

# The Implications of CIP Deviations for International Capital Flows

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# Motivation

## Key arbitrage pricing condition in international finance:

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

- ▶ Violated since the Global Financial Crisis
- These violations are referred to as the cross-currency basis (CCB)
- ▶ Owing to new banking regulations for major swap dealers (Du et al., JF 2018)

## Implications for financial investment?

- ▶ Concern: Turmoil → wider cross-currency basis → Amplification of the turmoil
- ▶ Response: Fed dollar swap lines with selected central banks

**This paper:** How do foreign investors who invest in US Dollar assets respond to a widening of the cross-currency basis?

# This Paper

## Part I: Stylized model of portfolio allocation and currency risk hedging

- ▶ 3 agents, including euro-area investor holding USD assets and hedging the currency risk

Shocks to FX swap market  $\Rightarrow$   $|CCB| \uparrow \Rightarrow$  FX hedging cost  $\uparrow \Rightarrow$  Hedging & USD demand  $\downarrow$  & EUR demand  $\uparrow$

## Part II: Empirical Evidence

1. Widening of CCB reduces demand for USD bonds by euro-area investors
  - Identification 1: Granular fixed effects
  - Identification 2: Heterogeneity in the need to rollover FX contracts
  - Identification 3: Granular instrumental variable
2. USD bond prices decrease when held by investors that need to roll over their FX swaps

## 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. 2024; 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; Florez-Orrego et al. 2023; Koijen and Yogo 2024)

*New:* CIP deviations → Currency preferences

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

*New:* Disaggregated data on entire euro area

⇒ CIP Deviations → Global Capital Allocation through Currency Hedging

# Data

## **Universe of USD-EUR FX derivatives positions for all agents in the euro area**

- ▷ Source: European Market Infrastructure Regulation (EMIR)
- ▷ Contract level
- ▷ Daily frequency, 03/2019 - 03/2024

## **Universe of securities holdings for each sectors in the euro area**

- ▷ Source: ECB Securities Holdings Statistics (SHS)
- ▷ Sample: Corporate & government bond holdings
- ▷ Country-sector (e.g., German insurers) and security (ISIN) levels
- ▷ Quarterly frequency, 2019q1 - 2024q1

**Bond mutual funds' holdings:** Lipper Fund Research Database

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

**Bond yields, macroeconomic controls, Interest rates:** Datastream / Bloomberg

# Cross-Currency Basis (CCB)

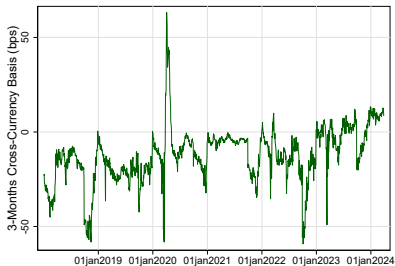
Excess return on direct vs. synthetic dollar investment:

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

$\tau$ : Time to maturity

$F$ : Forward exchange rate

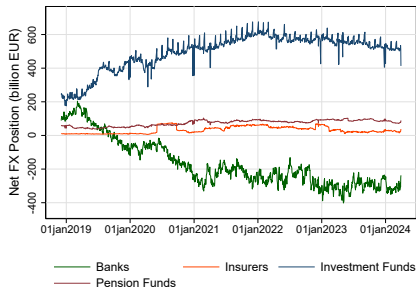
$S$ : Spot exchange rate



$\text{CCB} < 0 \Rightarrow$  Hedging USD currency risk is costly for euro-area investors

# New Facts about Currency Investment and Hedging in the Euro Area

1. There are EUR 2 trillion of USD-denominated bond holdings in the euro area
2. It costs EUR 5 billion annually to hedge some of the FX risk of these holdings
3. While average maturity USD bonds is 8.9 years, that of FX derivatives is solely 2.3 months
4. With EUR 8 trillion, USD-EUR FX derivatives market is roughly as large as European repo
5. Investment funds are the largest demanders of FX hedging
  - ▶ while banks are the largest suppliers



# Empirical Strategy

**Goal:** Impact of CCB on investment decisions

**Challenge:** Akin to regressing quantity (investment) on a price (CCB)

**Approach:**

1. Granular fixed effects
2. Cross-sectional heterogeneity in FX rollover risk

High rollover risk = Many FX hedging contracts are maturing shortly after the shock  
⇒ Larger exposure to CCB

3. Granular instrumental variable (Gabaix and Koijen, 2024 JPE)
  - i. **Residualize** daily FX positions using sector-country-time FEs:

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

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

- ▷ Relevance: Market concentration (largest 1% account for 44% of volume)
- ▷ Exclusion restriction: Idiosyncratic shocks



## Effect of CCB on Hedging demand

	(1)	(2)	(3)	(4)
	OLS	OLS	IV	IV
Dependent variable:	$\Delta\text{CCB}$		$\Delta\text{FX Position}$	
GFX	-0.13*** (0.01)			
$\Delta\text{CCB}$		0.09*** (0.03)	1.98*** (0.24)	
$\Delta\text{CCB} \times \text{High Rollover Risk}$				9.74** (4.12)
Rem. Time to Mat	Y	Y	Y	
Macro Controls	Y	Y	Y	
Aggregate Factors	Y	Y	Y	
High Rollover Risk FEs	Y			
Time FEs				Y
Investor-Cal. Month FEs				Y
F Statistic (1st)			62.2	
No. of obs.	1,256	1,256	1,256	547,414
No. of investors				1,033

Note: Daily frequency. Robust SEs in parentheses. Macro controls: US & EUR risk-free rates, S&P 500, Euro STOXX 50, dollar strength, VIX, spot rate volatility.

▶ Idiosyncratic FX demand  $\frac{1}{0.13\%} \uparrow \Rightarrow \underbrace{\text{CCB 1 bps } \downarrow}_{=\text{Hedging cost } \uparrow} \Rightarrow \text{FX hedging } 1.98\% \downarrow$

## Effect of CCB on USD Bond Holdings [Main result]

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	$\Delta \log$ Bond Holdings						
	OLS			IV			
USD $\times$ $\Delta$ CCB	0.20*** (0.02)		0.18*** (0.02)	0.32*** (0.04)		0.27*** (0.04)	
USD $\times$ $\Delta$ CCB $\times$ Low Rollover Risk		0.18*** (0.02)			0.27*** (0.04)		
USD $\times$ $\Delta$ CCB $\times$ High Rollover Risk		0.34*** (0.08)	0.16* (0.08)		0.66*** (0.20)	0.39* (0.22)	0.17*** (0.06)
Country-Sector-Time FEs	Y	Y	Y	Y	Y	Y	Y
Country-Sector-Bond FEs	Y	Y	Y	Y	Y	Y	Y
Issuer Industry-Time FEs	Y	Y	Y	Y	Y	Y	
Bond-Time FEs							Y
No. of obs.	8,568,914	8,568,914	8,568,914	8,568,914	8,568,914	8,568,914	6,816,419
No. of bonds	342,185	342,185	342,185	342,185	342,185	342,185	95,018

Note: Investor (country-sector)-bond-quarter level. SEs clustered at bond and country-time levels in parentheses.

- ▶  $\Delta \log \text{Held}_{i,b,t} = \alpha \Delta \text{CCB}_t \times \text{USD}_b + u_{i,t} + v_{i,b} + w_{\text{industry}(b),t} + \varepsilon_{i,b,t}$
- ▶ Compare bonds issued within same industry held by same investor but different currency
- ▶ CCB 1 bps  $\downarrow \Rightarrow$  USD bond demand up to 0.32%  $\downarrow$

## Bond Price Impact of the CCB

Sample:	$\Delta$ Yield Spread		
	(1)	(2)	(3)
	US Corporate	EA Gov	US Gov
$\Delta$ CCB $\times$ High Rollover Risk	-1.60*** (0.49)	0.43*** (0.13)	-1.16 (1.03)
Bond FEs	Y	Y	Y
High Rollover Risk FEs	Y	Y	Y
Maturity-Time FEs		Y	
Rating-Time FEs		Y	
Time FEs		Y	Y
No. of obs.	1,132,794	87,488	5,997

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

- ▶ Significant yield impact for corporate bonds held by high-rollover investors
- ▶ CCB 1 bps  $\downarrow$   $\Rightarrow$  USD corp bond yield 1.6 bps  $\uparrow$ , EA sovereign bond yields 0.43 bps  $\downarrow$
- ▶ No impact on US sov bond yields, possibly due to low market share of EA investors

# Conclusion and implications

- Our paper: Frictions in FX derivatives markets → International capital flows and asset prices
- Potential financial stability implication
  - Banking regulation introduced after the GFC broke the CIP
  - This has exposed the cost of hedging currency risk to demand and supply shocks
  - Our paper: The cost of hedging has an impact on non-bank investment choices
  - Implication: Banking regulation has unintended consequences on non-bank investment and risk taking

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# Appendix



## Summary Statistics (1/2)

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	N	Mean	SD	p5	p50	p95
<b>FX Derivatives Positions</b> (Sector-by-Day Level, Dec 2018 - Mar 2024)						
Net FX Position (bil EUR)	5,560	107.87	257.73	-290.36	59.82	575.46
Gross FX Position (bil EUR)	5,538	1,693.54	2,203.39	31.52	798.67	6,514.67
FX: Time to Maturity (months)	5,560	2.33	0.91	1.03	2.29	3.63
<b>Bond Holdings</b> (Sector-by-Quarter Level, 2019q1 - 2024q1)						
Share of USD Bonds	88	0.17	0.14	0.03	0.11	0.40
Time to Maturity of USD Bonds (ex. > 50 yrs)	88	8.87	1.77	6.18	9.03	12.24
Hedge Ratio (Banks)	21	-0.56	0.42	-1.02	-0.70	0.19
Hedge Ratio (Non-Banks)	63	0.43	0.17	0.16	0.40	0.73

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## Summary Statistics (2/2)

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	N	Mean	SD	p5	p50	p95
<b>Time-Series Variables</b> (Daily Frequency, 2019q2 - 2024q1)						
CCB (bps)	1,256	-9.7	13.4	-28.4	-8.7	8.9
$\Delta$ CCB (bps)	1,256	0.41	10.69	-16.63	0.75	16.28
GFX	1,256	-0.12	0.19	-0.44	-0.11	0.17
$\Delta$ FX position	1,256	0.06	0.12	-0.12	0.05	0.27
<b>Investor Characteristics</b> (Country-Sector-by-Quarter Level, 2019q2 - 2024q1)						
Rollover Risk (quarterly)	1,056	0.79	0.24	0.28	0.87	*
<b>EA Gov Bonds</b> (Maturity-by-Issuer-by-Day Level, Apr 2019 - Mar 2024)						
$\Delta$ Yield (ppt)	87,488	0.06	0.28	-0.35	0.02	0.61
Time to Maturity (years)	87,488	111.48	82.35	3.00	120.00	240.00

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## Role of Hedging Mandates [Alternative identification strategy]

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta \log$ Bond Holdings					
	OLS			IV		
Investors:	All	Non-Mandate	Mandate	All	Non-Mandate	Mandate
USD $\times$ $\Delta$ CCB	0.13*** (0.03)	0.12*** (0.03)	0.14*** (0.02)	0.12** (0.06)	0.11 (0.07)	0.19*** (0.05)
Investor-Time FEs	Y	Y	Y	Y	Y	Y
Investor-Bond FEs	Y	Y	Y	Y	Y	Y
No. of obs.	4,990,671	4,488,981	501,690	4,990,671	4,488,981	501,690
No. of bonds	54,757	51,144	26,525	54,757	51,144	26,525
p-value for H0: Mandate = Non-Mandate	0.50			0.21		

Note: Investor–security–quarter level. SEs clustered at fund's country-by-currency-by-time levels in parentheses.

- ▶ Bond-Mutual-Fund-Holdings level data from Lipper
- ▶ Hedging mandate dummy if hedged share class > 10% of outstanding
- ⇒ Rebalancing is mostly driven by funds with hedging mandates