Corporate Debt Maturity Matters For Monetary Policy

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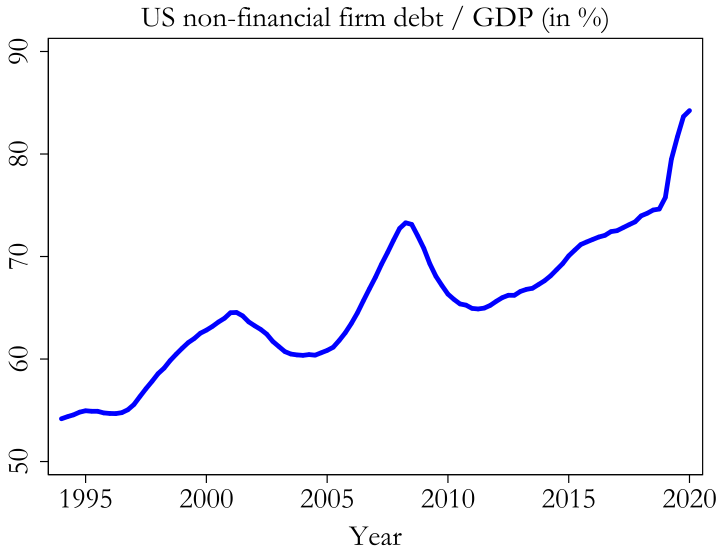
Tuesday, December 14th, 2021

Motivation



US non-financial firm debt / GDP (in %)
90
80
70
60
50
1995
2000
2005
2010
2015
2020
Year

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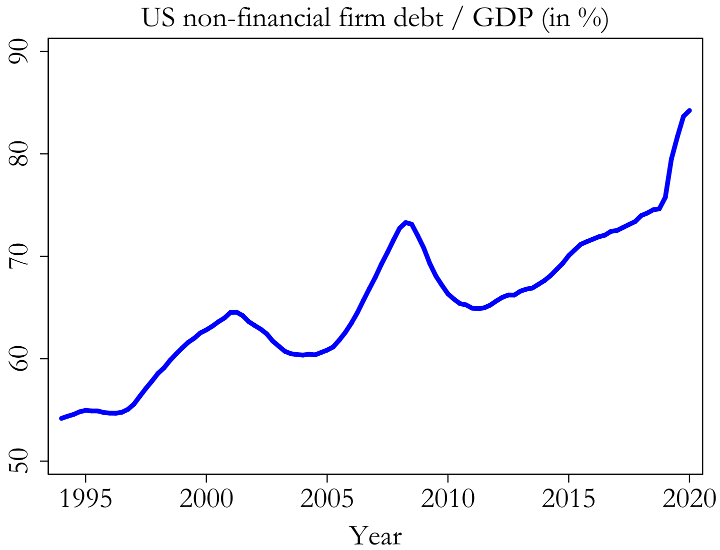

⇒ **Firm debt** is becoming more important

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debt maturing within next 12 months / total firm debt

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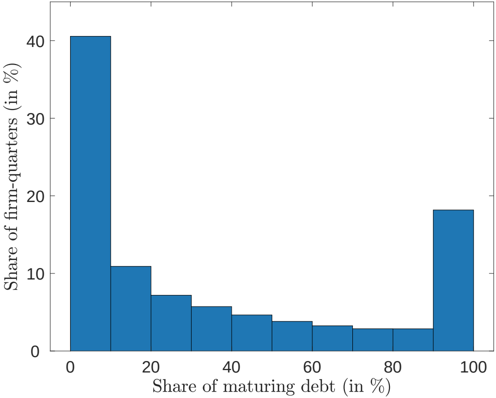

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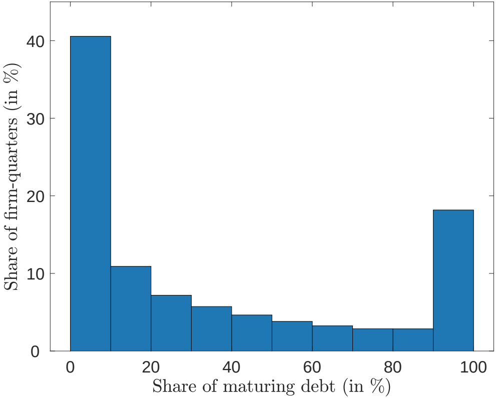

⇒ Large heterogeneity in **maturing debt share** across firms

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How does **debt maturity** matter for effectiveness of **monetary policy**?

Theoretically ambiguous:

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   $\Rightarrow$ **Long-term debt** should increase investment response to monetary policy (**debt overhang**)

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Empirical analysis:

- We merge bond-level information with firm-level balance sheet data and monetary policy shocks

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Result:

- Firm investment responds **more strongly** to monetary policy shocks when **share of maturing bonds** is larger

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▸ Literature

Outline

1. Introduction
2. Empirical Evidence
3. Model Results

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- Baseline sample:
  - Listed non-financial US firms with outstanding bonds
  - Non-callable and fixed-coupon bonds
  - 35,000 firm-quarters from 1995Q1 to 2017Q4
  - 50% of US non-financial firm debt
  - Average firm in sample: 62% of debt are bonds
  - Average bond maturity at issuance: 8 years
  - 50% of maturing bonds re-financed within same quarter

Data Set: Maturing Bonds Share

Key variable: **Maturing bonds share** of firm i in **quarter** t

$$\mathcal{M}_{it} = \frac{\text{maturing bonds (in \$)}_{it}}{\text{total debt (in \$)}_{it-1}} \times 100$$

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- sign-restrictions (Jarocinski-Karadi *AEJ:Macro* 2020)

Baseline Estimation

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Panel local projections:

$$\log K_{it+h} - \log K_{it-1} = \alpha_i^h + \alpha_{st}^h + \beta_0^h \mathcal{M}_{it} + \beta_1^h \mathcal{M}_{it}\, \varepsilon_t^{\text{MP}} + \nu_{it}^h$$

- firm-level **capital** K_{it}
- forecast horizon $h \geq 0$
- firm-fixed effect α_i^h, sector-quarter-fixed effect α_{st}^h
- **maturing bonds share** $\mathcal{M}_{it}$
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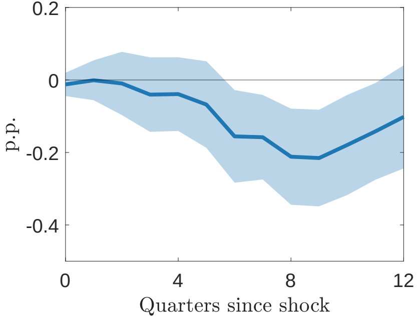
Baseline Estimation

Estimated coefficient β_1^h:



- **contractionary** 1-std **MP shock** $\varepsilon_t^{\text{MP}}$
- if $\mathcal{M}_{it}$ is **1 std (1.6pp) higher** at time of MP shock, 8 quarters later firm capital is **0.2 pp smaller**
  $\Rightarrow$ if $\mathcal{M}_{it}$ is **10 pp higher** at time of MP shock, 8 quarters later firm capital is **1.25 pp smaller**
- 95% confidence intervals

Robustness

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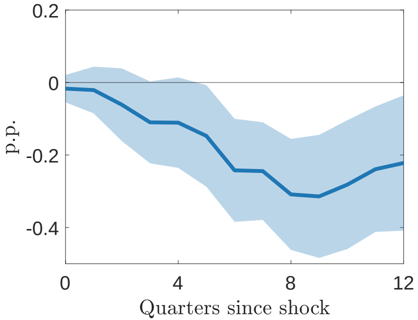

- Substitute $\mathcal{M}_{it}$ by **within-firm deviation** from firm-specific mean: $\mathcal{M}_{it} - \overline{\mathcal{M}}_i$
- Add within-firm deviations of **control variables**: assets, leverage, liquidity, sales growth, distance to default, average maturity of outstanding bonds

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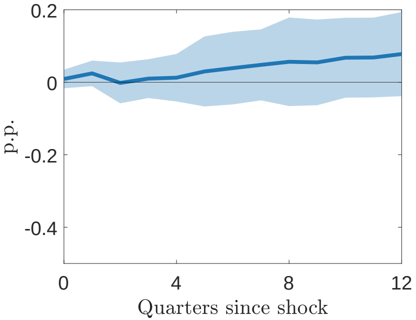

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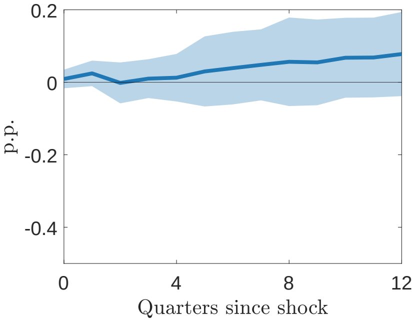

Debt level or maturity?

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- 1 std higher **maturing bonds share** $\mathcal{M}_{it}$ at time of 1-std MP shock $\Rightarrow$ 8 quarters later **firm capital** response is stronger by 0.2 pp

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Firm problem | Solution method | Calibration | Distribution

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⇒ **Commitment problem:**
leverage **ex-post** **higher** than optimal **ex-ante**

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- ... ex-ante **default risk** is higher

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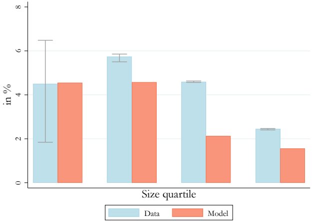
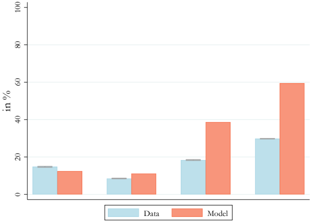
- ... choose lower share of **long-term debt**
- ... have higher **maturing debt share**

Model Results: Cross-Section by Firm Size

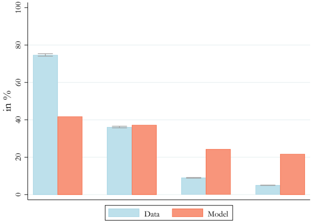
(a) Long-term credit spread



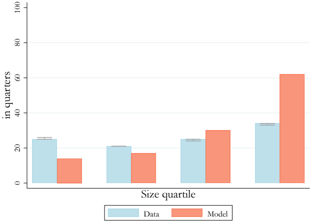
(b) Leverage



(c) Maturing debt share



(d) Age



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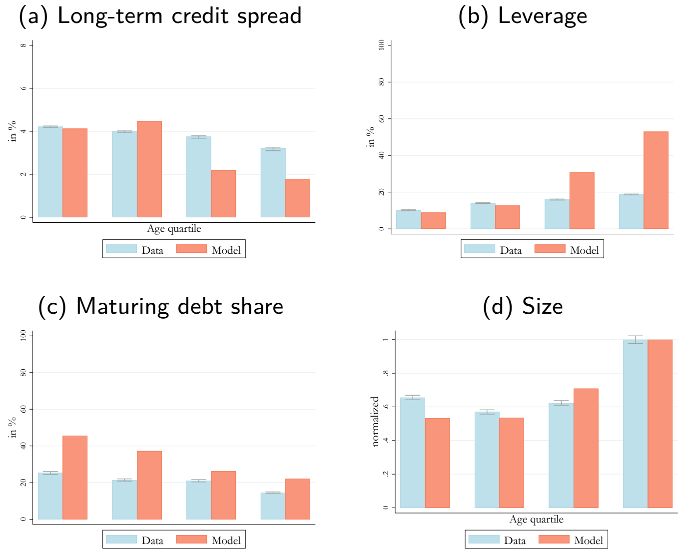

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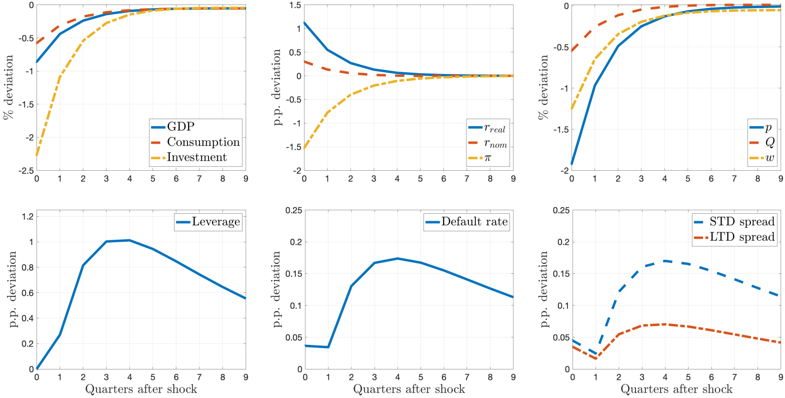

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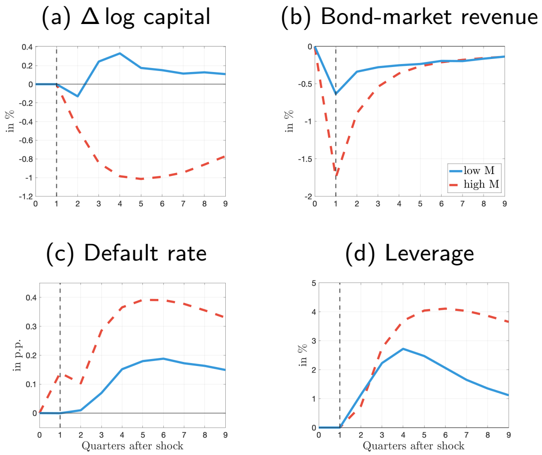

High $\mathcal{M}_{it}$:

- larger increase in **default risk**
- larger drop of **investment**

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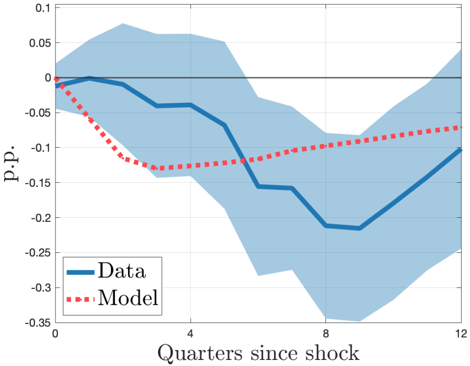
Estimated coefficient B^h:



⇒ Peak estimate about 60% of empirical counterpart

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Maturing debt share over time

Conclusion

Thank you!

Appendix: Literature

- **Empirical evidence on debt maturity and financial crises:**
  Duchin-Ozbas-Sensoy (2010), Almeida-Campello-Laranjeira-Weisbenner (2012), Kalemli-Ozcan-Laeven-Moreno (2018), Benmelech-Frydman-Papanikolaou (2019), Buera-Karmakar (2021), ...
- **Empirical evidence on monetary policy and firm heterogeneity:**
  Gertler-Gilchrist (1994), Cloyne-Ferreira-Froemel-Surico (2018), Ippolito-Ozdagli-Perez-Orive (2018), Jeenas (2019), Anderson-Cesa-Bianchi (2020), Ottonello-Winberry (2020), ...
- **Heterogeneous firm models with financial frictions:**
  Bernanke-Gertler-Gilchrist (1999), Cooley-Quadrini (2001), Khan-Thomas (2013), Gomes-Jermann-Schmid (2016), Crouzet (2018), Arellano-Bai-Kehoe (2019), Ottonello-Winberry (2020), ...

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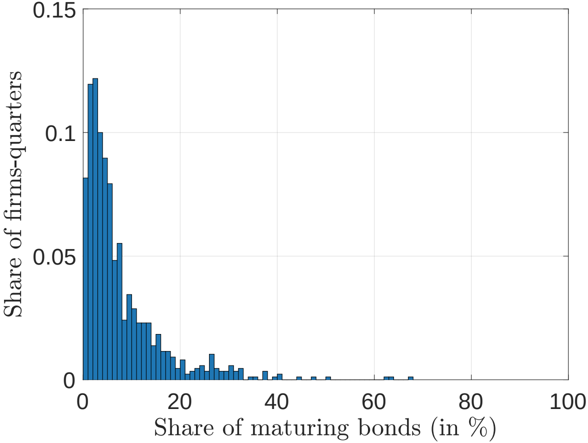
Appendix: Maturing Bonds Share

- 6% of firm-quarters with $\mathcal{M}_{it} > 0$
- Histogram conditional on $\mathcal{M}_{it} > 0$:



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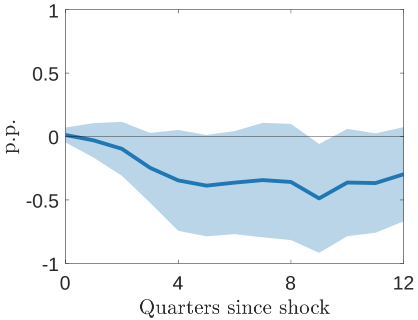
Appendix: Debt level or debt maturity?

Does higher **leverage** at time of MP shock imply stronger investment response?

Estimation **without** $\mathcal{M}_{it}$: Interaction with **leverage**



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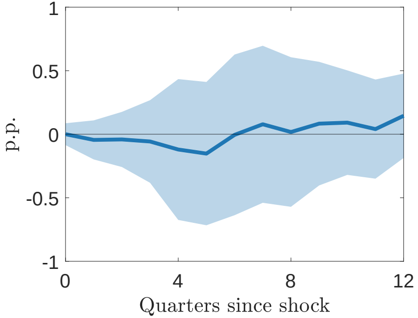

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Appendix: Firm Problem

$$V(q,b,z,S) = \max_{\phi(q,b,z,S)=\left\{k,e\geq \underline{e},\tilde{b}^S,\tilde{b}^L\right\}} -e - G(e) - H\left(\tilde{b}^S,\tilde{b}^L,b/\pi\right)$$

$$+\,\mathbb{E}\Lambda\int_{\bar{\varepsilon}}^{\infty}\left[(1-\kappa)\,V\left(q',b',z',S'\right)+\kappa\left(q'-\frac{b'}{\pi'}g(q',b',z',S')\right)\right]\varphi(\varepsilon)d\varepsilon$$

s.t.: $$q' = Q'k - \frac{\tilde{b}^S}{\pi'} - \frac{\gamma\tilde{b}^L}{\pi'} + (1-\tau)\left[py - wl + (\varepsilon-\delta)Q'k - f - \frac{c(\tilde{b}^S+\tilde{b}^L)}{\pi'}\right]$$

$$y = z\left(k^{\psi}l^{1-\psi}\right)^{\zeta}, \quad \text{where:} \quad l = \left(\zeta(1-\psi)pzk^{\psi\zeta}/w\right)^{\frac{1}{1-\zeta(1-\psi)}}$$

$$\bar{\varepsilon}: \quad (1-\kappa)\,\hat{\mathbb{E}}\,V\left(q',b',z',S'\right)+\kappa\left(q'-\frac{b'}{\pi'}\,\hat{\mathbb{E}}\,g(q',b',z',S')\right)=0$$

$$Qk = q + e + \tilde{b}^S p^S + \left(\tilde{b}^L - \frac{b}{\pi}\right)p^L$$

$$b' = (1-\gamma)\tilde{b}^L$$

$$p^S = \mathbb{E}\Lambda\left[[1-\Phi(\bar{\varepsilon})]\frac{1+c}{\pi'} + \frac{(1-\xi)}{\tilde{b}^S+\tilde{b}^L}\int_{-\infty}^{\bar{\varepsilon}}\underline{q}\;\varphi(\varepsilon)d\varepsilon\right]$$

$$p^L = \mathbb{E}\Lambda\left[\int_{\bar{\varepsilon}}^{\infty}\frac{\gamma+c+(1-\gamma)\,g\left(q',b',z',S'\right)}{\pi'}\varphi(\varepsilon)d\varepsilon + \frac{(1-\xi)}{\tilde{b}^S+\tilde{b}^L}\int_{-\infty}^{\bar{\varepsilon}}\underline{q}\;\varphi(\varepsilon)d\varepsilon\right]$$

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Appendix: Solution Method

Reiter (2009):

1. **global** solution of steady state
   - idiosyncratic firm-level shocks
   - stationary firm distribution $\mu(q, b, z)$
   - computational challenge in models of risky long-term debt: p^L
   - value function iteration and interpolation
2. **perturbation** for aggregate dynamics
   - aggregate monetary policy shock
   - first-order linear approximation

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Appendix: Calibration 1

Table: Externally calibrated parameters

Parameter	Description	Value
β	preference parameter	0.99
c	debt coupon	$1/\beta - 1$
θ	inverse Frisch elasticity	0.5
ζ	production technology	0.75
ψ	production technology	0.33
δ	depreciation rate	0.025
γ	repayment rate long-term debt	0.05
τ	corporate income tax	0.4
ρ	demand elasticity retail goods	10
λ	price adjustment cost parameter	90
ϕ	capital goods technology	4
φ_m	Taylor rule	1.25
ρ_m	Taylor rule	0.5

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Appendix: Calibration 2

Table: Internally calibrated parameters

Param.	Value	Target	Data	Model
σ_ε	0.66	Av. firm leverage	34.4%	29.3%
ξ	0.90	Av. credit spread on long-term debt	3.1%	3.3%
η	0.0045	Av. share of maturing debt	35.5%	33.6%
ν	0.0005	Av. annual equity issuance / assets	11.4%	14.7%
ρ_z	0.983	Median of av. capital growth (quart.)	1.0%	1.2%
σ_z	0.184	Median of s.d. of capital growth (quart.)	8.3%	9.7%
κ	0.0151	Total exit rate (quarterly)	2.2%	2.3%
f	0.274	Steady state value of entry $V(0, 0, z^e, S)$	-	0

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Appendix: Unconditional moments

	Mean	Percentile		
		25	50	75
Data				
Leverage	34.4	1.0	19.4	40.3
Credit spread on long-term debt	3.1	1.6	3.1	4.3
Share of maturing debt	35.5	1.8	18.1	67.2
Model				
Leverage	29.3	11.2	16.2	45.1
Credit spread on long-term debt	3.3	1.8	4.0	4.6
Share of maturing debt	33.6	23.1	33.1	39.2

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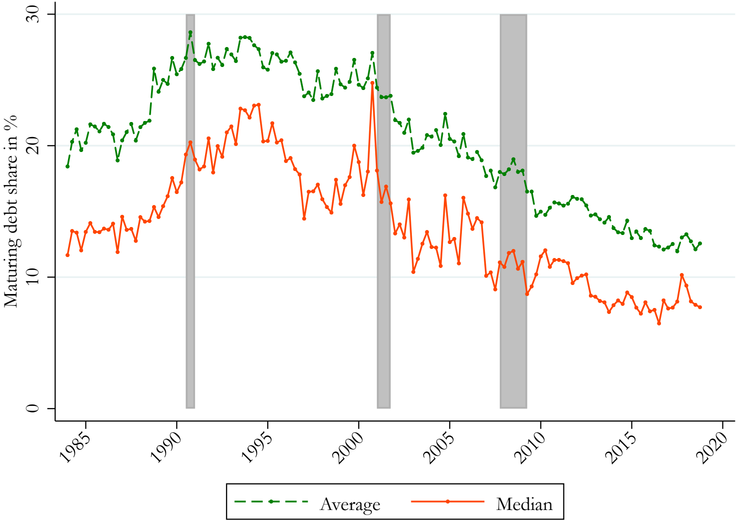
Appendix: Time trend



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