The Implications of CIP Deviations for International Capital Flows

Christian Kubitza (ECB), Jean-David Sigaux (ECB), Quentin Vandeweyer (Chicago Booth)

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Disclaimer: The views expressed herein are those of the authors and do not necessarily reflect those of the ECB.
Motivation

**Key arbitrage pricing condition in international finance:**

Covered Interest Rate Parity (CIP): \( r^{USD} = r^{EUR} \times \text{Cross-currency swap} \)

\( r^{USD} \) is the actual dollar rate, and \( r^{EUR} \) is the synthetic dollar rate.

- Violated since the GFC (Du et al., JF 2018)
- Frictions to intermediation (leverage ratio) → Opening of cross-currency basis (CCB)

**Implications for international capital flows?**

**FX Market Size:** Globally $ 80 tr. market, de facto USD funding market

**Concern:** Turmoil → Wider cross-currency basis → Foreign investors withdraw from USD

**Response:** Dollar swap lines between Fed and selected central banks

**This paper:** Response of foreign investors to a widening of the cross-currency basis
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Part I: Stylized Model

▷ 3 agents: European investors holding USD assets, CCB arbitrageurs, outside investors

▷ 3 frictions:
  ■ No direct USD borrowing for European investors ⇒ Hedge currency risk with derivatives
  ■ Balance sheet costs for CCB arbitrageurs ⇒ CIP deviations
  ■ Illiquid USD assets + short-term FX contracts ⇒ Rollover risk

Shocks to FX market ⇒ |CCB| ↑ ⇒ FX hedging ↓ & USD holdings ↓ & EUR holdings ↑

Part II: Empirical Evidence

▷ Widening of CCB reduces euro-area investors’ USD vs. EUR bond demand
  ■ Driven by investors who need to roll over FX contracts
  ■ Robust to using granular instrumental variable

▷ Decrease in yields of EUR bonds held by investors with rollover risk

▷ Implications for monetary policy: CIP deviations ↑ ⇒ Pass-through of ECB MoPo ↑
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Contribution

**CIP deviations** driven by intermediary constraints frictions (Du et al. 2018; Andersen et al. 2019; Avdjiev et al. 2019; Correa et al. 2020; Liao 2020; Cenedese et al. 2021; Rime et al. 2022; Aldunate et al. 2022; Dávila et al. 2023; Du et al. 2023; Augustin et al. 2024; Kloks et al. 2024; Moskowitz et al. 2024)

*New*: CIP deviations → International capital flows

**Global capital allocation** (French and Poterba 1991; Hau and Rey 2004; Hau and Rey 2006; Bruno and Shin 2015; Maggiori et al. 2020; Camanho et al. 2022; Faia et al. 2022; Bräuer and Hau 2023; Kojien and Yogo 2024)

*New*: CIP deviations → Currency preferences

**Currency risk hedging** (Alfaro et al. 2021; Sialm and Zhu 2021; Du and Huber 2023; Opie and Riddiough 2024)

*New*: Disaggregated data on entire euro area
Data

**USD-EUR FX derivatives positions**: European Market Infrastructure Regulation (EMIR)
- Daily FX derivatives position by entity
- 12/2018 - 09/2023

**Securities holdings**: ECB Securities Holdings Statistics
- Quarterly investment holdings by country-sector (e.g., German insurers) and security (ISIN)
- 2018q4 - 2023q3

**Exchange rates**: Reported by euro-area dealers (MMSR)

**Bond yields, macroeconomic controls**: Datastream

**Interest rates**: Bloomberg
Cross-Currency Basis (CCB)

Excess return on direct vs. synthetic dollar investment:

\[
CCB = r_{USD}^{\tau} - r_{EUR}^{\tau} \times \frac{1}{\tau} (F_{\tau} - S)
\]

\(\tau\): Time to maturity
\(F\): Forward exchange rate
\(S\): Spot exchange rate

If \(CCB < 0\) ⇒ Hedging USD assets is costly for EA investors
New Facts about Currency Investment and Hedging in the Euro Area

- USD bond investments: EUR 2.3 trillion
- USD-EUR FX derivatives market: EUR 7 trillion ≈ European repo market
- Cross-currency basis: EUR 5 billion annual cost to hedgers
- Average maturity of USD bonds is 8.3 years vs. FX derivatives of 2.8 months
Part I: Stylized Model (another time)

Part II: Empirical Evidence
Empirical Strategy: Granular Instrument for Cross-Currency Basis

**Goal:** Impact of CCB on international capital flows

**Challenge:** CCB and capital flows simultaneously determined, many confounding factors

(1) **Cross-sectional variation** in rollover risk:
   - High rollover risk = Large % of outstanding FX hedging contracts matures
   - \(\Rightarrow\) Larger exposure to CCB

(2) **Granular instrumental variable** (Gabaix and Koijen, 2024 JPE)
   - based on idiosyncratic changes in large entities’ daily FX derivatives positions:
     - (i.) Residuals of de-trended FX positions after absorbing sector-country–specific shocks:
       \[
       \Delta q_{i,t} = u_{s,c,t} + v_i + \beta \log(\text{mat}_{i,t}) + \Delta q_{i,t}
       \]
     - (ii.) Size-weighted average residual: \(\text{GFX}_t = \sum_i \left( \frac{Q_{i,t-1}}{\sum_j Q_{j,t-1}} - \frac{1}{N} \right) \Delta q_{i,t} \)

▷ Relevance: Market concentration (largest 1% account for 45% of volume)
▷ Exclusion restriction: Idiosyncratic shocks
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**IV Strategy: Relevance and FX Elasticity**

Idiosyncratic FX demand 8% ↑ ⇒ CCB 1 bps ↓

\[ \text{Hedging cost} \uparrow \]

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta \text{CCB} )</td>
<td>GFX</td>
<td>GFX</td>
<td>GFX</td>
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</tr>
<tr>
<td>OLS</td>
<td>-0.12***</td>
<td>-0.11***</td>
<td>[-8.17]</td>
<td>[-8.68]</td>
</tr>
<tr>
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<td>1.73***</td>
<td>[0.92]</td>
<td>[7.43]</td>
</tr>
</tbody>
</table>

Rem. Time to Mat: Y Y Y
Macro Controls: Y Y Y
Aggregate Factors: Y Y Y

F Statistic (1st) | 47.8 |
No. of obs. | 1,200 1,200 1,200 1,200 |

Note: Daily frequency. t-statistics in parentheses, robust SEs.
### IV Strategy: Relevance and FX Elasticity

Idiosyncratic FX demand 8% ↑ ⇒ CCB 1 bps ↓ ⇒ FX hedging 1.7% ↓

= Hedging cost ↑

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<td>IV</td>
<td></td>
<td></td>
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Macro Controls      | Y   | Y   | Y   |     |
Aggregate Factors   | Y   | Y   | Y   |     |

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## Empirical Results: USD Bond Holdings

CCB 1 bps ↓ ⇒ USD-EUR bond demand 0.66% ↓ ≈ USD bond demand 0.28%↓

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>( \Delta \log \text{Bond Holdings} )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
</tr>
<tr>
<td>( \text{USD} \times \Delta \text{CCB} )</td>
<td>(1) 0.45*** [10.24]</td>
</tr>
<tr>
<td>( \text{USD} \times \Delta \text{CCB} \times \text{Low Rollover Risk} )</td>
<td>(2) 0.41** [2.30]</td>
</tr>
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<tr>
<td>Country-Sector-Time FEs</td>
<td>Y</td>
</tr>
<tr>
<td>Country-Sector-Security FEs</td>
<td>Y</td>
</tr>
<tr>
<td>Issuer Industry-Time FEs</td>
<td>Y</td>
</tr>
<tr>
<td>High Rollover Risk FEs</td>
<td>Y</td>
</tr>
<tr>
<td>Security-Time FEs</td>
<td>Y</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>No. of obs.</th>
<th>No. of securities</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>8,890,984</td>
<td>351,484</td>
</tr>
<tr>
<td>(2)</td>
<td>8,890,984</td>
<td>351,484</td>
</tr>
<tr>
<td>(3)</td>
<td>8,087,520</td>
<td>337,205</td>
</tr>
<tr>
<td>(4)</td>
<td>6,371,383</td>
<td>92,215</td>
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Note: Investor (country-sector)–security–quarter level. t-statistics in parentheses, SEs clustered at bond and country-time levels.

▷ Compare bonds issued within same industry held by same investor but different currency
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CCB 1 bps ↓ ⇒ USD-EUR bond demand 0.66% ↓ ≈ USD bond demand 0.28%↓

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<td></td>
<td>(1)</td>
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<td>USD × ΔCCB</td>
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<td></td>
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<td>USD × ΔCCB × Low Rollover Risk</td>
<td>0.41**</td>
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<tr>
<td></td>
<td>[2.30]</td>
</tr>
<tr>
<td>USD × ΔCCB × High Rollover Risk</td>
<td>0.86***</td>
</tr>
<tr>
<td></td>
<td>[4.64]</td>
</tr>
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<td>Country-Sector-Time FEs</td>
<td>Y</td>
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<tr>
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<td>Y</td>
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<td>Y</td>
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- Driven by investors that need to roll over maturing FX hedges
Empirical Results: USD Bond Holdings at Portfolio Level

Consistent evidence from portfolio-level regressions:

<table>
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<th>ΔUSD Share</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>OLS (1)</td>
<td>IV (2)</td>
<td>IV (3)</td>
</tr>
<tr>
<td>∆CCB</td>
<td>0.03***</td>
<td>0.07***</td>
<td>0.03***</td>
</tr>
<tr>
<td></td>
<td>[2.98]</td>
<td>[2.86]</td>
<td>[2.86]</td>
</tr>
<tr>
<td>∆CCB × Low Rollover Risk</td>
<td></td>
<td></td>
<td>0.03*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[0.74]</td>
<td>[1.95]</td>
</tr>
<tr>
<td>∆CCB × High Rollover Risk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country-Sector FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>High Rollover Risk FE</td>
<td></td>
<td></td>
<td></td>
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<td>No. of obs.</td>
<td>1,080</td>
<td>1,080</td>
<td>749</td>
</tr>
<tr>
<td>No. of country-sectors</td>
<td>54</td>
<td>54</td>
<td>46</td>
</tr>
</tbody>
</table>

Note: Investor (country-sector)–quarter level. t-statistics in parentheses.
Empirical Results: Euro-Area Government Bond Prices

CCB 1 bps ↓ ⇒ EUR bond demand ↑ ⇒ Exposed EUR bond yields 1 - 1.5 bps ↓

<table>
<thead>
<tr>
<th>Sample:</th>
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<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large EA Share</td>
<td>0.30</td>
<td>-0.43</td>
<td>0.99***</td>
<td>0.16</td>
<td>0.42*</td>
</tr>
<tr>
<td>Low Rollover Risk</td>
<td>0.16</td>
<td>0.89**</td>
<td>0.89**</td>
<td>0.42*</td>
<td>1.56***</td>
</tr>
<tr>
<td>High Rollover Risk</td>
<td>0.42*</td>
<td>1.06**</td>
<td>1.56***</td>
<td>1.06**</td>
<td>1.06**</td>
</tr>
</tbody>
</table>

Bond FE, Large EA Share FE, High Rollover Risk FE, Issuer-Time FE

No. of obs. | 71,694 | 71,694 | 71,694 | 27,902 | 23,646
No. of bonds | 63 | 63 | 63 | 48 | 46

Note: Bond–day level. t-statistics in parentheses, SEs clustered at bond and time levels.

Driven by bonds held by (a) euro-area investors that (b) need to roll over maturing FX hedges.
Empirical Results: Monetary Policy Transmission

Trilemma: ECB hike ⇒ EUR-USD bond demand ↑ ⇒ Weaker transmission

FX frictions: ⇒ CCB ↑

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>(1) $\Delta CCB$</th>
<th>(2) $\Delta\text{FX Position}$</th>
<th>(3) $\Delta\text{EA Bond Yield}$</th>
<th>(4) $\Delta\text{EA Bond Yield}$</th>
<th>(5) $\Delta\text{EA Bond Yield}$</th>
<th>(6) $\Delta\text{EA Bond Yield}$</th>
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<td>10Y</td>
<td>1Y</td>
<td>All</td>
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<tr>
<td>MoPo × Large ($-CCB_{t-2}$)</td>
<td>3.03***</td>
<td>0.02***</td>
<td>1.56***</td>
<td>-0.62*</td>
<td>-0.68</td>
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<tr>
<td>MoPo</td>
<td>-0.88</td>
<td>-0.01***</td>
<td>1.23**</td>
<td>0.33</td>
<td>1.34***</td>
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<tr>
<td>Large ($-CCB_{t-2}$)</td>
<td>0.04*</td>
<td>-0.05*</td>
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<tr>
<td>MoPo × Large ($-CCB_{t-2}$) × Long TTM</td>
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<td>2.13***</td>
<td>2.25***</td>
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<td>Bond FE</td>
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<td>Time-Issuer FE</td>
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<tr>
<td>Remaining interaction (single) terms</td>
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<td>39</td>
<td>722</td>
<td>722</td>
<td>470</td>
<td>2,812</td>
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</table>

Note: Monetary policy events 2013 - 2023 and euro-area government bond yields. t-statistics in parentheses, SEs clustered at bond and time levels.
Empirical Results: Monetary Policy Transmission

Trilemma: ECB hike ⇒ EUR-USD bond demand ↑ ⇒ Weaker transmission

FX frictions: ⇒ CCB ↑

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>(1) ΔCCB</th>
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<th>(3) ΔEA Bond Yield 10Y</th>
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<tr>
<td>MoPo × Large (−CCB_t−2)</td>
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</table>

Bond FE: Y, Y, Y, Y, Y, Y
Time-Issuer FE: Y
Remaining interaction (single) terms: Y, Y

No. of obs. | 47 | 39 | 722 | 722 | 470 | 2,812 | 2,812

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Note: Monetary policy events 2013 - 2023 and euro-area government bond yields. t-statistics in parentheses, SEs clustered at bond and time levels.

▷ Driven by term premium (short rates anchored by central bank)
Conclusion

Frictions in FX derivatives markets
→ Deviations in covered interest parity
→ International capital flows and asset prices

Important implications for
▷ Financial stability (e.g., calibration of swap lines) and
▷ Monetary policy transmission (frictions relax trilemma).

Thanks!
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Thanks!


Appendix
### Summary Statistics (1/2)

<table>
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<th></th>
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<th>SD</th>
<th>p5</th>
<th>p50</th>
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<td><strong>FX Derivatives Positions</strong> (Sector-by-Day Level, Dec 2018 - Sep 2023)</td>
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<tr>
<td>Net FX Position (bil EUR)</td>
<td>5,040</td>
<td>105.02</td>
<td>241.83</td>
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<td>Share of USD Bonds</td>
<td>80</td>
<td>0.17</td>
<td>0.14</td>
<td>0.03</td>
<td>0.11</td>
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<td>USD Bonds: Time to Maturity (ex. &gt; 50 yrs)</td>
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<td>8.72</td>
<td>1.71</td>
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<td>8.99</td>
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<td>Hedge Ratio</td>
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<td>0.14</td>
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<td>N</td>
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<td>(Daily Frequency, Dec 2018 - Sep 2023)</td>
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<td>CCB (bps)</td>
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<td>(Country-by-Sector-by-Quarter Level, 2018q4 - 2023q2)</td>
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<td>Rollover Risk (monthly)</td>
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<td>0.25</td>
<td>0.22</td>
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<td>Rollover Risk (quarterly)</td>
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<td>0.73</td>
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<td>(Bond-by-Day Level, Dec 2018 - Sep 2023)</td>
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<td>∆Yield (ppt)</td>
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<td>0.69</td>
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<td>Time to Maturity (months)</td>
<td>71,694</td>
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<td>80.37</td>
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<td>60.00</td>
<td>240.00</td>
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<tr>
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<td>0.17</td>
<td>0.15</td>
<td>0.46</td>
<td>0.70</td>
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</table>
Currency Investment and Hedging in the Euro Area

EUR 2.3 trillion USD bond holdings

EUR 7 trillion USD-EUR derivatives notional outstanding ≈ European repo market

Non-banks buy USD currency risk protection, paying EUR 5 billion due to CCB

(a) USD/(USD + EUR) Bonds

(b) Net FX Derivatives Positions
Empirical Results: Heterogeneity

- Investment funds’ FX positions: least elastic $\rightarrow$ strict hedging mandates
- Long-duration & low-rated bonds: more elastic $\rightarrow$ trading off different risks

(a) FX Positions: by Sector

(b) Bonds: by Risk