

FRAGMENTATION IN EURO AREA BANKS' SOVEREIGN BOND PORTFOLIOS AND ITS IMPACT ON INTERNATIONAL PRICING

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The opinions expressed are those of the author and do not necessarily reflect the view of the European Central Bank.

MOTIVATION

Do deviations from the covered interest rate parity (CIP) persist because the arbitrageurs in the market have other business needs or restrictions?

- ▶ Persistent arbitrage opportunities since the onset of the global financial crisis, representing a deviation from CIP, i.e., hedged euro-dollar yield differentials (Du-Im-Schreger, 2017)
- ▶ Documented violations compare similar bonds in different currencies without information on the holder side

RESEARCH QUESTION & CONTRIBUTION

*Do banks in the eurozone have **different** arbitrage strategies for euro-dollar government bonds (i.e., receive heterogeneous currency premia)? If so, **why**?*

This paper:

- ▶ Brings granular data to answer if investor side matters and why for international sovereign pricing
- ▶ Presents heterogeneous arbitrage strategies across EA regions (HY vs. LY)
- ▶ Provides evidence for spillover effects from investor-side frictions like home issuer bias on currency premia of sovereign bonds

Why important?

- ▶ Inefficient resource allocation & uneven global monetary policy transmission
- ▶ Role of investor bases for currency pricing and bond convenience yield

RESEARCH QUESTION: HOW?

Confidential dataset on universe of securities held by **largest euro area banking groups** to study demand for **government bonds** denominated in **dollars** and **euros**

1. Examine existence of euro-dollar currency premia in banks' sovereign holdings
 - ▶ Econometric strategy controlling for security characteristics
2. Study demand-side factors as determinants for heterogeneous currency premia
 - ▶ Econometric strategy to identify banks' cross-currency convenience yield
 - ▶ Instrumental variable approach to identify demand-side constraints
3. Test implications for cross-border transmission of common monetary policy
 - ▶ Econometric strategy exploiting ECB's QE supply shock

STYLIZED FACTS: ISSUER AND HY/LY HOLDER BREAKDOWN

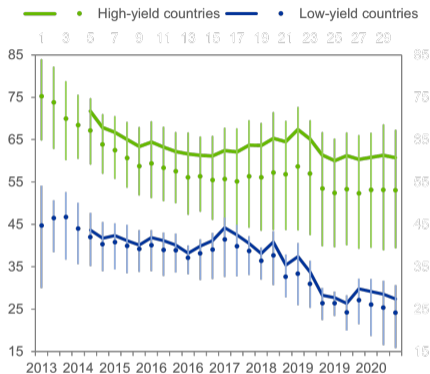


FIGURE: Banks' home bond share, (weighted) avg. & 10-90 pctl. (%)

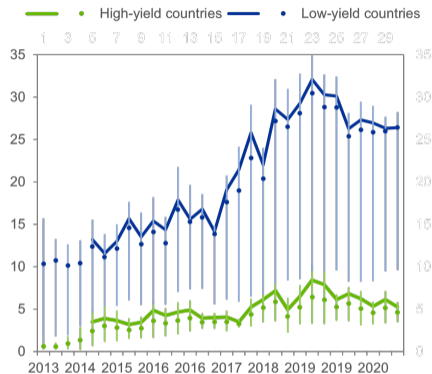


FIGURE: Banks' US bond share, (weighted) avg. & 10-90 pctl. (%)

EMPIRICAL STRATEGY: BANK-LEVEL CIP

Specification:

$$\dot{\tilde{y}}_{j,b,t} = CIP_{b,t} \mathcal{I}_{EUR,j} + \gamma_{m,t} + \delta_{i,t} + \varepsilon_{j,b,t}$$

$CIP_{b,t}$ = weighted average euro - dollar yield

Adapt standard CIP [$\frac{(F_{t,\tau})}{S_t}(1 + r_{t,\tau}^{\$}) = 1 + r_{t,\tau}^{euro}$] to **sovereign bonds** and **bank-level**:

→ Account for sovereign default risk: $y_t^{c,i,\tau} = r_t^{c,\tau} + \zeta_t^{c,i,\tau} - \omega_t^{c,i,\tau}$

→ Account for currency risk:

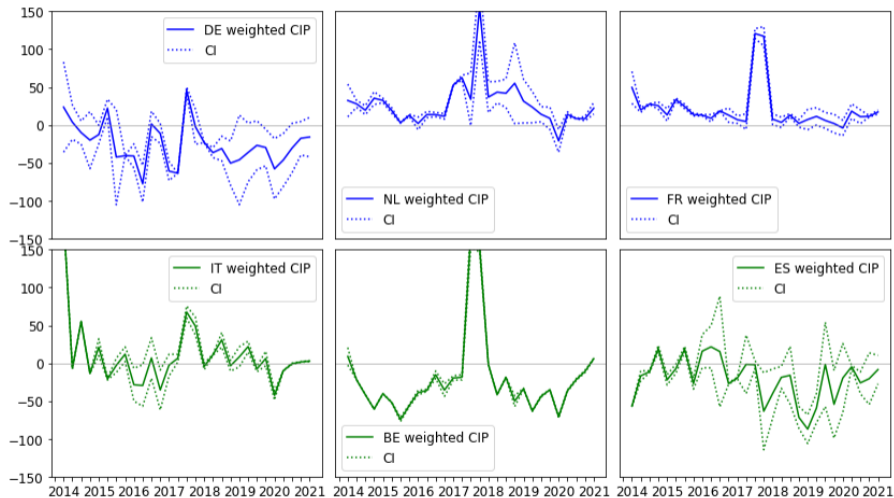
$$\tilde{y}_{j,t} = \begin{cases} y_{j,t} & \text{if euro} \\ IRS_{euro,\tau,t} + BS_{euro,usd,\tau,t} - IRS_{usd,\tau,t} + y_{j,t} & \text{if dollar \& hedged} \end{cases}$$

→ Account for portfolio weights: $\dot{\tilde{y}}_{j,t} = \sum_{j=1}^N w_{j,t-1}^c \tilde{y}_{j,t}^c$

→ Account for maturity composition and issuer convenience yield: $\gamma_{m,t}$ & $\delta_{i,t}$

RESULTS: HY/LY HETEROGENEOUS BANK CIP DEVIATIONS

FIGURE: Bank-level CIP, average by country (basis points)



Negative differentials: lower yields on euro than dollar after hedged FX

EMPIRICAL STRATEGY: DRIVERS

Is it a convenience for the currency?

$$\text{Recall: } y_t^{c,i,\tau} = r_t^{c,\tau} + \zeta_t^{c,i,\tau} - \omega_t^{c,i,\tau}$$

$$\underbrace{\ddot{y}_t^{\text{euro}} - \ddot{y}_t^{\text{SyntheticEuro}}}_{\text{residual yield differential } (\Gamma)} = \underbrace{\omega_t^{\text{SyntheticEuro}} - \omega_t^{\text{euro}}}_{\text{banks' currency convenience yield differential } (\Omega)}$$

Is it frictions on the demand-side?

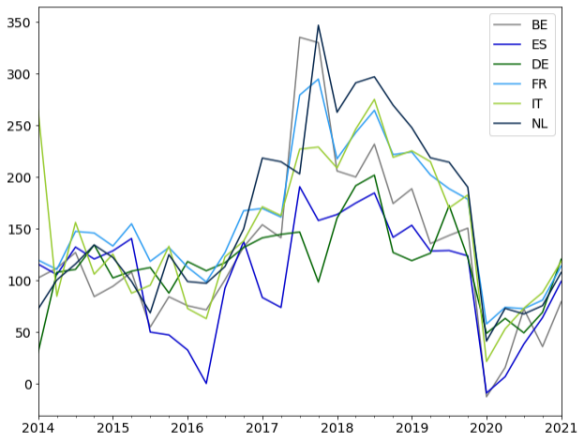
$$\hat{CIP}_{t,b} = \beta \text{GrowthHomeBiasShare}_{t,b} + \tau \text{LCR}_{t-1,b} + \gamma \text{RiskAversion}_{t-1,b} \\ + \chi \text{MonetaryPolicyShock}_t + v_b + u_{t,b}$$

Instrument $\text{GrowthHomeBiasShare}_{t,b}$ with $\beta \text{DevCountryDebtRedemption}_{t,c}$

Convenience

CHANNEL: CURRENCY CONVENIENCE YIELD

FIGURE: Banks' currency convenience yields, average by country (basis points)



Fails to clarify heterogeneity: all countries display a dollar preference (deviations > 0)

EMPIRICAL STRATEGY: DRIVERS

Is it a convenience for the currency?

$$\text{Recall: } y_t^{c,i,\tau} = r_t^{c,\tau} + \zeta_t^{c,i,\tau} - \omega_t^{c,i,\tau}$$

$$\underbrace{\ddot{y}_t^{euro} - \ddot{y}_t^{SyntheticEuro}}_{\text{residual yield differential } (\Gamma)} = \underbrace{\omega_t^{SyntheticEuro} - \omega_t^{euro}}_{\text{banks' currency convenience yield differential } (\Omega)}$$

Is it frictions on the demand-side?

$$\begin{aligned} \hat{CIP}_{t,b} = & \beta \text{GrowthHomeBiasShare}_{t,b} + \tau \text{LCR}_{t-1,b} + \gamma \text{RiskAversion}_{t-1,b} \\ & + \chi \text{MonetaryPolicyShock}_t + v_b + u_{t,b} \end{aligned}$$

Instrument $\text{GrowthHomeBiasShare}_{t,b}$ with $\beta \text{DevCountryDebtRedemption}_{t,c}$

Frictions

CHANNEL: INVESTOR-SIDE FRICTIONS

TABLE: Bank-level CIP deviations on determinants via IV

	(1)	(2)
<i>Dependent variable</i>	<i>1st stage</i> <i>GrowthHomeBias</i>	<i>2nd stage</i> <i>weighted CIP</i>
Dev. country debt redemption	0.355*** (0.127)	
Growth Home Bias		-1.248* (0.734)
Lagged LCR	-10.92*** (2.603)	-13.139** (5.598)
Lagged banks' risk aversion	14.703 (28.534)	20.574 (34.795)
MP spread shock	0.615* (0.343)	0.303 (0.377)
Bank fixed effects	Yes	Yes
Observations	519	519

Notes: Estimated weighted bank-level $CIP_{b,t}$ on drivers via IV for 2014Q4-2021Q1. 1st stage: $GrowthHomeBiasShare_{t,b} = \beta DevCountryDebtRedemption_{t,c} + Controls2^{nd} stage$; 2nd stage: $\hat{CIP}_{t,b} = \beta GrowthHomeBiasShare_{t,b} + \tau LCR_{t-1,b} + \gamma RiskAversion_{t-1,b} + \chi MonetaryPolicyShock_t + v_b + u_{t,b}$. Country clustered std. errors. ***p<.01, **p<.05, *p<.1

CONSEQUENCES & CONCLUSION

EA banks exhibit heterogeneous currency premia reflecting diverse currency "preferences" due to investor-side frictions within the region:

- ▶ Implications for cross-border transmission of a common monetary policy
 - Exploiting the ECB's asset purchase programme (APP) supply shock:*
 - ▶ Banks with higher pre-APP home issuer bias rebalanced less towards US bonds
- ▶ Implications for capital flows potentially affecting exchange rate formation
- ▶ Banks' balance sheet frictions (home issuer bias) constrain currency arbitrage
- ▶ Heterogeneous "preferences" suggest a role for investor bases in bond pricing

THANK YOU

APPENDIX

LITERATURE REVIEW

▶ **UIP/CIP deviations:**

- ▶ **Disaggregated data:** Liao 2020, Caramichael, Liao and Gopinath 2021 and Faia, Salomao and Ventula 2022
- ▶ **Determinants for violations:** Borio, McCauley, McGuire and Sushko 2018, Du, Tepper and Verdelhan 2018, Du, Im and Schreger 2021, Cerruti, Obstfeld and Zhaou 2021

▶ **Asset safety or convenience service:**

- ▶ Nagel 2016, Caballero, Gourinchas and Farhi 2017, Krishnamurthy and Vissing-Jorgensen 2012, Jiang, Lustig, Nieuwerburgh and Xiaolan 2020

▶ **Investor demand affecting asset pricing:**

- ▶ **Empirical:** Gabaix and Koijen 2020, Koijen, Koulischer, Nguyen and Yogo 2017, 2020, Coppola 2021
- ▶ **Theoretical:** D'Amico and King 2013, Caballero, Koijen and Yogo 2019, Caballero, Gourinchas and Farhi 2016, Curatola and Faia 2021, Gourinchas, Ray and Vayanos 2022

DATA

Matched security-bank data

1. Proprietary information on 26 largest euro area banking groups:
 - 1.1 ISIN-level securities holdings (ECB SHSG) and prices (ECB CSDB)
 - ▶ issuer and security characteristics (country, issuer sector, maturity, ...)
 - ▶ 2013Q4 - 2021Q1
 - 1.2 Balance sheet information (ECB Supervisory Statistics)
 - ▶ leverage ratio, total assets
 - ▶ 2014Q1 - 2021Q1
2. Cross-currency basis swaps, interest rate swaps and zero-coupon sovereign yields and Sovereign CDS spreads (Bloomberg and Refinitiv)
3. Monetary policy surprises (EA-MPD) and security-level ECB purchases under PSPP and PEPP

DATA

Details:

- ▶ These banking groups account for 60% of EA banks' consolidated total assets
- ▶ Hold around EUR 3 trillion in debt securities
- ▶ Aggregated at headquarter residency: AT, BE, DE, ES, FR, IT and NL

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EMPIRICAL STRATEGY: BANK-LEVEL CIP

Specification for yields:

1. Account for sovereign default risk:

$$y_t^{c,i,\tau} = r_t^{c,\tau} + \zeta_t^{c,i,\tau} - \omega_t^{c,i,\tau} \quad (-3)$$

where $y_t^{c,i,\tau}$: sovereign yield; $r_t^{c,\tau}$: risk-free interest rate; $\zeta_t^{c,i,\tau}$: sovereign risk spread (\approx Sovereign CDS spread) and $\omega_t^{c,i,\tau}$: convenience yield for currency c , issuer country i and maturity τ

2. Hedge for FX movements:

$$\hat{y}_t^{c,\tau} = \begin{cases} \hat{y}_t^{c,\tau} & \text{if euro} \\ IRS_{euro,\tau,t} + BS_{euro,usd,\tau,t} - IRS_{usd,\tau,t} + y_{i,t} & \text{if dollar \& hedged} \end{cases} \quad (-3)$$

where $IRS_{euro,n,t}$ and $IRS_{usd,n,t}$: interest rate swaps; $BS_{euro,usd,n,t}$: cross-currency basis swap

3. Portfolio weighted:

$$\bar{y}_c = \sum_{j=1}^N w_{j,t-1}^c \hat{y}_{j,t}^c \quad (-3)$$

where $w_{j,t-1}^c$ is in nominal terms and bond j embeds issuer country i and maturity τ

EMPIRICAL STRATEGY: BANK-LEVEL CIP

Security-level econometric specification for bank-level CIP:

$$\dot{\tilde{y}}_{j,b,t} = CIP_{b,t} \mathcal{I}_{EUR,j} + \gamma_{m,t} + \delta_{i,t} + \varepsilon_{j,b,t} \quad (-2)$$

- ▶ $\dot{\tilde{y}}_{j,b,t}$ is the annualized *adjusted* yield for bond j held by bank b at time t
- ▶ $\mathcal{I}_{EUR,j}$ equals 1 if bond j is denominated in the euro
- ▶ $\gamma_{m,t}$ are fixed effects for maturity bucket m at date t
- ▶ $\delta_{i,t}$ are issuer-country fixed effects i at date t
- ▶ regression estimated for each date t and bank b

$CIP_{b,t} = \textit{weighted average}$ euro - dollar yield for bank b at time t

BANK-LEVEL CIP: CURRENCY CONVENIENCE YIELD

To identify currency convenience we can further decompose bank-level CIP:

$$\text{Recall: } y_t^{c,i,\tau} = r_t^{c,\tau} + \zeta_t^{c,i,\tau} - \omega_t^{c,i,\tau} \quad (-1)$$

$$\begin{aligned} \hat{y}_t^{euro,\tau} &= r_t^{euro,\tau} - \omega_t^{euro,\tau}, \\ \hat{y}_t^{dollar,\tau} &= r_t^{dollar,\tau} - \omega_t^{dollar,\tau} \end{aligned} \quad (0)$$

$$\begin{aligned} \ddot{y}_t^{euro,\tau} &= -\omega_t^{euro,\tau}, \\ \ddot{y}_t^{dollar,\tau} &= -\omega_t^{dollar,\tau} \end{aligned} \quad (1)$$

$$\underbrace{\ddot{y}_t^{euro} - \ddot{y}_t^{SyntheticEuro}}_{\text{residual yield differential } (\Gamma)} = \underbrace{\omega_t^{SyntheticEuro} - \omega_t^{euro}}_{\text{banks' currency convenience yield differential } (\Omega)} \quad (2)$$

To the data: obtain Ω as a residual:

$$\Gamma_{j,b,t} = \Omega_{b,t} \mathcal{I}_{EUR,j} + \gamma_{m,t} + \varepsilon_{j,b,t} \quad (3)$$

where $\Gamma_{j,b,t}$ is the yield-residual: $\Gamma_t^{c,i,\tau} = y_t^{c,i,\tau} - \zeta_t^{c,i,\tau} - r_t^{c,\tau}$; *SyntheticEuro*: hedged EUR-denominated USD yield

CIP DRIVERS

To uncover determinants driving the estimated CIPs I run the following model:

$$\text{1st stage: } \text{GrowthHomeBiasShare}_{t,b} = \beta \text{DevCountryDebtRedemption}_{t,c} + \tau \text{LCR}_{t-1,b} \\ + \gamma \text{RiskAversion}_{t,b} + \chi \text{MonPolShock}_t + v_b + u_{t,b}$$

$$\text{2nd stage: } \hat{\text{CIP}}_{t,b} = \beta \text{GrowthHomeBiasShare}_{t,b} + \tau \text{LCR}_{t-1,b} + \gamma \text{RiskAversion}_{t,b} \\ + \chi \text{MonPolShock}_t + v_b + u_{t,b}$$

1. Bank's regulation → Lagged LCR dummy which equals one if the bank has a ratio above the 25th percentile in t-1)
2. Macroeconomic risks → Bank's risk aversion: calibrated parameter by matching a factor model to a myopic portfolio choice model
3. Home bias growth instrumented → Exogeneity in home bias share growth following countries debt redemption profiles (deviation from median)
4. Monetary policy → Monetary policy surprise shock on OIS/yield spread (IT-DE 10y)
5. Bank fixed effects → v_b

INTERNATIONAL REBALANCING BEHAVIOUR FOLLOWING ECB'S PSPP AND GOVPEPP PROGRAMMES

The specification is:

$$\begin{aligned} ChangeShareUS2015Q1_{t,b} = & \beta weightedCumAPPShare_{t-1,b} + \beta TotalHoldings_{t-1,b} \\ & + \beta LeverageRatio_{t-1,b} + \gamma RiskAversion_{t,b} \\ & + \gamma TotalAssets_{t,b} + \eta_b + u_{t,b} \end{aligned} \quad (4)$$

$$weightedCumAPPshare_{t+1,b} = \sum_{j=1}^N w_{j,b,t-1}^c \frac{CumulativeGovPurchases_{j,b,t}}{OutstandingAmount_{j,b,t}} \quad (5)$$

where $w_{j,b,t-1}^c$: holdings-weight for security j purchased by the ECB and held by bank b at the end of the period $t - 1$; $\frac{CumulativeGovPurchases_{j,b,t}}{OutstandingAmount_{j,b,t}}$: share bought of security j over its outstanding amount at time t

INTERNATIONAL REBALANCING BEHAVIOUR FOLLOWING ECB'S PSPP AND GovPEPP PROGRAMMES

	(1)	(2)	(3)	(4)
	$\Delta USshare$	$\Delta USflow$	$\Delta USshare$	$\Delta USshare$
APP shock	0.183*	0.111***	0.721**	0.147***
	(0.10)	(0.04)	(0.28)	(0.04)
APPShockXpreHomeBias			-0.009**	
			(0.00)	
APPShockXLowSpreadCountry				0.197*
				(0.11)
Total Holdings	0.027	0.161***	0.060	-0.009
	(0.09)	(0.06)	(0.13)	(0.07)
Lagged leverage ratio	0.830	0.437	0.406	-0.658
	(0.86)	(0.34)	(1.28)	(0.84)
Total assets	-0.004	0.010	-0.002	0.004
	(0.03)	(0.01)	(0.03)	(0.00)
Bank risk aversion	25.985***	0.517	26.826***	13.606
	(8.73)	(1.75)	(9.31)	(8.82)
Constant	-13.458	-13.296	-14.205	-5.399
	(14.21)	(8.74)	(14.64)	(3.57)
Bank fixed effects	Yes	Yes	Yes	
Country fixed effects				Yes
Observations	515	515	515	515
R-squared	0.564	0.560	0.587	0.255

Notes: Regressing the change in banks' US holdings share on APP shock during the sample period 2015Q1-2020Q2. Bootstrapped standard errors clustered on the fixed effect variable. P-values indicated as: *** p<0.01, ** p<0.05, * p<0.1.