

Convenience yields and the foreign demand for US Treasuries: portfolio-level evidence from European banks

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Research question

US Treasuries global safe asset, trade at a premium w.r.t ...

- ▶ Assets with similar liquidity or safety (Krishnamurthy, Vissing-Jorgensen (2012))
- ▶ Foreign treasuries swapped into dollars (Du, Im, Schreger (2018))

Convenience yield: investors forgo yield to hold US Treasuries because of unique safety and liquidity

Research question

Foreign demand important driver of convenience yield (Gourinchas, Rey (2007); Caballero, Fahri, Gourinchas (2008); Jiang, Lustig, Krishnamurthy (2021))

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But profitable for € investor to rebalance portfolio **away** from US Treasuries if

$$\frac{F_t^{\text{€/$}}}{S_t^{\text{€/$}}} y_{\$,t}^{\text{Govt}} < y_{\text{€},t}^{\text{Govt}}$$

Research question

Are there any investors who take advantage of Treasury premia to increase their portfolio returns?

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Yes! European banks, they ...

- ▶ **Reduce** US relative to domestic govt. bond exposure when convenience yield **high**
- ▶ Stronger response by commercial bank
- ▶ No difference between GIPS and other EU countries

Data overview - Bank balance sheets

Why European banks?

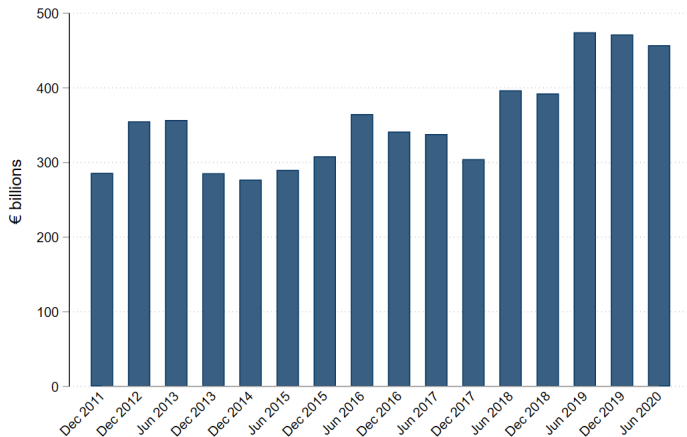
- ▶ Significant but **small** holdings of US Treasuries
- ▶ Institutional environment
 - ▶ Zero regulatory risk weight for **both** domestic and US (safe) govt bonds \implies No constraints to rebalancing
 - ▶ Exogenous variation in sovereign debt outstanding due to PSPP

EBA Transparency Exercise and Stress Test database. 177 EU and EEA banks, circa 70% of European banking assets.

1603 biannual bank-period level observations, 12/2011 to 06/2020

Data overview - US Treasuries holdings

Significant bank holdings of US Treasuries, but **small** compared to US Treasury market size (\approx \$22 trn.) Determinants



Data overview - Convenience yields

Convenience yield estimated as **US Treasury premium** relative to country i 's government bonds in currency k of tenor n following Du, Im and Schreger(2018)

$$\phi_{i,n,t} = y_{i,n,t}^{Govt} - \underbrace{\rho_{n,t}}_{\text{USD forward premium}} - y_{USD,n,t}^{Govt}$$

- ▶ Country-level convenience yield for all EU sovereign bonds (only Germany in original dataset)
- ▶ Expanded the original dataset to include
 - ▶ Romanian Leu
 - ▶ Czech Koruna

Data overview - Convenience yields

$\phi_{i,k,n,t} \approx$ Convenience yield if

- ▶ No frictions in swap/forward markets \implies Plausible for European currencies/USD
- ▶ No default risk \implies Non-negligible: European debt crisis

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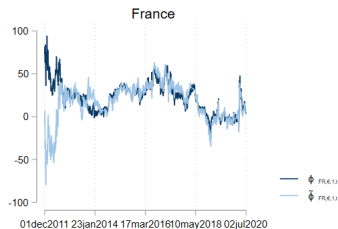
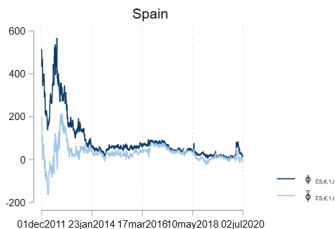
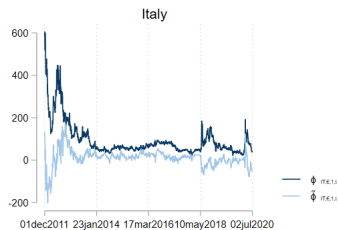
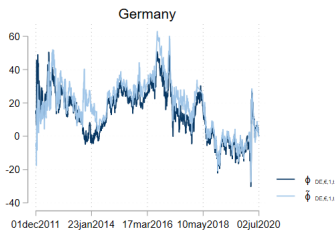
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Adjust Treasury premia by credit default swap rates

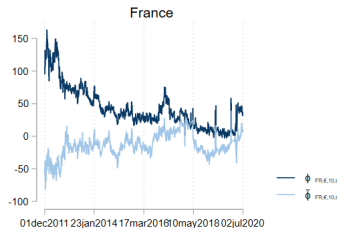
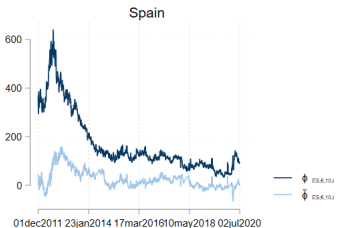
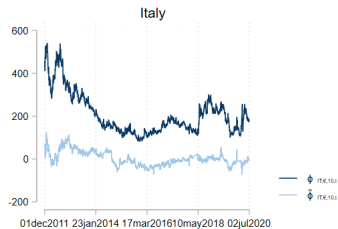
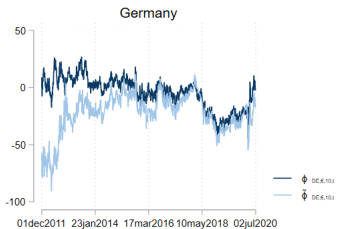
"Pure" convenience yield

$$\tilde{\phi}_{i,n,t} = y_{i,n,t}^{Govt} - CDS_{i,n,t} - \rho_{k,n,t} - (y_{USD,n,t}^{Govt} - CDS_{USD,n,t})$$

Data overview - Convenience yields 1y



Data overview - Convenience yields 10y



Identification problem

We are interested in

- ▶ Relative US/domestic sovereign bond holdings

$$b_{j,i,n,t}^{US/i} = \text{Quantity}$$

- ▶ Convenience yield of US Treasuries over domestic bond

$$\phi_{i,n,t} \approx \text{Relative price}$$

Identification problem

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 $\phi_{i,n,t} \approx \text{Relative price}$

⇒ Classic identification problem in demand and supply estimation

To identify **demand** curve slope, observed price-quantity pairs driven by **supply** shocks only

Identification - Fixed effects

Exploit bank-level data to estimate **time fixed effects** model

Identifying assumptions

- ▶ Demand by European banks ($\approx 2.5\%$ of outstanding US Treasuries) at the country level does not affect convenience yields
- ▶ Not marginal investors in US Treasury markets

\implies Demand shocks by European banks not affect convenience yield.

Identification - Fixed effects

Exploit bank-level data to estimate **time fixed effects** model

Identifying assumptions

- ▶ Demand by European banks ($\approx 2.5\%$ of outstanding US Treasuries) at the country level does not affect convenience yields
- ▶ Not marginal investors in US Treasury markets

\implies Demand shocks by European banks not affect convenience yield.

- ▶ Time fixed effects control for global demand shocks

\implies **Relative supply** shocks drive observed price-quantity pairs

\implies Recover **demand** curve slope

Identification - Instrumental variable

Convenience yield **high** when US Treasuries **scarce** relative to other govt. bonds (Krishnamurthy Vissing-Jorgensen (2012), Du, Im, Schreger (2018))

Goal: identify **demand** curve slope

⇒ Need variation in relative EU govt. bond supply exogenous to unobserved demand shocks

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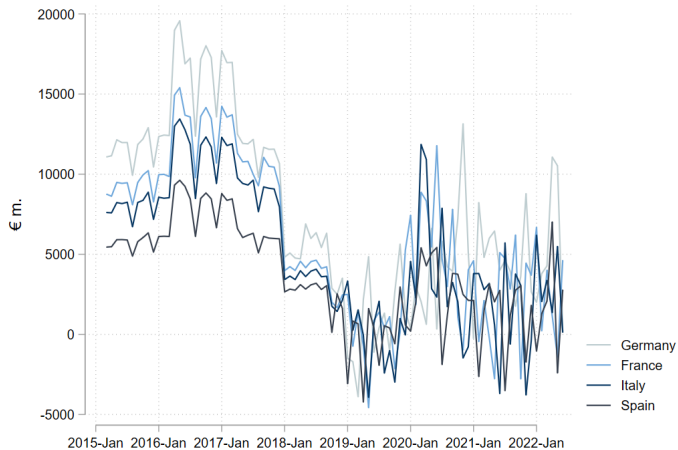
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⇒ Need variation in relative EU govt. bond supply exogenous to unobserved demand shocks

ECB holdings under PSPP, reduce outstanding supply

- ▶ Holdings distributed across countries according to Capital Key
- ▶ Capital Key depends only on population and GDP

Identification - Instrumental variable



Empirical specification

$$b_{j,i,t}^{US/i} = \beta_0 + \beta_1 \phi_{i,t} + \beta_2 e_t^{USD,i} + \beta_3 X_{j,i,t} + \beta_4 C_{i,t} + \beta_5 W_t + \gamma_t + \varepsilon_{j,i,t}$$

$b_{j,i,t}^{US/i}$ = Ratio of US to country i government bonds held by bank j in country i at time t

$\phi_{i,t}$ = US Treasury convenience yield over country i sovereign debt at time t , averaged over maturities

$X_{j,i,t}$ = Variables at bank j , country i , time t level

$C_{i,t}$ = Variables at country i , time t level

W_t = Variables at time t level

$e_t^{USD,i}$ = Log USD nominal exchange rate of country i 's currency

γ_t = Time fixed effect

Results - IV first stage

	$\tilde{\phi}_{i,t}^{US}$		$\phi_{i,t}^{US}$	
	(1)	(2)	(3)	(4)
$\log(\text{PSPP})_{i,t}$	-5.687*** (-4.18)	-5.166*** (-3.92)	-4.426 (-1.46)	-4.013 (-1.36)
$e_t^{USD,k}$	118.1** (2.53)		187.6*** (3.94)	
$\log(\text{VIX})_t$	-31.59*** (-9.14)		-1.652 (-0.24)	
Time FE	No	Yes	No	No
Bank controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
N	509	509	509	509
R ²	0.392	0.455	0.485	0.496

Results - "Pure" convenience yield

	(1)	(2)	(3)	(4)
	OLS	FE	IV	IV
$\tilde{\phi}_{i,t}^{US}$	-0.000824* (-1.97)	-0.000616* (-1.78)	-0.00319* (-1.74)	-0.00340* (-1.89)
$e_t^{USD,k}$	-0.0726* (-1.89)	-0.0670* (-1.69)	0.610 (1.38)	
$\log(\text{VIX})_t$	0.0434 (0.30)		0.207 (1.36)	
Time FE	No	Yes	No	Yes
Bank controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
N	652	652	526	526
Underid (KP LM)			7.879	6.996
Weak id (KP Wald)			22.81	22.02
SY critical value			16.38	16.38

Results - Treasury premium

	(1) OLS	(2) FE	(3) IV	(4) IV
$\phi_{i,t}^{US}$	-0.000673** (-2.17)	-0.000614** (-2.26)	-0.00225* (-1.83)	-0.00271** (-2.06)
$e_t^{USD,k}$	-0.0650* (-1.74)	-0.0608 (-1.54)	0.599 (1.47)	
$\log(\text{VIX})_t$	0.0719 (0.51)		0.209 (1.39)	
Time FE	No	Yes	No	Yes
Bank controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
N	652	652	526	526
Underid (KP LM)			10.77	9.333
Weak id (KP Wald)			77.44	55.22
SY critical value			16.38	16.38

Conclusions

- ▶ European banks reduce relative US Treasuries in response to return differentials
- ▶ Similar reaction to both
 - ▶ "Pure" convenience yield
 - ▶ Non risk-corrected Treasury premium
- ▶ Heterogeneous response
 - ▶ Country
 - ▶ Bank size
 - ▶ Business model

Appendix A



Bank-level determinants of sovereign holdings

US Treasurys

	(1)	(2)	(3)
$\log(\text{Tot Assets})_{i,j,t}$	0.0834 (0.109)	-0.121 (0.161)	-0.102 (0.151)
Loans/Tot Assets	-0.0194 (0.0150)	-0.0507* (0.0286)	-0.0462* (0.0258)
RWA/Tot Assets $_{i,j,t}$	-0.00249 (0.0139)	-0.0151 (0.0375)	-0.0365 (0.0440)
Tier 1 ratio $_{i,j,t}$	0.0799*** (0.0244)	0.115** (0.0443)	0.124*** (0.0406)
Cash/Tot Assets	-0.0296 (0.0296)	-0.0604** (0.0298)	-0.0524** (0.0252)
US Credit/Tot Assets	0.0895 (0.102)	0.329 (0.238)	0.381 (0.240)
Net Interest Income/Tot Assets $_{i,j,t}$	-0.0823 (0.332)	-0.0359 (0.137)	0.142 (0.217)
Net Fee Income/Tot Assets $_{i,j,t}$	0.726 (0.693)	0.311 (0.197)	0.489** (0.221)
Time FE	No	No	Yes
Bank FE	No	Yes	Yes
N	244	242	242
R ²	0.265	0.903	0.908

Domestic bonds

	(1)	(2)	(3)
<i>Bank-level determinants</i>			
$\log(\text{Tot Assets})_{i,j,t}$	-3.003*** (1.059)	2.516 (3.751)	3.366 (3.532)
Loans/Tot Assets	0.0254 (0.0438)	-0.146 (0.102)	-0.124 (0.0994)
RWA/Tot Assets $_{i,j,t}$	-0.161 (0.135)	-0.0450 (0.0851)	-0.0745 (0.0905)
Tier 1 ratio $_{i,j,t}$	0.158*** (0.0574)	0.0592** (0.0259)	0.0614* (0.0310)
Cash/Tot Assets	-0.191 (0.208)	-0.167** (0.0680)	-0.144** (0.0686)
Net Interest Income/Tot Assets $_{i,j,t}$	-0.780 (1.108)	0.743* (0.401)	0.759 (0.512)
Net Fee Income/Tot Assets $_{i,j,t}$	1.169 (2.142)	-1.390 (0.955)	-0.864 (0.825)
<i>Country-level determinants</i>			
CDS $_{i,t}$	0.0118 (0.0195)	-0.00444 (0.00501)	-0.00780 (0.00554)
Govt debt/GDP $_{i,t}$	-0.00896 (0.0419)	0.0320 (0.0251)	0.0581 (0.0548)
Debt risk $_{i,t}$	-2.635 (2.020)	-0.0976 (0.766)	-0.0405 (0.739)
Time FE	No	Yes	Yes
Bank FE	No	No	Yes
N	424	421	421
R ²	0.322	0.974	0.974

Appendix B



Full set of bank-level controls

Bank-level controls - "Pure" convenience yield

Add all bank-level controls significant in at least 1 specification

	(1) OLS	(2) FE	(3) IV	(4) IV
$\tilde{\phi}_{i,t}^{US}$	-0.000781 (-0.57)	-0.000410 (-0.32)	0.00171 (0.64)	0.00182 (0.66)
$e_t^{USD,k}$	-0.0159 (-0.50)	0.00276 (0.08)	0.0394 (0.01)	
$\log(\text{VIX})_t$	-0.0434 (-0.53)		0.0760 (0.44)	
Time FE	No	Yes	No	Yes
Bank controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
N	413	413	329	329
Underid (KP LM)			8.964	9.192
Weak id (KP Wald)			17.98	18.48
SY critical value			16.38	16.38

Bank-level controls - Treasury premium

	(1) OLS	(2) FE	(3) IV	(4) IV
$\phi_{i,t}^{US}$	-0.00108 (-1.07)	-0.000717 (-0.78)	0.00214 (0.62)	0.00224 (0.63)
$e_t^{USD,k}$	-0.00902 (-0.29)	0.00538 (0.15)	5.446 (0.58)	
$\log(\text{VIX})_t$	-0.0115 (-0.19)		0.221 (0.70)	
Time FE	No	Yes	No	Yes
Bank controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
N	413	413	329	329
Underid (KP LM)			5.970	6.054
Weak id (KP Wald)			10.58	10.78
SY critical value			16.38	16.38

Appendix C



Domicile country-level heterogeneity

Country - "Pure" convenience yield

Sovereign-bank nexus in GIPS (Battistini et al. (2014), Altavilla et al. (2017), Andreeva Vlassopoulos (2019))

	(1) OLS	(2) FE	(3) IV	(4) IV
$\tilde{\phi}_{i,t}^{US}$	-0.00432* (-1.89)	-0.00304 (-1.53)	-0.00811 (-1.12)	-0.0106 (-1.04)
$\mathbb{1}_{GIPS} \times \tilde{\phi}_{i,t}^{US}$	0.00386* (1.70)	0.00267 (1.33)	-0.0911 (-0.57)	-0.124 (-0.56)
$e_t^{USD,k}$	-0.0944** (-2.18)	-0.0826** (-2.08)	0.760 (0.59)	
$\log(VIX)_t$	0.00542 (0.04)		-0.377 (-0.43)	
Time FE	No	Yes	No	Yes
Bank controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
N	652	652	526	526
Underid (KP LM)			0.411	0.393
Weak id (KP Wald)			0.203	0.189
SY critical value			7.030	7.030

Country - Treasury premium

	(1) OLS	(2) FE	(3) IV	(4) IV
$\phi_{i,t}^{US}$	-0.00297* (-1.67)	-0.00259 (-1.56)	-0.00233** (-2.01)	-0.00299** (-2.41)
$\mathbb{1}_{GIPS} \times \phi_{i,t}^{US}$	0.00238 (1.38)	0.00204 (1.26)	-0.000498 (-0.43)	-0.00108 (-0.93)
$e_t^{USD,k}$	-0.0723* (-1.82)	-0.0672* (-1.79)	0.625 (1.55)	
$\log(\text{VIX})_t$	0.0446 (0.31)		0.200 (1.31)	
Time FE	No	Yes	No	Yes
Bank controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
N	652	652	526	526
Underid (KP LM)			15.68	17.29
Weak id (KP Wald)			50.59	58.18
SY critical value			7.030	7.030

Debt service risk and Treasury premium

	(1) OLS	(2) FE	(3) IV	(4) IV
$\phi_{i,t}^{US}$	0.00211* (1.83)	0.00164 (1.57)	-0.0148 (-1.06)	-0.0107 (-0.92)
Debt risk $_{i,t}$	0.0425 (0.44)	0.0231 (0.26)	-0.0843 (-0.82)	-0.0298 (-0.32)
Debt risk $_{i,t} \times \phi_{i,t}^{US}$	-0.000615** (-2.26)	-0.000500** (-2.07)	0.00129 (0.92)	0.000819 (0.70)
$e_t^{USD,k}$	-0.0654* (-1.72)	-0.0615 (-1.64)	0.593 (1.41)	
$\log(\text{VIX})_t$	0.0803 (0.58)		0.215 (1.44)	
Time FE	No	Yes	No	Yes
Bank controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
N	652	652	526	526
Underid (KP LM)			2.822	2.929
Weak id (KP Wald)			7.269	8.039
SY critical value			7.030	7.030

Appendix C

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Bank-level heterogeneity

Bank size

	(1)	(2)	(3)	(4)
	OLS	FE	IV	IV
$\tilde{\phi}_{i,t}^{US}$	0.0128 (1.08)	0.00539 (0.55)	-0.108** (-2.01)	-0.106** (-2.09)
$\log(\text{Tot Assets})_{i,j,t} \times \tilde{\phi}_{i,t}^{US}$	-0.00123 (-1.13)	-0.000544 (-0.61)	0.0117** (2.03)	0.0116** (2.10)
$e_t^{USD,k}$	-0.0712* (-1.88)	-0.0666* (-1.70)	-1.140 (-1.15)	
$\log(\text{VIX})_t$	0.0457 (0.32)		0.991** (2.49)	
Time FE	No	Yes	No	Yes
Bank controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
N	652	652	526	526
Underid (KP LM)			6.508	6.632
Weak id (KP Wald)			3.815	3.919
SY critical value			7.030	7.030

Back

Business model - Commercial banks

Excluding top quartile by net fee income/total assets (\approx investment banks)

	(1)	(2)	(3)	(4)
	OLS	FE	IV	IV
$\tilde{\phi}_{i,t}^{US}$	-0.000904*	-0.000757*	-0.00198	-0.00242
	(-1.87)	(-1.93)	(-1.45)	(-1.63)
$e_t^{USD,k}$	-0.0297	-0.0111	0.573	
	(-0.51)	(-0.19)	(1.12)	
$\log(\text{VIX})_t$	-0.148		0.0969	
	(-1.05)		(0.59)	
Time FE	No	Yes	No	Yes
Bank controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
N	498	498	380	380
Underid (KP LM)			6.202	6.117
Weak id (KP Wald)			17.55	19.61
SY critical value			16.38	16.38

Business model - Investment banks

Only top quartile by net fee income/total assets

	(1)	(2)	(3)	(4)
	OLS	FE	IV	IV
$\tilde{\phi}_{i,t}^{US}$	-0.00177 (-1.32)	-0.000476 (-0.36)	-0.00559 (-1.47)	-0.00438 (-1.26)
$e_t^{USD,k}$	-0.0854** (-2.61)	-0.0946*** (-2.94)	1.172 (0.96)	
$\log(\text{VIX})_t$	0.149 (0.81)		0.0974 (0.44)	
Time FE	No	Yes	No	Yes
Bank controls	Yes	Yes	Yes	Yes
Macro controls	Yes	Yes	Yes	Yes
N	154	154	146	146
Underid (KP LM)			6.383	4.527
Weak id (KP Wald)			15.31	9.169
SY critical value			16.38	16.38

Back