The Implications of CIP Deviations for International Capital Flows

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Motivation

Key arbitrage pricing condition in international finance:

Covered Interest Rate Parity (CIP): $\underbrace{r^{USD}}_{\text{Actual dollar rate}} = \underbrace{r^{EUR} \times \text{Cross-currency swap}}_{\text{Synthetic dollar rate}}$

▷ 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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This Paper

Part I: Stylized Model

- 3 agents: European investors holding USD assets, CCB arbitrageurs, outside investors
- 3 frictions:
  - No direct USD borrowing for European investors $\Rightarrow$ Hedge currency risk with derivatives
  - Balance sheet costs for CCB arbitrageurs $\Rightarrow$ CIP deviations
  - Illiquid USD assets + short-term FX contracts $\Rightarrow$ Rollover risk

Shocks to FX market $\Rightarrow$ $|CCB| \uparrow \Rightarrow$ FX hedging $\downarrow$ & USD holdings $\downarrow$ & EUR holdings $\uparrow$

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 $\uparrow \Rightarrow$ Pass-through of ECB MoPo $\uparrow$

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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; Koijen 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:

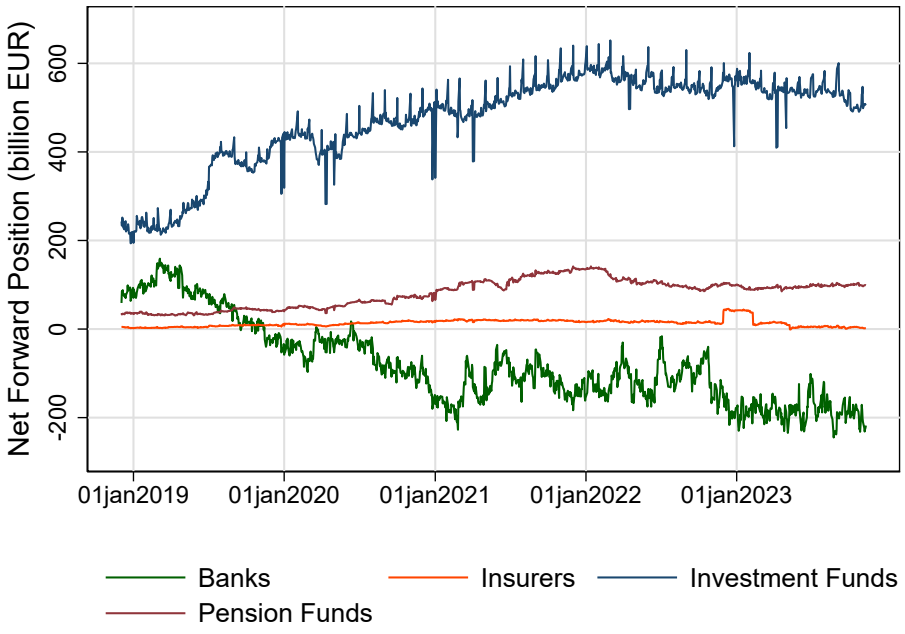
$$\text{CCB} = \underbrace{r_\tau^{USD}}_{\text{Actual dollar rate}} - \underbrace{r_\tau^{EUR} \times \frac{1}{\tau}(F_\tau - S)}_{\text{Synthetic dollar rate: EUR + FX swap}}$$

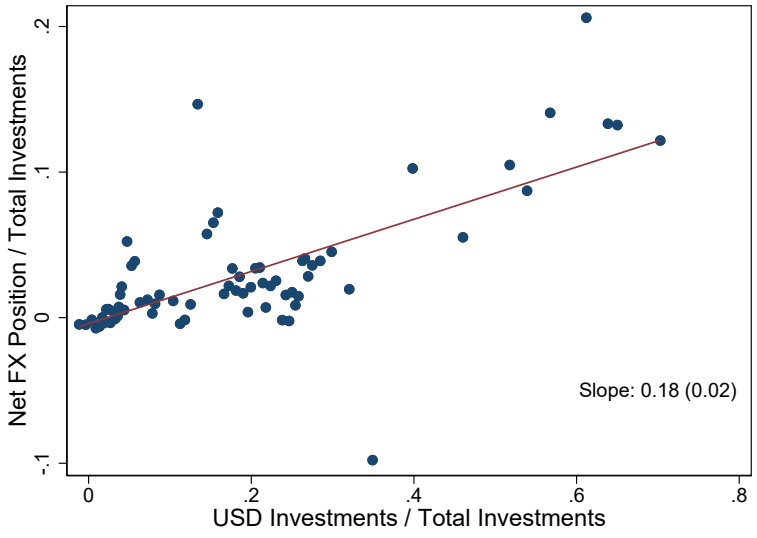
τ: Time to maturity
F: Forward exchange rate
S: Spot exchange rate

CCB $< 0 \Rightarrow$ 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:

$$\Delta q_{i,t} = u_{s,c,t} + v_i + \beta \log(\text{mat}_{i,t}) + \widetilde{\Delta q}_{i,t}$$

(ii.) Size-weighted average residual: $\text{GFX}_t = \sum_i \left(\frac{Q_{i,t-1}}{\sum_j Q_{j,t-1}} - \frac{1}{N} \right) \widetilde{\Delta q}_{i,t}$

▷ 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% ↑ $\Rightarrow$ $\underbrace{\text{CCB 1 bps} \downarrow}_{=\text{Hedging cost}\uparrow}$

Dependent variable:	(1)	(2)	(3)	(4)
	ΔCCB		ΔFX Position	
		OLS		IV
GFX	-0.12***	-0.11***		
	[-8.17]	[-8.68]		
ΔCCB			0.02	1.73***
			[0.92]	[7.43]
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% ↑ $\Rightarrow$ $\underbrace{\text{CCB 1 bps} \downarrow}_{=\text{Hedging cost}\uparrow}$ $\Rightarrow$ FX hedging 1.7% ↓

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Empirical Results: USD Bond Holdings

CCB 1 bps $\downarrow \Rightarrow$ USD-EUR bond demand 0.66% $\downarrow \approx$ USD bond demand 0.28%$\downarrow$

Dependent variable:	Δlog Bond Holdings			
	OLS		IV	
	(1)	(2)	(3)	(4)
USD $\times$ ΔCCB	0.45***	0.66***		
	[10.24]	[4.97]		
USD $\times$ ΔCCB $\times$ Low Rollover Risk			0.41**	
			[2.30]	
USD $\times$ ΔCCB $\times$ High Rollover Risk			0.86***	0.41**
			[4.64]	[2.53]
Country-Sector-Time FEs	Y	Y	Y	Y
Country-Sector-Security FEs	Y	Y	Y	Y
Issuer Industry-Time FEs	Y	Y	Y	
High Rollover Risk FEs			Y	Y
Security-Time FEs				Y
No. of obs.	8,890,984	8,890,984	8,087,520	6,371,383
No. of securities	351,484	351,484	337,205	92,215

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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- 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:

Dependent variable:	ΔUSD Share		
	OLS	IV	
	(1)	(2)	(3)
ΔCCB	0.03***	0.07***	
	[2.98]	[2.86]	
ΔCCB × Low Rollover Risk			0.03
			[0.74]
ΔCCB × High Rollover Risk			0.05*
			[1.95]
Country-Sector FEs	Y	Y	Y
High Rollover Risk FEs			Y
No. of obs.	1,080	1,080	749
No. of country-sectors	54	54	46

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 ↓

Dependent variable:	(1)	(2)	(3)	(4)	(5)
	ΔEA Bond Yield				
	IV				
Sample:	All			Large EA Share	
ΔCCB	0.30				
	[1.24]				
ΔCCB × Small EA Share		-0.43			
		[-1.13]			
ΔCCB × Large EA Share		0.99***			
		[3.79]			
ΔCCB × Low Rollover Risk			0.16	0.89**	
			[0.49]	[2.45]	
ΔCCB × High Rollover Risk			0.42*	1.56***	1.06**
			[1.78]	[3.93]	[2.02]
Bond FEs	Y	Y	Y	Y	Y
Large EA Share FEs	Y	Y			
High Rollover Risk FEs			Y	Y	Y
Issuer-Time FEs					Y
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 $\Rightarrow$ EUR-USD bond demand $\uparrow$ $\Rightarrow$ Weaker transmission

FX frictions: $\Rightarrow$ CCB $\uparrow$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable:	ΔCCB	ΔFX Position	ΔEA Bond Yield				
Bond maturity:			10Y		1Y	All	
MoPo $\times$ Large $(-\text{CCB}_{t-2})$	3.03***	0.02***		1.56***	-0.62*	-0.68	
	[3.17]	[3.90]		[3.13]	[-2.24]	[-1.54]	
MoPo	-0.88	-0.01***	1.23**	0.33	1.34***	1.35***	
	[-1.17]	[-5.07]	[2.82]	[0.90]	[4.96]	[3.07]	
Large $(-\text{CCB}_{t-2})$	0.04*	-0.05*		-0.01	0.00	-0.01	
	[1.90]	[-1.89]		[-0.75]	[0.58]	[-0.82]	
MoPo $\times$ Large $(-\text{CCB}_{t-2})$ $\times$ Long TtM						2.13***	2.25***
						[5.35]	[4.95]
Bond FE			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

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

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MoPo $\times$ Large $(-\text{CCB}_{t-2})$	3.03***	0.02***		1.56***	-0.62*	-0.68	
	[3.17]	[3.90]		[3.13]	[-2.24]	[-1.54]	
MoPo	-0.88	-0.01***	1.23**	0.33	1.34***	1.35***	
	[-1.17]	[-5.07]	[2.82]	[0.90]	[4.96]	[3.07]	
Large $(-\text{CCB}_{t-2})$	0.04*	-0.05*		-0.01	0.00	-0.01	
	[1.90]	[-1.89]		[-0.75]	[0.58]	[-0.82]	
MoPo $\times$ Large $(-\text{CCB}_{t-2})$ $\times$ Long TtM						2.13***	2.25***
						[5.35]	[4.95]
Bond FE			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

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

$\rightarrow$ Deviations in covered interest parity

$\rightarrow$ 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!

Conclusion

Frictions in FX derivatives markets

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Thanks!

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Appendix

Summary Statistics (1/2)

	N	Mean	SD	p5	p50	p95
FX Derivatives Positions (Sector-by-Day Level, Dec 2018 - Sep 2023)						
Net FX Position (bil EUR)	5,040	105.02	241.83	-254.04	49.60	553.83
Gross FX Position (bil EUR)	5,040	1,472.48	1,942.47	28.14	399.04	5,801.27
FX: Time to Maturity (months)	5,040	2.28	0.91	1.05	2.10	3.60
Securities Holdings (Sector-by-Quarter Level, 2018q4 - 2023q3)						
Share of USD Bonds	80	0.17	0.14	0.03	0.11	0.40
USD Bonds: Time to Maturity (ex. > 50 yrs)	80	8.72	1.71	5.95	8.99	11.92
Hedge Ratio	80	0.04	0.30	-0.64	0.14	0.31

Summary Statistics (2/2)

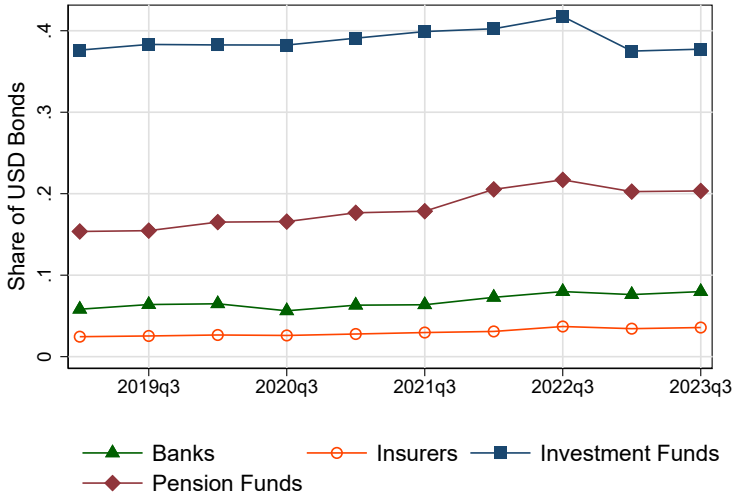
	N	Mean	SD	p5	p50	p95
Time-Series Variables (Daily Frequency, Dec 2018 - Sep 2023)						
CCB (bps)	1,200	-11.1	12.8	-29.1	-10.3	4.6
ΔCCB (bps)	1,200	0.79	11.33	-16.46	0.66	19.32
GFX	1,200	-0.12	0.21	-0.48	-0.11	0.23
ΔFX position	1,200	0.07	0.11	-0.11	0.06	0.27
Investor Characteristics (Country-by-Sector-by-Quarter Level, 2018q4 - 2023q2)						
Rollover Risk (monthly)	958	0.25	0.22	*	0.24	0.65
Rollover Risk (quarterly)	958	0.73	0.27	0.02	0.82	*
Euro-Area Bonds (Bond-by-Day Level, Dec 2018 - Sep 2023)						
ΔYield (ppt)	71,694	0.08	0.29	-0.30	0.01	0.69
Time to Maturity (months)	71,694	90.67	80.37	3.00	60.00	240.00
EA Share	71,694	0.44	0.17	0.15	0.46	0.70

Currency Investment and Hedging in the Euro Area

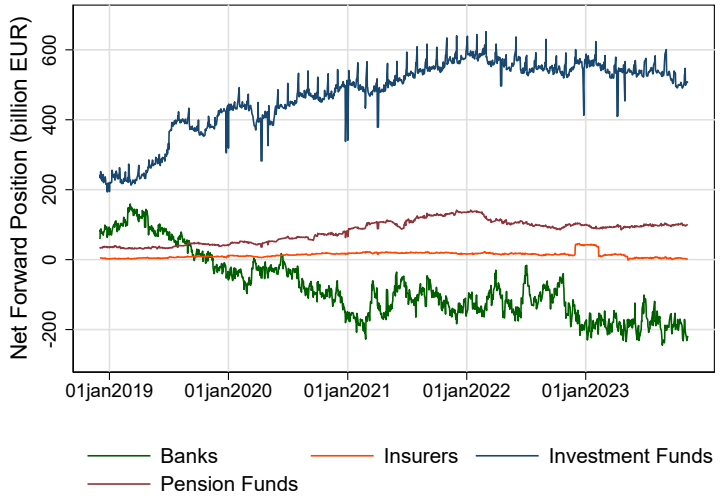
EUR 2.3 trillion USD bond holdings

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



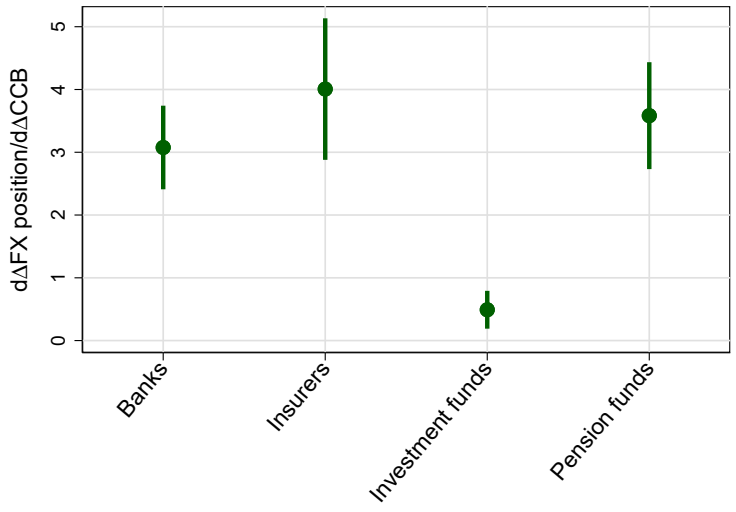
(a) USD/(USD + EUR) Bonds



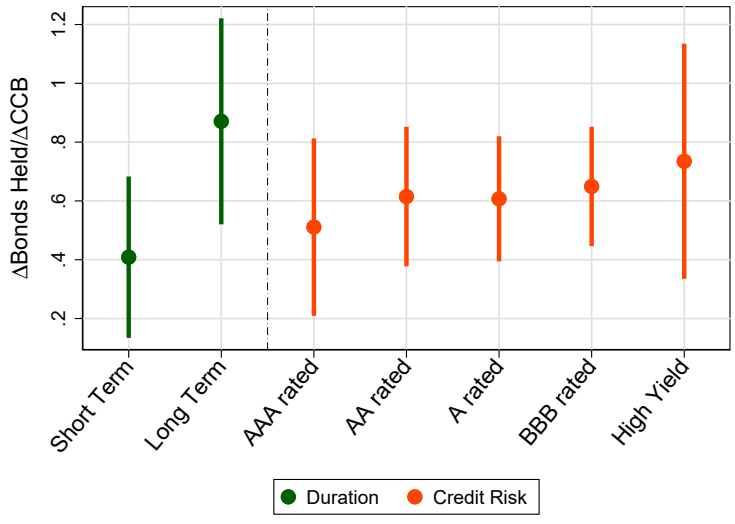
(b) Net FX Derivatives Positions

Empirical Results: Heterogeneity

- Investment funds' FX positions: least elastic → strict hedging mandates
- Long-duration & low-rated bonds: more elastic → trading off different risks



(a) FX Positions: by Sector



(b) Bonds: by Risk