Learning About Convenience Yields from Holdings

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Convenience Yields

- Investors value not only the cash flows of financial assets but also "service flows"
- Services are a source of "convenience yield"
  (Krishnamurthy and Vissing-Jorgensen (2012b), Jiang, Lustig, Van Nieuwerburgh, and Xiaolan (2020), Nagel (2016), Kacperczyk, Pérignon, and Vuillemey (2021), Mota (2023))
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Research question:

- What are these services that drive CY of Treasury bonds?
- Can monetary policy/regulation affect asset prices through these services?

This paper

Using . . .

- Euro area data on bond-level characteristics and portfolio holdings,
- a model where investors have heterogeneous preferences for asset-specific services

1. The drivers of CY
   - Consider three services: liquidity, collateral eligibility, and regulatory capital.
   - Estimate the contribution of each service to CY of AAA-sovereign bonds
   - Revealed preference: portfolio heterogeneity $\rightarrow$ differences in service valuation

2. Who values these services?
   - Use policy-driven changes to service flows to identify sectors that value each service
     - ECB corporate QE programs
     - Changes in ECB collateral framework
     - Solvency II regulation

Main results

1. Decomposition:
    - CY is mainly driven by regulatory capital value
    - Insurers and pension funds (ICPF) are main contributors

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2. Monetary policy affects CY:
   - **Liquidity:** Corporate QE
     - increases CY of eligible, yet mutual funds strongly rebalance towards eligible bonds, especially funds with volatile flows
   - **Collateral**: ECB collateral eligibility
     - German bank bonds' CY drops, and banks rebalance away from them
   - **Regulatory value:** Solvency II
     - ICPF rebalance toward bonds with high regulatory value and long duration

Model

Environment

We follow Fama and French (2007), Pástor, Stambaugh, and Taylor (2021), and model with heterogenous investors with "taste" for service flows.

- There are N assets indexed by n
- Continuum of investors indexed by i
- Investors have indirect mean-variance utility over wealth w_{it}
- **New ingredient:** Investors value service-flows of holding an asset

Investors' maximization problem

$$
\begin{aligned}
\max_{\boldsymbol{x}_{it}} \quad & \mathbb{E}_t\left[\tilde{w}_{it+1}\right] - \frac{a_{it}}{2} Var_t\left[\tilde{w}_{it+1}\right] \\
s.t. \quad & \tilde{w}_{it+1} = w_{it+1} + w_{it}\boldsymbol{x}_{it}^{\top}\boldsymbol{s}_{it} \\
& w_{it+1} = w_{it}\left(1 + r(f)_{t+1} + \boldsymbol{x}_{it}^{\top}\boldsymbol{r}_{t+1}\right)
\end{aligned}
\tag{1}
$$

Where

- $\boldsymbol{x}_{it}(n)$ is portfolio weight of asset n
- Service-flows depend on asset characteristics Z_t, a $(N \times K)$ matrix
- $\boldsymbol{\lambda}_{it}$, a $(K \times 1)$ represents investors's heterogeneous preferences for Z_t
- $\implies s_{it} = Z_t \boldsymbol{\lambda}_{it}$

Optimal portfolio allocation

From the agent's FOC, we have

$$\boldsymbol{x}_{it} = \frac{1}{a_{it}} \Sigma_t^{-1} \left(\boldsymbol{\mu}_t + Z_t \boldsymbol{\lambda}_{it} \right) \tag{2}$$

For simplicity, we assume $a_{it} = a_t$, constant across investors.

In equilibrium, investors:

- Diverge from the tangency portfolio $\rightarrow$ overweight assets that provide service
- The larger $\boldsymbol{\lambda}_i$ is, the larger the portfolio tilt

Defining a convenience yield

From the market-clearing condition, the expected returns are

$$\boldsymbol{\mu}_t = \mu_{mt}\boldsymbol{\beta}_{mt} - \underbrace{Z_t\bar{\boldsymbol{\lambda}}_t}_{\text{Convenience Yield (CY)}} \tag{3}$$

where m is the market portfolio and $\bar{\boldsymbol{\lambda}}_t = \int_i \frac{w_{it}}{w_t}\boldsymbol{\lambda}_{it}di$. Note:

- CY is the deviation from a benchmark in which investors do not value service flows.
- CY depends on a wealth-weighted average of the value of service flows.
  - $\uparrow$ CY for bonds with $\uparrow$ Z and with large investors that value it.

Convenience Yields Decomposition

Data

- Sovereign and corporate bond prices and features
  - **CSDB**: Security-level information
  - iBoxx index pricing data
- CDS spreads
  - Markit single-name CDS spread composites
- Treasury benchmark
  - Euro-area AAA yield curve
- Portfolio holdings
  - **SHSS:** ISIN-level holdings by sector (Banks, MF, ICPF, etc.)
  - Morningstar MF holdings
- Period: January 2015 to December 2024

How to measure CY in corporate bonds?

Spread between two assets with same cash-flows (Krishnamurthy and Vissing-Jorgensen (2012a), Mota (2023))

- Treasury ($y_{T,t}$)
- Corporate bond yield ($y_{i,t}$) + CDS with matching maturity

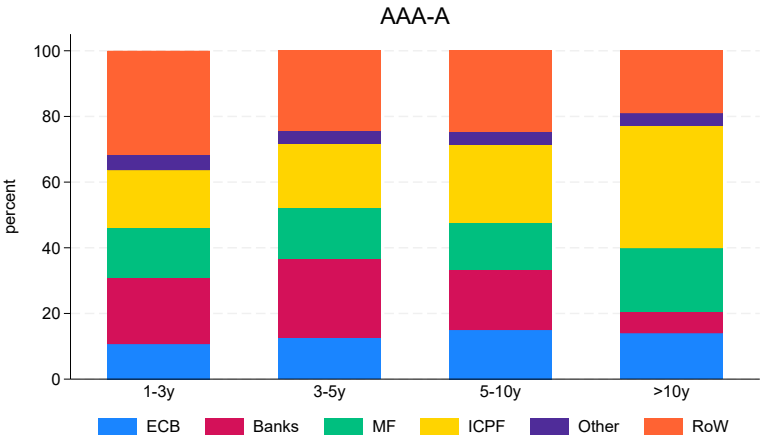
$$Basis_t(n) = y_{T,t} - (y_{i,t} - CDS_{i,t}) = \underbrace{[\boldsymbol{Z}_t(n) - \boldsymbol{Z}_t(T)] \times \bar{\boldsymbol{\lambda}}_t}_{\substack{\text{Relative CY} \\ \text{with respect to Treasury}}}$$

CDS-bond basis is on average negative and monotonic in ratings

$$Basis_t(n) = cds_t^{\tau}(n) - [y_t^{\tau}(n) - y_t^{\tau}(RF)]$$

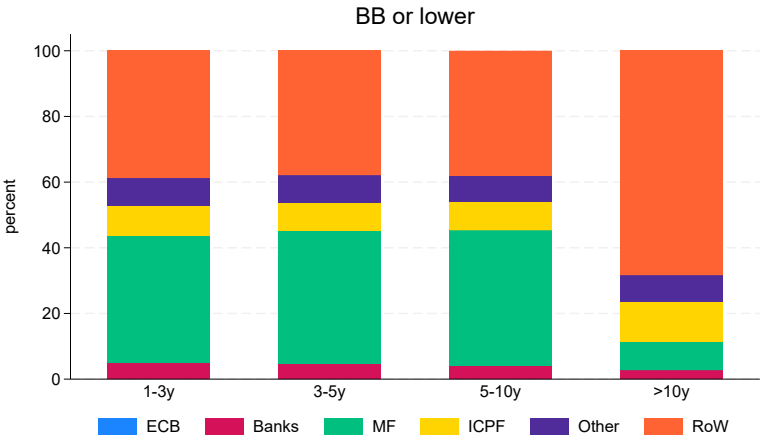
by Investor

Investor heterogeneity: AAA-A is mostly held by banks and ICPF (and RoW)



Investor composition of AAA-A corporate bonds (2021Q4)

Investor heterogeneity: HY is mostly held by MF and RoW



Investor composition of HY corporate bonds (2021Q4)

Convenience Yield Decomposition

Estimate service value

- In our framework

$$Basis_t(n) = [\boldsymbol{z}_t(n) - \boldsymbol{z}_t(T)]\,\bar{\boldsymbol{\lambda}}_t$$

Estimate service value

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$$Basis_t(n) = [\boldsymbol{z}_t(n) - \boldsymbol{z}_t(T)]\,\bar{\boldsymbol{\lambda}}_t$$

- Measured basis is services + noise $\Longrightarrow$

$$Basis_t(n) = \sum_k \lambda_{kt}\,[z_{kt}(n) - z_{kt}(T)] + \varepsilon_t(n)$$

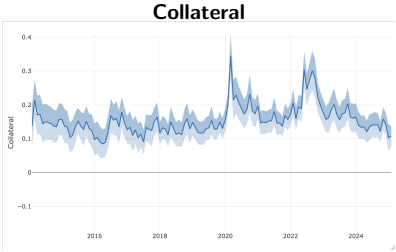
- Cross-sectional regressions a la Fama-MacBeth
  - we standardize $z_{kt}(n)$ to have mean zero and sd 1
  - coefficients identify λ_t
  - the CY of AAA sovereign debt is $\boldsymbol{\lambda}_t^\top \boldsymbol{z}_t(T)$

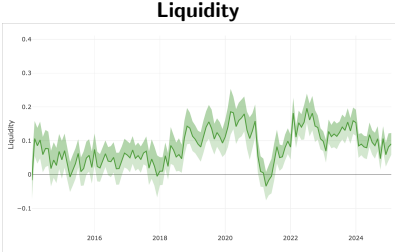
Assume three services

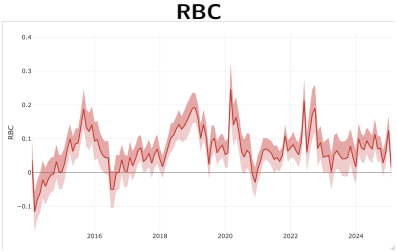
1. **Liquidity**, particularly valuable for mutual funds exposed to redemption risk
   - Proxy: $1 - BidAsk_t(n)$
2. **Collateral value** for borrowing from ECB (valuable for banks)
   - Proxy: $1 - haircut_t(n) \in [0, 1]$, increasing in credit risk and residual maturity
3. **Risk based capital** (relevant for insurance corporations and banks)
   - Proxy: $1 - stress_t(n) \in [0, 1]$, since Solvency II requires capital in proportion to

$$stress_t(n) = f\left(\underbrace{duration_t(n)}_{(+)}, \underbrace{credit\ risk_t(n)}_{(+)}\right)$$

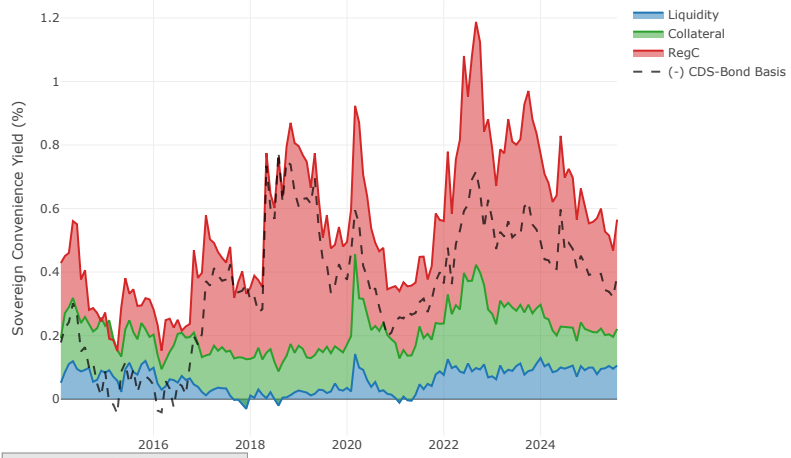
AAA-Treasury convenience yields: service value estimates







AAA-Treasury convenience yields: services share



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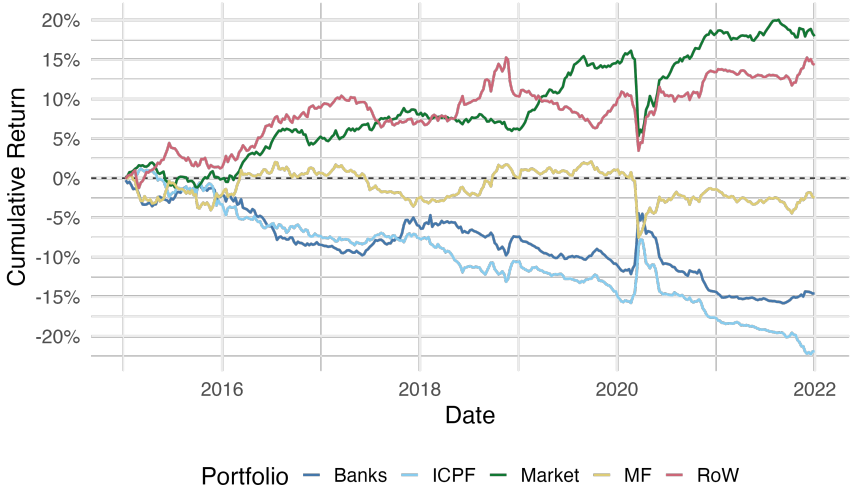
Triple-sorted corp. bond portfolios based on investor composition



Monetary Policy and Service Flows

Monetary Policy and Service Flows

Corporate QE

Corporate bonds purchase programs by the ECB

- Corporate Sector Purchase Program (**CSPP**), announced in March 2016
  - Goal: further monetary policy accommodation, achieve inflation ↑
  - Only IG non-bank corporate bonds (EA-issued, EUR-denominated)
  - Cumulative net purchases since June 2016: EUR 341 billion
  - Net purchases discontinued in June 2022
- Pandemic Emergency Purchase Program (**PEPP**), announced in March 2020
  - Goal: Maintain MP transmission mechanism, economic stabilization
  - Temporary purchase of private and public sector securities
  - Initial volume EUR 750 billion, later increased to EUR 1.85 trillion
  - Net purchases discontinued in March 2022

The effect of CSPP on credit spreads and its decomposition

$$y_t(n) = \theta \; Elig(n) \times Post_t + \alpha_r \times \alpha_m + \alpha_t + u_t(n)$$

	(1) Bond Yield	(2) Credit Spread	(3) CDS Spread	(4) CDS - Bond Basis
Post=1 × CSPP eligible=1	-0.255***	-0.223***	-0.0659***	0.157***
	(0.0152)	(0.0149)	(0.0115)	(0.0133)
CSPP eligible=1	-0.0154	-0.0293***	-0.173***	-0.143***
	(0.0113)	(0.0111)	(0.00857)	(0.00986)
Time FE	✓	✓	✓	✓
Rating x Maturity FE	✓	✓	✓	✓
R^2	0.53	0.39	0.44	0.11
Observations	38,357	38,357	38,357	38,357

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

by rating

Estimates of the effect of CSPP on sectoral holdings

$$\log(B_{it}(n)) = \psi_i Elig(n) \times Post_t + \alpha_M \times \alpha_R + \alpha_{it} + u_{i,t}(n)$$

	Dependent variable: Portfolio share				
	(1)	(2)	(3)	(4)	(5)
	Banks	MF	ICPF	Other	RoW
Post=1 × CSPP eligible=1	-0.338	0.297**	-0.0164	-0.444***	-0.408
	(0.189)	(0.0822)	(0.0719)	(0.0912)	(0.253)
CSPP eligible=1	-2.529**	-0.964*	0.345	-1.427**	1.709*
	(0.660)	(0.363)	(0.411)	(0.348)	(0.654)
Holder country x Time FE	✓	✓	✓	✓	✓
Rating x Maturity FE	✓	✓	✓	✓	✓
R^2	0.29	0.22	0.25	0.15	0.02
Observations	45,863	71,314	74,807	74,289	20,340

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Why do we consider QE eligibility a liquidity service?

$$\log(B_{kit}(n)) = Elig_t(n) \times Post_t \times AF_k + Elig_t(n) \times Post_t + \alpha_M \times \alpha_R + \alpha_{it} + \alpha_k + u_{i,t}(n)$$

	Dependent variable: Log(Holding)					
	CSPP: 2015-09 - 2016-09			PEPP: 2019-09 - 2020-09		
	(1)	(2)	(3)	(4)	(5)	(6)
Elig=1 x Post=1	0.561***	0.595***	0.564***	0.322***	0.240***	0.244***
	(0.033)	(0.057)	(0.057)	(0.026)	(0.040)	(0.042)
Elig=1 x Post=1 x AssetFlightiness		−0.668			1.980***	
		(1.009)			(0.758)	
Elig=1 x Post=1 x HighAF=1			−0.003			0.127**
			(0.070)			(0.053)
Holder Country × Time FE	✓	✓	✓	✓	✓	✓
Rating × Maturity FE	✓	✓	✓	✓	✓	✓
Fund FE	✓	✓	✓	✓	✓	✓
Observations	647,401	647,401	647,401	1,038,195	1,038,195	1,038,195
R^2	0.110	0.111	0.111	0.112	0.112	0.112
Note:						*p<0.1; **p<0.05; ***p<0.01

Monetary Policy and Service Flows

ICPF Capital Requirements

After Solvency II, bonds with high RBC and long duration have higher CY

$$b_t(n) = \beta \times HighRBC_t(n) \times 20y_t(n) \times Post_t + \alpha_{r \times m} + \alpha_t + u_t(n)$$

	Dependent variable: CDS-bond basis	
	(1)	(2)
High RBC=1 × 20y=1 × Post=1	0.207***	
	(0.0362)	
High RBC=1 × Post=1 × Duration		0.00453***
		(0.00155)
20y=1 × Post=1	-0.164***	
	(0.0295)	
Post=1 × Duration		-0.00624***
		(0.00123)
Time FE	✓	✓
Rating x Maturity FE	✓	✓
R^2	0.14	0.14
Observations	87,829	87,829

ICPF reach for bonds with high regulatory value after Solvency II

$$x^i_{ct}(n) = \beta^i \times HighRBC_t(n) \times 20y_t(n) \times Post_t + \alpha_c + \alpha_{r\times m} + \alpha_t + u_{ict}(n)$$

	Dependent variable: Portfolio share			
	(1)	(2)	(3)	(4)
	Banks	MF	ICPF	Other
High RBC=1 × 20y=1 × Post=1	-0.263	-0.534	1.193**	-0.375
	(0.877)	(0.799)	(0.529)	(0.696)
20y=1 × Post=1	-0.553	-0.227	-0.430	-0.222
	(0.810)	(0.726)	(0.449)	(0.638)
Time FE	✓	✓	✓	✓
Rating x Maturity FE	✓	✓	✓	✓
Holder country FE	✓	✓	✓	✓
R^2	0.12	0.15	0.17	0.08
Observations	83,802	98,031	110,040	115,537

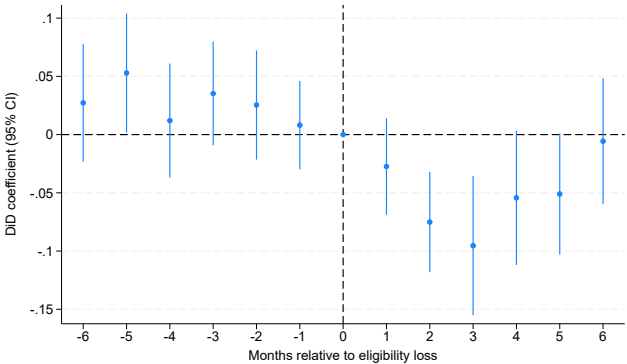
Standard errors in parentheses

$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Monetary Policy and Service Flows

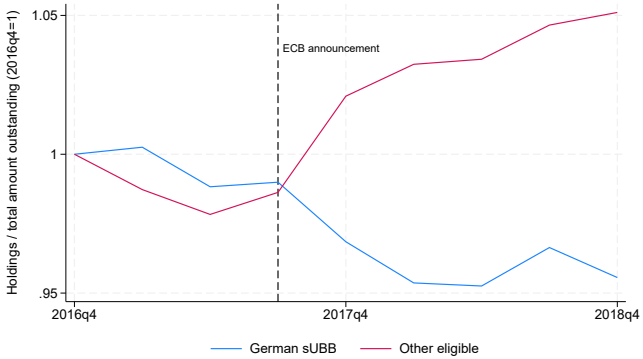
ECB Collateral Eligibility

December 2018: All senior unsecured German bank bonds lose eligibility



CDS-bond basis – DiD coefficients around the loss of collateral eligibility.

Banks reduce holdings of German sUBB relative to other eligible sUBB



Estimates of the effect of ECB collateral eligibility on sectoral holdings

$$\frac{B_{it}(n)}{\sum_n B_{it}(n)} = \beta_i German(n) \times Post_t + \gamma_i German(n) + \alpha_c + \alpha_{r\times m} + \alpha_t + \varepsilon_{it}(n)$$

	Dependent variable: Portfolio share				
	(1)	(2)	(3)	(4)	(5)
	Banks	MF	ICPF	Other	RoW
German=1 × Post=1	-4.532***	-0.686	-3.018	-0.661	-1.289
	(1.090)	(2.122)	(1.912)	(1.043)	(0.827)
German=1	-6.172***	-12.43***	-16.93***	-9.515***	-14.30***
	(1.201)	(2.765)	(2.090)	(1.197)	(1.497)
Time FE	✓	✓	✓	✓	✓
Holder country FE	✓	✓	✓	✓	✓
Rating x Maturity FE	✓	✓	✓	✓	✓
R^2	0.40	0.21	0.19	0.17	0.10
Observations	26,860	21,351	24,221	27,677	10,888

Standard errors in parentheses

$p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Summary

1. Decomposition:
    - For the last decade, CY is mainly driven by regulatory capital value
    - Regulatory capital is mainly valued by ICPF
2. Monetary policy affects CY through these services:
    - Corporate QE $\rightarrow$ liquidity (MF)
    - Collateral eligibility $\rightarrow$ collateral value (banks)
    - Solvency II $\rightarrow$ regulatory value (ICPF)
3. Regulation has large and pervasive effects on asset prices in a way that privileges Treasury securities.

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