Maturity Walls

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BSE Summer Forum

Motivation

- Maturity walls: a majority of debt scheduled to mature within short period (< 2 yrs)
  - Large source of rollover risk
  - Failure to rollover $\longrightarrow$ cut investment, fire workers, and default

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RATING ACTION COMMENTARY

Fitch Downgrades Antero Resources LT IDR to 'B'; Places Ratings on Rating Watch Negative

Thu 02 Apr, 2020 - 5:12 PM ET

Elevated Refinancing Risk: AR has a sizable large maturity wall due between 2021 and 2023 ($2.63 billion, starting with its 5.375% 2021 note, of which $953 million remains outstanding). The unsecured bond markets have remained closed to the company, even as select peers have tapped it during a brief January window opening. The collapse in prices since that time have made this situation more difficult.

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- Pose understudied risks to the aggregate economy

Opinion **Markets Insight**

The great wall of debt

Given the pile of maturing financing, 2025 and 2026 will prove challenging years for investors

If bull markets always climb a wall of worry, then financial crises often smash into a wall of debt. We are already walking into the foothills of another crisis. It is not just the growing size of the interest bill that matters, but more so the task of rolling over a pile of maturing debts. Next year and particularly 2026 will prove challenging years for investors.

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- Pose understudied risks to the aggregate economy
  - May amplify aggregate shocks if many firms refinance maturity walls during crisis

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Research Questions

1. Why do firms concentrate debt payments, and how do they impact borrowing and default risk?
2. How much do maturity walls amplify transmission of a credit market freeze?

What I do in this paper

- Novel measure of debt maturity dispersion: standard deviation of debt maturity dates
  - Mergent FISD (bond level data) + Compustat
  - 47% firms choose maturity walls (firms w/ 1 bond outstanding)
  - Maturity walls associated w/ higher credit risk (higher expected defaults and credit spread)
  - **Why?** Large fixed costs to issue bonds (economies of scale in bond issuance size)

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- Dynamic heterogeneous firm credit risk model:
  - Receive persistent income shocks
  - Pick level of long-term debt
  - Choose to concentrate or disperse debt payments
  - Trade-off: Fixed debt (convex equity) issuance costs $\longrightarrow$ concentrate (disperse) payments

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- Estimate model via SMM, externally validate, & quantify risks of maturity walls

Preview of results

1. How much do maturity walls matter for firm credit risk?
   - In equilibrium: account for 8% of firm defaults
   - Causal effect: $\uparrow$ default rates by 36 bps (25%) & borrowing costs by 30 bps (21%)

2. Are firms less risky if it is cheaper to issue debt?
   - Solve for counterfactual economy w/ lower debt issuance costs
   - Higher eqm default (1 pp) & credit spreads (1.2 pp) b/c firms $\uparrow$ borrowing compared to baseline

3. Do maturity walls amplify an aggregate credit shock to firm defaults?
   - Firms w/ maturity walls due at shock are most likely to default
   - Account for 16% of firm defaults

4. What do we get wrong by omitting maturity walls?
   - Underestimate transmission of credit shock to default rates by 14% – 60%

Literature

Determinants of corporate debt structure:

- Stohs and Mauer (1996); Custodio, Ferreira, Laureano (2013); Huang, Oehmke, Zhong (2019); Choi, Hackbarth, and Zechner (2018, 2021); Mota and Siani (2024)

  Contribution: First to focus on maturity walls & impacts on firm default risk

Long-term debt and firm dynamics:

- Leland and Toft (1996); He and Xiong (2012); Diamond and He (2014); He and Milbradt (2016); Geelen (2019); DeMarzo and He (2021); Dangl and Zechner (2021); Jungherr and Schott (2021), Chaderina (2023)

  Contribution: Literature assumes stylized schedule of debt payments, at odds with data

  Incorporate maturity walls to fill gap

Financial heterogeneity and aggregate shocks:

- Crouzet (2017); Ottonello and Winberry (2020); Jungherr, Meier, Reinelt, Schott (2022); Crouzet and Tourre (2023)

  Contribution: Aggregate implications of maturity walls

Roadmap

Empirical Facts

Model

Mapping Model to Data

Quantitative Exercises

Empirical Facts

Data

Mergent FISD: Universe of Corporate Bond Issuances

Bank Debt

- Focus: Non-financial corporate bonds
- Bonds excluded: foreign currency, asset-backed, convertible, and foreign issuer bonds
- Provides terms and history of bond issue
  - date of issuance, maturity at issuance, coupon payments, and repurchases
  - credit spreads, yield at issuance, underwriter fees
- Construct amount of debt outstanding by maturity for all (parent) firm-year pairs

Compustat: Balance sheet information

Sample Period: Annual, 1995 - 2019

Constructing a measure of debt payment dispersion

Share of debt due in m years:

$$s_{m,t} = \frac{\overbrace{b_{m,t}}^{\text{Debt due in } m \text{ yrs}}}{\sum_{m=1}^{M} b_{m,t}}$$

Standard deviation of debt maturity dates:

$$\sigma_{Mat,t} = \sqrt{\sum_{m=1}^{M} s_{m,t}(m - \underbrace{\mu_{Mat,t}}_{\text{Avg. Mat}})^2}$$

- Low $\sigma_{Mat,t} \longrightarrow$ concentrated debt payments

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When measuring payment dispersion, two features are desirable:

1. How large $s_{m,t}$
2. Size of neighboring debt payments (i.e: $s_{m-1,t}$ and $s_{m+1,t}$)
   - Firm A: pays $1/2$ debt in $m = 1$ and $m = 2$ ($\sigma_{Mat} = 0.5$ years, $HI_{Mat} = 0.5$)
   - Firm B: pays $1/2$ debt in $m = 1$ and $m = 20$ ($\sigma_{Mat} = 9.5$ years, $HI_{Mat} = 0.5$)
   - Reasonable to think rollover risk between firms is different

σ_{Mat} and HI_{Mat}

Taking Stock

1. 47% of firms have maturity walls More
   Primarily made up of firms with 1 bond outstanding
2. Maturity walls are associated with higher credit risk More
   $\uparrow$ 2.8 pp prob. default & 26 bps credit spread
3. Firms face economies of scale in bond issuance More
   Consistent with presence of fixed issuance costs

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Next: Quantitative model informed by these facts

- Firm optimally choose:
  1. How much to borrow
  2. How concentrated their debt payments are
- Key trade-off: convex equity costs (rollover risk) v. fixed debt issuance costs

Model

Model Environment

Firms

- Continuum of risk-neutral firms that maximize dividend stream over infinite horizon
- Heterogeneous in states $\mathcal{S} \equiv (b_D, b_C, y, \eta, \varepsilon)$
  - b_D: debt w/ dispersed payments
  - b_C: debt w/ concentrated payment
  - y: firm revenue $y \sim G(y|y_{-1})$
  - η: iid repayment shock $Pr(\eta = 1) = \lambda$
  - $\varepsilon(b'_D, b'_C)$: iid manager pref. shocks over debt choices $\varepsilon \sim$ Type 1 EV$(0, \sigma_\varepsilon)$
- Firm chooses:
  - $b'_D \in \mathcal{B}_\mathcal{D} \equiv \{b_{1,D}, b_{2,D}, \ldots, b_{n_D,D}\}$
  - $b'_C \in \mathcal{B}_\mathcal{C} \equiv \{b_{1,C}, b_{2,C}, \ldots, b_{n_C,C}\}$

Model Environment

Firms

- Continuum of risk neutral firms maximize equity value
- Persistent revenue shocks: $y \sim G(y|y_{-1})$
- Jointly choose debt level and repayment concentration

Lenders

- Priced by representative lender
- Firm-specific prices $\{q_D(b'_D, b'_C, y),\ q_C(b'_D, b'_C, y)\}$ depend on debt choices
- Zero-profit condition reflects default risk and recovery rates

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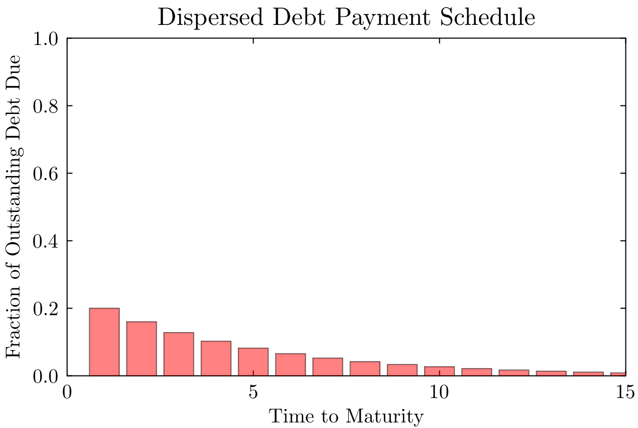
Frictions

- Tax benefit of debt $\tau(b_D + b_C)\tilde{c}$
- Convex equity issuance cost α: reduced-form rollover risk
- Fixed debt issuance cost c_I
- Limited liability & liquidation costs (lender recovers χ of assets in default)

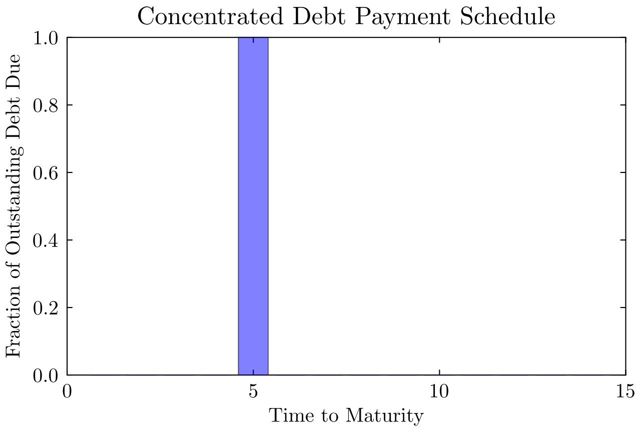
Modeling dispersed and concentrated debt payments



Dispersed Debt Payments (b_D):

- Exponentially maturing coupon bonds with constant amortization rate λ
- Each period: λb_D units of required principal repayments from maturing bonds

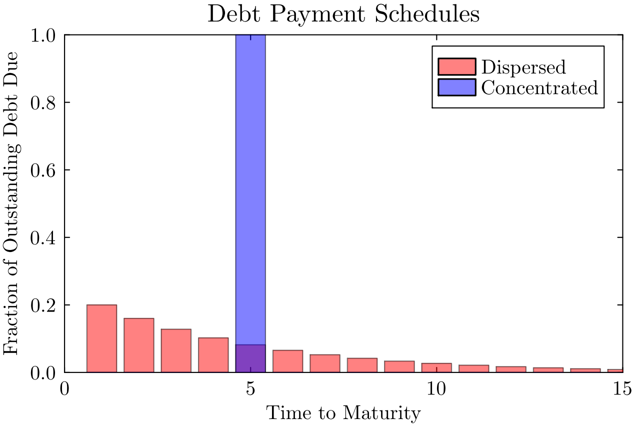
Modeling dispersed and concentrated debt payments



Concentrated Debt Payment (b_C):

- Bond pays a coupon until random expiration $(\eta = 1)$ which arrives w/ probability λ
- When bond expires $(\eta = 1)$, firm must fully repay b_C

Modeling dispersed and concentrated debt payments



Remarks:

- Firm required to pay $\overbrace{\tilde{c}(b_D + b_C)}^{\text{Coupon}} + \overbrace{\lambda b_D + \eta b_C}^{\text{Principal}}$ to avoid default
- Bonds are identical in terms of (i) payment amount and (ii) average maturity $(1/\lambda)$
- Differ only in terms of schedule of payments

(Continuing) Firm's Problem

$$V(\mathcal{S}) = \max_{\{b'_D, b'_C\}} \left\{ \psi(d) + \overbrace{\varepsilon(b'_D, b'_C)}^{\text{Manager Pref. Shock}} + \beta \mathop{\mathbb{E}}_{\{y', \eta', \varepsilon'\}} \max\left\{ V(\mathcal{S}'), 0 \right\} \right\}$$

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Subject to:

$$d = \overbrace{(y - \underbrace{c_F}_{\text{Production Cost}} - \tilde{c}(b_D + b_C))(1 - \tau)}^{\text{After tax income}} - \overbrace{(\lambda b_D + \eta b_C)}^{\text{Debt repaid}}$$

$$+ \underbrace{q_D(b'_D, b'_C, y) I_D}_{\substack{\text{Dispersed debt} \\ \text{issuance revenue}}} + \underbrace{q_C(b'_D, b'_C, y) I_C}_{\substack{\text{Concentrated debt} \\ \text{issuance revenue}}} - \underbrace{c_I(\mathbb{1}_{I_D > 0} + \mathbb{1}_{I_C > 0})}_{\text{Debt issuance cost}}$$

$$I_D = b'_D - (1 - \lambda) b_D$$
$$I_C = b'_C - (1 - \eta) b_C$$

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$$I_D = b'_D - (1-\lambda) b_D$$
$$I_C = b'_C - (1-\eta) b_C$$

$$\psi(d) = \begin{cases} d & \text{if } d \geq 0 \\ d - \underbrace{\alpha d^2}_{\text{Eq. issuance Cost}} & \text{if } d < 0 \end{cases}$$

Lender’s Problem

Debt is priced by rep lender making zero-profits in expectation

- $\delta(\mathcal{S}')$: default decision in state $\mathcal{S}' \equiv (b_D', b_C', y', \eta')$
- $\mathcal{R}(b_D, b_C, y)$: lender’s recovery value in default

Full Definition

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Full Definition

Price of unit of dispersed debt

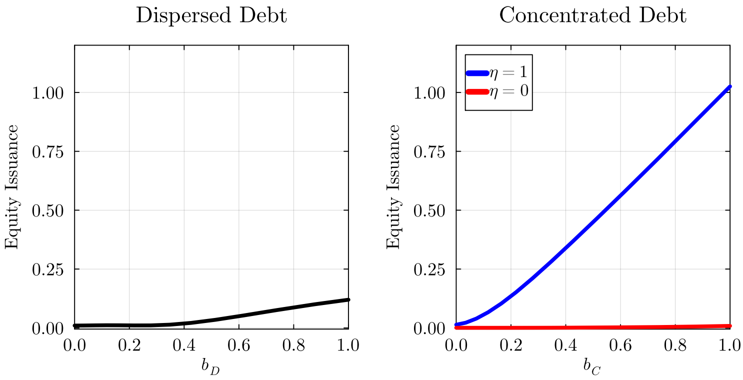
$$q_D(b'_D, b'_C, y) = \beta \mathop{\mathbb{E}}_{\{y', \eta', \varepsilon'\}} \left\{ (1 - \delta(\mathcal{S}')) \Big(\overbrace{\tilde{c} + \lambda}^{\text{Payment tomorrow}} + \overbrace{(1 - \lambda) q_D(b''_D, b''_C, y')}^{\text{Expected future revenue to lender}} \Big) + \delta(\mathcal{S}') \mathcal{R}(b'_D, b'_C, y') \right\}$$

Price of unit of concentrated debt

$$q_C(b'_D, b'_C, y) = \beta \mathop{\mathbb{E}}_{\{y', \eta', \varepsilon'\}} \left\{ (1 - \delta(\mathcal{S}')) \Big(\overbrace{\tilde{c} + \eta}^{\text{Payment tomorrow}} + \overbrace{(1 - \eta) q_C(b''_D, b''_C, y')}^{\text{Expected future revenue to lender}} \Big) + \delta(\mathcal{S}') \mathcal{R}(b'_D, b'_C, y') \right\}$$

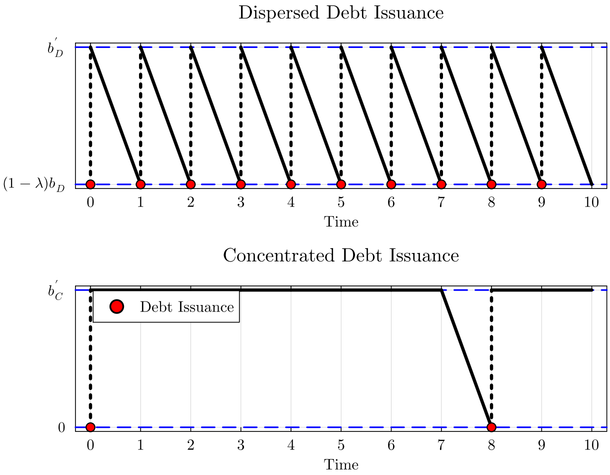
where $Pr(\eta = 1) = \lambda$

Dispersed debt smooths required repayments across states



- Dispersed debt spreads principal repayments across states
- Smaller repayment needs reduce costly equity injections
- Benefit strongest when debt levels are high or firm income is low

Concentrated debt avoids repeated small issuances



- Dispersed debt requires frequent refinancing/top-ups
- Each issuance triggers a fixed cost
- Concentrated debt economizes on issuance costs
- Benefit strongest when rollover risk is low

Mapping Model to Data

Mapping the model to the data

Model is estimated on annual FISD & Compustat data from 1995 - 2019

- Parameters divided into externally calibrated and internally estimated

- Externally calibrated parameters are chosen outside model
  - Estimate income process to capture underlying asset value fluctuations
  - Income is mapped to annual sales data
  - $log(y') = \rho_y log(y) + \sigma_y \varepsilon_y, \quad \varepsilon_y \sim \mathcal{N}(0,1)$
  - Average maturity $1/\lambda$ is matched to average maturity of corp. bonds

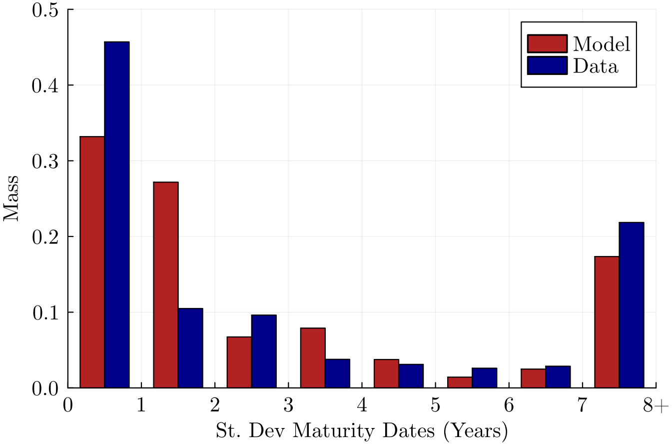
- Internally estimated parameters are jointly estimated via SMM
  - Match empirical moments important for debt issuance, rollover, and concentration
  - Construct model equivalent St. Dev of Debt Maturity Dates

Mapping b_D & b_C to σ_{Mat}

Model Estimation

Parameter	Description	Value	SE	Target/Reference	Data	Model
Externally Calibrated						
β	Discount factor	0.960	–	4% Annual Risk Free Rate	–	–
$\tilde{c}$	Per-period coupon payment	$1/\beta - 1$	–	Eqm price of riskless debt is 1	–	–
τ	Corporate tax rate	0.300	–	Hennessy & Whited (2007)	–	–
ρ_y	Persistence: income shock	0.660	–	Auto-correlation of log sales	0.66	0.66
σ_y	St. dev: income shock	0.310	–	Log sales volatility	0.31	0.31
$1/\lambda$	Average Maturity of debt	8.300	–	Avg. debt maturity	8.30	8.30
Internally Estimated						
c_f	Fixed cost of production	0.967	0.244	Default rate (%)	1.13	1.20
α	Equity issuance cost	0.011	0.002	Avg. debt to income	2.22	2.22
σ_ε	St. dev: pref. shock	0.001	0.000	St. dev debt to income	5.36	5.34
χ	Lender recovery fraction	0.093	0.040	Avg. credit spread	1.87	1.70
c_l	Fixed debt issuance cost	0.003	0.001	Avg. dispersion maturity dates	2.61	2.62
				Avg. underwriter fee (%)	0.79	0.75

Model matches the distribution of maturity dispersion



- SMM targets only the average of σ_{Mat} (2.61 data vs. 2.62 model)
- Untargeted: model reproduces the full *distribution* of σ_{Mat}
- Captures both maturity walls ($\sigma_{Mat} \leq 1$) and dispersed firms

Leverage fit Underwriter Fee fit

Quantitative Exercises

1. How much do maturity walls contribute to credit risk?
2. Are firms less risky if issuing debt is cheaper?
3. Do maturity walls amplify transmission of credit market freeze?

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Causal effect of maturity walls on credit risk:

- Can't compare two firms w/ & w/o maturity wall, since it is endogenous choice
- Use structural model to generate exogenous variation in debt structure

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Counterfactual economy:

i firm's total leverage decision is held constant at baseline values
ii firm's borrow all in b_C
iii firm's optimally choose to default
iv lender's optimally price debt to make zero profits

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	bps	%	Baseline Value
Δ Default Rate	35.9	25.0	1.2%
Δ Credit Spread	30.0	21.1	1.7%

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Manconi, Neretina, Renneboog (2019)

- Corporate bond underwriters have market power
- Economically significant:
  - Mean market power: 12.2 bps (16%) of underwriter fee
  - Max market power: 19.4 bps (25%) of underwriter fee

Are firms less risky if issuing debt is cheaper?

Underwriter fees (c_I) are important input in firm's choice to have maturity wall or not

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How does eliminating underwriter market power affect firm's spreads, default, and market value?

- Counterfactual equilibrium: underwriter fee in perfectly competitive economy
- Reduce underwriter fee by mean/max percentage of underwriter market power estimates

How does underwriter market power impact default & spreads?

Underwriter fees (c_I):

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- Reducing c_I: firm can disperse debt payments at lower cost

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Ex-ante unclear how decreasing issuance cost will impact default & spreads:

- Composition of debt changes:

  borrow more b_D and less b_C: $\downarrow$ default risk & credit spreads

- Total debt level increases:

  maintain higher total debt with b_D: $\uparrow$ default risk & credit spreads

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In economy with competitive underwriter market

- $\uparrow$ risk from borrowing more $>$ $\downarrow$ reduced risk from debt composition changes
- Credit spreads $\uparrow$ 1.2 pp & default rates $\uparrow$ 1 pp

Counterfactual table

Quantitative Exercises

1. How much do maturity walls contribute to credit risk?
2. Are firms less risky if issuing debt is cheaper?
3. Do maturity walls amplify transmission of credit market freeze?

Macroeconomic implications of maturity walls on market freezes

Credit market freeze

- $\sim$50% of firms have a maturity wall $\rightarrow$ exposed to rollover risk
- Unanticipated one-period shock where
  i. debt market shuts down
  ii. equity issuance cost rises (matched to GFC $\uparrow$ in default)
- Firms may be "unlucky" repaying a maturity wall at the freeze
  - Unable to rollover $\longrightarrow$ amplifies default

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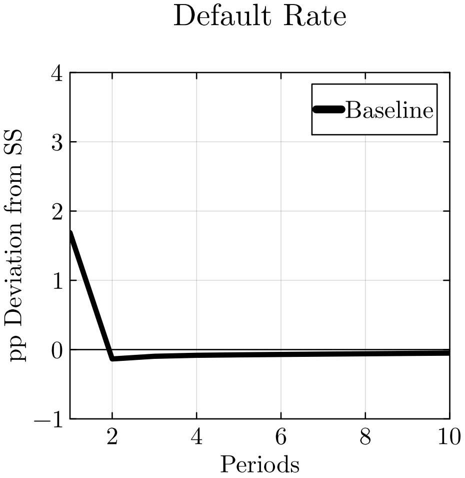
Takeaway:

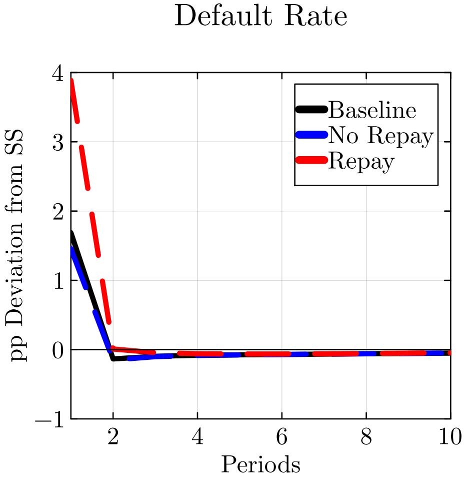
- Freeze $\uparrow$ aggregate default 168 bps
-



Macroeconomic implications of maturity walls on market freezes

Credit market freeze

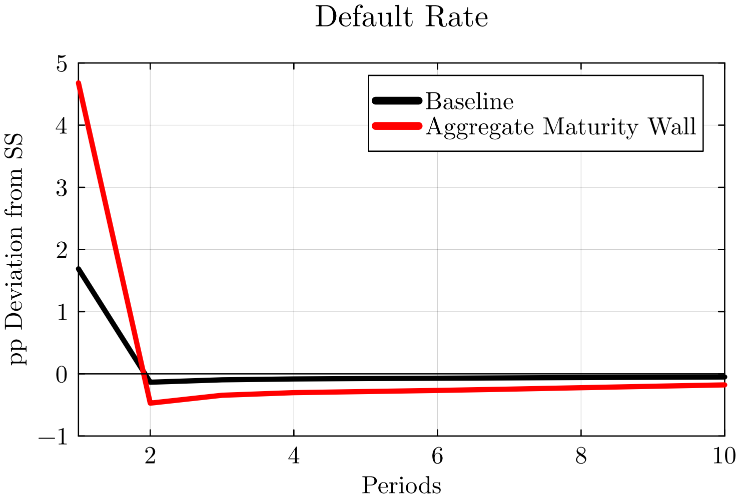
- $\sim$50% of firms have a maturity wall $\rightarrow$ exposed to rollover risk
- Unanticipated one-period shock where
  i. debt market shuts down
  ii. equity issuance cost rises (matched to GFC $\uparrow$ in default)
- Firms may be "unlucky" repaying a maturity wall at the freeze
  - Unable to rollover $\longrightarrow$ amplifies default



Takeaway:

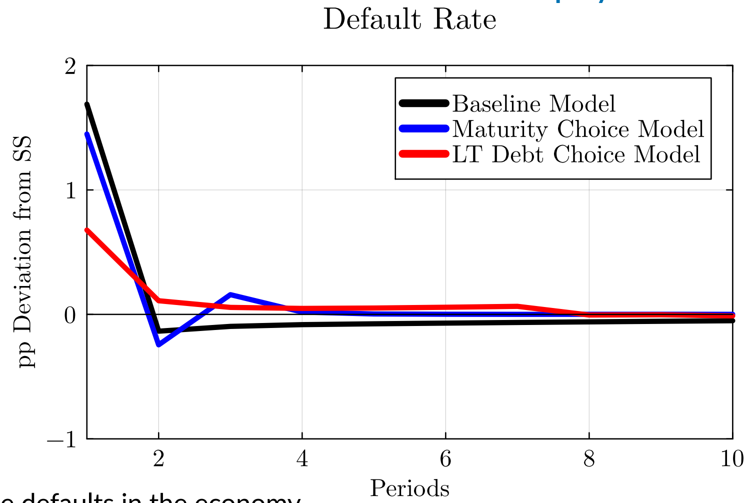
- Freeze $\uparrow$ aggregate default 168 bps
- Firms repaying b_C at the freeze are 16% of defaults (2$\times$ baseline)

Aggregate maturity wall during credit market freeze



Aggregate maturity wall (η common across firms) $\longrightarrow$ 299bps (178%) higher default rate

What do we miss without concentrated debt payments?



We underestimate defaults in the economy

- 14% (25 bps) compared to maturity choice model (Arellano & Ramanarayanan, 2012)
- 60% (100 bps) compared to LT debt choice model (Chatterjee & Eyigungor, 2012)

Conclusion

Maturity walls matter for borrowing level, default, and borrowing costs

- Structural model of firm debt and maturity date concentration
- Key trade-off: issuance cost v. rollover risk
- Joint determination of leverage and maturity walls is important

Today I showed:

- Maturity walls $\uparrow$ default rates by 36 bps (25%) & borrowing costs by 30 bps (21%)
- Removing market power in underwriter market $\rightarrow$ higher eqm default compared to baseline
- Miss up to 60% of defaults during credit market freeze by omitting maturity walls
- Aggregate maturity walls amplify defaults during credit market freeze 299 bps

Appendix

What about bank debt?

Conditional on being bond issuer:

- Bond debt accounts for 87% of bank + bond debt
- Bond debt accounts for 60% of total debt (bank, bond, mortgages, credit lines, CP, etc.)

At aggregate level (Flow of Funds):

- Bond debt accounts for 55% of aggregate corporate borrowing
- Bank debt accounts for 10% of aggregate corporate borrowing

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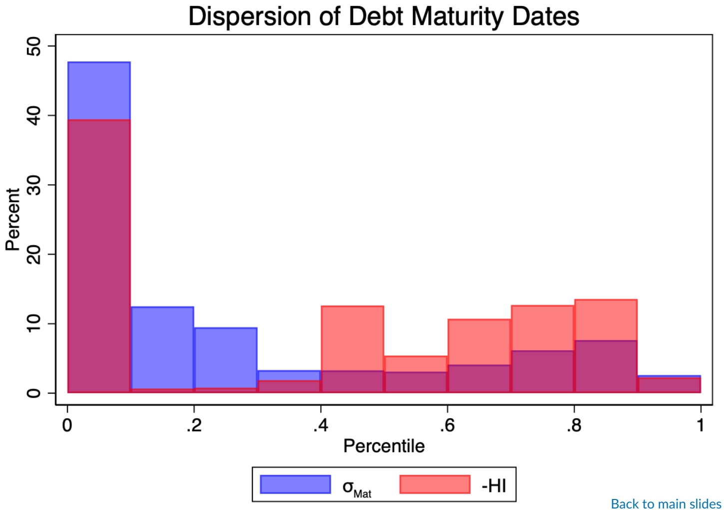
Constructing a measure of maturity walls

$$HI_{Mat,t} = \sum_{m=1}^{M} s_{m,t}^2$$

- High $HI_{Mat} \longrightarrow$ concentrated debt payments

- σ_{Mat} picks up in maturity walls missed by HI_{Mat}



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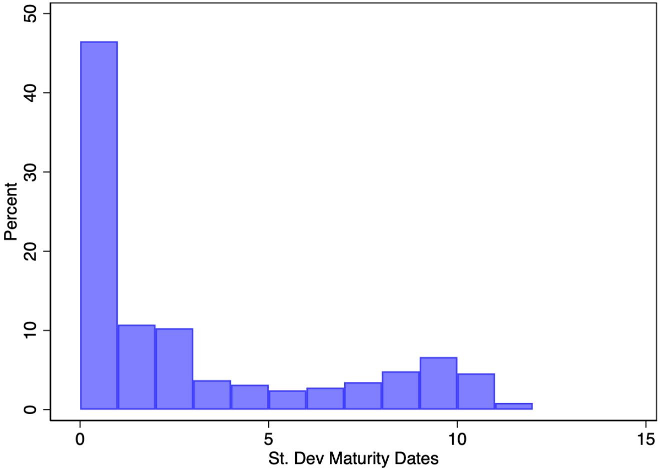
Fact 1: 47% of firms have maturity walls



- Avg σ_{Mat}: 2.6 years
  Median σ_{Mat}: 1.5 years
- Maturity Wall: $\sigma_{Mat} \leq 1$
  (Antero's σ_{Mat} at rating downgrade)
- Firms w/ maturity walls typically issue few bonds
  - Avg. # of bonds: 1.8
  - Median # of bonds: 1
  - P75 # of bonds: 2

Weighted by age Weighted by size Weighted by leverage Weighted by bond fraction
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Which firms are holding maturity walls?

	(1) St. Dev Maturity Dates	(2) Maturity Wall
Leverage	0.827***	-0.154***
	(0.062)	(0.011)
Size	1.521***	-0.257***
	(0.085)	(0.014)
Age	0.258***	-0.050***
	(0.060)	(0.009)
Q	0.285***	-0.069***
	(0.085)	(0.012)
Revenue	-0.064	0.018*
	(0.066)	(0.010)
Cash	-0.007	-0.003
	(0.056)	(0.009)
Avg. Bond Maturity	1.618***	-0.043***
	(0.079)	(0.009)
Observations	8986	8986
R^2	0.649	0.442
FEs	Yes	Yes

Firms w/ maturity walls associated w/:

- $\uparrow$ leverage, concerned about rollover risk
  $\rightarrow$ disperse payments
- $\uparrow$ revenue, less concern about rollover risk
  $\rightarrow$ concentrate payments
- $\uparrow$ Q, more concern about rollover risk (investment opportunities valuable to firm)
  $\rightarrow$ disperse payments

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Fact 3: Firms with maturity walls appear more risky

	(1) Prob Default (pps)	(2) Prob Default (pps)	(3) Credit Spread(bps)	(4) Credit Spread(bps)
Leverage	5.010***	3.617***	48.041***	41.883***
	(0.415)	(0.497)	(9.972)	(9.607)
Avg. Bond Maturity	-0.281	-0.389*	-3.444	-3.291
	(0.203)	(0.201)	(3.413)	(3.297)
Maturity Wall	2.805***	2.649***	25.979***	64.405***
	(0.474)	(0.449)	(8.561)	(12.077)
Leverage $\times$ Maturity Wall		2.401***		69.966***
		(0.612)		(14.357)
Observations	6410	6410	1213	1213
R^2	0.234	0.242	0.685	0.694
Controls	Firm	Firm	Firm & Bond	Firm & Bond
Fixed Effects	Industry & Year	Industry & Year	Industry & Year	Industry & Year

Takeaway:

- Firms w/ maturity walls associated w/ $\uparrow$ prob. default & credit spreads
- Large maturity walls associated w/ $\uparrow$ credit risk

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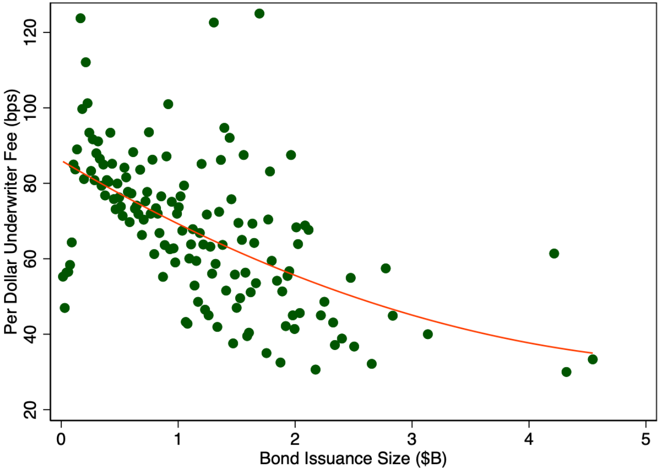
Fact 3: Firms face economies of scale issue bonds

Underwriter fees:

- Cost to *issue* corporate bond (fixed + variable cost)
- Spread out fixed cost by issuing larger amounts
- What are these fixed costs?
  - Pricing bond
  - Rating & regulatory filings
  - Determining who wants to buy bond on secondary market
- Underwriter spread (Fee / Iss. Size)
  - $<$ \$1B issue: 80 bps
  - $>$ \$3B issue: 40 bps



Takeaway: Economies of scale consistent with large fixed issuance costs

Bond Issuance Freq Robustness

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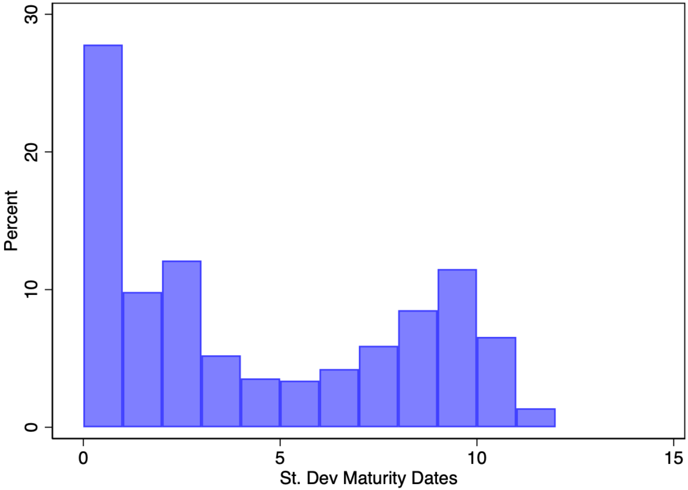
Firms concentrate debt maturity dates (weighted by firm age)



Average: 3.1 years Median: 4.5 years

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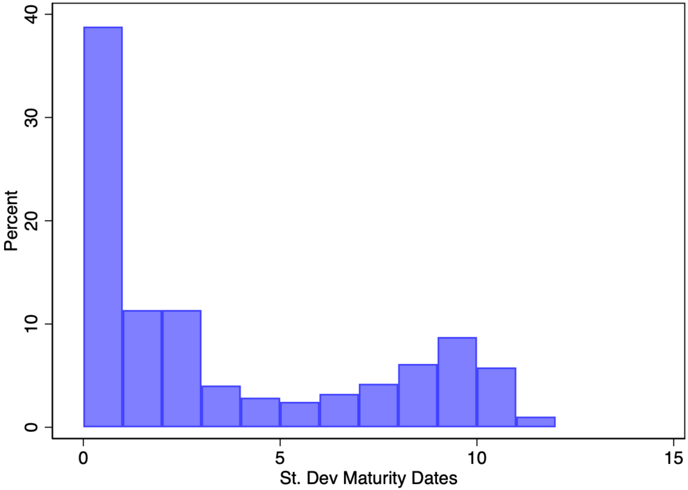
Firms concentrate debt maturity dates (weighted by firm size)



Average: 3.8 years Median: 2.7 years

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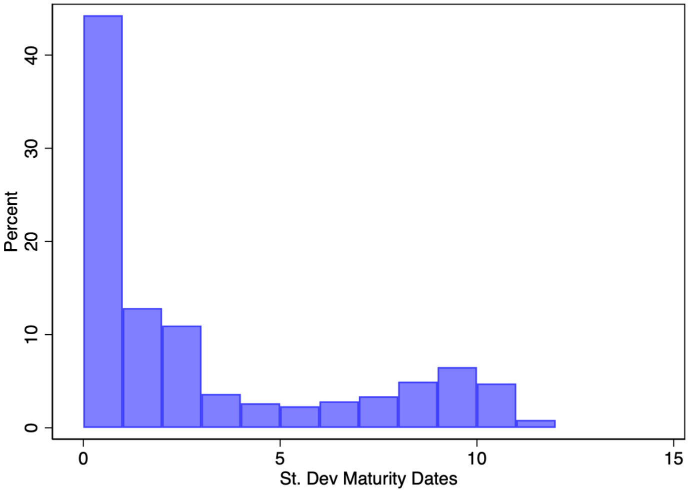
Firms concentrate debt maturity dates (weighted by firm leverage)



Average: 3.3 years   Median: 1.8 years

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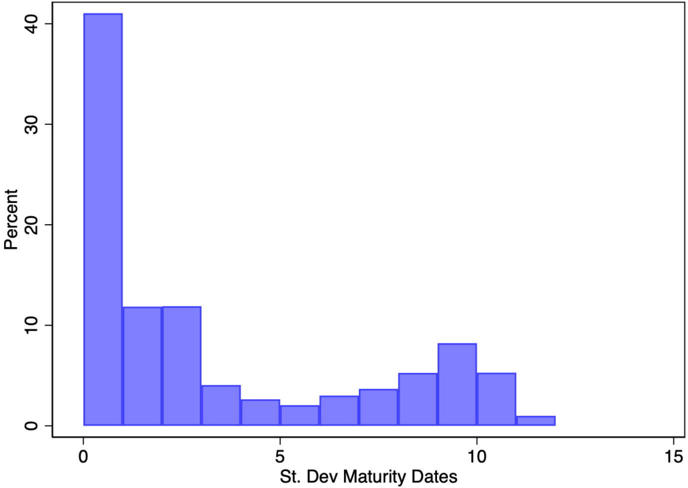
Firms concentrate debt maturity dates (weighted by bond debt pct)



Average: 3.4 years Median: 1.9 years

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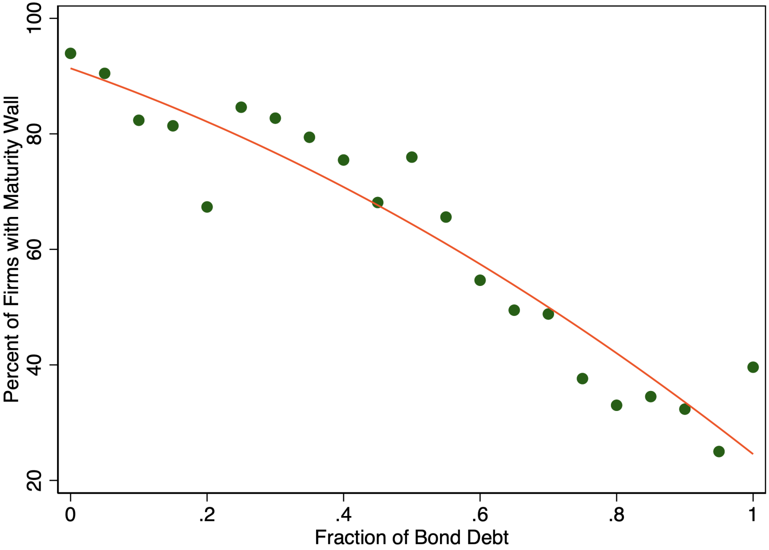
Fact 2: Maturity walls not driven by financing over firms' life cycle



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Firms infrequently issue corporate bonds

	Mean	Std. Dev
Bond Issuance Frequency	0.114	0.318
Number of Bonds Issued	1.874	1.360
Time Since Last Issue (Years)	3.359	2.263
Bond Issuance Size ($M)	435.980	421.972
Bond Amount Outstanding ($M)	1,681.264	3,658.709
Bond Issuance to Amount Outstanding	0.407	0.334
Number of Bonds Issued Last 5 Years	1.037	2.590
Number of Bonds Issued Last 10 Years	1.902	4.358
Number of Bonds Issued Last 20 Years	3.098	6.663

Firms issue bonds infrequently:

- 11.4% obs feature bond issuance
- Avg bonds issued in last 10 years is 1.9

Firms issue large amounts

- New bond issuance accounts for 40% of total amount outstanding

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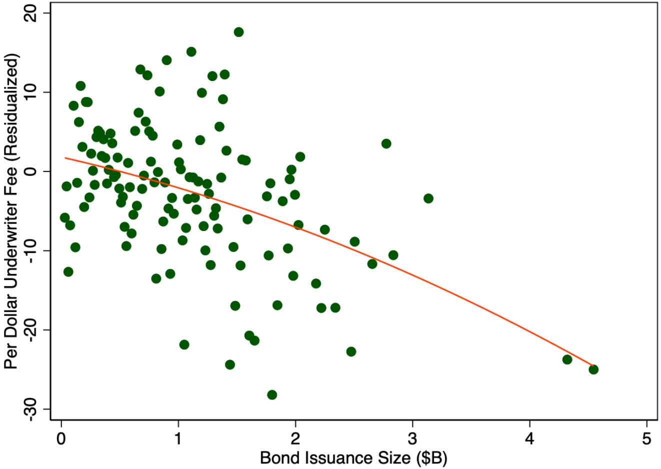
Economies of scale robust to firm and bond controls



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Do firms behave differently before large repayment dates?

	Cash	Investment	$\mathbf{1}_{\text{Buyback}}$
s_1	-0.002	0.007	-0.241***
	(0.007)	(0.008)	(0.052)
s_2	-0.003	0.002	-0.228***
	(0.008)	(0.008)	(0.051)
s_3	-0.002	0.003	-0.217***
	(0.007)	(0.008)	(0.049)
s_4	-0.006	0.002	-0.253***
	(0.007)	(0.008)	(0.048)
s_5	-0.007	0.002	-0.222***
	(0.006)	(0.007)	(0.048)
Fixed Effects	Firm & Year	Firm & Year	Firm & Year
Additional Controls	Yes	Yes	Yes

Note: s_m is share of long-term debt due in m years

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How has the literature modeled long-term debt?

Modeling long-term debt with exponentially declining maturity structure:

- Hatchondo and Martinez (JIR, 2009); Arellano and Ramanarayanan (JPE, 2012); Aguiar et. al (ECMA, 2019)
- He and Xiong (JF, 2012); Dangl & Zechner (RFS, 2021); DeMarzo & He (JF, 2021); Jungherr and Schott (RED, 2021); Jungherr et. al (R&R ReSTUD, 2023)

Modeling long-term debt randomly maturing "lumpy" bond:

- Geelen (R&R JF, 2019); Gomes and Schmid (JF, 2021); Chen et al (JFE, 2021)

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Debt is priced by rep lender making zero-profits in expectation

- $\delta(\mathcal{S}')$: default decision in state $\mathcal{S}' \equiv (b'_D, b'_C, y', \eta', \varepsilon')$
- $\tilde{V}(y) = \psi((y - c_F)(1-\tau)) + \beta \mathbb{E}_{\{y'\}} \max\left\{\tilde{V}(y'), 0\right\}$
- $\mathcal{R}(b_D, b_C, y) = \min\left[1, \chi \tilde{V}(y) / b_D + b_C\right]$

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Price of unit of dispersed debt

$$q_D(b'_D, b'_C, y) = \beta \mathop{\mathbb{E}}_{\{y', \eta', \varepsilon'\}} \left\{ \left(1 - \delta(\mathcal{S}')\right) \left(\overbrace{\tilde{c} + \lambda}^{\text{Payment tomorrow}} + \overbrace{(1-\lambda) q_D(b''_D, b''_C, y')}^{\text{Expected future revenue to lender}} \right) + \delta(\mathcal{S}') \mathcal{R}(b'_D, b'_C, y') \right\}$$

Price of unit of concentrated debt

$$q_C(b'_D, b'_C, y) = \beta \mathop{\mathbb{E}}_{\{y', \eta', \varepsilon'\}} \left\{ \left(1 - \delta(\mathcal{S}')\right) \left(\overbrace{\tilde{c} + \eta}^{\text{Payment tomorrow}} + \overbrace{(1-\eta) q_C(b''_D, b''_C, y')}^{\text{Expected future revenue to lender}} \right) + \delta(\mathcal{S}') \mathcal{R}(b'_D, b'_C, y') \right\}$$

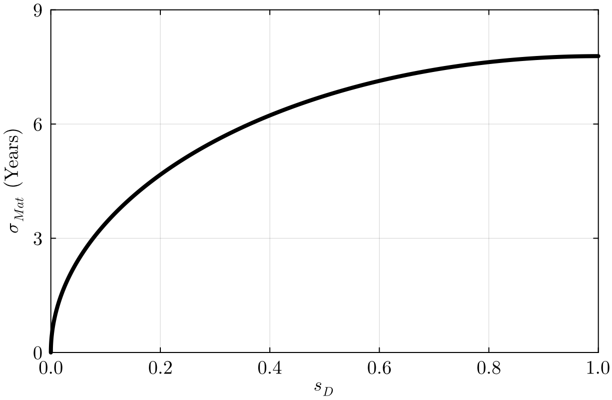
Constructing σ_{Mat} in the model

Let

$$s_D = \frac{b_D}{b_D + b_C}$$

The mapping from s_D to σ_{Mat} is

$$\sigma_{Mat} = \frac{\sqrt{(1-\lambda)(2s_D - s_D^2)}}{\lambda}$$



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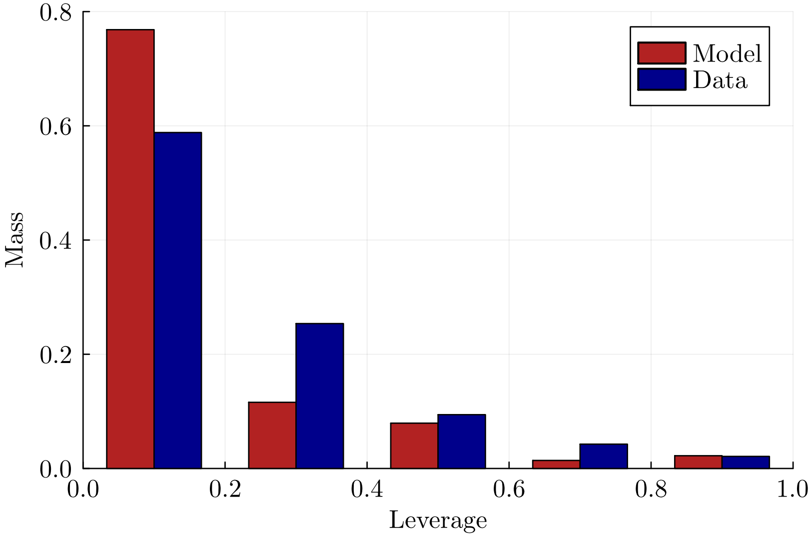
Model Fit: Market Leverage Distribution



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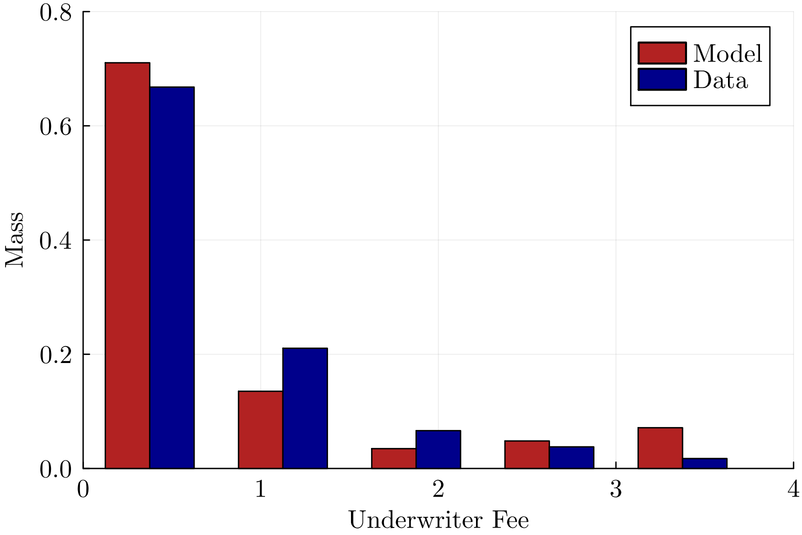
Model Fit: Underwriter Fee Distribution



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Lender's Problem

Debt is priced by rep lender making zero-profits in expectation

- $\delta(\mathcal{S}')$: default decision in state $\mathcal{S}' \equiv (b'_D, b'_C, y', \eta')$
- $\mathcal{R}(b_D, b_C, y)$: lender's recovery value in default

Price of unit of dispersed debt

$$q_D(b'_D, b'_C, y) = \beta \underset{\{y',\eta',\varepsilon'\}}{\mathbb{E}} \left\{ \left(1 - \delta(\mathcal{S}')\right) \Big(\overbrace{\tilde{c} + \lambda}^{\text{Payment tomorrow}} + \overbrace{(1-\lambda) q_D(b''_D, b''_C, y')}^{\text{Expected future revenue to lender}} \Big) + \delta(\mathcal{S}') \mathcal{R}(b'_D, b'_C, y') \right\}$$

Price of unit of concentrated debt

$$q_C(b'_D, b'_C, y) = \beta \underset{\{y',\eta',\varepsilon'\}}{\mathbb{E}} \left\{ \left(1 - \delta(\mathcal{S}')\right) \Big(\overbrace{\tilde{c} + \eta}^{\text{Payment tomorrow}} + \overbrace{(1-\eta) q_C(b''_D, b''_C, y')}^{\text{Expected future revenue to lender}} \Big) + \delta(\mathcal{S}') \mathcal{R}(b'_D, b'_C, y') \right\}$$

where $Pr(\eta = 1) = \lambda$

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Counterfactual equilibrium: competitive underwriter market

	Baseline	$0.84c_I$	$0.75c_I$
Share of debt held in b_D	18.25%	42.46%	50.00%
Debt Maturity Dispersion σ_{Mat}	2.62 years	4.85 years	5.62 years
Book leverage	20.72%	38.03%	42.48%
Market leverage	14.67%	24.26%	26.59%
Credit spread on b_D	1.44%	2.54%	2.84%
Credit spread on b_C	1.70%	2.65%	2.89%
Average credit spread	1.69%	2.64%	2.88%
Firm default rate	1.19%	1.96%	2.15%
Δ Market value	–	0.85%	1.01%

Takeaway: Firm's borrowing increases $\longrightarrow \uparrow$ credit spreads & default rates

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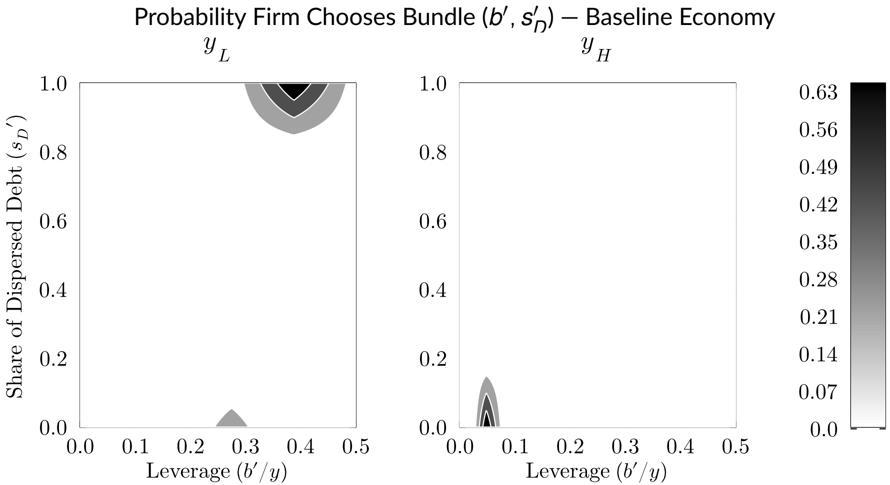

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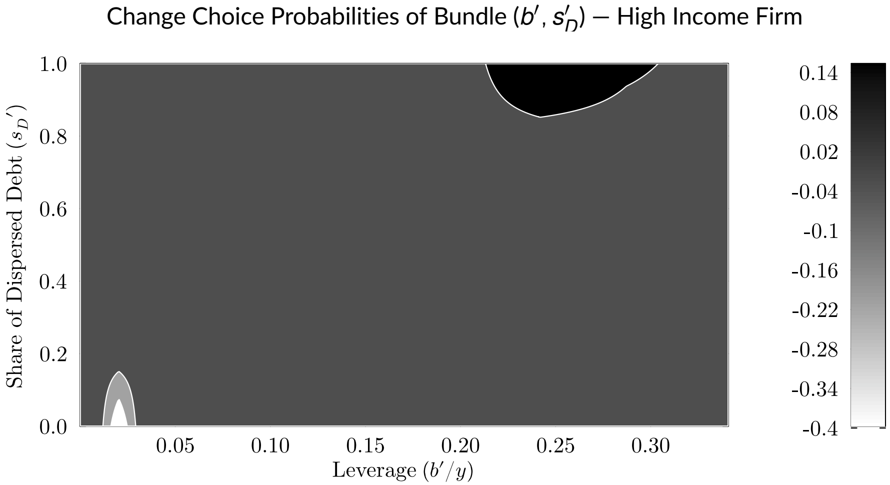

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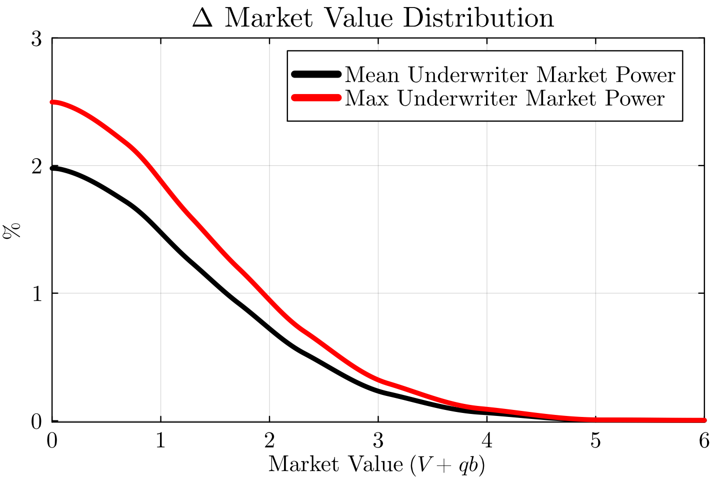
How does underwriter market power impact firm value?



- Average market value $\uparrow$ 0.85% – 1.01%

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Where is increase in market value coming from?

Let $W(\mathcal{S})$ be the market value of the firm

$$W(\mathcal{S}) = \overbrace{V(\mathcal{S})}^{\text{Equity Value}} + \overbrace{q_D(b'_D, b'_C, y)b'_D + q_C(b'_D, b'_C, y)b'_C}^{\text{Debt Value}}$$

$$\approx \overbrace{J_{AT}(\mathcal{S})}^{\text{Unlevered Value of Asset}} - \overbrace{J_{DC}(\mathcal{S})}^{\text{NPV: Default Costs}} +$$

$$\overbrace{J_{TB}(\mathcal{S})}^{\text{NPV: Tax Benefits of Debt}} - \overbrace{J_{EC}(\mathcal{S})}^{\text{NPV: Equity Issuance Costs}} - \overbrace{J_{BC}(\mathcal{S})}^{\text{NPV: Debt Issuance Costs}}$$

Back to main slides   Definition of J's

Where is increase in market value coming from?

Let $W(\mathcal{S})$ be the market value of the firm

$$\frac{\partial W(\mathcal{S})}{\partial c_l} \approx \overbrace{\cancel{\frac{\partial J_{AT}(\mathcal{S})}{\partial c_l}}^{\,0}}^{\Delta \text{ Unlevered Value of Asset}} - \overbrace{\frac{\partial J_{DC}(\mathcal{S})}{\partial c_l}}^{\Delta \text{ Default Costs}} +$$

$$\overbrace{\frac{\partial J_{TB}(\mathcal{S})}{\partial c_l}}^{\Delta \text{ Tax Benefits of Debt}} - \overbrace{\frac{\partial J_{EC}(\mathcal{S})}{\partial c_l}}^{\Delta \text{ Equity Issuance Costs}} - \overbrace{\frac{\partial J_{BC}(\mathcal{S})}{\partial c_l}}^{\Delta \text{ Debt Issuance Costs}}$$

1. Δ Tax Benefits of Debt +108.3%
2. Δ Equity Issuance Costs Paid: +6.9%
3. Δ Debt Issuance Costs Paid: -15.4%
4. Δ Default Costs: +0.2%

Back to main slides Definition of J's

NPV of underlying frictions

Unlevered value of underlying asset:

$$J_{AT}(\mathcal{S}) = (y - c_F)(1-\tau) - \alpha\Big((y - c_F)(1-\tau)\Big)^2 \mathbb{1}_{y<c_F} + \beta \mathop{\mathbb{E}}_{\{y'\}} \max\left\{J_{AT}(\mathcal{S}'), 0\right\}$$

NPV of Default Costs:

$$J_{DC}(\mathcal{S}) = (1 - X(\mathcal{S}))(1-\chi)(y - c_F)(1-\tau)$$

NPV of Tax Benefits of Debt:

$$J_{TB}(\mathcal{S}) = \tau\tilde{c}(b_D + b_C) + \beta \mathop{\mathbb{E}}_{\{y',\eta',\varepsilon'\}} \max\left\{J_{TB}(\mathcal{S}'), 0\right\}$$

NPV of Equity Issuance Costs:

$$J_{EC}(\mathcal{S}) = \alpha d^2 \mathbb{1}_{d<0} + \beta \mathop{\mathbb{E}}_{\{y',\eta',\varepsilon'\}} \max\left\{J_{EC}(\mathcal{S}'), 0\right\}$$

NPV of Debt Issuance Costs:

$$J_{BC}(\mathcal{S}) = c_I(\mathbb{1}_{I_D>0} + \mathbb{1}_{I_C>0}) + \beta \mathop{\mathbb{E}}_{\{y',\eta',\varepsilon'\}} \max\left\{J_{BC}(\mathcal{S}'), 0\right\}$$

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