The Development of Domestic Bond Markets

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- Crucial for financial stability and macroeconomic development
- Emerging markets have made substantial progress in bond market development
- Development often involved governments initiating bond issuance

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What is the role of government debt in developing corporate debt markets?

- Policymakers & international organizations: creates positive spillovers
- Standard theory: crowding-out/substitution effects in bond markets

How do domestic bond markets develop?

This Paper: causal effect of government debt on corporate debt issuance

- Exploit cross-sectional variation along the maturity structure in Brazil
- Instrumental variable approach
  - Rule-based government issuance
  - Remaining maturity of outstanding bonds

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- As government debt levels rise, relationship ***shifts*** to substitution
- **Real effects:** long-term government debt $\Longrightarrow$ increase in investment by borrowing firms
- Simple framework to rationalize findings, explore mechanism: price discovery

Related Literature

1. Relationship between Government and Corporate Bond Markets
   - Substitution (Elmendorf and Mankiw, 1999; Hubbard, 2012; Krishnamurthy and Vissing-Jorgensen, 2012, 2015; Greenwood *et al.*, 2010, 2015)
   - Complementarity (Friedman, 1978; Pagano, 1989; Matsuyama *et al.*, 1993; Farhi and Maggiori, 2018; Coppola *et al.*, 2023; Grundy *et al.*, 2024)

   ⇒ Causal evidence of positive effect of government bonds on corporate issuance

2. Emerging Markets Financing
   - Development of EM Markets (Eichengreen and Hausmann, 1999; Obstfeld, 2009; Florez-Orrego *et al.*, 2024; Burger and Warnock, 2007; Burger *et al.*, 2012; Claessens *et al.*, 2007; Laeven, 2014; Clayton *et al.*, 2024)
   - Overcoming 'original sin' (Du and Schreger, 2016; Bertaut *et al.*, 2021; Du and Schreger, 2022; Ottonello and Perez, 2019; Engel and Park, 2022)

   ⇒ LC government bond market as precursor for corporate bond market development

3. Real Effects of Bond Market Dynamics
   - Market Driven Capital Structure (Stein, 1996; Baker and Wurgler, 2002; Becker and Ivashina, 2014; Begenau and Salomao, 2019; Ma, 2019)
   - Impact on firm financing and investment (Gilchrist and Zakrajšek, 2007; Philippon, 2009; Chernenko and Sunderam, 2012; Benmelech and Dvir, 2013; Coppola, 2024; Darmouni *et al.*, 2020; Mota, 2023; Graham *et al.*, 2014)

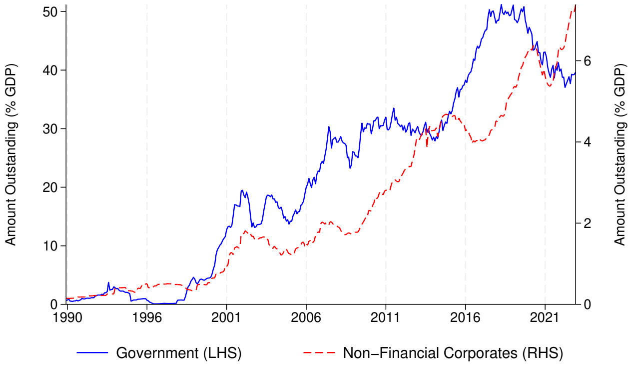
   ⇒ Government bond market development spurs corporate investment

Road Map

1. Institutional Background and Data
2. Role of Government Debt in Corporate Debt Market Development
3. Implication: Effects on Firms' Financing and Investment
4. Framework & Inspecting the Mechanism

Evolution of the Brazilian Domestic Bond Market

- Successful case of domestic bond market development
  - → Second largest among EM (after China) ▷
- Crucial for government and firm financing
- Universe of domestic issuances at the bond-level since market inception



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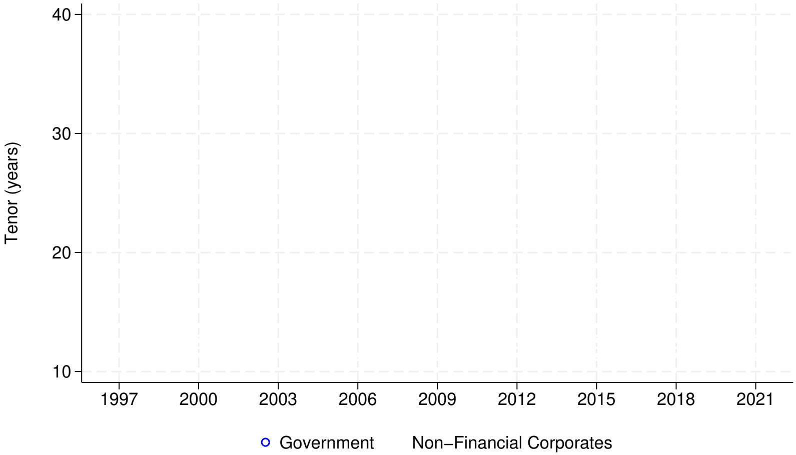
How Vale Chooses the Maturity Structure of Domestically Issued Debt

- **Matching the maturity of outstanding government bonds**

  "(...) four series of inflation-linked senior secured bonds upsizable to BRL1.01bn. A 2020 tranche would pay a fixed rate matching the yield on the NTN-B government bond at the time of pricing plus up to 40bp. A 2022 would pay NTN-B plus up to 55bp, a 2024 would pay NTN-B plus up to 66bp, and a 2029 would pay NTN-B plus up to 75bp." (Vale, Issuance Announcement, 2013)

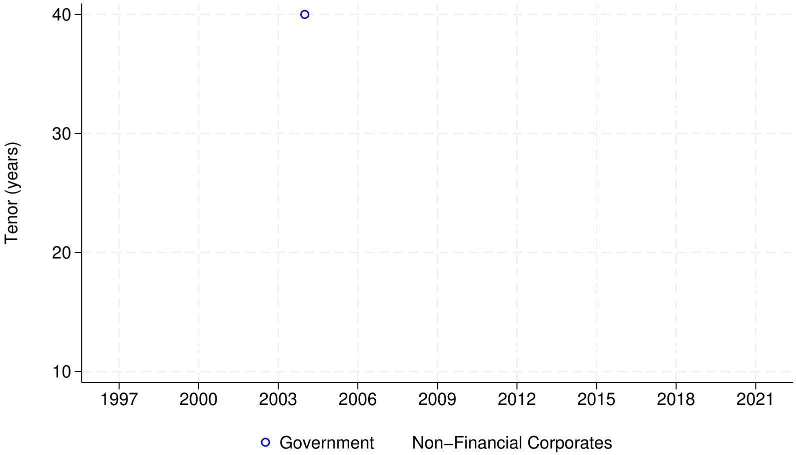
Complementarity in Bond Markets

- Exploit cross-sectional variation along the maturity dimension



Complementarity in Bond Markets

- Blue circles indicate bonds with that **remaining maturity** available in that year



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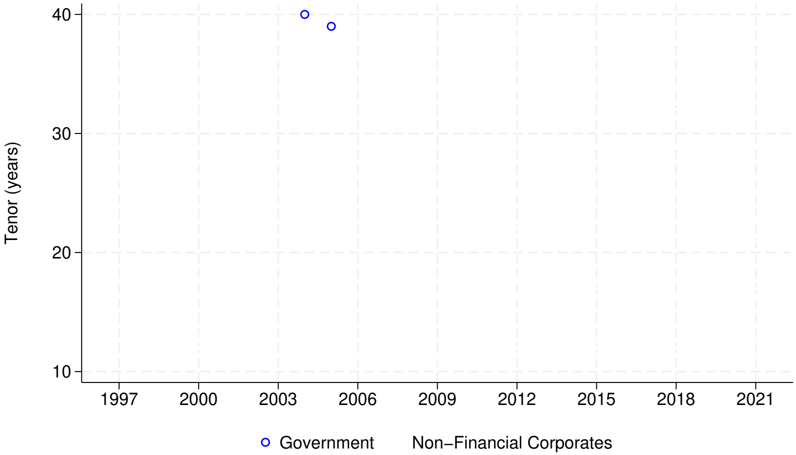

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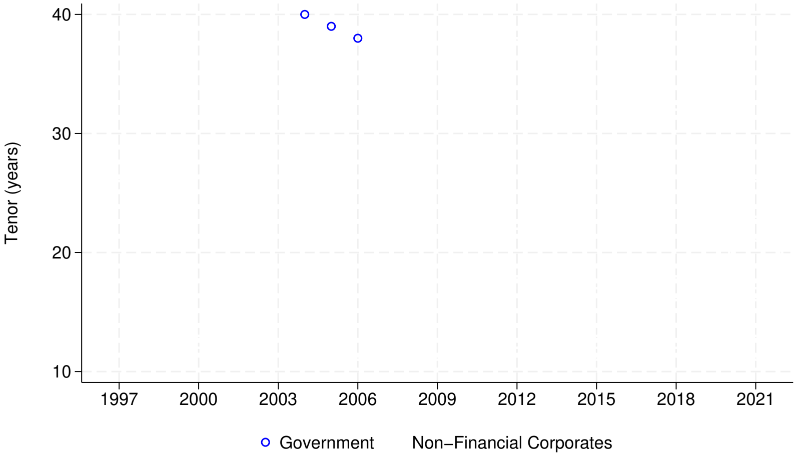

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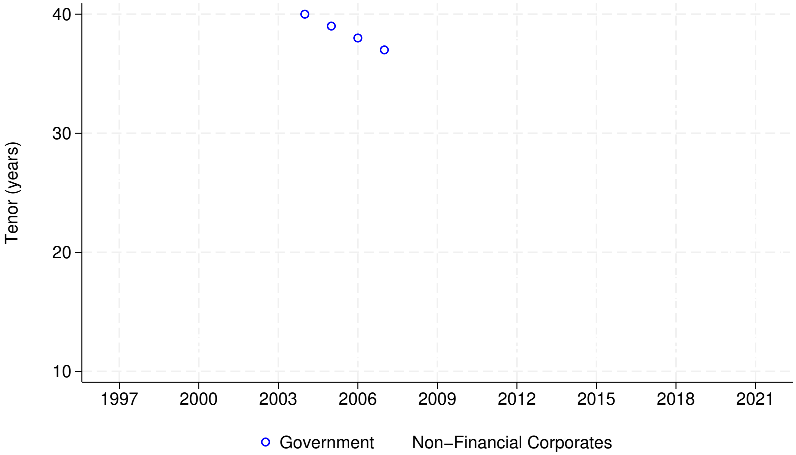

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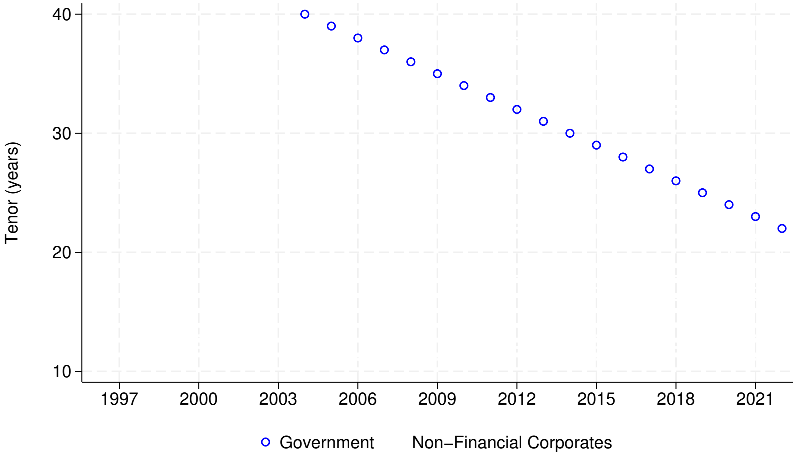

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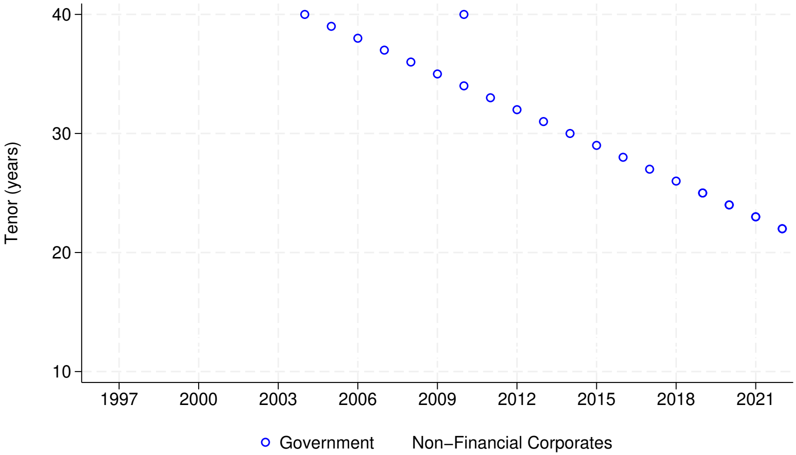

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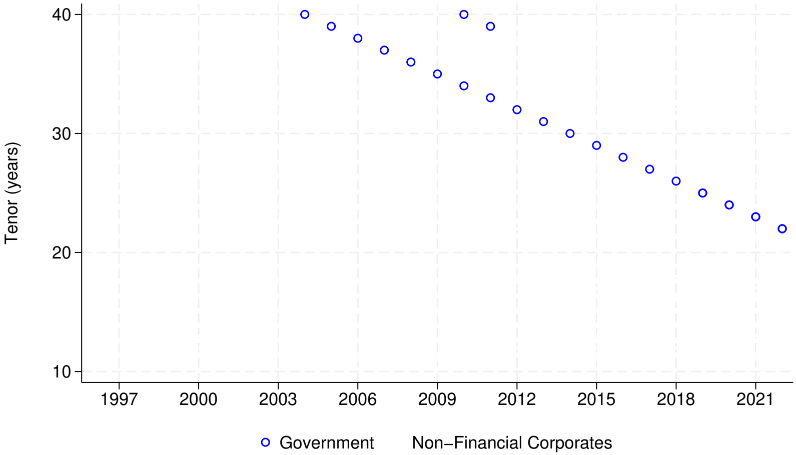

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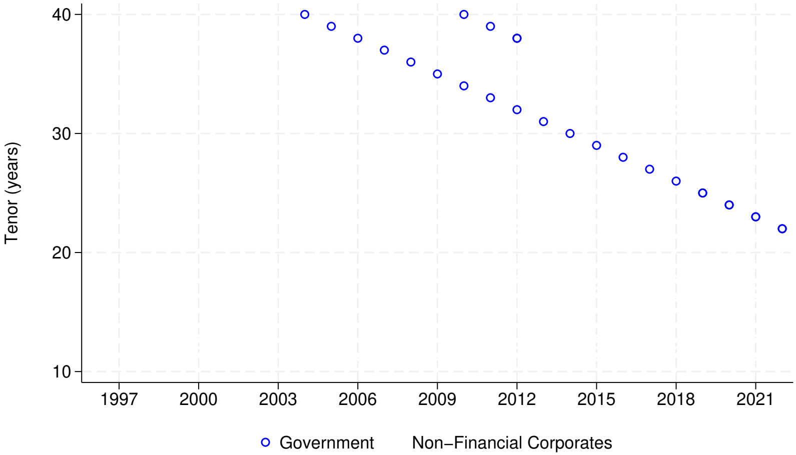

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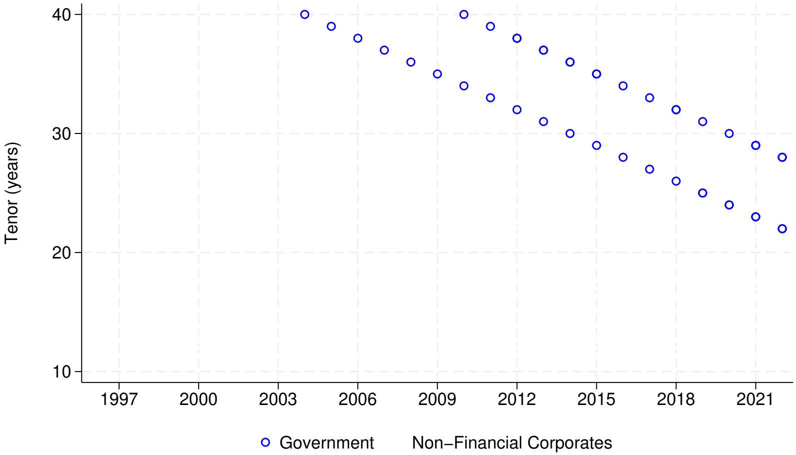

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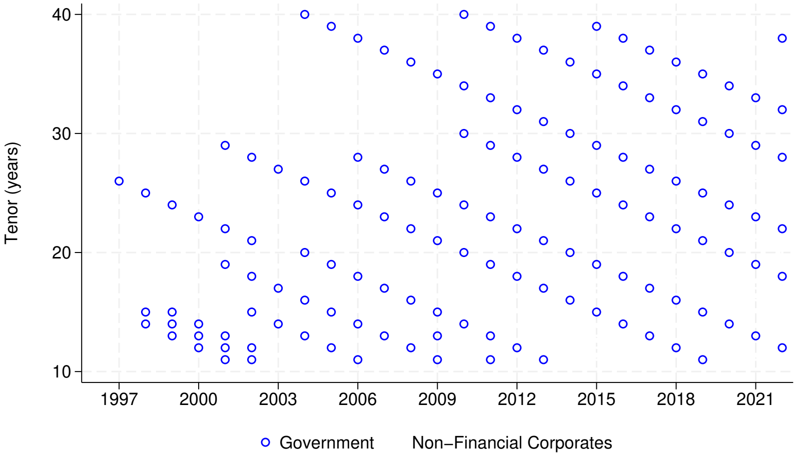
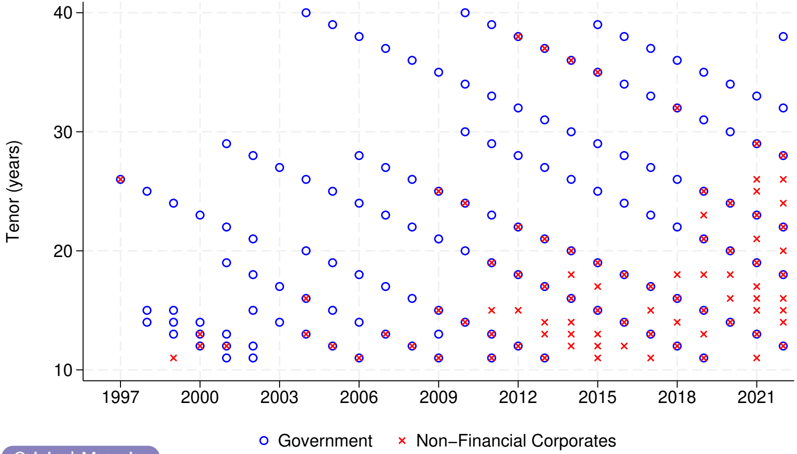


Complementarity in Bond Markets: Maturity Matching

- Corporates concentrate issuance in active tenors of the government yield curve ▷



Foreign Debt
Original Maturity

Complementarity in Bond Markets: Empirical Strategy

$$C_{\tau,t} = \boldsymbol{\beta} \cdot G_{\tau,t} + \gamma_\tau + \alpha_t + \varepsilon_{\tau,t}$$

- $C_{\tau,t}$ corporates ***gross issuance*** of domestic bonds with maturity τ in t
- $G_{\tau,t}$ ***amount outstanding*** in domestic govt bonds with remaining maturity τ at time t

Complementarity in Bond Markets: Empirical Strategy

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Instrumental Variable Approach

- Two key features
  1. **Remaining maturity:** bonds that have 'aged' into maturity τ due to the passage of time

     $\Longrightarrow$ isolate contemporaneous variation
  2. **Rule-based issuance framework:** planned issuance and maturity structure ▷

     $\Longrightarrow$ ensure that maturity structure is predetermined
     (not systematically adjusted in response to expectations about future conditions)

Instrument Construction: Derivation

- Decompose amount outstanding of government debt $G_{\tau,t}$

$$G_{\tau,t} = \underbrace{G^{\text{issued}}_{\tau,\,t} - G^{\text{redeemed}}_{\tau,\,t}}_{\text{Net Issuance}} + G_{\tau+1,\,t-1}$$

Instrument Construction: Derivation

- Decompose amount outstanding of government debt $G_{\tau,t}$

$$G_{\tau,t} = \sum_{k=0}^{K-1} G^{\text{issued}}_{\tau+k,\ t-k} - \sum_{k=0}^{K-1} G^{\text{redeemed}}_{\tau+k,\ t-k} + G_{\tau+K,\ t-K}$$

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- Rewrite $G_{\tau+K,\, t-K}$, amount of bonds with maturity $\tau + K$ in $t - K$, as

$$G_{\tau+K,\, t-K} = \sum_{j=0}^{\infty} G^{\text{issued}}_{\tau+K+j,\, t-K-j} - \sum_{j=0}^{\infty} G^{\text{redeemed}}_{\tau+K+j,\, t-K-j}$$

$\equiv$ (all) cumulative decisions made up to $t - K$

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$\equiv$ (all) cumulative decisions made up to $t - K$

- Consider only *ex-ante* scheduled amount $\widetilde{G}_{\tau,t}$ to define

$$Z^{\text{K}}_{\tau,t} = \sum_{j=0}^{\infty} \widetilde{G}^{\text{issued}}_{\tau+K+j,\, t-K-j} - \sum_{j=0}^{\infty} \widetilde{G}^{\text{redeemed}}_{\tau+K+j,\, t-K-j}$$

$\implies$ Instrument $\equiv$ (all) cumulative *ex-ante* scheduled decisions made up to $t - K$

Relevance | Excl Restriction

Effect of Government Debt in Corporate Issuance

- Baseline estimates $K = 4$ years; sample: 2001 - 2022
- 1% GDP $\uparrow$ govt debt (w/ remaining maturity τ) $\Rightarrow$ 0.027% GDP $\uparrow$ domestic τ-bonds by corps
- **Economically large:** 46% of the corp bond issuance in a given tenor$\times$year due to govt debt

	OLS			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
$G_{\tau,t}$	0.048***	0.048***	0.034***	0.040***	0.031***	0.027**
	(0.007)	(0.007)	(0.008)	(0.009)	(0.010)	(0.010)
Observations	814	814	814	814	814	814
Time FE	–	✓	✓	–	✓	✓
Tenor FE	–	–	✓	–	–	✓
First-Stage F	–	–	–	108.3	89.8	94.9

Other K First-stage Reduced-form Robustness Extensive/intensive Margin

Diminishing Effects in Bond Market Complementarity

- Relationship changes as markets mature and debt levels increase
- Impact of increasing government debt levels

$$C_{\tau,t} = \beta_1 \cdot G_{\tau,t} + \beta_2 \cdot G^2_{\tau,t} + \gamma_\tau + \alpha_t + \varepsilon_{\tau,t}$$

	OLS			2SLS		
	(1)	(2)	(3)	(4)	(5)	(6)
$G_{\tau,t}$	0.078***	0.077***	0.049***	0.095***	0.088***	0.057***
	(0.013)	(0.013)	(0.010)	(0.014)	(0.016)	(0.013)
$G^2_{\tau,t}$	-0.563**	-0.556**	-0.261*	-1.170***	-1.136***	-0.597**
	(0.244)	(0.243)	(0.138)	(0.284)	(0.305)	(0.269)
Observations	814	814	814	814	814	814
Time FE	–	✓	✓	–	✓	✓
Tenor FE	–	–	✓	–	–	✓
First-Stage F	–	–	–	48.8	47.7	34.9

First-stage Reduced-form US Evidence

Impact of Increasing Government Debt Levels

- Marginal effect of government debt depends on the level of government debt

		Percentile		
		(1) 5th	(2) 50th	(3) 95th
$\mathbb{E}(C)$	2SLS	0.056^{***}	0.046^{***}	-0.041
		(0.013)	(0.009)	(0.032)
	Tobit	0.071^{***}	-0.006	-0.077^{***}
		(0.014)	(0.011)	(0.018)
$\mathbb{E}(C \mid C > 0)$	Tobit	0.080^{***}	-0.007	-0.085^{***}
		(0.017)	(0.014)	(0.018)
$\mathbb{P}\text{rob}(C > 0)$	Tobit	35.166^{***}	-2.477	-40.881^{***}
		(4.364)	(4.553)	(8.300)
Observations		814	814	814
Time FE		✓	✓	✓
Tenor FE		✓	✓	✓

$\uparrow G_{\tau,t} \implies$ **Shift:** $\downarrow$ Issuance Amount & $\downarrow$ Probability of Issuance Spillovers U.S. DiD

Road Map

1. Institutional Background and Data
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Measuring Firm Exposure to Government Issuance

Asset-Liability Maturity Matching

- Theoretical argument (Myers, 1977)
- Empirical evidence (Stohs and Mauer, 1996; Guedes and Opler, 1996; Barclay and Smith Jr, 1995; Graham and Harvey, 2001; De Fraisse, 2023)
- Balance sheet data: Orbis + Economatica; compute firm-level **asset duration**

$$\text{Asset Duration}_f = \frac{1}{T}\sum_t \left[\frac{\text{CA}_{f,t}}{\text{CA}_{f,t} + \text{Net PPE}_{f,t}} \cdot 1 + \frac{\text{Net PPE}_{f,t}}{\text{CA}_{f,t} + \text{Net PPE}_{f,t}} \cdot \frac{\text{Net PPE}_{f,t}}{\text{Depreciation}_{f,t}} \right]$$

  - where CA: current assets; Net PPE: net property, plant, and equipment

⇒ In sample: firms with longer asset duration issue longer-dated bonds Regression

More LT Debt, More Investments

- Compare high asset duration firms' response to LT/ST govt debt issuance to other firms

$$\Delta y_{f,t} = \beta_{LT} \cdot \mathbb{1}_{HAD} \cdot \Delta \widehat{G}_{LT,t} + \beta_{ST} \cdot \mathbb{1}_{HAD} \cdot \Delta \widehat{G}_{ST,t} + \gamma_f + \gamma_{t,s} + \text{Controls} + \varepsilon_{f,t}$$

	Financing			**Investment**	
	LT Debt (1)	Total Debt (2)	ST Debt (3)	Total Assets (4)	Fixed Assets (5)
β_{LT}	0.93***	0.42***	0.33	0.31***	0.31***
	(0.29)	(0.12)	(0.25)	(0.07)	(0.10)
β_{ST}	-0.23	-0.11	0.41	-0.06	0.06
	(0.47)	(0.24)	(0.32)	(0.13)	(0.20)
Observations	34,090	34,090	34,090	34,090	34,090
Controls	✓	✓	✓	✓	✓
Time x Size FE	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓

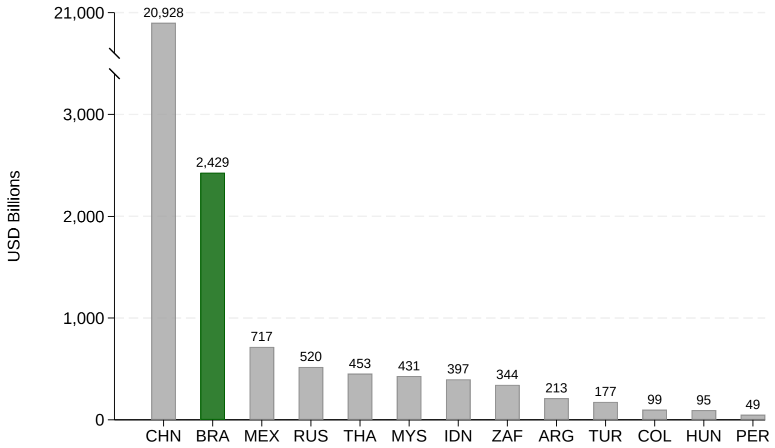
Low | Both | Balance Sheets

Road Map

Conclusion

- Government debt plays catalytic role in developing corporate bond markets
- Relationship evolves from complementarity to substitution as markets mature
- Key mechanism: reduction in corporate bond pricing uncertainty
- Policy implications:
  - Strategic role for government debt in market development
  - Different effects at different stages of development

Domestic Bond Markets



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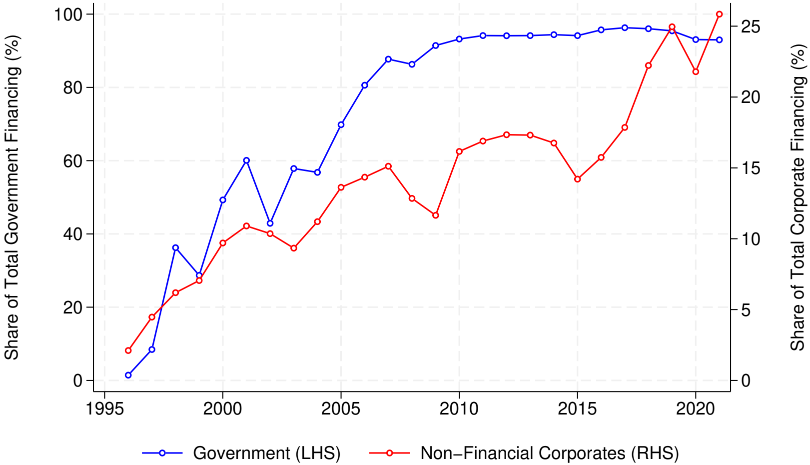
Share of Total Financing in Domestic Debt



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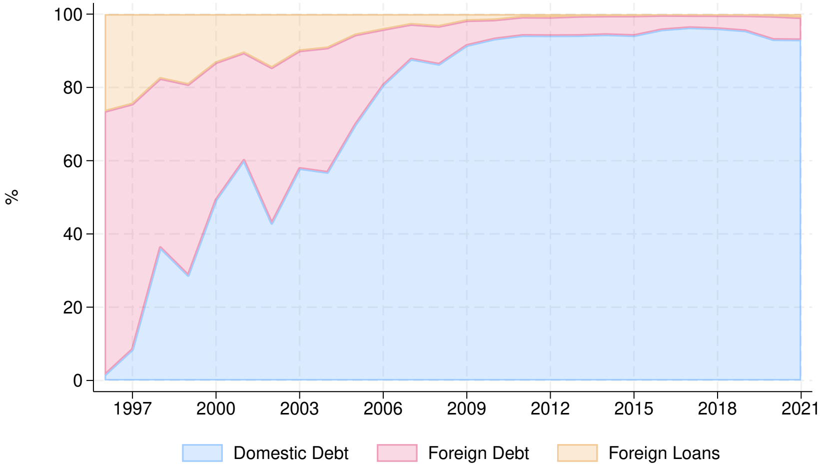
Decomposition of Brazilian Government Funding Sources



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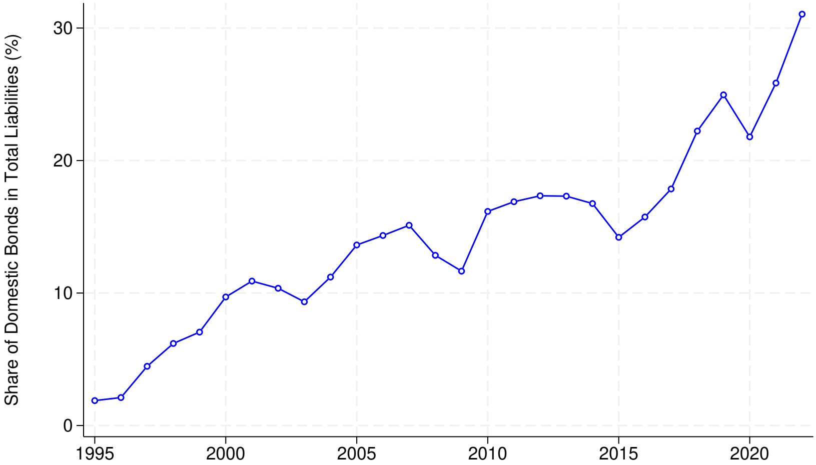
Share of Domestic Debt in Total Liabilities



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Corporate Bond Market: Summary Statistics

		Issuance (BRL, π-Adj.)			Tenor		
	N	*Mean*	*Median*	*95th*	*Mean*	*Median*	*95th*
Total	5,063	442	228	994	6	5	10
2000	38	1,060	484	3,336	5	5	7
2005	39	875	565	2,218	5	5	10
2010	173	575	317	1,146	5	5	11
2015	240	350	153	790	6	4	11
2020	282	397	222	852	7	6	15

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Coverage Comparison with Commercial Data Sources

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Fisher's Exact Test

H_0 : There is no association between the existence of government debt and corporate issuance.

H_A : There is an association between the existence of government debt and corporate issuance.

Govt	**Corp**		**Total**
	0	**1**	
0	609	36	645
1	81	54	135
Total	690	90	780

Test	**Value**
Fisher's exact	0.000
1-sided Fisher's exact	0.000
P-value	4.9×10^{-23}

- **Conclusion:** Observed maturity matching between corporate domestic issuances and active tenors of government yield curve highly unlikely to occur by chance

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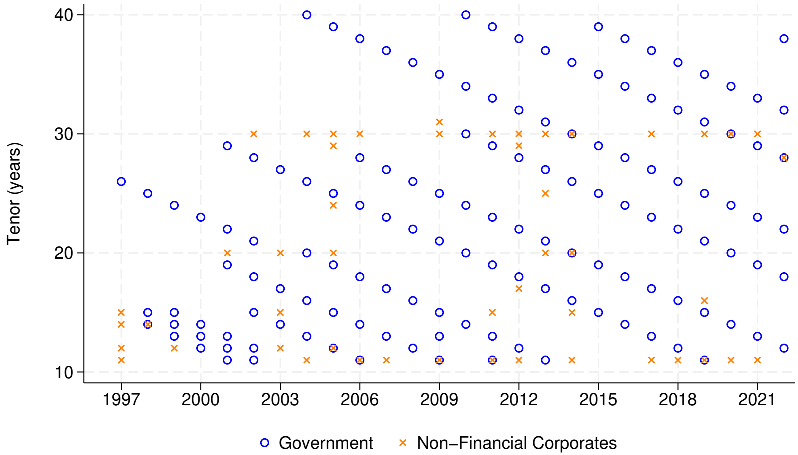
Placebo: Foreign Debt Issuance by Corporates

- No correlation between foreign corporate issuance and the existence of government bonds



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Instrument Construction: Intuition

Two key features:

1. Exploit difference between the **original** and the **remaining** maturity of outstanding bonds
   - Focus on bonds that have 'aged' into maturity τ simply due to the passage of time
   - E.g.: 10-year bonds issued in 2018 becoming 5-year bonds in 2023
   - Amount of 10-year bonds in 2018 is plausibly exogenous to economic conditions in 2023

   $\Longrightarrow$ isolate variation from contemporaneous economic conditions and government decisions

2. Leverage government's adherence to a **regular-and-predictable** issuance framework
   - National Financing Plan: long-term strategy for debt management
   - Bond maturities are set according to a predefined issuance calendar
   - Use planned – as opposed to actual – issuance

   $\Longrightarrow$ ensure that maturity structure of government debt is predetermined
   (not systematically adjusted in response to expectations about future conditions)

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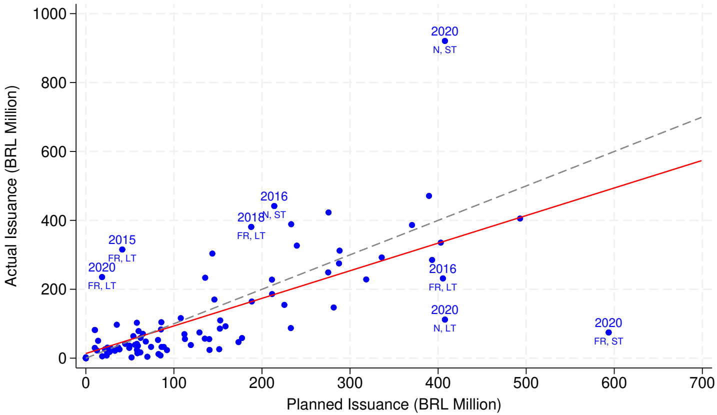
Regular-and-Predictable Government Debt Issuance

- Government follows the rule: $G^{\text{iss}}_{\tau,t}$ is explained by the scheduled quantities $\widetilde{G}^{\text{iss}}_{\tau,t}$



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Identifying Assumption

Exclusion Restriction

- $Z^{\mathsf{K}}_{\tau,t}$ is orthogonal to omitted variables that affect the outcome of interest ($C_{\tau,t}$), conditional on the included controls:

$$\mathbb{E}\left[Z^{\mathsf{K}}_{\tau,t} \cdot \varepsilon_{\tau,t} \mid \mathcal{F}_{\tau,t}\right] = 0$$

- $Z^{\mathsf{K}}_{\tau,t}$ should only affect corporate issuance through its impact on actual government bond supply
- Corporates are **not** choosing to issue in a particular tenor for unobservable reasons that correlate with the instrument beyond existence of a government bond in that tenor

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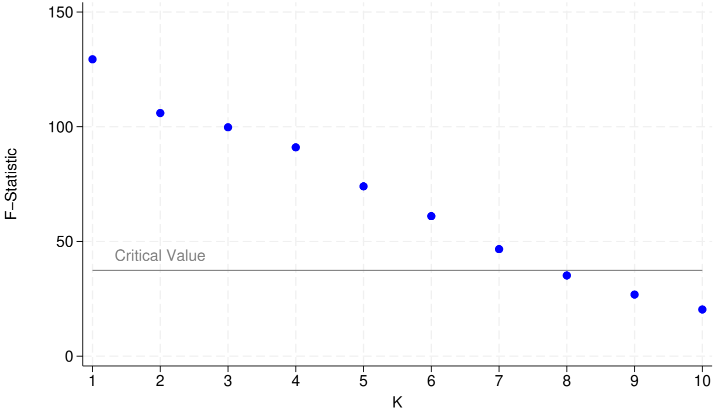
Identifying Assumption

Relevance Condition



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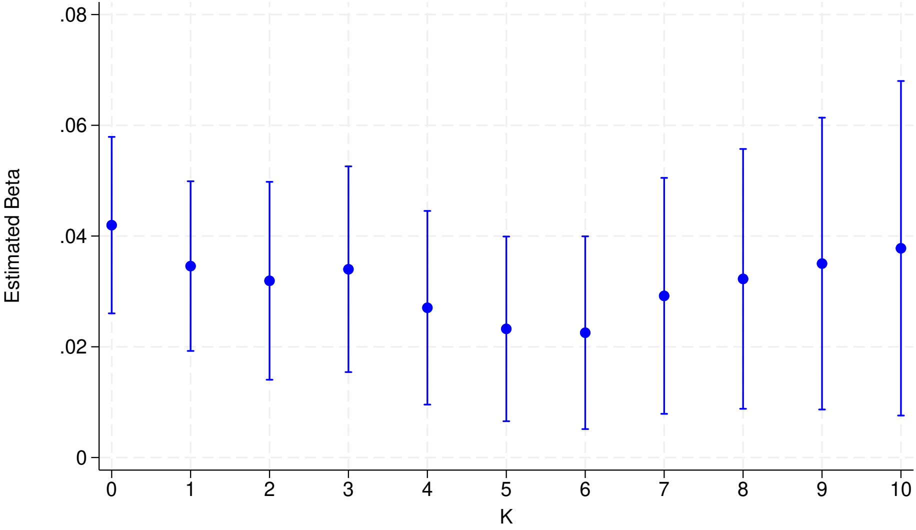
Alternative K



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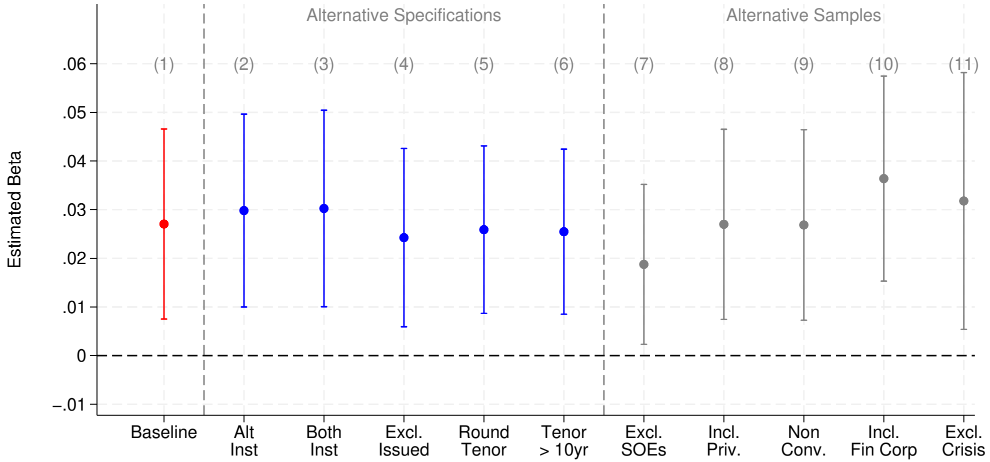
Alternative Empirical Specifications



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First-stage and Reduced-form Results

	First-Stage			Reduced Form		
	(1)	(2)	(3)	(4)	(5)	(6)
$Z^{K}_{\tau,t}$	0.192^{***}	0.193^{***}	0.142^{***}	0.007^{***}	0.006^{***}	0.004^{**}
	(0.020)	(0.020)	(0.015)	(0.002)	(0.002)	(0.001)
Observations	814	814	814	814	814	814
Time FE	–	✓	✓	–	✓	✓
Tenor FE	–	–	✓	–	–	✓
F Stat	92.6	89.8	94.9	14.1	10.0	7.1

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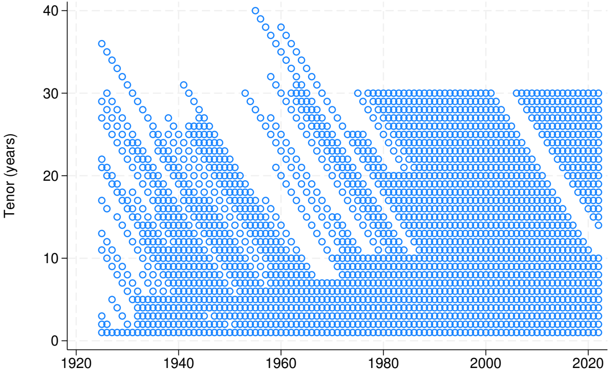
Quadratic Specification: First-stage and Reduced-form Results

	First-Stage			Reduced Form		
	(1)	(2)	(3)	(4)	(5)	(6)
$Z^{K}_{\tau,t}$	0.192***	0.193***	0.142***	0.007***	0.006***	0.004**
	(0.020)	(0.020)	(0.015)	(0.002)	(0.002)	(0.001)
Observations	814	814	814	814	814	814
Time FE	–	✓	✓	–	✓	✓
Tenor FE	–	–	✓	–	–	✓
F Stat	92.6	89.8	94.9	14.1	10.0	7.1

Back

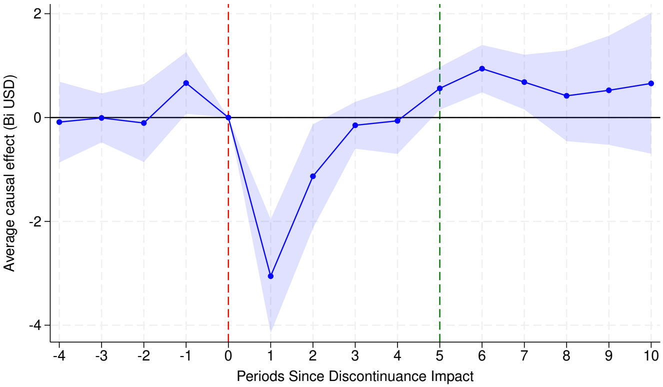
U.S. Bond Market: Effect of Limited Supply of Government Debt

- Exploit shock to the supply of long-term government debt
- U.S. Government yield curve with Corporates
  - Oct 2001: Treasury announces discontinuance of 30-year bond issuance ▷
  - Feb 2006: 30-year bond issuance re-introduced ▷



U.S. Bond Market: Effect of Limited Supply of Government Debt

- Difference-in-differences approach DiD
  - Treatment: absence of a government bond in tenor×year
  - Staggered and dynamic treatment (De Chaisemartin and d'Haultfoeuille, 2024)



Evidence of the Effect from the U.S.

- Extending analysis to the U.S. bond market
- Instrumental variable approach adapted for U.S. data
  - Based on remaining maturity: actual govt debt issuance (vs. planned in Brazil)

	OLS		2SLS	
	(1)	(2)	(3)	(4)
$G_{\tau,t}$	0.042***	0.086***	0.019***	0.024***
	(0.005)	(0.008)	(0.004)	(0.009)
$G^2_{\tau,t}$		-0.526***		-0.555**
		(0.061)		(0.075)
Observations	928	928	928	928
Time FE	✓	✓	✓	✓
Tenor FE	✓	✓	✓	✓
First-Stage F	–	–	278.6	255.4

Pre-2008 Back

Evidence of the Effect from the U.S.

- Extending analysis to the U.S. bond market
- Instrumental variable approach adapted for U.S. data
  - Based on remaining maturity: actual govt debt issuance (vs. planned in Brazil)

	Percentile		
	(1) 5th	(2) 50th	(3) 95th
$\mathbb{E}(C)$	0.019^{*} (0.011)	-0.018^{***} (0.007)	-0.052^{***} (0.016)
Observations	814	814	814
Time FE	✓	✓	✓
Tenor FE	✓	✓	✓

$\Rightarrow$ Unlike markets at early stages, the median U.S. tenor is in the substitution range

Back

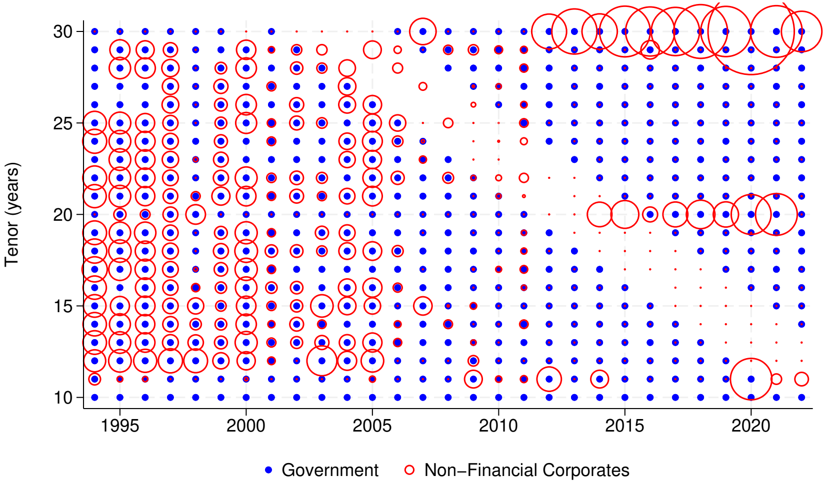
Instrumental Variable Approach: Pre-2008

- Restricting the sample from 1995 to 2007:

	OLS		2SLS	
	(1)	(2)	(3)	(4)
$G_{\tau,t}$	-0.037^{**}	-0.048^{**}	-0.032	-0.076^{**}
	(0.013)	(0.017)	(0.027)	(0.032)
$G^2_{\tau,t}$			-0.103	0.792
			(0.352)	(0.516)
Observations	928	928	928	928
Time FE	✓	✓	✓	✓
Tenor FE	✓	✓	✓	✓
First-Stage F	–	–	83.1	44.0

Back

US Yield Curve: Government and Corporate



Back

USA: 30-year Bond Issuance Discontinuance

- Arguments in favor of the discontinuance:
  - **Cost:** "30yr bonds are too costly and imprudent because shorter-term debt can be issued to cover its needs at lower rates"
  - **Private issuers would step in:** "Some large corporate borrowers are also positioning themselves as benchmark issuers, including Ford Motor Credit (with its GLOBUS program), and the General Motors Acceptance Corporation"

Back

USA: 30-year Bond Issuance Resumption

- Arguments in favor of the resumption:
  - Policymakers should not ignore the fact that on-the-run 2-, 3-, 5-, 10- and 30-year Treasury securities are now unchallenged as the most preferred hedging and pricing instrument for market makers and speculators in the global fixed income markets. **The fact remains that no other security and no other issuer can fill the role at the long-end of the yield curve that the 30-year U.S. Treasury bond continues to serve, despite the absence of a new issue in nearly 5 years.** Nor can any other issuer offer large global investors the same sort of regular and predictable issuance of a very large, liquid and risk-free dollar asset. **There are only a handful of corporations left with triple-A credit ratings, and they issue long-term debt opportunistically, infrequently, and in relatively small volume.**
  - "The reintroduction of the 30-year Treasury bond is likely to spur the issuance of more long-dated corporate bonds, and thus ease the sharp demand-supply mismatch currently existing at the long end of the yield curve"

Back

US DiD: Identifying Assumption

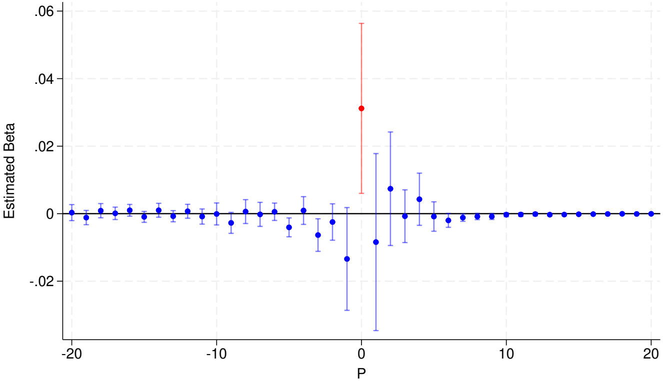
- **Identifying assumption:** treatment timing is orthogonal to corporate issuance
  - Treatment timing of a specific tenor determined by the passage of time
  - Staggered nature $\rightarrow$ isolate the effect from other contemporaneous factors
    (e.g. 15-year tenor becomes treated in 2017, well after the initial policy change)
  - Policy change based on long-term budget surplus projections
  - Part of broader debt management strategy

Back

Spillovers Across the Maturity Spectrum

- Expand the analysis to account for spillover effects across the maturity spectrum
  - Absence of spillovers → Approximate measure broader impact (Chodorow-Reich, 2020)

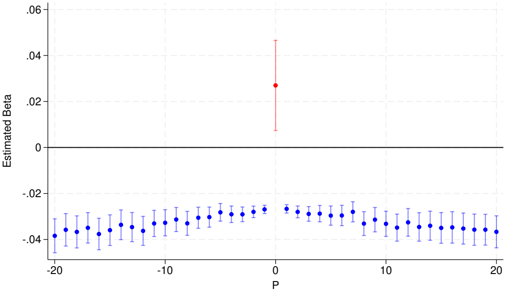
$$\mathcal{C}_{P,\tau,t} = \begin{cases} \frac{1}{|P|} \sum_{p=1}^{|P|} C_{\tau+p,t} & \text{if } P > 0 \\ \frac{1}{|P|} \sum_{p=1}^{|P|} C_{\tau-p,t} & \text{if } P < 0 \end{cases}$$



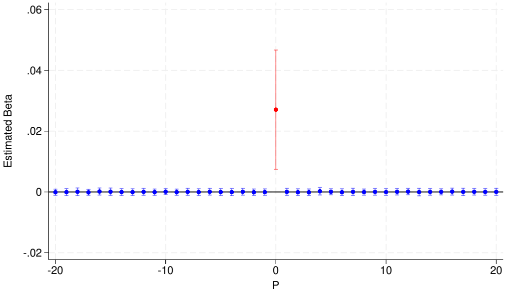
Simulation Back

Cross-Tenor Spillover Effects: Simulated Data

Full Spillover in P



No Spillover in P



Back

Asset-Liability Maturity Matching

- Estimate the following specification:

$$\tau_{i,f,t} = \beta \cdot \text{Asset Maturity}_f + \gamma_{t,q} + \varepsilon_{i,f,t}$$

	All	**Tenor > 10y**
	(1)	(2)
Asset Maturity	0.08***	0.32***
	(0.02)	(0.08)
Observations	2566	310
R^2	0.061	0.195
Time x Size FE	✓	✓

Back

Firm Financing and Investment Outcomes: Low Asset Duration

	Financing			Investment	
	LT Debt	Total Debt	ST Debt	Total Assets	Fixed Assets
	(1)	(2)	(3)	(4)	(5)
β_{LT}	-0.17	-0.06	-0.04	-0.01	0.02
	(0.28)	(0.05)	(0.10)	(0.03)	(0.06)
β_{ST}	-0.11	-0.12	-0.07	-0.10**	-0.16**
	(0.35)	(0.09)	(0.13)	(0.05)	(0.07)
Observations	34,090	34,090	34,090	34,090	34,090
Controls	✓	✓	✓	✓	✓
Time x Size FE	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓

Back

Firm Financing and Investment Outcomes: High and Low Asset Duration

	Financing			Investment	
	LT Debt (1)	Total Debt (2)	ST Debt (3)	Total Assets (4)	Fixed Assets (5)
$\mathbb{1}_H \cdot \Delta\widehat{G}_{LT,t}$	0.92^{***}	0.41^{***}	0.33	0.32^{***}	0.31^{***}
	(0.29)	(0.12)	(0.25)	(0.07)	(0.10)
$\mathbb{1}_H \cdot \Delta\widehat{G}_{ST,t}$	−0.23	−0.11	0.41	−0.07	0.05
	(0.47)	(0.24)	(0.32)	(0.13)	(0.20)
$\mathbb{1}_L \cdot \Delta\widehat{G}_{LT,t}$	−0.13	−0.03	0.01	0.02	0.00
	(0.34)	(0.07)	(0.11)	(0.04)	(0.07)
$\mathbb{1}_L \cdot \Delta\widehat{G}_{ST,t}$	0.12	−0.05	0.04	-0.13^{***}	-0.23^{**}
	(0.49)	(0.14)	(0.21)	(0.04)	(0.08)
Observations	34090	34090	34090	34090	34090
Time x Size FE	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓

Back

Domestic Corporate Bonds and Issuers' Balance Sheets

- Decomposition of the average balance sheet changes

$$\Delta Y_{f,t} = \beta \text{ Domestic Gross Issuance}_{f,t} + \Phi \cdot X_{f,t} + \alpha_f + \gamma_t + \varepsilon_{f,t}$$

	Liabilities & Shareholder's Equity					Assets	
	Total Liabilities	Domestic Bonds	Foreign Bonds	Loans & Others	Total Equity	Total Assets	Fixed Assets
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CorpIssuance	0.65***	0.92***	-0.59	0.32	0.22*	0.87***	0.50***
	(0.19)	(0.25)	(0.65)	(0.68)	(0.11)	(0.23)	(0.15)
Observations	1,031	1,031	1,031	1,031	1,031	1,031	1,031
R^2	0.539	0.536	0.182	0.203	0.499	0.590	0.584
Time FE	✓	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓	✓

New credit: R$1 $\uparrow$ in bond issuance $\Rightarrow$ R$0.65 $\uparrow$ in total liabilities

Balance sheet expansion: R$1 $\uparrow$ in bond issuance $\Rightarrow$ R$0.87 $\uparrow$ in total assets

Back

Why Firms Match the Maturity of Government Bonds

- Corporate bonds are usually priced as a credit spread to the risk-free rate
- Government bonds provide a yield curve that serves as a pricing benchmark
- **Price Discovery ⇒ reduction in corporate pricing uncertainty** ▷

  "synchronization of corporate debt securities payment dates with those of government bonds not only ***reduce the informational frictions*** *in the primary market, but also facilitate trading in the secondary market [...]* ***facilitating the assessment of the risk premium*** *associated with a corporate bond at any given time"* (CVM, Survey of Market Participants, 2018)

A Simple Framework for Complementarity

- Standard model of segmented markets with risk-averse arbitrageurs (Vayanos and Vila, 2021)
- Two key additions:
  - Issuance by risk-averse firms
    - → Use (default-free) long-term debt b_c for financing scalable projects
    - → Timing of issuance decisions is a la Calvo (1988)
  - Pricing uncertainty ▷

$$\tilde{R}_c = R + \tilde{\varepsilon}_c$$

where $\tilde{\varepsilon}_c \sim N(0, \sigma_\varepsilon^2 f(g))$ and $f(g) \geqslant 0$ continuous and decreasing in government debt g and R is endogenous risk-free interest-rate

Supply and Demand

Supply Side

- Government: exogenous amount g
- Firms: Choose issuance b_c to maximize:

$$\max_{b_c} \mathbb{E}(\Pi) - \frac{\gamma^F}{2} Var(\Pi)$$

where $\Pi = (Q - R_c)b_c$

- Optimal corporate issuance:

$$b_c = B_c = \frac{Q - R}{\gamma^F \sigma_\varepsilon^2 f(g)}$$

Supply and Demand

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- Optimal corporate issuance:

$$b_c = B_c = \frac{Q - R}{\gamma^F \sigma_\varepsilon^2 f(g)}$$

Details Supply Demand

Demand Side

- Risk-averse arbitrageurs maximize:

$$\max_{B_c, B_g} \mathbb{E}(W) - \frac{\gamma}{2} Var(W)$$

- Preferred-habitat investors: Inelastic demand L
- Interest rate determination:

$$R = \bar{r} + \gamma\sigma^2(B_g + B_c)$$

A Simple Framework for Complementarity

- Market clearing condition implies

$$B_c = \frac{Q - \bar{r}}{\gamma^F \sigma_\varepsilon^2 f(g) + \gamma\sigma^2} - \frac{\gamma\sigma^2 g}{\gamma^F \sigma_\varepsilon^2 f(g) + \gamma\sigma^2}$$

  - If $f(g) = 0$: only traditional interest rate channel for crowding out

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  - If $f(g) = 0$: only traditional interest rate channel for crowding out

- **Complementarity benefits:** $f(g) = (\kappa + \delta g)^{-1} - 1$
  κ: initial bond pricing uncertainty; δ: increases the concavity of the relationship

A Simple Framework for Complementarity

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- **Complementarity benefits:** $f(g) = (\kappa + \delta g)^{-1} - 1$
  κ: initial bond pricing uncertainty; δ: increases the concavity of the relationship

- Linear-quadratic specification

$$B_c = A\kappa + L\kappa + (A\delta + \delta L - \kappa)g - \delta g^2 \quad \text{where } A = \frac{Q-\bar{r}}{\gamma^F \sigma_\varepsilon^2}$$

A Simple Framework for Complementarity

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$$B_c = \frac{Q - \bar{r}}{\gamma^F \sigma_\varepsilon^2 f(g) + \gamma\sigma^2} - \frac{\gamma\sigma^2 g}{\gamma^F \sigma_\varepsilon^2 f(g) + \gamma\sigma^2}$$

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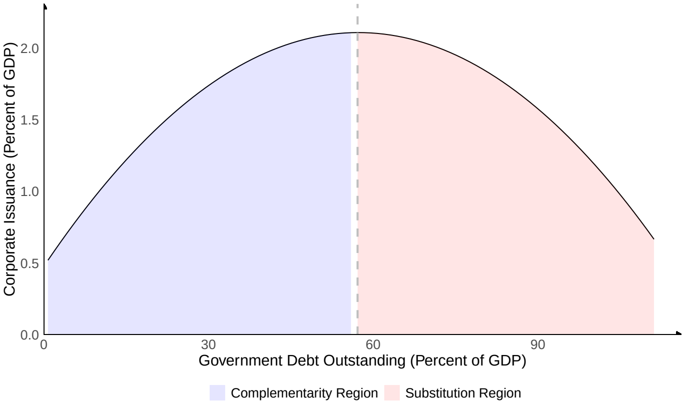
- Linear-quadratic specification

$$B_c = A\kappa + L\kappa + \underbrace{(A\delta + \delta L - \kappa)}_{\beta_1} g + \underbrace{(-\delta)}_{\beta_2} g^2 \quad \text{where } A = \frac{Q-\bar{r}}{\gamma^F \sigma_\varepsilon^2}$$

From Complementarity to Substitution

⇒ Inverted U-shaped relationship between government and corporate debt



Calibration

Cross-Country Implications

- Threshold varies with country fundamentals:
  - + Higher expected returns on firms' projects $\rightarrow$ higher threshold
  - – Higher short-term rates $\rightarrow$ lower threshold
  - – Higher pricing uncertainty (σ_ε^2) $\rightarrow$ lower threshold
- Emerging markets: competing effects
  - Higher expected returns supports higher government debt levels
  - Higher rates and greater volatility push it down

Why does maturity matching occur?

- Bonds with a higher distance to a benchmark exhibit higher price dispersion

$$\text{Dispersion}_{i,t} = \boldsymbol{\beta} \cdot \text{DistBenchmark}_{i,t} + \gamma_\tau + \gamma_t + \varepsilon_{i,t}$$

	(1)	(2)	(3)
DistBenchmark	1.495***	0.720***	0.124***
	(0.210)	(0.0595)	(0.0268)
Observations	143,401	142,810	142,802
R-squared	0.262	0.872	0.899
Time FE	-	✓	✓
Tenor FE	-	-	✓

Back

A Simple Framework for Maturity Matching: Key Components

- Three-date model: $t = 0, 1, 2$ (capturing short and long-term)
- Focuses on the development of a long-term bond market
- Short-term rates: exogenously determined
- Default-free long-term bonds with endogenous interest-rate R
- Partially segmented bond market (Vayanos and Vila, 2021)
  - Bond supply: Government and corporations (no credit-risk)
  - Bond demand: Arbitrageurs and preferred-habitat agents

Back

Bond Supply

- Government
  - Issues exogenous amount $g \geqslant 0$ of long-term bonds at $P = {}^{1}/_{R}$
- Corporate Sector
  - Unit mass of competitive firms
  - Use (default-free) long-term debt b_c for scalable projects
  - Exogenous real return Q at time 2
- **Key assumption:** Corporate bond pricing uncertainty

$$\tilde{R}_c = R + \tilde{\varepsilon}_c \sqrt{f(g)}$$

where $\tilde{\varepsilon}_c \sim N(0, \sigma_\varepsilon^2)$ and $f(g) \geqslant 0$ continuous and decreasing in government debt g

Back

Corporate Issuance Decision

- Optimization problem

$$\max_{b_c} \mathbb{E}(\Pi) - \frac{\gamma^F}{2} Var(\Pi)$$

where $\Pi = (Q - R_c)b_c$: net value of the project at $t = 2$

- Timing of the debt issuance decisions is a la Calvo (1988)
- Optimal issuance

$$B_c = b_c = \frac{Q - R}{\gamma^F \sigma_\varepsilon^2 f(g)}$$

where B_c integrating over the unit mass of firms

- LOOP does not hold: limits to arbitrage and of slow moving capital (Duffie, 2010) decentralized OTC trading (Duffie *et al.*, 2005, 2007); balance sheet costs of financial intermediaries (Duffie, 2017; Gârleanu and Pedersen, 2011; Du *et al.*, 2018)

Back

Bond Demand

- Arbitrageurs
  - Risk-averse with zero initial wealth
  - Choose portfolios of short- and long-term bonds
  - Buy amount $B = B_c + B_g$ of long-term bonds
  - Terminal wealth: $W = B_c(R - r_1 r_2) + B_g(R - r_1 r_2)$
  - Optimization Problem

$$\max_{B_c, B_g} \mathbb{E}(W) - \frac{\gamma}{2} Var(W)$$

- Preferred-habitat agents
  - Inelastic demand L for long-duration assets
  - $L \equiv G - g$, where G is total government debt outstanding
- Arbitrageurs' demand for long-term bonds

$$R = \bar{r} + \gamma\sigma^2(B_g + B_c)$$

Back

Market Clearing

- New government issuance must be absorbed by the arbitrageurs $\implies B_g = g$
- Market clearing condition implies

$$B_c = \frac{Q - \bar{r}}{\gamma^F \sigma_\varepsilon^2 f(g) + \gamma\sigma^2} - \frac{\gamma\sigma^2 g}{\gamma^F \sigma_\varepsilon^2 f(g) + \gamma\sigma^2}$$

Market Clearing

- New government issuance must be absorbed by the arbitrageurs $\implies B_g = g$
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$$B_c = \frac{Q-\bar{r}}{\gamma^F \sigma_\varepsilon^2 f(g) + \gamma\sigma^2} - \frac{\gamma\sigma^2 g}{\gamma^F \sigma_\varepsilon^2 f(g) + \gamma\sigma^2}$$

- **Connect the model to the data:**
  assume $\gamma\sigma^2 = \gamma^F \sigma_\varepsilon^2$ and $f(g) = (\kappa + \delta g)^{-1} - 1$

$$B_c = A\kappa + L\kappa + (A\delta + \delta L - \kappa)g - \delta g^2$$

  where $A = \frac{Q-\bar{r}}{\gamma^F \sigma_\varepsilon^2}$

- **Key result:** Inverted U-shape relationship

→ firms response depends on the level of govt debt, shifting from complementarity to substitutability

Back

Model Calibration

Parameter	Description	Value	Source
Q	Return on real project	0.136	Marginal product of capital from Penn World Tables
$\bar{r}$	Short-term rate: Selic rate	0.13	Sample average from Central Bank data
σ_{ε}^{2}	Variance of lending rate to non-financial corporates	0.012	Sample variance from IMF IFS data
γ	Coefficient of risk-aversion	8	

Back

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