves to calculate the change in the basis implied by the benchmark switch (market). We then compare this curve-implied change with the actual change in the observed quoted cross-currency basis (observed). Across ten pairs, the observed re-quote differs from the curve-implied re-quote by only 1.10 basis points on average in absolute value. The close correspondence shows that most of the observed change in the quoted basis at the transition can be accounted for by the change in the underlying interest-rate benchmark.

For comparison, Table 1 also reports the change implied by the fixed ISDA fallback spreads. These fallbacks are predetermined adjustments used to convert legacy IBOR contracts to the new reference rates. They need not coincide exactly with the contemporaneous difference between the old and new swap curves at the transition date.

Table 1. Benchmark re-quotes, fixed fallbacks, and contemporaneous conversions

Currency	Conversion	Fallback	Observed	Market	Obs.–fallback	Obs.–market
CAD (CORRA)	both legs	+5.98	+6.28	+6.06	+0.30	+0.22
EUR	both legs	−13.16	−9.40	−8.40	+3.76	−1.00
GBP	both legs	−14.23	−10.70	−9.43	+3.53	−1.27
JPY	both legs	−17.80	−19.53	−15.23	−1.73	−4.30
CHF	both legs	−21.28	−21.64	−20.61	−0.36	−1.03
CAD (CDOR)	USD leg only	−26.16	−23.72	−25.44	+2.44	+1.72
NOK	USD leg only	−26.16	−24.07	−24.43	+2.09	+0.36
AUD	USD leg only	−26.16	−24.24	−24.47	+1.92	+0.23
NZD	USD leg only	−26.16	−24.44	−24.31	+1.72	−0.13
SEK	USD leg only	−26.16	−24.45	−25.03	+1.71	+0.58

Notes: All entries are in basis points. *Observed* is the observed level of the five-year cross-currency basis under the indicated benchmark convention. *Fallback* is the basis level implied by converting the legacy quote using the fixed ISDA IBOR–RFR fallback spreads. *Market* is the basis level implied by converting the legacy quote using the contemporaneous difference between the old and new term swap curves. *Obs.–fallback* and *Obs.–market* report the difference between the observed basis level and the two implied levels. “Both legs” means that the benchmark convention changes in both currencies, while “USD leg only” means that only the USD benchmark changes. CAD appears twice because CDOR/SOFR and CORRA/SOFR quotes coexisted during the transition window.

The same-issuer residual should not depend on the benchmark. It is calculated from bond yields and the forward-implied differential, and the bond leg contains no floating-rate reference. If the new basis and the new benchmark curves imply the same forward differential as before, the same-issuer residual does not change. The IRS residual does, because the quoted basis changes. Table 2 reports the results from two tests. In the first, we only use interest rate swap data as interest rate input. When old and new cross currency quotes are available on the same day, they imply almost the same forward differential. The average difference is between 0.7 and 1.7 basis points for AUD, CAD, EUR, and GBP. For JPY, the difference is 4.4 basis points because we do not observe an exact JPY LIBOR curve. The results are reported in the first three columns of table 2.

The second test uses the monthly series. From December 2021 to January 2022, the quoted basis changes sharply for every pair, by 12 to 25 basis points. These are among the largest monthly changes in the sample. The same-issuer residual changes much less and is not unusually large for any pair. For EUR and GBP, where the issuer samples are large, the residual moves by about one basis point. For AUD, CAD and JPY the changes are larger in absolute value, but the issuer samples are small and raw bond yields are noisy, so changes of this size are ordinary months for these pairs. The residual moves from month to month, but there is no break when the convention changes. The bond-based measure is essentially unchanged by the quoting convention, while the swap-based measure changes with it. We report the results in the last four columns of table 2.

3.2 Residuals across interest-rate curves

In subsection 3.1 we show that the reported basis depends on the floating-rate benchmarks used to quote the swap. We now turn to which interest-rate differential is most closely aligned with the differential implied by the forward premium. This matters because IRS, government, and bond yields represent different economic prices. IRS rates are derivative-market benchmarks relying on a specific benchmark rate, government yields represent safe investment returns, and bond yields measure the term-funding costs faced by issuers and dealers. We therefore calculate the residual using each interest-rate differential and compare this to the implied interest-rate differential from the forward premium. If the residual is

Table 2. Benchmark-transition invariance of the same-issuer residual

Pair	Same-day old and new quotes			December 2021 to January 2022			
	Days	Mean $ d^{old} - d^{new} $	Max. $ d^{old} - d^{new} $	Δx	Percentile	$\Delta LOOP$	Percentile
USD/AUD	188	1.04	4.49	-20.0	100.0	+21.2	60.6
USD/CAD	18	0.68	1.47	-17.5	98.6	+26.1	80.6
USD/EUR	131	1.40	3.02	-14.4	96.7	+1.4	10.0
USD/GBP	130	1.70	3.21	-11.8	97.2	+1.2	4.7
USD/JPY	126	4.37	9.26	-24.6	99.1	-27.2	68.5

Notes: All values except percentiles and observation counts are in basis points. For the same-day test, $d^{old} = 100(s^{USD,old} - s^{j,old}) - x^{old}$ and $d^{new} = 100(s^{USD,new} - s^{j,new}) - x^{new}$. The old and new curves are the curves named in each quote. The new foreign curve is ESTR for EUR, SONIA for GBP, TONA for JPY, and CORRA for CAD; BBSW remains on the AUD leg. The JPY old curve is the closest available par-swap proxy and does not establish an exact JPY-LIBOR mapping. The monthly series uses the contemporaneous market quote: the legacy convention through December 2021 and the market convention used in the paper from January 2022. The post-transition foreign legs in that monthly series are BBSW, CDOR, Euribor, SONIA, and TONA for AUD, CAD, EUR, GBP, and JPY, respectively. *LOOP* is the issuer-averaged raw USD-minus-foreign bond-yield differential less d . Multiple bond matches are first averaged within issuer and month, and issuers then receive equal weight. The percentile is the rank of the absolute December-to-January change in all available adjacent monthly changes from 2006–2023. Bond yields come from the monthly ICE files; basis quotes and curves are the last available observations for the same calendar month. The monthly change contains market movement between the two month ends and therefore need not equal the same-day re-quote in Table 1.

substantially smaller when same-issuer bond yields are used, the conventional IRS basis is consistent with the forward premium reflecting cross-currency differences in term-funding costs.

For currency pair p , rate curve q , and month t , we calculate

$$R_{p,t}^q = (r_{p,t}^{q,i} - r_{p,t}^{q,j}) - d_{p,t}^F, \quad (18)$$

where $r_{p,t}^{q,i}$ and $r_{p,t}^{q,j}$ are the interest rates from curve q in currencies i and j , respectively, and $d_{p,t}^F$ is the interest-rate differential implied by the observed forward premium. $R_{p,t}^q$ is the difference between these two interest-rate differentials. When q is the same-issuer bond curve, $R_{p,t}^q$ is the LOOP deviation. The forward-implied differential is the same across the IRS, government, and same-issuer bond calculations. Only the interest-rate differential used in the comparison changes.

Panel A of Table 3 reports signed period means of $R_{p,t}^q$ for the five USD pairs. We divide the sample into three periods and calculate the average residual for each currency pair in each period. IRS data are available for 13 of these estimates. Their average absolute value is 26.1 basis points, compared with 6.9 basis points for the corresponding same-issuer residuals. The same-issuer comparison holds the borrower and seniority fixed across currencies. Bond-specific liquidity, maturity matching, and evaluated-price measurement can still affect the result.

Panel B compares the IRS and same-issuer residuals at the monthly observation level. For each rate curve, the mean absolute gap is

$$\text{MAE}_q = \frac{1}{N} \sum_{p,t} |R_{p,t}^q| = \frac{1}{N} \sum_{p,t} |(r_{p,t}^{q,i} - r_{p,t}^{q,j}) - d_{p,t}^F|. \quad (19)$$

This statistic takes the absolute residual in each pair-month and then averages across observations. It therefore does not allow positive and negative residuals to offset one another.

By contrast, Panel A first averages the signed residual within each pair and period. Panel B reports the mean absolute residual for the IRS and same-issuer bond differentials on the same pair-months, together with their difference. Confidence intervals are obtained from a moving-block bootstrap that resamples calendar months jointly across currency pairs.

Panel B shows that the same-issuer residual is substantially smaller than the IRS residual. In the common sample, the mean absolute same-issuer residual is 10.9 basis points, compared with 24.9 basis points for the IRS residual. The difference is 14.0 basis points, with a 95 percent confidence interval of 11.1 to 16.9 basis points. The result is almost unchanged when the sample ends in 2021: the mean absolute residuals are 10.8 and 24.1 basis points, respectively, and the difference is 13.3 basis points. The comparison is therefore not driven by the 2022 benchmark transition. The 10.9 basis point monthly residual is larger than the 6.9 basis point period-average residual reported in Panel A because Panel B takes the absolute value in each month before averaging, while positive and negative monthly residuals can offset within a period in Panel A.

Government and swap rates do not need to be mispriced for these residuals to be large. Government securities provide liquidity, collateral, and safe-asset services. Swap rates are derivative prices and reflect conditions in the swap market. If the funding residual is small, the other residuals measure how these curves differ from the term-funding curve across currencies.

To illustrate that actual bond yields fit the implied interest-rate differential better than the IRS, we plot the IRS basis together with the same-issuer bond basis. The relation between the IRS basis and the same-issuer bond basis follows directly from their construction. The IRS basis is

$$x_{pt} = \left(r_{pt}^{\text{IRS},i} - r_{pt}^{\text{IRS},j} \right) - d_{pt}^F, \quad (20)$$

where $d_{p,t}^F$ is the interest-rate differential implied by the forward premium. Define the same-issuer bond basis as the foreign-minus-domestic difference in the issuer's asset-swap spreads:

Table 3. Residuals across alternative interest-rate curves

Pair	Period	IRS	Government	Same-issuer bond
<i>Panel A: Signed mean residuals by pair and period (bp)</i>				
USD/AUD	2006–2015	25.8	50.4	11.7
USD/AUD	2016–2021	22.3	27.1	5.0
USD/AUD	2022–2023	33.3	65.4	20.3
USD/CAD	2006–2015	5.4	16.5	2.4
USD/CAD	2016–2021	−11.2	20.6	−2.2
USD/CAD	2022–2023	−43.9	−3.6	−0.3
USD/EUR	2006–2015	−26.4	1.7	5.4
USD/EUR	2016–2021	−23.9	15.6	5.0
USD/EUR	2022–2023	−27.3	45.9	−3.1
USD/GBP	2006–2015	−6.8	5.2	−5.2
USD/GBP	2016–2021	−2.2	23.6	5.4
USD/GBP	2022–2023	−	46.4	5.7
USD/JPY	2006–2015	−57.5	−61.5	−8.9
USD/JPY	2016–2021	−53.9	−43.1	−14.3
USD/JPY	2022–2023	−	−32.3	5.2
<i>Panel B: Paired comparison of IRS and same-issuer residuals</i>				
Sample	Obs.	IRS MAE	Bond MAE	MAE difference [95% CI]
Full sample	793	24.9	10.9	14.0*** [11.1, 16.9]
Through 2021	739	24.1	10.8	13.3*** [10.0, 16.6]

Notes: The residual is $R_{pt}^q = D_{pt}^q - d_{pt}^F$, where D_{pt}^q is the interest-rate differential from curve q and d_{pt}^F is the interest-rate differential implied by the forward premium. Every column therefore uses the same forward-implied differential and changes only the interest-rate curve used in the comparison.

Panel A reports signed mean residuals by currency pair and period. The same-issuer bond differential is the issuer-averaged bond-yield differential, holding issuer and seniority fixed across currencies.

Panel B compares the IRS and same-issuer bond residuals within the same pair-month. The sample contains USD/AUD, USD/CAD, USD/EUR, USD/GBP, and USD/JPY. IRS MAE and Bond MAE are the mean absolute residuals, $\text{mean}|R_{pt}^{IRS}|$ and $\text{mean}|R_{pt}^{bond}|$. MAE difference is $\text{MAE}_{IRS} - \text{MAE}_{bond}$. The 95% confidence intervals use a paired circular moving-block bootstrap with 20,000 replications and twelve-month blocks. Calendar months are resampled jointly across currency pairs. The through-2021 sample is reported separately because benchmark conventions differ across currencies after 2021. *** denotes a bootstrap p -value below 0.001 for the null that the MAE difference is zero.

$$BB_{pt} = \left(r_{p,t}^{\text{bond},j} - r_{p,t}^{\text{IRS},j} \right) - \left(r_{p,t}^{\text{bond},i} - r_{p,t}^{\text{IRS},i} \right). \quad (21)$$

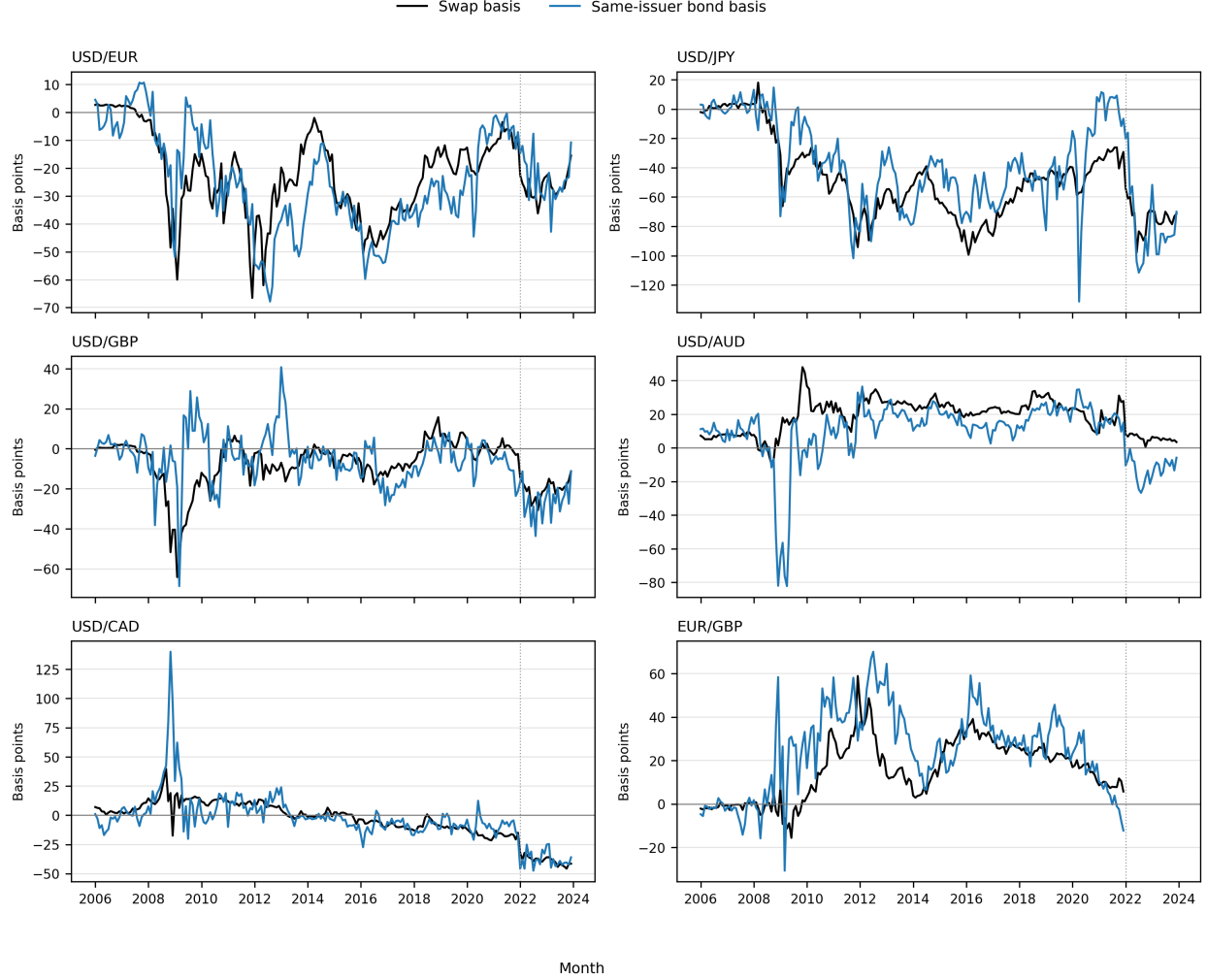
Combining Equations (20) and (21) gives

$$x_{p,t} - BB_{p,t} = \left(r_{p,t}^{\text{bond},i} - r_{p,t}^{\text{bond},j} \right) - d_{p,t}^F = \text{LOOP}_{p,t}. \quad (22)$$

Thus, the difference between the IRS basis and the same-issuer bond basis is exactly the same-issuer residual. If the issuer's bond-yield differential is close to the differential implied by the forward premium, $\text{LOOP}_{p,t}$ is close to zero and $BB_{p,t}$ is close to $x_{p,t}$.

Figure 1 plots the IRS basis and the same-issuer bond basis for the five USD pairs. The two series move together in several periods, as implied by the small same-issuer residual. The fit is not exact, however, and is a bit lower during periods of stress.

Figure 1. Five-year swap and same-issuer bond bases



Notes: The black line is the five-year cross-currency swap basis. The blue line is the same-issuer bond basis, $BB = x - LOOP$. Both series use the contemporaneous market convention: the legacy quote through December 2021 and the re-quoted market convention from January 2022. The vertical dotted line marks this change. The figure shows the five USD pairs used in the main bond analysis and EUR/GBP as a descriptive comparison. EUR/GBP is excluded from the headline bond statistics because matched non-USD bond markets are thinner. Bond observations satisfy the USD 500 million equivalent size screen, the four-to-six-year remaining-maturity screen, the seniority and rating match, and the preferred staleness rule.

The comparison is descriptive. The five-year forward-implied differential is recovered from the cross-currency swap quote and its benchmark curves because there is no liquid outright five-year forward quote. The bond yields are monthly evaluated prices and may adjust more slowly than derivative-market quotes. We therefore interpret the results as evidence that the level of the forward-implied differential is closely aligned with relative term-funding costs.

3.3 The bond basis before the crisis

Section 2.4 notes that before 2007 banks obtained term funding at small margins over swap rates and often charged no term premium internally. If the post-crisis bond basis reflects term-funding premia that differ across currencies, it should have been close to zero in that period. Table 4 reports the same-issuer bond basis for USD/EUR and USD/JPY, the two pairs with the largest post-crisis basis, in 2004–2006 and in 2010–2021.

Table 4. The same-issuer bond basis before and after the financial crisis

Pair	Period	Mean BB (bp)	Mean BB (bp)	Months
USD/EUR	2004–2006	2.6	5.2	36
	2010–2021	−31.0	31.0	144
USD/JPY	2004–2006	3.3	4.6	36
	2010–2021	−45.2	46.2	143

Notes: BB is the five-year foreign-minus-USD difference in same-issuer asset-swap spreads. Negative values mean that the issuer’s spread over swaps is lower in EUR or JPY than in USD. Each month first averages across all matched bond pairs. Mean |BB| is the mean of the absolute monthly value. The 2004–2005 extension applies the same USD 500 million issue-size screen, four-to-six-year remaining-maturity screen, seniority and rating match, and staleness rule as the main sample, with issue sizes converted at Federal Reserve H.10 exchange rates. For 2006, the extended construction reproduces the main-sample values exactly. January 2007 through December 2009 is omitted.

In 2004–2006, the mean bond basis is 2.6 basis points for USD/EUR and 3.3 basis points for USD/JPY, and the mean absolute value is about 5 basis points for both pairs. The same issuers paid nearly the same spread over swaps in each currency. In 2010–2021, the means are −31.0 and −45.2 basis points. The quoted basis shows the same pattern over the two

periods. Before the crisis, banks priced term funding internally at or close to the swap curve (Grant, 2011; Cadamagnani et al., 2015). This was innocuous for cross-currency pricing as the same issuer paid nearly the same spread over swaps in each currency, so the omitted premium cancelled from the relative funding cost and a basis close to zero was consistent with it.

The change is not common to all USD pairs. For USD/GBP and USD/CAD, where the quoted basis remained small after the crisis, the mean bond basis is -6.8 and -3.4 basis points, and for USD/AUD it is positive (Table C.1). The widening for EUR and JPY therefore does not reflect a general increase in USD asset-swap spreads relative to other currencies.

The comparison is an illustration. Since the same-issuer residual is small in both periods, the bond basis and the quoted basis have to open up together. What the table adds is the timing: same-issuer spreads over swaps began to differ across currencies over the same years in which banks started to include term-funding premia in their internal prices.

4 Term-funding differentials and dealer pricing

Equation (12) links relative term-funding costs to the price at which dealer order flow balances. We do not observe internal FTP curves or dealer-specific customer order flow. The bond data therefore cannot identify the quote-setting rule directly, but can show whether observed funding differentials have the cross-sectional structure implied by the mechanism. We first test whether the differential varies with issuer credit quality. We then compare the importance of dealer identity in funding levels and cross-currency differentials.

4.1 The cross-currency differential and issuer credit

The first test asks whether issuer credit quality explains the direction of LOOP. The sample excludes January 2008 through December 2009 and March through May 2020. For issuer m ,

currency pair p , and month t , Panel A estimates

$$\text{LOOP}_{mpt} = \alpha_{pt} + \beta C_{mpt} + \boldsymbol{\delta}' \mathbf{M}_{mpt} + \varepsilon_{mpt}, \quad (23)$$

where α_{pt} denotes pair-month fixed effects. The variable C_{mpt} is either the issuer's rating notch or its average asset-swap spread across the two currencies. The vector $\mathbf{M}_{mpt}$ contains the maturity-gap, issue-size, and coupon-difference controls. The regression compares issuers observed in the same currency pair and month. Standard errors are clustered by issuer and calendar month.

The estimated rating coefficient is -0.248 basis points, with a standard error of 0.306 . Moving from AA3 to BBB2 changes fitted LOOP by -1.24 basis points. The coefficient on the average asset-swap spread is 0.023 , with a standard error of 0.016 . Neither estimate is statistically significant. The results therefore do not show that credit quality systematically moves LOOP in one direction.

Panel B puts these residuals in perspective by comparing them with the quoted basis in the same observations. Banks include global dealer banks and other banks. The remaining group includes non-financial corporations, supranationals, and agencies. Each issuer is assigned to one group for the full sample. We first average signed LOOP across issuers within each group, currency pair, and month. We then take the absolute value of that group average.

For banks, the mean absolute quoted basis is 30.04 basis points, compared with mean absolute group-average LOOP of 14.16 basis points. The difference is 15.88 basis points, with a standard error of 1.00 . The corresponding medians are 22.46 and 10.06 basis points. Absolute LOOP is below the absolute quoted basis in 71 percent of the observations. For the remaining issuers, the mean absolute quoted basis is 28.83 basis points and mean absolute LOOP is 13.58 basis points. The difference is 15.24 basis points, with a standard error of 0.82 . The corresponding medians are 20.55 and 9.07 basis points, and absolute LOOP is below the absolute quoted basis in 72 percent of observations. Both reductions are statistically significant at the 1 percent level.

The comparison therefore shows that using group-average funding differentials reduces the mean absolute deviation by about one half relative to the quoted basis. The reduction is similar for the two groups. Comparing absolute LOOP for the two groups in the same pair and month gives a difference of -0.01 basis points, with a standard error of 0.65 and a p -value of 0.986.

Panel C examines whether group-average bond differentials move with the forward-implied differential. For group g , pair p , and month t , it estimates

$$\overline{BB}_{gpt} = \alpha_{gp} + \beta_{gp}x_{pt} + u_{gpt} \quad (24)$$

separately by group and currency pair. The table reports the mean and median of the pair-specific slopes. The mean slope is 0.803 for banks and 0.861 for the remaining issuers. The corresponding median slopes are 0.937 and 0.769. The relation between bond funding differentials and the forward-implied differential is therefore similar in the two groups.

Table 5. Credit gradients and group-specific funding relations

<i>Panel A: Signed LOOP and issuer credit quality</i>						
Credit proxy	<i>N</i>	$\hat{\beta}$	s.e.	<i>p</i> -value	Implied AA3–BBB2 gap	
Rating notch	28,071	-0.248	(0.306)	0.417	-1.24	
Average ASW	28,071	0.023	(0.016)	0.144	—	
<i>Panel B: Quoted basis and absolute group-average LOOP</i>						
Group	Obs.	Issuers	Mean Basis	Mean LOOP	LOOP < Basis	
Banks	848	130	30.04	14.16	0.71	
Rest	942	343	28.83	13.58	0.72	
<i>Panel C: Bond-differential slopes on the forward-implied differential</i>						
Group	Pair models	Mean $\hat{\beta}$	Median $\hat{\beta}$	Mean R^2		
Banks	5	0.803	0.937	0.325		
Rest	5	0.861	0.769	0.413		

Notes: Panel A estimates Equation (23). Standard errors are clustered by issuer and pair–month. Panel B reports summary statistics for issuer-level LOOP by group. Panel C regresses monthly group-average bond differentials on the basis separately by currency pair and reports moments of the pair-specific estimates. Issuer groups are assigned once at the issuer-proxy level and held fixed throughout the sample.

4.2 Dealer effects in funding levels and cross-currency differentials

The second test compares variation in absolute funding spreads with variation in cross-currency funding differentials. Banks differ in credit quality, funding structure, and business model, so dealer identity should matter for the level of their funding spreads. The relevant question for our mechanism is whether the same is true after taking the difference across currencies. If an important part of relative term-funding costs is currency-specific, cross-currency funding differentials should be more similar across dealers than absolute funding spreads.

We test this by comparing dealers within the same market conditions. For funding levels, we compare dealers within a given currency and month. For funding differentials, we compare dealers within a given currency pair and month. We estimate

$$ASW_{mct} = \alpha_{ct} + \mu_m + e_{mct}, \quad (25)$$

$$BB_{mpt} = \alpha_{pt} + \mu_m + v_{mpt}, \quad (26)$$

where α_{ct} is a currency-month effect in the level regression, α_{pt} is a currency-pair-month effect in the differential regression, and μ_m is a dealer effect. The cell effects capture market conditions common to all dealers in the same currency or currency pair at a given point in time, while the dealer effects capture persistent differences across dealers.

Table 6 reports the R^2 from the cell effects alone, dealer effects alone, and both sets of effects. It also reports the average cross-dealer standard deviation within each currency-month or currency-pair-month cell.

Dealer-specific differences are smaller for cross-currency funding differentials than for funding levels. Dealer effects alone explain 9.3 percent of the variation in funding-spread levels and 6.9 percent of the variation in cross-currency differentials. The same pattern is visible in the dispersion across dealers. Within the same currency and month, the average cross-dealer standard deviation of funding spreads is 41.2 basis points. Within the same currency pair and month, the corresponding standard deviation of cross-currency funding differentials is

Table 6. Dealer fixed effects in funding levels and cross-currency differentials

Sample	Object	Obs	Issuers	R^2 cell FE	R^2 issuer FE	R^2 two-way	Within-cell SD (bp)
All issuers	ASW level	53254	478	0.241	0.458	0.671	62.8
All issuers	ASW differential (BB)	30496	478	0.336	0.262	0.522	24.9
Global dealer banks	ASW level	6896	27	0.642	0.093	0.722	41.2
Global dealer banks	ASW differential (BB)	4138	27	0.524	0.069	0.575	23.3

Notes: The sample contains global dealer banks with five-year matched bonds from 2006 through 2023. For funding-spread levels, observations are compared within currency-month cells. For cross-currency funding differentials, observations are compared within currency-pair-month cells. Dealer fixed effects capture persistent differences across dealers, while cell fixed effects capture conditions common to dealers in the same currency and month, or currency pair and month. Cells with fewer than two dealers are excluded. “Within-cell SD” is the average cross-dealer standard deviation within the corresponding cell.

23.3 basis points.

Common market conditions explain a much larger share of the variation. Currency-month effects explain 64.2 percent of the variation in funding levels, while currency-pair-month effects explain 52.4 percent of the variation in funding differentials. Dealers therefore differ substantially in their absolute funding costs, and some heterogeneity also remains in relative funding costs. However, cross-currency funding differentials are considerably more similar across dealers than funding levels. This is consistent with an important currency-specific component in relative term-funding costs without requiring funding differentials to be identical across dealers.

4.3 Relative central-bank balance sheets and the cross-currency basis

The preceding results show that relative term-funding costs have an important currency-specific component. We next examine whether this component is related to the relative supply of liquidity across currencies. Central-bank balance sheets provide one measure of such differences. Changes in central-bank balance sheets affect the supply of reserves and safe assets and may therefore affect funding conditions in the corresponding currency. We use relative central-bank balance sheets to examine whether changes in these conditions

are associated with changes in the cross-currency basis. The analysis is descriptive because central-bank balance sheets respond to the same macroeconomic and financial conditions that affect funding markets.

For USD currency pair p , we estimate the monthly error-correction specification

$$\Delta x_{pt} = \alpha_p + \phi x_{p,t-1} + \beta \Delta \log(RelBS_{pt}) + \gamma' \Delta Z_t + \varepsilon_{pt}, \quad (27)$$

where $RelBS_{pt}$ is the foreign central-bank balance-sheet index relative to the U.S. index. An increase in $RelBS_{pt}$ therefore means that the foreign central-bank balance sheet has expanded relative to the Federal Reserve’s balance sheet. The vector Z_t contains the VIX, the commercial-paper spread, and the LIBOR–OIS spread. All specifications include currency fixed effects. We estimate the regressions monthly from 2010 through 2019 and use Driscoll–Kraay standard errors.

Table 7 reports the results across maturities from one to ten years. Relative balance-sheet growth is negatively associated with changes in the cross-currency basis at every maturity. The coefficients range from -21.3 basis points at one year to around -10 basis points at the longer maturities and are statistically significant throughout. At the five-year maturity used in most of our analysis, the coefficient is -11.7 . A 10 percent increase in the foreign central-bank balance sheet relative to the U.S. balance sheet is therefore associated with approximately a 1.2 basis point decline in the five-year basis. The negative coefficient on the lagged basis also indicates some mean reversion in the basis.

The pooled relation may hide substantial differences across currencies. We split the sample based on the extent of central-bank balance-sheet expansion during 2010–2019. EUR, GBP, JPY, and CHF experienced large and sustained balance-sheet expansions over this period, while balance-sheet policies were much less pronounced for AUD, CAD, and NZD. Table 8 reports the same regressions separately for these two groups.

The association is considerably stronger for EUR, GBP, JPY, and CHF. In Panel A, the coefficient on relative balance-sheet growth is negative and statistically significant at every

Table 7. Relative Central-Bank Balance Sheets and the Cross-Currency Basis, 2010–2019: Changes in Relative Balance Sheets

	(1)	(2)	(3)	(4)	(5)
	1Y	3Y	5Y	7Y	10Y
Dependent variable	Δ Basis	Δ Basis	Δ Basis	Δ Basis	Δ Basis
Basis_{t-1}	−0.137*** (0.031)	−0.112*** (0.027)	−0.092*** (0.019)	−0.089*** (0.019)	−0.084*** (0.018)
$\Delta \log(\text{RelBS})$	−21.345*** (5.653)	−17.300*** (4.249)	−11.733*** (3.703)	−9.832*** (3.790)	−11.143*** (3.990)
ΔVIX	−0.137* (0.082)	−0.124* (0.066)	−0.115** (0.056)	−0.106** (0.047)	−0.095** (0.047)
$\Delta \text{CPspread}$	−1.422 (1.066)	−1.742 (1.272)	−1.738 (1.775)	−1.677 (1.385)	−2.673* (1.566)
$\Delta \text{LiborOIS}$	−7.673 (5.985)	−9.535* (5.768)	−8.358 (6.354)	−6.714 (5.796)	−5.689 (6.357)
Currency fixed effects	Yes	Yes	Yes	Yes	Yes
Currencies	7	7	7	7	7
N	807	807	807	807	807
R^2 (within)	0.129	0.123	0.099	0.088	0.085

Notes: The table reports monthly panel regressions from January 2010 through December 2019. The dependent variable is the monthly change in the cross-currency basis. RelBS is the foreign central-bank balance-sheet index relative to the U.S. index, constructed from BIS data. The balance-sheet regressor is the monthly change in $\log(\text{RelBS})$. The regressions include currency fixed effects. Driscoll–Kraay standard errors are in parentheses. The basis, the commercial-paper spread, and the LIBOR–OIS spread are measured in basis points. The VIX is measured in index points. *, **, and *** denote significance at the 10, 5, and 1 percent levels.

maturity. It declines in magnitude from -60.9 at one year to -15.0 at ten years. At five years, the coefficient is -27.1 , implying that a 10 percent relative balance-sheet expansion is associated with about a 2.7 basis point decline in the basis.

For AUD, CAD, and NZD, the coefficients are much smaller. At five years, the estimate is -4.8 and is not statistically significant. The estimates are statistically significant only at some maturities and are generally between -5 and -9 basis points. The pooled result in Table 7 is therefore largely associated with the first group of currencies rather than being equally strong across all currencies.

The balance-sheet regressions above use only the quoted basis. The ECB’s targeted longer-term refinancing operations (TLTROs) provide a more direct look at term funding. The operations gave euro-area banks funding for up to four years at rates close to the policy rate. They therefore reduced the cost of euro term funding relative to dollar term funding.

If relative term-funding costs matter for the cross-currency price, this gives a simple prediction. Cheaper euro funding should make both the same-issuer bond basis and the quoted USD/EUR basis more negative. The difference between the two, which we call the same-issuer residual, should change much less.

We compare USD/EUR with USD/JPY, USD/AUD, USD/GBP, and USD/CAD around the start of TLTRO I in September 2014 and TLTRO II in June 2016. For each event, we use the six months before and the six months after the operation began and estimate

$$z_{p,t} = \alpha_p + \gamma_t + \beta \mathbf{1}\{p = \text{USD/EUR}\} \times \text{Post}_t + \varepsilon_{p,t}, \quad (28)$$

where $z_{p,t}$ is either the bond basis, the quoted basis, or the same-issuer residual. Post_t equals one after the TLTRO begins. Pair fixed effects, α_p , control for average differences across currency pairs, while month fixed effects, γ_t , control for shocks that affect all pairs at the same time. The coefficient β therefore measures how much USD/EUR changes after the TLTRO relative to the other four USD pairs.

Table 9 reports the results. Around TLTRO I, the USD/EUR bond basis falls by 14.1 basis

Table 8. Relative Central-Bank Balance Sheets and the Cross-Currency Basis, 2010–2019: Changes in Relative Balance Sheets by Currency Group

Dependent variable	(1) 1Y Δ Basis	(2) 3Y Δ Basis	(3) 5Y Δ Basis	(4) 7Y Δ Basis	(5) 10Y Δ Basis
<i>Panel A: EUR, GBP, JPY, and CHF</i>					
Basis _{<i>t</i>−1}	−0.168*** (0.038)	−0.127*** (0.032)	−0.093*** (0.022)	−0.083*** (0.019)	−0.073*** (0.015)
$\Delta \log(\text{RelBS})$	−60.895*** (15.485)	−43.333*** (11.460)	−27.062*** (7.703)	−21.275*** (6.529)	−15.037*** (5.588)
ΔVIX	−0.150 (0.113)	−0.146 (0.094)	−0.094 (0.086)	−0.039 (0.070)	−0.006 (0.058)
$\Delta \text{CPspread}$	−2.446 (1.967)	−2.365 (2.235)	−2.546 (3.014)	−2.052 (2.330)	−2.446 (1.829)
$\Delta \text{LiborOIS}$	−20.235** (8.401)	−20.458** (9.051)	−14.075 (9.989)	−10.161 (8.592)	−6.572 (6.721)
Currency fixed effects	Yes	Yes	Yes	Yes	Yes
Currencies	4	4	4	4	4
<i>N</i>	447	447	447	447	447
<i>R</i> ² (within)	0.234	0.203	0.125	0.091	0.071
<i>Panel B: AUD, CAD, and NZD</i>					
Basis _{<i>t</i>−1}	−0.068*** (0.018)	−0.067*** (0.016)	−0.104*** (0.030)	−0.138*** (0.034)	−0.105*** (0.035)
$\Delta \log(\text{RelBS})$	−4.758* (2.865)	−5.683** (2.523)	−4.765 (3.400)	−4.467 (4.048)	−9.003* (4.781)
ΔVIX	−0.065 (0.059)	−0.065 (0.054)	−0.130** (0.052)	−0.182*** (0.062)	−0.207*** (0.059)
$\Delta \text{CPspread}$	−0.606 (0.956)	−1.263 (0.884)	−0.719 (1.317)	−1.188 (0.927)	−3.082** (1.414)
$\Delta \text{LiborOIS}$	16.426*** (5.261)	10.330** (4.753)	1.508 (3.738)	−1.506 (3.876)	−4.305 (7.845)
Currency fixed effects	Yes	Yes	Yes	Yes	Yes
Currencies	3	3	3	3	3
<i>N</i>	360	360	360	360	360
<i>R</i> ² (within)	0.132	0.114	0.112	0.141	0.119

Notes: The table reports monthly panel regressions from January 2010 through December 2019. The dependent variable is the monthly change in the cross-currency basis. RelBS is the foreign central-bank balance-sheet index relative to the U.S. index, constructed from BIS data. The balance-sheet regressor is the monthly change in $\log(\text{RelBS})$. The regressions include currency fixed effects. Driscoll–Kraay standard errors are in parentheses. The basis, the commercial-paper spread, and the LIBOR–OIS spread are measured in basis points. The VIX is measured in index points. *, **, and *** denote significance at the 10, 5, and 1 percent levels. Panel A includes EUR, GBP, JPY, and CHF. Panel B includes AUD, CAD, and NZD. The panel is unbalanced because the CHF basis series starts later.

points relative to the other pairs, while the quoted basis falls by 11.0 basis points. The same-issuer residual changes by only 3.1 basis points and is not statistically different from zero. Around TLTRO II, the changes have the same sign but are smaller. The bond basis falls by 5.5 basis points and the quoted basis by 4.5 basis points, while the same-issuer residual changes by only 0.9 basis points. In both episodes, the bond basis and the quoted basis therefore move together and by similar amounts.

Table 9. The bond basis and the quoted basis around the TLTRO operations

Event	ΔBB (bp)	Δx (bp)	Same-issuer residual (bp)
TLTRO I begins	-14.1*** (3.2)	-11.0*** (2.8)	3.1 (2.9)
TLTRO II begins	-5.5 (4.7)	-4.5** (2.1)	0.9 (4.2)

Notes: Each coefficient compares the change in USD/EUR with the change in USD/JPY, USD/AUD, USD/GBP, and USD/CAD over the six months before and after each TLTRO began. TLTRO I began in September 2014 and TLTRO II in June 2016. The regressions include pair and month fixed effects. Standard errors clustered by month are in parentheses.

We do not claim causality as both TLTROs were announced in advance and were part of broader policy packages. Other central banks also changed policy around these dates. We therefore do not attribute the estimates to the TLTROs alone. The more limited result is that, during these episodes, the same-issuer funding differential and the quoted basis moved in the same direction, while the residual between them changed little.

Summarized, the results show that changes in relative central-bank balance sheets are associated with changes in the cross-currency basis, that the relation is stronger for EUR, GBP, JPY, and CHF, and that around the TLTRO operations the same-issuer funding differential moved with the basis. This is consistent with currency-specific liquidity and funding conditions contributing to the long-dated basis. The evidence does not identify a causal effect of central-bank policy, since policy balance sheets and funding conditions respond to broader financial and macroeconomic developments.

5 Arbitrage and the long-dated basis

The conventional IRS basis is often described as a CIP deviation and hence as a risk-free profit. The quoted residual is not, however, the return earned by an institution that must finance the trade. A five-year IRS represents the price of rolling benchmark funding over five years. A bank that finances a five-year currency position with short-term debt still faces refinancing risk and a maturity mismatch. The IRS does not remove this exposure. If maturity transformation were costless, banks could fund every long-term asset at the shortest maturity.

We examine two distinct arbitrage conditions that do not rely on increasing roll-over risk or net funding at all. We first test whether a bilateral position earns a positive return after the dealer’s observed term-funding cost is taken into account. This exercise extends the principle in [Rime et al. \(2022\)](#) to long maturities. Their short-maturity analysis evaluates CIP arbitrage using the institution’s actual marginal funding cost; at five years, the additional issue is that replacing term funding with a short-term benchmark also introduces roll-over risk. Next, we test whether bilateral quotes are consistent across currency triangles. Neither condition implies the other. A bilateral trade can be profitable even when currency routes are mutually consistent, and a triangular inconsistency can arise even when a funded bilateral trade is unprofitable.

5.1 Funded returns

We test whether a dealer can earn a positive return by borrowing in one currency, investing in a government security in another currency, and hedging the exchange-rate risk. The calculation involves two yields. The first is the dealer’s bond yield in the funding currency. The second is the government yield in the investment currency after the forward premium or discount is included. We express this hedged investment yield in the funding currency.

Let $y_{d,p,t}^{\text{fund}}$ denote dealer d ’s bond yield in the funding currency for currency pair p in month t . Let $\hat{r}_{p,t}^{\text{gov}}$ denote the government yield in the investment currency after hedging, expressed in the funding currency. The funded return is

$$\Pi_{d,p,t} = \hat{r}_{p,t}^{\text{gov}} - y_{d,p,t}^{\text{fund}}. \quad (29)$$

A positive value of $\Pi_{d,p,t}$ means that the hedged government yield exceeds the dealer’s funding yield. A negative value means that the government investment does not cover the dealer’s funding cost.

The direction of the trade follows the sign of the quoted basis. For a USD/foreign pair, a positive basis selects foreign-currency funding and an investment in a U.S. government security. A negative basis selects USD funding and an investment in a foreign government security. A positive value of $(\Pi_{d,p,t})$ means that the hedged government yield exceeds the dealer’s funding yield. A negative value means that the government investment does not cover the dealer’s promised funding payment.

This is the term version of the cash-flow calculation in [Rime et al. \(2022\)](#). The calculation uses the dealer’s observed borrowing yield and a government yield on the investment leg. We therefore do not subtract an additional funding value adjustment. The test does not measure the total profitability of intermediating a client trade. It asks only whether the hedged government investment earns more than the dealer’s observed term-funding cost.

Panel A of Table [10](#) reports five-year results by period. In 2008–2010, the mean dealer funding yield is 4.944 percent. The mean hedged government yield is 2.547 percent. The difference is a funded return of (-239.6) basis points. In 2016–2021, the corresponding yields are 2.898 and 1.728 percent, giving a mean return of (-117.1) basis points. The mean return is negative in every period.

Panel B reports the same comparison by tenor over the common December 2011–December 2015 sample. The mean hedged government yield is below the mean funding yield at every tenor. Mean funded returns range from (-104.3) basis points at two years to (-165.2) basis points at seven years.

Senior unsecured debt may not be the cheapest source of term funding available to a dealer.

Table 10. Dealer funding yields and hedged government investment yields

<i>Panel A: Five-year funded returns by period</i>							
Period	Observations	Pairs	Dealers	Funding yield (%)	Hedged government yield (%)	Mean Π (bp)	Share $\Pi > 0$ (%)
2006–2007	186	5	9	4.510	3.801	−70.9	0.54
2008–2010	438	5	13	4.944	2.547	−239.6	0.00
2011–2015	1,173	5	17	3.078	1.524	−155.4	0.00
2016–2021	1,609	5	25	2.898	1.728	−117.1	0.12
2022–2023	156	2	8	5.112	3.059	−205.3	0.00
<i>Panel B: Funded returns by tenor, December 2011–December 2015</i>							
Tenor	Observations	Pairs	Dealers	Funding yield (%)	Hedged government yield (%)	Mean Π (bp)	Share $\Pi > 0$ (%)
2Y	987	5	14	1.778	0.735	−104.3	0.71
5Y	729	5	14	2.918	1.433	−148.4	0.00
7Y	397	3	10	3.348	1.696	−165.2	0.00
10Y	405	3	12	3.757	2.180	−157.7	0.00

Notes: Each observation is a matched pair of dealer bonds issued in USD and a foreign currency in a given month. The funding yield is the effective yield on the dealer bond in the currency used to finance the trade. The hedged government yield is the government yield in the investment currency after the forward premium or discount is included, expressed in the funding currency. The funded return is the hedged government yield minus the dealer funding yield. Panel A uses five-year senior unsecured bonds from January 2006 through December 2023. Panel B uses the common December 2011–December 2015 window. Each bond has at least USD 500 million equivalent outstanding and satisfies the maturity and staleness screens. U.S. government yields are month-end constant-maturity Treasury yields from FRED. Foreign government yields are constructed using the foreign-minus-U.S. government-yield differentials in the Du–Keerati–Schreger data. Share ($\Pi > 0$) is the percentage of observations for which the hedged government yield exceeds the dealer funding yield.

Table 11 therefore repeats the calculation using broader sets of funding instruments. The senior preferred sample adds senior preferred bonds where they are available. The secured sample uses secured or covered bonds. The final row selects the lowest observed funding-currency bond yield available for each dealer, currency pair, and month.

The mean funded return remains negative under each funding assumption. In the secured or covered sample, the mean funding yield is 2.434 percent and the mean hedged government yield is 1.646 percent. The resulting mean return is (-78.7) basis points. When the cheapest available tier is selected separately for each dealer, pair, and month, the mean return is (-139.0) basis points. The secured sample is small and concentrated in a limited set of currencies and periods. Its mean should therefore not be compared directly with the full senior-unsecured sample.

Table 11. Funded returns under alternative funding instruments

Funding instrument	Observations	Funding yield (%)	Hedged government yield (%)	Mean Π (bp)	Share $\Pi > 0$ (%)
Strict senior unsecured	3,562	3.390	1.928	-146.2	0.08
Senior unsecured and senior preferred	5,153	3.362	1.926	-143.7	0.10
Secured or covered	241	2.434	1.646	-78.7	0.41
Cheapest tier available	4,952	3.286	1.895	-139.0	0.12

Notes: The funded return is calculated as in Table 10. The funding yield is the effective yield on the selected dealer bond in the funding currency. The hedged government yield is the government yield in the investment currency after hedging, expressed in the funding currency. The senior preferred sample adds ICE Type SNPR to the baseline senior unsecured sample. The secured sample uses ICE Type SECR. The cheapest-tier row selects the lowest observed funding-currency bond yield within each dealer-currency-pair-month. Coverage of secured and covered bonds is limited, so that row is not based on the same sample as the senior-unsecured results.

Across the strict five-year sample, three observations have positive funded returns, all for USD/JPY. In the common multi-tenor sample, positive observations are confined to USD/JPY at the two-year tenor.

Bond yields are market yields rather than transaction-specific marginal funding quotes. Dealers can also use short-term funding and refinance the position over time. This may reduce the current funding cost, but it exposes the dealer to future funding spreads and future short-dated cross-currency bases. Our conclusion is therefore limited to the observed term-funding yields: the hedged government yield is generally below the dealer's observed term-funding

cost.

5.2 Triangular consistency

A large bilateral basis could also reflect pair-specific pricing. Currency-level components cancel around a closed currency triangle, so a large triangular sum would reveal a pair-specific difference that could be reaped without a net funding position. For a USD–EUR– k triangle, define

$$T_t^k = x_t^{USD/EUR} + x_t^{EUR/k} - x_t^{USD/k}. \quad (30)$$

Across the seventeen quoted pairs these sums are small beside the bases they connect. At five years, on 94,274 pair-days, the root mean square remainder is 0.60 basis points against 26.47 basis points for the bilateral basis, so the currency-level representation accounts for 99.95 percent of the cross-sectional sum of squares, and the median absolute remainder is 0.21 basis points. Table G.1 presents the same calculation at every tenor, where the currency share runs from 99.87 percent at twenty years to 99.96 percent at two, and Table G.2 presents the five-year decomposition pair by pair.

With bid and ask quotes, the data imply an interval rather than a single value. Table 12 reports, for each triangle, the share of days on which zero lies outside this interval. The share ranges from 0.2 percent for USD–EUR–NZD to 2.3 percent for USD–EUR–AUD. Two-sided quotes are available for the five triangles in that table, so this test runs on those and not on the whole network. Some crosses are quoted from USD legs, so quoting conventions contribute to this consistency, and the test does not account for market depth, DV01, collateral, or asynchronous quote collection. We use the result only for what it shows: large bilateral bases coexist with very small differences across currency routes, so the quoted basis cannot usually be avoided by trading through a third currency. Appendix A gives the decomposition and additional diagnostics.

The two tests are different. The funded-return calculation measures whether the basis remains profitable after the dealer pays its observed borrowing cost. The triangular test does not need net funding at all and measures whether the quoted basis can be avoided through another currency route. The data provide little evidence of either type of arbitrage. This

Table 12. Triangular consistency relative to quoted bid–ask bounds

Triangle	Days	Interval excludes zero (%)	Maximum net violation (bp)
USD–EUR–JPY	4,847	0.9	9.01
USD–EUR–GBP	4,821	0.5	6.80
USD–EUR–CAD	4,896	0.6	8.25
USD–EUR–AUD	4,863	2.3	13.00
USD–EUR–NZD	4,755	0.2	2.50

Notes: For each currency k , daily bid and ask quotes on USD/EUR, EUR/ k , and USD/ k imply an interval for T_t^k . The lower bound is $x_{t,bid}^{USD/EUR} + x_{t,bid}^{EUR/k} - x_{t,ask}^{USD/k}$, and the upper bound is $x_{t,ask}^{USD/EUR} + x_{t,ask}^{EUR/k} - x_{t,bid}^{USD/k}$. “Interval excludes zero” is the percentage of days on which zero lies outside this interval. “Maximum net violation” is the largest distance between the interval and zero. The sample ends in December 2021, and the anomalous USD–EUR–AUD observation on 29 December 2010 is excluded.

does not rule out every institution-specific trading opportunity, but it suggests that the conventional five-year IRS residual should not be read mechanically as an arbitrage return.

6 Conclusion

The five-year cross-currency basis is closely related to differences in term-funding costs across currencies. Holding the forward premium fixed, the same-issuer funding differential gives a much smaller residual than the IRS differential in the main USD sample. In the common monthly sample, the mean absolute residual is 24.9 basis points using IRS rates and 10.9 basis points using same-issuer bond yields. After 2021, the same-issuer residual is the smallest in absolute value for all five USD pairs, and it changes little at the 2022 benchmark transition, whereas the quoted basis changes substantially.

The same-issuer design keeps the borrower and seniority fixed. Under our maintained decomposition, this removes the common issuer credit component and leaves the currency-specific funding component plus issuer–currency effects. The cross-currency differential varies little with issuer rating, and dealer identity explains much less dispersion in differentials than in funding levels. These results are consistent with a large common currency component in

relative term-funding costs.

The 2022 benchmark transition provides a separate way to see why the conventional basis should not be treated as the underlying economic object. The quoted basis changes materially when the floating-rate convention changes, while the recovered forward-implied differential and the same-issuer residual are approximately invariant. The relevant question is therefore which interest-rate differential is aligned with the forward-implied differential. Our results point to relative term-funding costs as an important anchor.

Dealer price setting provides a mechanism through which this funding difference can enter the swap quote. Dealers quote both sides of the market and adjust the basis as customer order flow changes. Relative funding costs change the marginal cost of accommodating flow in each direction and therefore the price at which order flow balances. Temporary imbalances create funding positions that Treasury prices through internal funding curves. We do not observe those curves or dealer-specific order flow, so the bond evidence tests implications of the mechanism rather than the quote-setting rule itself.

The conventional IRS residual should also not be read directly as an arbitrage return. At observed dealer term-funding costs, funded returns are negative on average in every period and tenor in our sample. Triangular deviations are small relative to the bilateral basis, so the quoted basis usually cannot be avoided through another currency route.

The funding relation is not exact. The same-issuer residual widens in stress, and the fit weakens at longer tenors for several pairs. Bond liquidity, evaluated-price measurement, issuer–currency effects, and differences between observed funding rates and the dealer’s marginal cost of carrying the position can all contribute. Direct observations of dealer FTP curves by currency and maturity, together with dealer-specific order flow, would provide the cleanest next test of the pricing mechanism.

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A Triangular Decomposition

This appendix describes the triangular decomposition used in Section 5.2. We write each quoted basis as a currency-level component plus a pair-specific component. The observed triangle sums identify the part that cannot be represented by currency-level differences. Figure A.1 illustrates the construction.

A.1 Triangular relationships

Identification uses a standard property of foreign exchange markets, triangular arbitrage consistency. For any three currencies, the product of spot rates around a triangle equals one, abstracting from transaction costs,

$$S_t^{i/j} \times S_t^{j/k} \times S_t^{k/i} = 1. \quad (31)$$

This extends to forward rates and hence to cross-currency basis swaps. Define the triangular inconsistency as

$$\Delta_{t,N}^{i,j,k} = x_{t,N}^{i/j} + x_{t,N}^{j/k} - x_{t,N}^{i/k}. \quad (32)$$

There are two ways to move from currency i to currency k . The direct route uses the i/k swap. The indirect route goes through currency j and uses the i/j and j/k swaps. The difference between the two routes is $\Delta_{t,N}^{i,j,k}$. For USD, EUR, and JPY, for example,

$$\Delta_{t,N}^{\text{USD,EUR,JPY}} = x_{t,N}^{\text{USD/EUR}} + x_{t,N}^{\text{EUR/JPY}} - x_{t,N}^{\text{USD/JPY}}.$$

A non-zero value means that the two quoted routes are not exactly consistent.³

A.2 Cancellation of currency-specific components

From Section 5.2, the basis decomposes as $x_{t,N}^{i/j} = \delta_{t,N}^{i/j} + \pi_{t,N}^{i/j}$, and the currency-specific component can be written as a difference of currency terms, $\delta_{t,N}^{i/j} = \delta_{t,N}^i - \delta_{t,N}^j$. Substituting into the triangular inconsistency,

$$\begin{aligned} \Delta_{t,N}^{i,j,k} &= [(\delta_{t,N}^i - \delta_{t,N}^j) + \pi_{t,N}^{i/j}] + [(\delta_{t,N}^j - \delta_{t,N}^k) + \pi_{t,N}^{j/k}] \\ &\quad - [(\delta_{t,N}^i - \delta_{t,N}^k) + \pi_{t,N}^{i/k}]. \end{aligned} \quad (33)$$

³The additive relationship in (32) is exact for continuously compounded rates and is an approximation for quoted par basis-swap spreads. At the rate and basis levels in our sample, the approximation error is below 0.5 basis points. Exact cash-flow calculations give very similar results.

Each currency-specific component appears twice with opposite signs,

$$(\delta_{t,N}^i - \delta_{t,N}^j) + (\delta_{t,N}^j - \delta_{t,N}^k) - (\delta_{t,N}^i - \delta_{t,N}^k) = 0, \quad (34)$$

so the triangular inconsistency depends only on pair-specific frictions,

$$\Delta_{t,N}^{i,j,k} = \pi_{t,N}^{i/j} + \pi_{t,N}^{j/k} - \pi_{t,N}^{i/k}. \quad (35)$$

We identify triangular remainders from triangular inconsistencies and recover currency-specific components by subtraction,

$$\delta_{t,N}^{i/j} = x_{t,N}^{i/j} - \pi_{t,N}^{i/j}. \quad (36)$$

Figure A.1 gives a numerical example in which a triangular inconsistency of 8 basis points is attributed entirely to triangular remainders while currency-specific components cancel exactly.

The currency component is common to all pairs that contain a given currency. The triangular component is the part that cannot be represented in this way. A non-zero triangular sum can reflect pair-specific quoting, execution, or market frictions. In an ideal closed triangle, the currency notionals can be arranged so that the net currency position cancels. This is why a currency-specific funding wedge can be large in bilateral quotes and still disappear around the triangle.

A.3 Implementation

Our quote network contains ten currencies and seventeen independently quoted bilateral pairs: USD against EUR, JPY, GBP, CHF, CAD, AUD, NZD, SEK and NOK, and EUR against the same eight partners. Every other cross is constructed from these quotes and carries no independent pricing information, so it is left out of the system. The network is connected. A connected network with n currencies and m quoted pairs has $m - n + 1$ independent currency cycles. Here this gives

$$17 - 10 + 1 = 8.$$

The eight USD–EUR– X triangles, for $X \in \{\text{JPY, GBP, CHF, CAD, AUD, NZD, SEK, NOK}\}$, form an independent set of cycles: every quoted pair other than USD/EUR lies in exactly one of them, and USD/EUR lies in all eight. The solve runs date by date on the pairs quoted that date, so the dimensions below are those of the full network and a date on which a cross is not quoted carries the corresponding subnetwork.

Stack the pair-specific components in $\pi_{t,N}$, in the pair order above, and the five observed

triangular sums in $\Delta_{t,N}$. The cycle restrictions can be written as

$$D\boldsymbol{\pi}_{t,N} = \Delta_{t,N}, \quad (37)$$

where D is the 8×17 incidence matrix of the triangles. Each row carries the three signs of Equation (32) for one triangle, +1 on USD/EUR, -1 on USD/ X and +1 on EUR/ X , and nothing else:

$$D = [\mathbf{1}_8 \quad -I_8 \quad I_8], \quad (38)$$

with $\mathbf{1}_8$ a column of ones and I_8 the identity matrix. The matrix has rank 8, so the eight equations are independent, and its null space has dimension $17 - 8 = 9$, which is $n - 1$.

The null space has one form. Write A for the 17×10 matrix whose row for pair i/j carries +1 in the column of currency i and -1 in the column of currency j , so that $A\boldsymbol{\theta}$ is the vector of pair differences $\theta^i - \theta^j$ of any currency-level vector $\boldsymbol{\theta}$. Then $DA = 0$, by the cancellation of Equation (34), and A has rank 9, one less than the number of currencies because a constant added to every element of $\boldsymbol{\theta}$ changes no pair difference. The column space of A is therefore the null space of D : the directions that the triangles do not reach are exactly the currency-level shifts. It follows that the decompositions consistent with the quotes and with every triangle form the set

$$\{ (\boldsymbol{\delta}_{t,N} + A\boldsymbol{\theta}, \boldsymbol{\pi}_{t,N} - A\boldsymbol{\theta}) : \boldsymbol{\theta} \in \mathbb{R}^{10} \}, \quad (39)$$

a family of dimension nine in which a currency-level vector is moved from one component to the other without changing any basis or any triangular sum.

The minimum-norm decomposition of Section 2.3 selects one element of this set by requiring $\boldsymbol{\pi}_{t,N}$ to be orthogonal to the column space of A . The selected element is the minimum-norm solution

$$\hat{\boldsymbol{\pi}}_{t,N} = D^+ \Delta_{t,N} = D^\top (DD^\top)^{-1} \Delta_{t,N}, \quad (40)$$

where D^+ is the Moore–Penrose pseudoinverse. The solution lies in the row space of D , which is the orthogonal complement of the column space of A , and it is the unique solution of Equation (37) with that property. For the incidence matrix of Equation (38), $DD^\top$ is $2I_8$ plus a matrix of ones, with eigenvalues 10 and 2, the latter of multiplicity seven, so the inverse has condition number 5 and no regularisation enters. The currency-level part is then the remainder,

$$\hat{\delta}_{t,N}^{i/j} = x_{t,N}^{i/j} - \hat{\pi}_{t,N}^{i/j}. \quad (41)$$

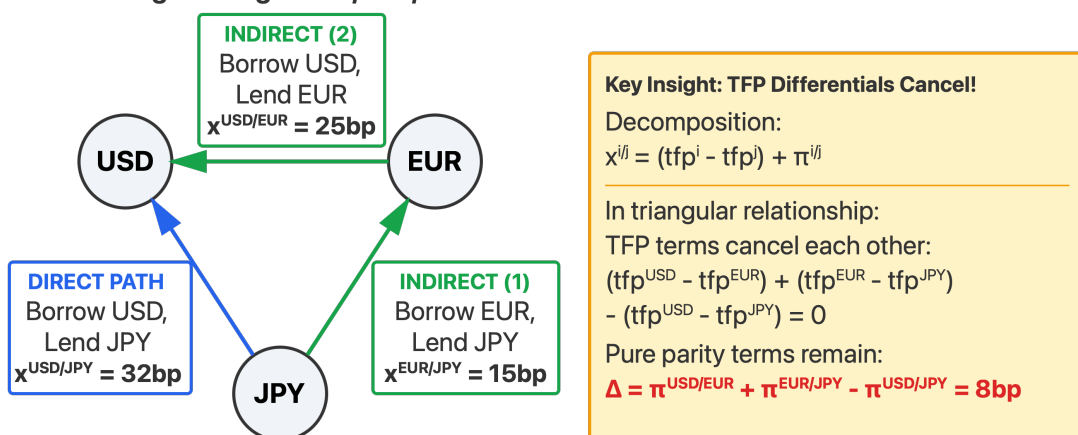
Because $\hat{\boldsymbol{\pi}}_{t,N}$ satisfies every triangle, $\hat{\boldsymbol{\delta}}_{t,N}$ has zero triangular sums and is exactly a vector of pair differences of currency-level terms. These terms are recovered up to an additive constant, and we set the USD term to zero; every other choice of the constant leaves every pair difference unchanged.

The decomposition is descriptive. The five triangular sums are directly observed, depend on no restriction, and are the main evidence on cross-route consistency. The minimum-norm step allocates those cycle deviations across the bilateral pairs of each triangle and is used for the decomposition statistics reported below; a different selection within Equation (39) would move a currency-level vector between the two components and leave the sums untouched. The step does not identify the economic source of the currency-level component, and it does not distinguish a currency-common price of any origin from a term funding risk premium, since both lie in the column space of A . That distinction is made with the same-issuer funding differentials and the dealer-level evidence of Sections 3 and 4, which are observed outside the swap network.

Figure A.1. Triangular construction for cross-currency bases

Notation: $x^{i/j}$ = cross-currency basis spread (observed); $\pi^{i/j}$ = pure parity deviation;
 tfp^i = term funding premium; $\Delta^{i,j,k}$ = triangular inconsistency; $x^{i/j} = (\text{tfp}^i - \text{tfp}^j) + \pi^{i/j}$

Panel A: Single Triangle USD/EUR/JPY



Direct Path: Borrow USD in exchange for JPY. Total cost = 32bp

Indirect Path: Effectively the same (Borrow USD in exchange for JPY) but with two swaps:
 (1) Borrow EUR in exchange for JPY + (2) Borrow USD in exchange for EUR
 Total cost = 15bp + 25bp = 40bp. Triangular Inconsistency $\Delta = 40\text{bp} - 32\text{bp} = 8\text{bp}$

Panel B: Multiple Triangles - Over-Identified System

Triangle 1 (USD-EUR-JPY):

$$\Delta^1 = 8\text{bp} = \pi^{\text{USD/EUR}} + \pi^{\text{EUR/JPY}} - \pi^{\text{USD/JPY}}$$

Triangle 2 (USD-EUR-GBP):

$$\Delta^2 = 3\text{bp} = \pi^{\text{USD/EUR}} + \pi^{\text{EUR/GBP}} - \pi^{\text{USD/GBP}}$$

Triangle 3 (USD-JPY-GBP):

$$\Delta^3 = -5\text{bp} = \pi^{\text{USD/JPY}} + \pi^{\text{JPY/GBP}} - \pi^{\text{USD/GBP}}$$

Matrix System: $D\pi = \Delta$

With 7 currencies:

- 21 bilateral pairs
- 35 triangular constraints
- **Over-identified: 35 > 21**

Solution: $\hat{\pi} = (D'D)^{-1}D'\Delta$

Result: $\hat{\pi}^{\text{USD/EUR}} = 5\text{bp}$, $\hat{\pi}^{\text{EUR/JPY}} = 5\text{bp}$, $\hat{\pi}^{\text{USD/JPY}} = 2\text{bp}$, ...

Panel C: Recovering Term Funding Premium Differentials

Step 1: Known pure parity deviations

$$\hat{\pi}^{\text{USD/EUR}} = 5\text{bp}$$

$$\hat{\pi}^{\text{EUR/JPY}} = 5\text{bp}$$

$$\hat{\pi}^{\text{USD/JPY}} = 2\text{bp}$$

... (all pairs identified)

These are cross-currency pair-specific frictions (e.g., USD/EUR pair specific)

Step 2: TFP differentials as residuals

$$(\text{tfp}^i - \text{tfp}^j) = x^{i/j} - \hat{\pi}^{i/j}$$

Examples:

$$(\text{tfp}^{\text{USD}} - \text{tfp}^{\text{EUR}}) = 25\text{bp} - 5\text{bp} = 20\text{bp}$$

$$(\text{tfp}^{\text{EUR}} - \text{tfp}^{\text{JPY}}) = 15\text{bp} - 5\text{bp} = 10\text{bp}$$

$$(\text{tfp}^{\text{USD}} - \text{tfp}^{\text{JPY}}) = 32\text{bp} - 2\text{bp} = 30\text{bp}$$

TFPs are currency-specific (e.g., USD)

Note: TFPs identified only up to a normalization constant. We can set $\text{tfp}^{\text{USD}} = 0$ and express all others relative to USD.

B Accounting Relation Between Swap- and Bond-Based CIP Measures

This appendix proves the identity used in Section 2.5 and works it through numerically. The three objects are

$$x_{t,N}^{i/j} = y_{t,N}^{\text{IRS},i} - \left(y_{t,N}^{\text{IRS},j} - \rho_{t,N}^{i/j} \right), \quad (42)$$

$$x_{t,N}^{\text{bond},i/j} = y_{t,N}^{\text{bond},i} - \left(y_{t,N}^{\text{bond},j} - \rho_{t,N}^{i/j} \right), \quad (43)$$

$$\text{ASW}_{t,N}^k = y_{t,N}^{\text{bond},k} - y_{t,N}^{\text{IRS},k}, \quad \text{BB}_{t,N}^{i/j} = \text{ASW}_{t,N}^j - \text{ASW}_{t,N}^i. \quad (44)$$

Result. $x_{t,N}^{i/j} = x_{t,N}^{\text{bond},i/j} + \text{BB}_{t,N}^{i/j}$.

Proof. Substitute $y^{\text{IRS},k} = y^{\text{bond},k} - \text{ASW}^k$ into the definition of $x^{i/j}$:

$$\begin{aligned} x_{t,N}^{i/j} &= \left(y_{t,N}^{\text{bond},i} - \text{ASW}_{t,N}^i \right) - \left(y_{t,N}^{\text{bond},j} - \text{ASW}_{t,N}^j - \rho_{t,N}^{i/j} \right) \\ &= \underbrace{\left[y_{t,N}^{\text{bond},i} - \left(y_{t,N}^{\text{bond},j} - \rho_{t,N}^{i/j} \right) \right]}_{x_{t,N}^{\text{bond},i/j}} + \underbrace{\left(\text{ASW}_{t,N}^j - \text{ASW}_{t,N}^i \right)}_{\text{BB}_{t,N}^{i/j}}. \quad \square \end{aligned} \quad (45)$$

The identity is exact, holds date by date, and involves no economics. It is also the reason the ordering of the bond basis in (16) is j minus i : written that way, BB is the quantity the swap basis would equal if parity held at bond funding costs, and the two carry the same sign.

Illustration

Take $i = \text{USD}$ and $j = \text{EUR}$ and suppose the five-year swap basis is $x^{\text{USD}/\text{EUR}} = -20$ basis points. Negative means the direct dollar rate lies below the synthetic dollar rate obtained by borrowing euros and swapping, so dollars raised through the euro are expensive. Suppose matched issuers pay a spread over the swap curve that is 26 basis points wider in dollars than in euros, so $\text{BB}^{\text{USD}/\text{EUR}} = \text{ASW}^{\text{EUR}} - \text{ASW}^{\text{USD}} = -26$. Both numbers are negative. The identity gives the deviation evaluated at the rates these issuers actually pay, $\text{LOOP}^{\text{USD}/\text{EUR}} = x - \text{BB} = -20 - (-26) = +6$ basis points. A deviation of twenty basis points against swap benchmarks becomes six against bond yields. The opposite ordering, $\text{ASW}^i - \text{ASW}^j$, would give $\text{BB} = +26$ and $\text{LOOP} = -46$, which would say that measuring

parity against actual funding costs more than doubles the deviation. That is the wrong sign, not a different convention.

Economic interpretation

The identity has no structural content. It puts the swap quote and the same-issuer funding comparison in the same units. If LOOP is close to zero, the swap basis is close to the difference between the same issuer's asset-swap spreads across currencies. Under the decomposition in Section 2.4, the common issuer credit component drops out. The remaining object is the currency-specific term-funding component plus issuer–currency residuals. The bond yield need not be risk free. It is the market yield on the issuer's outstanding term debt, while the IRS rate is a derivative price. Section 4 examines whether the cross-currency difference is similar across issuers with very different credit quality.

C Bond Data Construction and Sensitivities

The local ICE archive does not contain issue dates, a verified ultimate-parent identifier, or a fixed-rate bullet flag. The preferred construction therefore uses the available issuer information together with ICE type and composite rating, and applies screens based on USD-equivalent face value, remaining maturity, and stale prices or asset-swap spreads. Table C.1 changes the size conversion, maturity variable, and staleness rule in sequence. The USD 500 million conversion matters most for CAD, while replacing effective duration with remaining maturity matters most for AUD and JPY. The preferred rule uses USD-equivalent size, remaining maturity, and exclusion when either price or ASW repeats for at least three monthly files.

Table C.1. Bond-basis estimates under alternative construction rules

Construction	USD/AUD	USD/CAD	USD/EUR	USD/GBP	USD/JPY
Native 500; duration 4–6	14.90	−3.59	−30.54	−5.74	−42.29
USD 500; duration 4–6	14.47	−6.13	−30.32	−6.94	−42.65
USD 500; maturity 4–6	8.68	−3.25	−27.52	−6.76	−40.35
Stale only if both repeat	8.68	−3.25	−27.52	−6.76	−40.35
Stale if either repeats	8.59	−3.41	−27.56	−6.82	−40.38

Notes: Entries are mean five-year bond differentials in basis points over January 2006–December 2023. “Native 500” applies the threshold in each bond’s native currency. “USD 500” converts both legs to USD equivalents.

Table C.2 reports the observation count, maturity gap, and issuer concentration under the preferred rule.

Table C.2. Preferred-sample matching diagnostics

Pair	Obs.	Months	Issuers	Issuers/month	Median gap (years)	p90 gap (years)	Top-five share	Mean LOOP (bp)
USD/AUD	2,059	216	46	10.0	0.14	0.51	0.43	10.13
USD/CAD	2,900	216	68	12.5	0.15	0.70	0.26	−1.34
USD/EUR	18,762	216	431	88.5	0.22	1.00	0.06	−5.10
USD/GBP	4,934	216	155	20.0	0.21	0.94	0.15	−8.75
USD/JPY	1,855	215	70	8.0	0.20	0.79	0.23	−17.53

D Currency-Pair Selection

The main bond analysis uses USD pairs only: USD/EUR, USD/JPY, USD/GBP, USD/AUD, and USD/CAD. The non-USD crosses have thinner matched-bond coverage and are more

sensitive to bond liquidity and benchmark conventions. We therefore exclude them from the funding comparison but retain them in the swap-only triangular analysis. Table D.1 reports coverage for all nine candidate pairs.

Table D.1. Bond coverage and final pair selection

Pair	Months	Median issuers	Months ≥ 5	Stale share	Bond screen	Taxonomy
USD/EUR	216	92.5	216	2.6%	Pass	Include
USD/JPY	215	8.0	158	7.0%	Pass	Include
USD/GBP	216	20.0	216	1.1%	Pass	Include
USD/AUD	216	10.0	197	3.6%	Pass	Include
USD/CAD	216	13.0	188	1.2%	Pass	Include
EUR/GBP	216	25.0	216	3.2%	Pass	Exclude
EUR/AUD	213	6.0	166	8.4%	Pass	Exclude
EUR/CAD	203	6.0	130	4.0%	Pass	Exclude
EUR/JPY	210	6.0	132	12.1%	Pass	Exclude

E Benchmark Transition Details

Table 1 combines the fixed-fallback comparison with the contemporaneous market conversion for the 2022 benchmark transition discussed in Section 3.1. The fixed fallbacks predict the broad direction and magnitude of the re-quotes. The market conversion is more precise because it uses the term value of the old and new curves at the transition date. Across ten convention pairs, the mean absolute observed-minus-market difference is 1.10 basis points and the root mean square difference is 1.62 basis points. JPY is the main mapping limitation: the legacy cross-currency quote referenced JPY LIBOR, while the available JYBC5 series is a 3M-versus-6M JPY basis quote, so the observed-minus-market difference of about four basis points can reflect a mismatch between JPY curve conventions.

F Calendar Effects Across Maturities

Quarter-end and year-end balance-sheet costs are important in short-dated CIP. We test whether the same calendar pattern is visible at five years. A five-year contract spans many reporting dates regardless of its initiation date. The five-year coefficients should therefore be interpreted as initiation-date effects, not as the total cost of carrying the position across future reporting dates.

Table E.1. Benchmark re-quotes, fixed fallbacks, and contemporaneous conversions

Currency	Conversion	Fallback	Observed	Market	Obs.–fallback	Obs.–market
CAD (CORRA)	both legs	+5.98	+6.28	+6.06	+0.30	+0.22
EUR	both legs	−13.16	−9.40	−8.40	+3.76	−1.00
GBP	both legs	−14.23	−10.70	−9.43	+3.53	−1.27
JPY	both legs	−17.80	−19.53	−15.23	−1.73	−4.30
CHF	both legs	−21.28	−21.64	−20.61	−0.36	−1.03
CAD (CDOR)	USD leg only	−26.16	−23.72	−25.44	+2.44	+1.72
NOK	USD leg only	−26.16	−24.07	−24.43	+2.09	+0.36
AUD	USD leg only	−26.16	−24.24	−24.47	+1.92	+0.23
NZD	USD leg only	−26.16	−24.44	−24.31	+1.72	−0.13
SEK	USD leg only	−26.16	−24.45	−25.03	+1.71	+0.58

Notes: Fallback is the re-quote implied by fixed ISDA IBOR–RFR spreads. Market is the contemporaneous conversion implied by the corresponding term swap curves. Observed is the same-day new-minus-old convention change in the five-year basis. CAD appears twice because CDOR/SOFR and CORRA/SOFR quotes coexist in the transition window.

For series s in currency pair p , we estimate

$$y_{spt} = \alpha_{spq(t)} + \beta_Q QEnd_t + \beta_Y YEnd_t + \varepsilon_{spt}, \quad (46)$$

where $\alpha_{spq(t)}$ is a series–pair–calendar–quarter fixed effect. $QEnd_t$ identifies the last five trading days of a quarter, and $YEnd_t$ identifies the last five trading days of the fourth quarter separately. Standard errors are clustered by date. The dependent variables are the three-month government-yield basis, the three-month OIS basis, and the quoted five-year swap basis.

Table F.2 reports the estimates. At quarter-ends outside December, the three-month government basis rises by 5.13 basis points. The three-month OIS basis rises by 4.14 basis points. Both estimates are statistically significant. The corresponding five-year coefficient is 0.07 basis points and is not statistically significant. The year-end quote-date coefficients are −6.04 and −6.91 basis points at three months and 0.20 basis points at five years. A separate test asks whether a three-month contract spans 31 December. This contract-exposure test gives positive premia of 9.48 basis points for the government measure and 11.26 basis points for the OIS measure. The two year-end results answer different questions. Table F.2 measures the date on which the quote is observed. The contract-exposure test measures whether the contract crosses the reporting date.

The results show a clear reporting-date pattern at three months but no comparable initiation-

Table F.2. Quarter-end and year-end effects by tenor

Series	Obs	Within-cell SD (bp)	Quarter-end (bp)	Year-end (bp)
DKS government basis 10y	38329	6.5	-0.62*** (0.15)	-0.67* (0.40)
DKS government basis 1y	37818	9.0	0.15 (0.20)	0.80** (0.32)
DKS government basis 3m	39408	15.9	5.13*** (1.14)	-6.04*** (1.94)
DKS government basis 5y	38233	6.3	-0.51*** (0.16)	-0.77** (0.35)
OIS-based CIP deviation 3m	13966	12.6	4.14*** (0.83)	-6.91*** (1.29)
Swap basis 10Y	28620	3.4	0.13 (0.11)	-0.31 (0.20)
Swap basis 1Y	28515	4.0	0.61*** (0.20)	-0.36* (0.22)
Swap basis 5Y	29020	3.3	0.07 (0.12)	0.20 (0.26)

Notes: The table estimates Equation (46) using daily USD currency pairs. The quarter-end indicator marks the last five trading days of a calendar quarter. The year-end indicator marks the corresponding days in the fourth quarter and is included separately. All specifications include series–currency-pair–calendar-quarter fixed effects. Standard errors are clustered by date. The three-month measures use government yields or OIS rates. The five-year measure is the quoted swap basis. *, **, and *** denote significance at the 10, 5, and 1 percent levels.

date pattern at five years. This difference is consistent with the maturity structure of the contracts. It does not rule out a role for regulation in long-dated pricing because a five-year position uses balance sheet across many future reporting dates. The test only shows that the date on which a five-year contract is initiated has little additional effect on its quoted basis.

G Additional Triangular Diagnostics

Table G.1 extends the triangular calculation across maturities. The currency-component share is at least 99.87 percent at every tenor from one to twenty years, and the root mean square remainder runs from 0.45 basis points at two years to 0.99 at twenty. The remainder is largest at the two ends of the quoted curve, where the crosses are quoted least densely.

Table G.1. Triangular consistency across the term structure

Tenor	Pair-days	RMS basis (bp)	RMS remainder (bp)	RMS ratio	Currency share (%)	Median $ \pi $ (bp)
1Y	91,438	22.59	0.72	0.032	99.90	0.19
2Y	91,914	23.38	0.45	0.019	99.96	0.14
5Y	94,274	26.47	0.60	0.023	99.95	0.21
10Y	92,612	28.29	0.77	0.027	99.93	0.26
20Y	63,832	27.97	0.99	0.036	99.87	0.21

Notes: Daily pair-level remainders from the minimum-norm solve of Appendix A, on the seventeen quoted pairs from 2 January 2002 to 30 June 2026, restricted to pair-days on which the pair sits in a closed triangle. The currency share is one less the ratio of the remainder’s sum of squares to the basis’s, in percent.

Table G.2 presents the five-year decomposition pair by pair. The mean absolute remainder lies between 0.25 and 0.64 basis points on every pair, and its ratio to the mean absolute basis between 0.85 and 3.79 percent. In this hub-and-spoke network the minimum-norm selection places equal and opposite remainders on the two spokes of a triangle, which is why the dollar and euro rows for a partner currency carry the same magnitude with opposite signs.

Table G.3 presents the five-year remainder by episode. It rises in the global financial crisis, the euro-area crisis and the benchmark transition, and stays small beside the bilateral basis throughout: the largest of the five, at the benchmark transition, is a root mean square of 1.50 basis points against 26.47 for the basis itself.

Table G.4 presents the post-March 2024 holdout, which tests the construction on quotes that no part of it was built around. Six triangles have successor quotes on both euro legs

Table G.2. Five-year decomposition by currency pair

Pair	Pair-days	Mean x (bp)	Mean δ (bp)	Mean π (bp)	Mean $ \pi $ (bp)	$ \pi / x $ (%)
EUR/AUD	5,218	35.55	35.37	0.180	0.528	1.48
EUR/CAD	5,218	20.06	20.01	0.048	0.279	1.32
EUR/CHF	1,807	-14.39	-14.24	-0.153	0.322	2.24
EUR/GBP	6,357	11.12	11.07	0.042	0.250	2.04
EUR/JPY	6,293	-24.12	-23.93	-0.195	0.349	1.38
EUR/NOK	6,291	4.50	4.40	0.101	0.264	2.47
EUR/NZD	6,390	32.06	32.01	0.044	0.638	1.97
EUR/SEK	6,368	10.10	10.04	0.063	0.271	2.03
USD/AUD	5,218	17.77	17.95	-0.180	0.528	2.92
USD/CAD	5,218	2.55	2.59	-0.048	0.279	2.89
USD/CHF	1,807	-33.85	-34.00	0.153	0.322	0.95
USD/EUR	6,390	-16.75	-16.95	0.200	0.422	2.43
USD/GBP	6,357	-5.91	-5.87	-0.042	0.250	3.23
USD/JPY	6,293	-40.67	-40.87	0.195	0.349	0.85
USD/NOK	6,291	-12.92	-12.82	-0.101	0.264	2.04
USD/NZD	6,390	15.02	15.06	-0.044	0.638	3.79
USD/SEK	6,368	-7.04	-6.98	-0.063	0.271	3.32

Notes: Five-year quoted basis x , currency-level component δ and pair-level remainder π , averaged over the pair-days on which the pair sits in a closed triangle. The last column is the mean absolute remainder as a percentage of the mean absolute basis. The euro crosses against the Australian and Canadian dollars end at the benchmark transition and the Swiss pairs begin in December 2009, so the pair-day counts differ.

Table G.3. Triangular remainders during stress periods

Period	Pair-days	RMS π (bp)	Median $ \pi $ (bp)	p95 $ \pi $ (bp)
Other days	85,188	0.53	0.18	1.06
Global financial crisis	2,130	1.04	0.61	2.07
Euro-area crisis	4,339	0.91	0.60	1.77
COVID-19	975	0.51	0.31	0.89
Benchmark transition	1,642	1.50	0.71	3.88

Notes: Five-year pair-level remainders on triangle-identified pair-days. The episodes are 15 September 2008 to 31 March 2009, July 2011 to July 2012, March to May 2020, and December 2021 to June 2022; every other pair-day in the sample is in the first row.

after March 2024. The root mean square triangular sum falls in every one of them, from between 0.69 and 2.49 basis points before to between 0.12 and 0.67 after. The Australian and Canadian triangles have no post-2024 coverage, their euro crosses having no successor quote.

Table G.4. Post-2024 holdout for closed currency triangles

Triangle	Sample	Days	RMS Δ (bp)	Median $ \Delta $ (bp)	p95 $ \Delta $ (bp)
USD–EUR–AUD	2002–Mar. 2024	5,218	1.94	0.85	4.00
USD–EUR–CAD	2002–Mar. 2024	5,218	1.01	0.50	1.82
USD–EUR–CHF	2002–Mar. 2024	1,220	0.69	0.25	1.38
USD–EUR–CHF	Apr. 2024–Jun. 2026	587	0.24	0.12	0.50
USD–EUR–GBP	2002–Mar. 2024	5,770	0.99	0.30	2.19
USD–EUR–GBP	Apr. 2024–Jun. 2026	587	0.12	0.00	0.21
USD–EUR–JPY	2002–Mar. 2024	5,706	0.93	0.26	1.97
USD–EUR–JPY	Apr. 2024–Jun. 2026	587	0.18	0.12	0.38
USD–EUR–NOK	2002–Mar. 2024	5,704	1.22	0.39	2.40
USD–EUR–NOK	Apr. 2024–Jun. 2026	587	0.21	0.12	0.38
USD–EUR–NZD	2002–Mar. 2024	5,803	2.49	1.23	4.97
USD–EUR–NZD	Apr. 2024–Jun. 2026	587	0.67	0.27	1.90
USD–EUR–SEK	2002–Mar. 2024	5,781	1.17	0.34	2.62
USD–EUR–SEK	Apr. 2024–Jun. 2026	587	0.22	0.12	0.50

Notes: The five-year triangular sum Δ of Equation (32), by triangle and sample. The sum is taken on the quoted bases and so depends on no restriction. A triangle appears in the second sample only where both its euro legs are quoted after March 2024.