Collateral and Secured Debt

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Theory to Distinguish between Secured Debt and Collateral

- **Secured debt**
  - Explicit collateralization: lien on specific assets, recovered in default
  - Secured lenders' strong claim on assets enables **higher leverage**
  - Entails costs: direct or indirect (operational flexibility)
- **Unsecured debt**
  - Backed by unencumbered assets, implicitly collateralized
- **Key insights**
  - **Collateral restricts both secured and unsecured debt**
  - **Constrained firms use more secured debt within and across firms**
- **Consistent with stylized facts and evidence from causal forest**
  - Bulk of debt secured for most firms
  - Positive relation between secured debt and financial constraints
  - Positive relation between leverage and tangible assets

Why Do We Care?

- **Collateral central to macro finance and corporate finance**
  - Kiyotaki/Moore (1997)
  - Rampini/Viswanathan (2013)

- **Recent puzzles on secured debt**
  - Secured debt acyclical/countercyclical – Azariadis/Kass/Wen (2016)
    - Relatedly: leasing countercyclical – Gal/Pinter (2017)
  - Limited use of secured debt by large firms – Lian/Ma (2021)
  - Secular decline in secured debt – Benmelech/Kumar/Rajan (2021)

- **No distinction between secured debt and collateral!**

- **Terminology**
  - **Collateral (law):** Assets pledged to secure loan
  - **Collateral (economics):** Collateralizable assets, esp. tangible assets

- Punchline
  - **Collateral is essential to understanding capital structure**

Law Perspective on Secured Debt

- Based on Mann (1997)
- **Benefits of secured debt: enforcement of payment**
  - "increases the lender's ability to collect the debt forcibly through liquidation of the collateral"
  - "enhances the lender's remedy (so that the lender can coerce payment more quickly than it could if its debt were not secured)"
- **Costs of secured debt**
  - Direct costs, such as information and transactions costs
  - Indirect costs, such as operating flexibility

    "you just don't have the same flexibility of dealing with your properties as if you owned them unencumbered"
- Very similar to basic trade-off in our model

Law Perspective on Secured Debt

- **Trade off depends on firms' financial condition**
  - "as a borrower's financial strength increases, secured credit becomes a less attractive alternative: its benefits decrease and its costs at best, remain constant" – Mann (1997)
  - "borrowers exhibit an increasing tendency toward unsecured debt as their financial strength increases" – Mann (1997)
  - "unsecured creditors frequently choose to waive negative pledge covenants in exchange for a quid pro quo, such as becoming equally and ratably secured" – Schwarcz (1997)

- **Contracting in the shadow of the law**
  - Borrowers and lenders are "reacting to the 'shadow' of the law – the parties' anticipation of what would happen if formal legal proceedings were to occur" – Mann (1997)

Outline

(1) Stylized facts

(2) Model
- Key distinction between secured and unsecured debt
- Simple, deterministic model
- Stochastic model with quantitative evaluation

(3) Secured debt and leasing (skipped today)

(4) Evidence from causal forest

Stylized Facts on Secured Debt

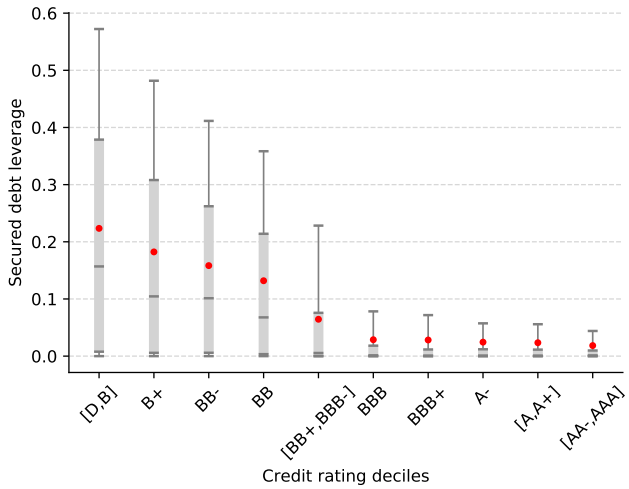
- Data
  - Compustat; 1981-2018; annual; excluding SIC 6000-6999
  - **Secured debt:** Debt/Mortgages & Other Secured (`DM`)
  - **Debt:** Long-Term Debt (`DLTT`) + Debt in Current Liabilities (`DLC`)
  - **Assets:** Assets (`AT`)

- Two key stylized facts
  - **Fact 1:** Secured debt increases with financial constraints
  - **Fact 2:** Leverage increases with tangible assets

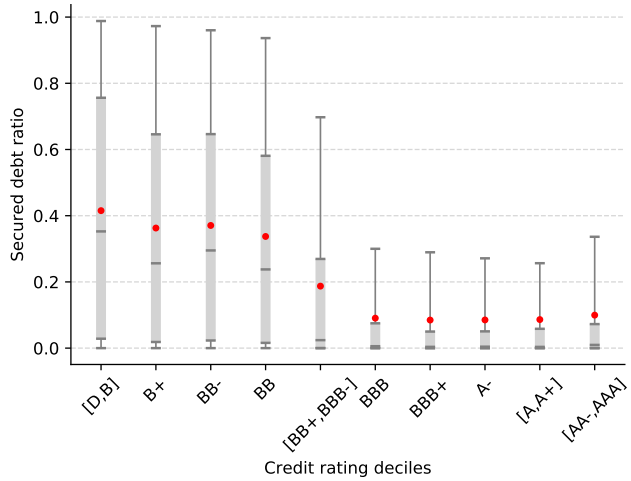
Stylized Fact 1 – Secured Debt and Financial Constraints

- **Financial structure across rating deciles** ▸ Model ▸ Long-term debt

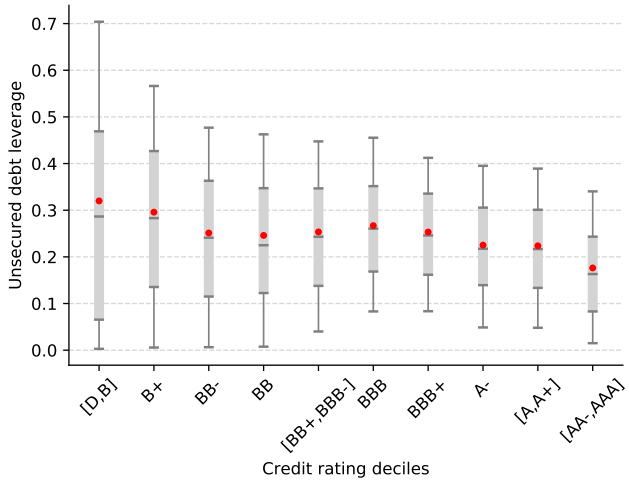
Panel A: Secured debt/Assets



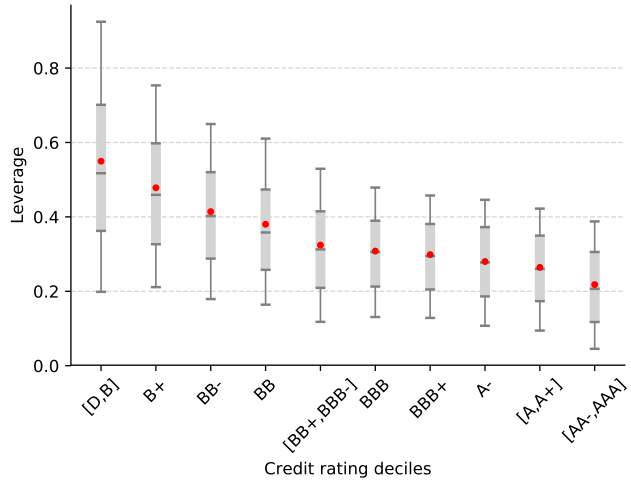
Panel B: Secured debt/Total debt



Panel C: Unsecured debt/Assets



Panel D: Debt/Assets

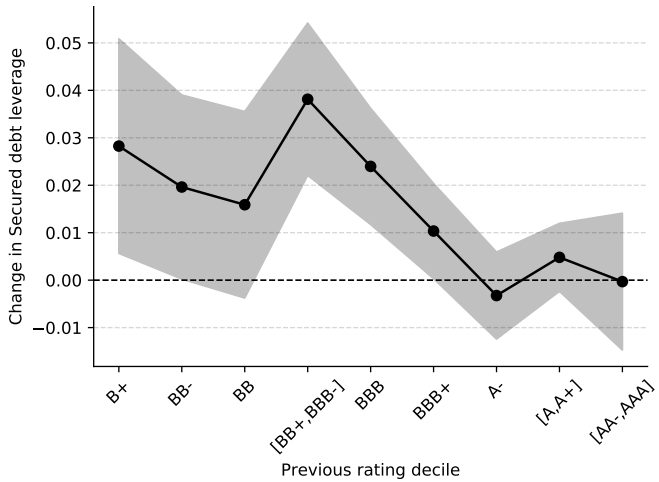


- **Cross section:** constrained firms have more secured debt ▸ Assets & Div

Stylized Fact 1 – Secured Debt and Financial Constraints

- **Within-firm variation: heterogeneous effects of downgrades**

Panel A: Secured debt/Assets



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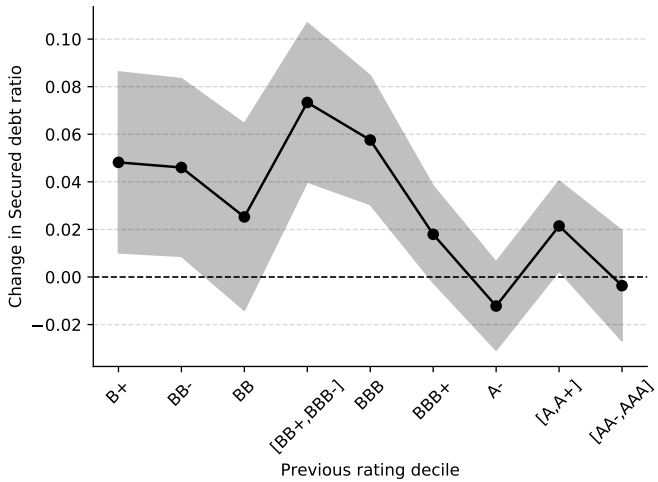

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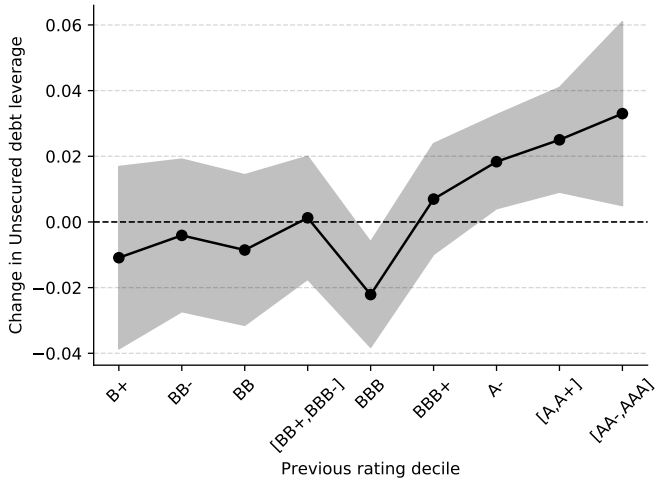

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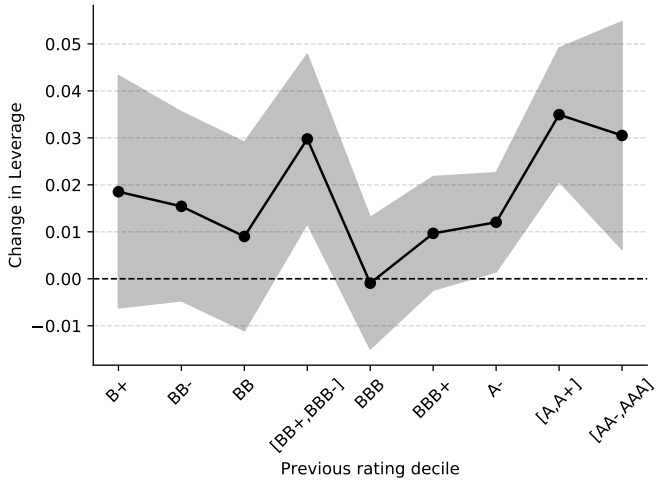
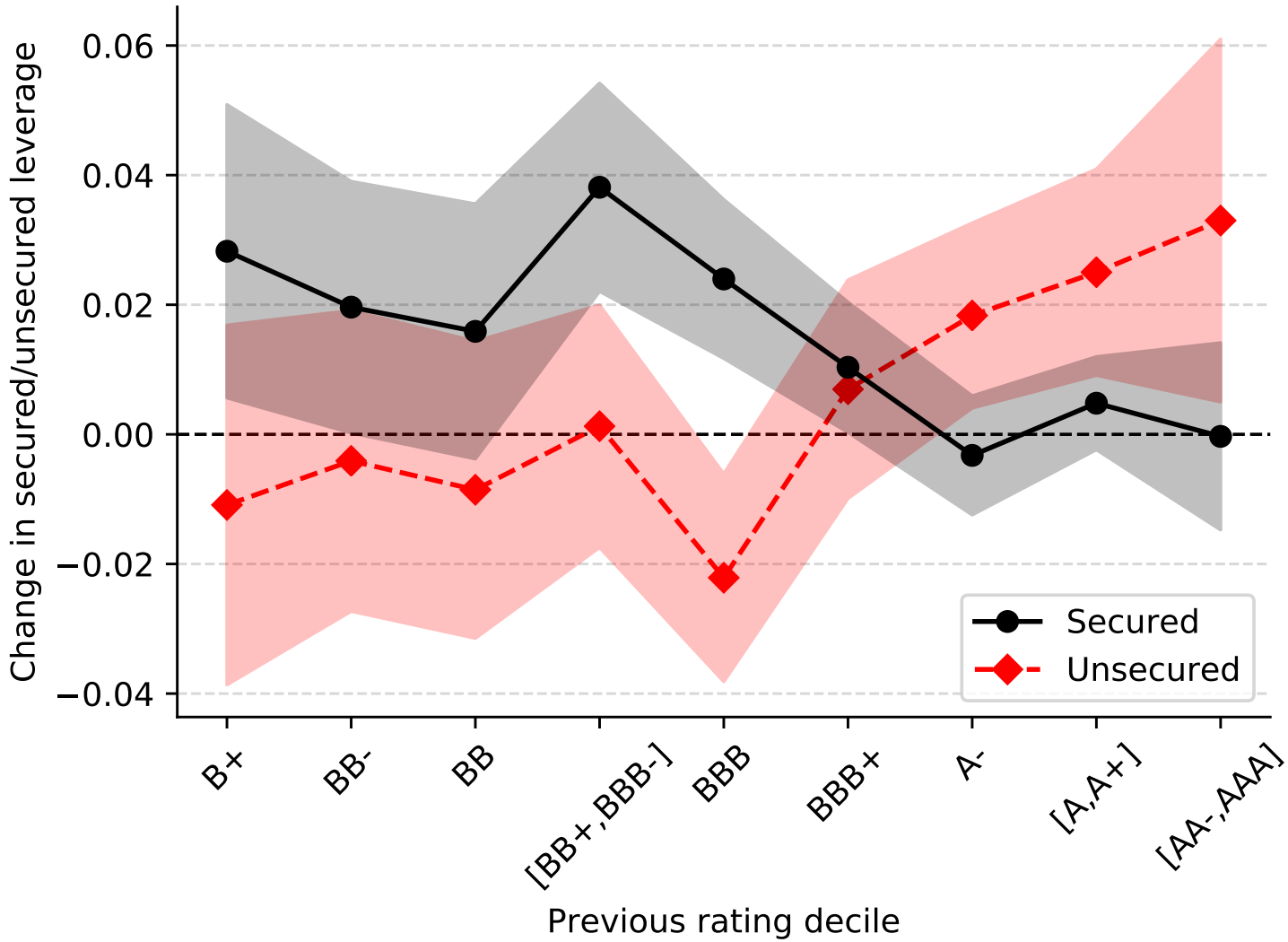


- Downgraded firms shift to secured debt, esp. low-rated

▸ Assets & Div

Stylized Fact 1 – Secured Debt and Financial Constraints

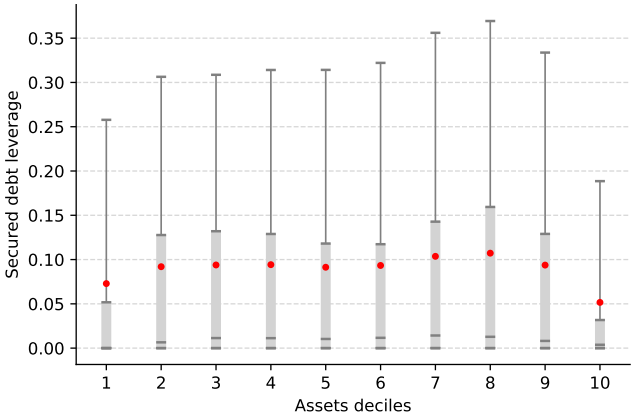
- **Shift to secured debt, esp. low-rated firms**



Stylized Fact 1 – Secured Debt and Financial Constraints

- **Financial structure and assets across size deciles**

Panel A: Secured debt/Assets



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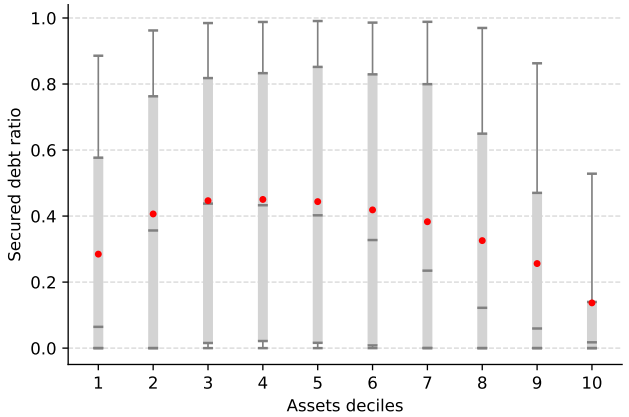

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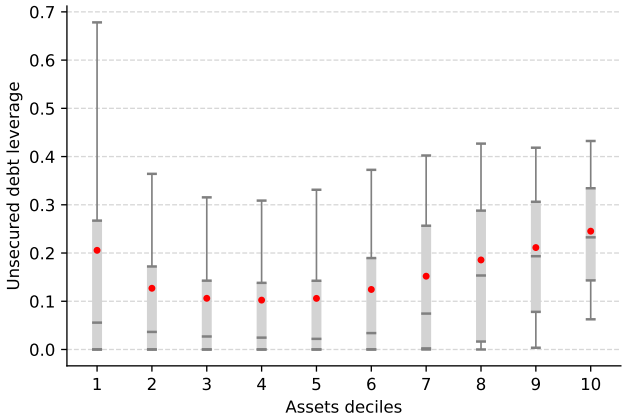

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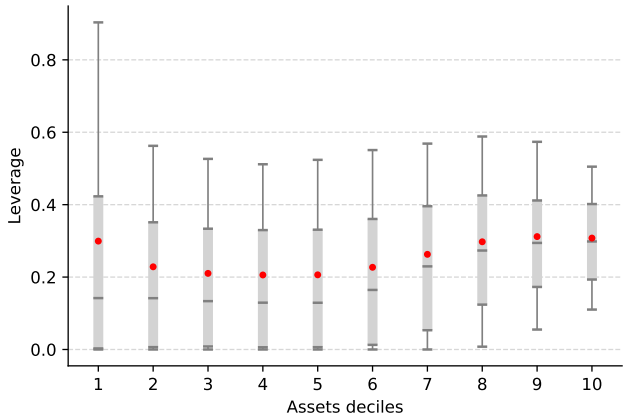


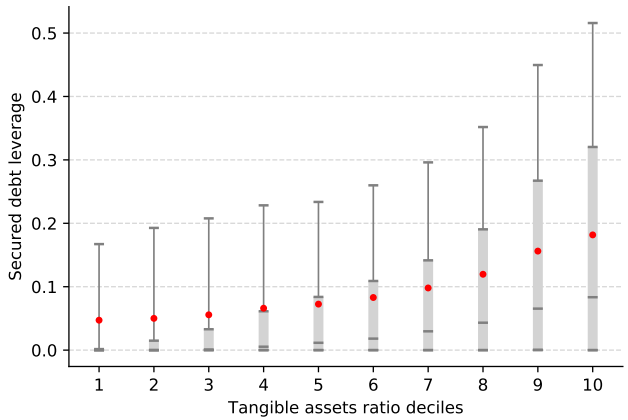
- Small (financially constrained) firms high fraction secured

▸ Assets & Div

Stylized Fact 2 – Financial Structure and Tangible Assets

- **Financial structure and assets across tangibility deciles**

Panel A: Secured debt/Assets



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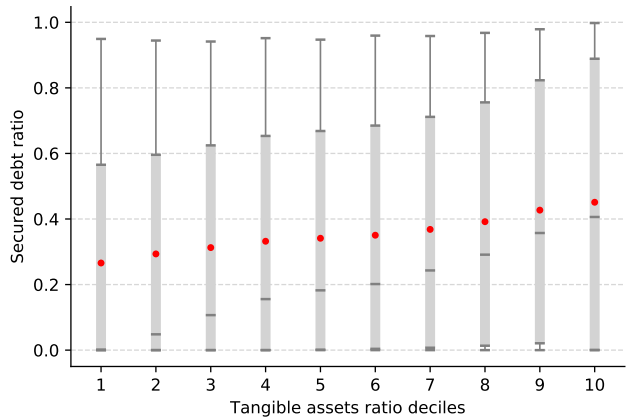

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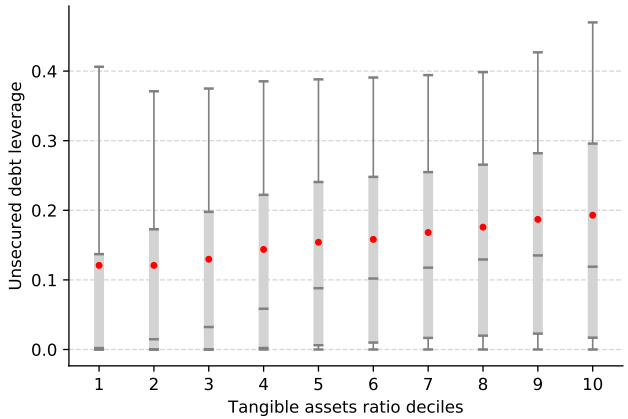

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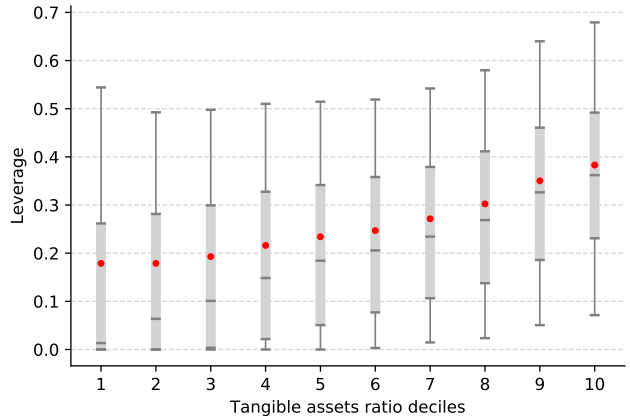
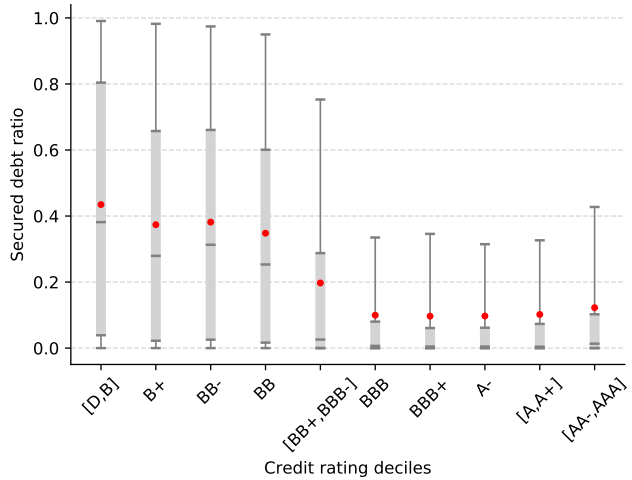


- Secured debt and total leverage increase substantially with tangibility

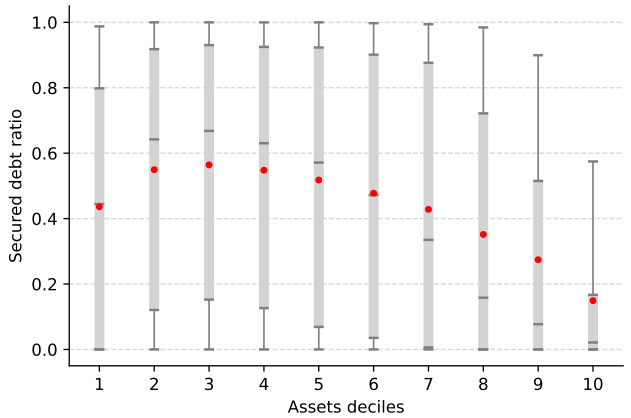
Stylized Facts – Secured Long-Term Debt Ratio

- **Ratio of secured debt to long-term debt**

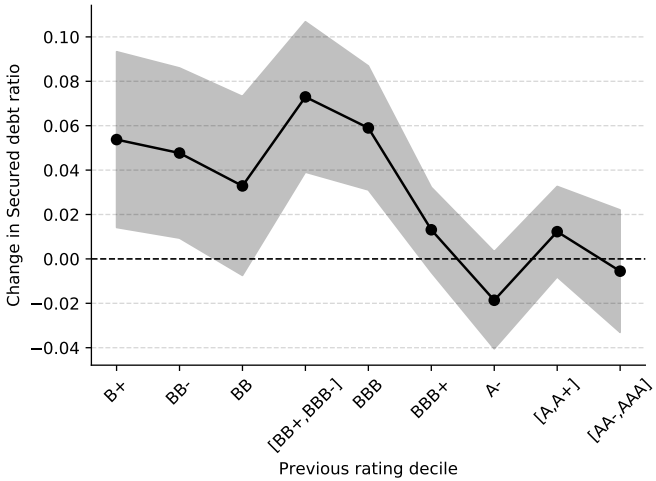
Panel A: Secured LT debt ratio by ratings



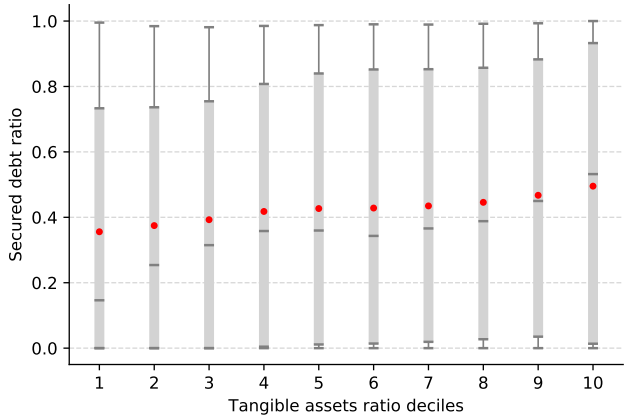
Panel B: Secured LT debt ratio by assets



Panel C: Δ Secured LT debt ratio



Panel D: Secured LT debt ratio by tangibility



- Patterns in secured LT debt still more pronounced

Model with Secured and Unsecured Debt

- Environment
  - Discrete time, infinite horizon: $t = 0, 1, 2, \ldots$.
  - Risk-neutral firm discounts at rate $\beta \in (0, 1)$; limited liability
  - Net worth w_0 at time 0
  - Two types of capital: tangible and intangible (fixed proportions)
  - Leontief aggregator $k \equiv \min\{k_p/\varphi, k_i/(1-\varphi)\}$; $\varphi \in (0, 1]$ tangible
  - Capital k yields cash flow $A(z')f(k)$ with productivity $A(z')$
  - z' follows Markov chain with transition function $\Pi(z, z')$ on $z' \in Z$
  - Capital k depreciates at rate $\delta \in (0, 1)$

- Production function
  - Decreasing returns and Inada condition
  - Assumption 1. *Production function f strictly increasing, strictly concave, $f(0) = 0$, $\lim_{k\to 0} f'(k) = +\infty$, and $\lim_{k\to+\infty} f'(k) = 0$*

Secured vs. Unsecured Debt

- Financing
  - Intangible capital $(1-\varphi)k$ internally financed
  - Tangible capital φk can be financed with secured and unsecured debt
    - Encumbered capital k_s explicitly pledged to secured lender
    - Unencumbered capital $k_u = \varphi k - k_s$ backs unsecured debt
- Collateralizability θ_s and cost κ of secured debt – Mann (1997)
  - Benefit: *"increas[es] the lender's ability to collect the debt forcibly through liquidation of the collateral"* and *"enhanc[es] the lender's remedy (so that the lender can coerce payment more quickly than it could if its debt were not secured)"*
  - Cost (direct and indirect): *"[y]ou just don't have the same flexibility of dealing with your properties as if you owned them unencumbered"*
  - Assumption 2. $1 > \theta_s > \theta_u \geq 0$ *and* $\kappa > 0$
- Benefits and costs of secured and unsecured debt
  - Assumption 3. $R^{-1}(\theta_s - \theta_u)(1-\delta) > \kappa > (R^{-1} - \beta)(\theta_s - \theta_u)(1-\delta)$
- Alternative: encumbered capital less efficient (indirect cost)
  - $\varphi k = k_u + \phi k_s$ with $\phi < 1$

Deterministic Model with Secured & Unsecured Debt

- Simplified model without uncertainty
  - No uncertainty (A' constant); no intangible capital ($\varphi = 1$)

- Firm's problem

$$v(w) = \max_{\{d,k_s,k_u,w',b'_s,b'_u\} \in \mathbb{R}^4_+ \times \mathbb{R}^2} d + \beta v(w') \tag{1}$$

subject to budget constraints for current and next period

$$w + \sum_{j \in \mathcal{J}} b'_j \quad \geq \quad d + \sum_{j \in \mathcal{J}} k_j + \kappa k_s \tag{2}$$

$$A' f\Big(\sum_{j \in \mathcal{J}} k_j\Big) + \sum_{j \in \mathcal{J}} k_j (1-\delta) \quad \geq \quad w' + \sum_{j \in \mathcal{J}} R b'_j \tag{3}$$

collateral constraints on secured and unsecured borrowing

$$\theta_j k_j (1-\delta) \geq R b'_j, \qquad \forall j \in \mathcal{J}, \tag{4}$$

where $\mathcal{J} \equiv \{s, u\}$.

Deterministic Model – First-order Conditions

- Notation
  - Multipliers on constraints (2) to (4): μ, $\beta\mu'$, and $\beta\lambda'_j$
  - Multipliers on non-negativity constraints for k_j and d: $\underline{\nu}_j$ and $\underline{\nu}_d$
  - Let $k \equiv \sum_{j\in\mathcal{J}} k_j$

- **First-order conditions**

$$\begin{aligned}
\mu &= 1 + \underline{\nu}_d && (5)\\
\mu &= \beta R\mu' + \beta R\lambda'_j, \qquad \forall j \in \mathcal{J}, && (6)\\
\mu(1+\kappa) &= \beta\mu'[A' f_k(k) + (1-\delta)] + \beta\lambda'_s\theta_s(1-\delta) + \underline{\nu}_s && (7)\\
\mu &= \beta\mu'[A' f_k(k) + (1-\delta)] + \beta\lambda'_u\theta_u(1-\delta) + \underline{\nu}_u && (8)\\
\beta\mu' &= \beta v_w(w') && (9)
\end{aligned}$$

- Envelope condition: $v_w(w) = \mu$ (marginal value of net worth)

- Note: $\lambda'_u = \lambda'_s \equiv \lambda'$

Model with Secured and Unsecured Debt

- **Down payments and investment Euler equation**
  - Down pmts: $\wp_s = 1 - R^{-1}\theta_s(1-\delta) + \kappa$; $\wp_u = 1 - R^{-1}\theta_u(1-\delta)$
  - Firm's investment Euler equation (IEE)

$$1 = \beta \frac{\mu'}{\mu} \frac{A' f_k(k) + (1-\theta_j)(1-\delta)}{\wp_j} + \frac{\underline{\nu}_j/\mu}{\wp_j}, \qquad \forall j \in \mathcal{J}. \tag{10}$$

- **Choice between secured and unsecured debt**
  - Rewrite IEEs using Jorgenson's (1963) frictionless user cost $u \equiv r + \delta$

$$u + R\kappa + R\frac{\lambda'}{\mu'}\wp_s \geq A' f_k(k) \tag{11}$$

$$u + R\frac{\lambda'}{\mu'}\wp_u \geq A' f_k(k), \tag{12}$$

    with equality if $k_j > 0$
  - Trade-off between cost of encumbering assets and down payments
  - Assumption 3 implies $\wp_s < \wp_u$ (otherwise secured debt dominated)
    - Secured debt enables more borrowing/higher leverage

Model with Secured and Unsecured Debt

- Using IEEs we get

$$1 = \beta \frac{\mu'}{\mu} \frac{(\theta_s - \theta_u)(1-\delta)}{\wp_u - \wp_s} + \frac{\underline{\nu}_u/\mu - \underline{\nu}_s/\mu}{\wp_u - \wp_s} \tag{13}$$

  - Let $R_s \equiv \frac{(\theta_s - \theta_u)(1-\delta)}{\wp_u - \wp_s} > R$ (by Assumption 2)
  - Secured debt is more costly

- **Severely constrained firms ($w \to 0$) use secured debt only**
  - (2) & (4) $\Rightarrow w \geq \sum_{j \in \mathcal{J}} \wp_j k_j$ and $k_j \to 0$, $\forall j \in \mathcal{J} \Rightarrow k \to 0$
  - IEE implies $\beta\mu'/\mu \to 0$; then (13) implies $\underline{\nu}_u > 0$

- **Dividend-paying firms ($d > 0$) use unsecured debt only**
  - Firm pays dividends in steady state: $\mu = \mu' = 1$, so $\beta\mu'/\mu = \beta$
  - By Assumption 3 $R_s > \beta^{-1}$; then (13) implies $\underline{\nu}_s > 0$
  - IEE: $1 = \beta \frac{A' f_k(k) + (1-\theta_u)(1-\delta)}{\wp_u}$ implicitly defines $\bar{k}$

- **Firms indifferent between secured and unsecured debt**
  - From (13): $\beta\mu'/\mu = R_s^{-1}$; IEE defines $\underline{k} < \bar{k}$

Model with Secured and Unsecured Debt: Characterization

- Given Assumptions 1 to 3, $\exists$ thresholds $0 < \underline{w}_s < \bar{w}_s < \bar{w} < +\infty$
- **Financing policy**
  - $w \leq \underline{w}_s$: issue only secured debt
  - $w \in (\underline{w}_s, \bar{w}_s)$: substitute from secured debt to unsecured debt
  - $w \geq \bar{w}_s$: use only unsecured debt
- **Investment** k increases in w; strictly if $w \leq \underline{w}_s$, $w \in [\bar{w}_s, \bar{w}]$
- **Payout policy:** firms with $w > \bar{w}$ pay dividends
- **Firm life cycle**
  - Over time, firms accumulate net worth, ...
  - ... increase investment,
  - ... substitute from secured debt to unsecured debt,
  - ... and eventually initiate dividends.

Model with Secured and Unsecured Debt with Uncertainty

- Stochastic productivity
  - Assumption 4. $\forall z_+, z \in Z \ni z_+ > z$, *(i)* $A(z_+) > A(z)$, *(ii)* $A(z) > 0$

- Firm's problem

$$v(w,z) = \max_{\{d,k_s,k_u,w',b'_s,b'_u\} \in \mathbb{R}^4_+ \times \mathbb{R}^{2S}} d + \beta E[v(w',z')|z] \tag{14}$$

subject to budget constraints for current and next period, $\forall z' \in Z$,

$$w + E\Big[\sum_{j\in\mathcal{J}} b'_j \Big| z\Big] \geq d + \frac{1}{\varphi}\sum_{j\in\mathcal{J}} k_j + \kappa k_s \tag{15}$$

$$A' f\Big(\frac{1}{\varphi}\sum_{j\in\mathcal{J}} k_j\Big) + \frac{1}{\varphi}\sum_{j\in\mathcal{J}} k_j(1-\delta) \geq w' + \sum_{j\in\mathcal{J}} Rb'_j \tag{16}$$

and collateral constraints (4) $\forall \{j, z'\} \in \mathcal{J} \times Z$

Model with Secured and Unsecured Debt

- **Investment Euler equation (IEE)**

$$1 = E\left[\beta\frac{\mu'}{\mu}\frac{A'f_k(k)+(1-\varphi\theta_j)(1-\delta)}{\wp_j^{\varphi}}\middle| z\right] + \frac{\varphi\underline{\nu}_j/\mu}{\wp_j^{\varphi}} \qquad (17)$$

  where $\wp_j^{\varphi} \equiv 1-\varphi+\varphi\wp_j$

- **Severely constrained firms ($w \to 0$) use secured debt only**
  - (15) & (4) $\Rightarrow w \geq \frac{1}{\varphi}\sum_{j\in\mathcal{J}}\wp_j^{\varphi}k_j \Rightarrow k_j \to 0,\ \forall j \in \mathcal{J};\ k \to 0$
  - IEE implies $\beta\mu'/\mu \to 0,\ \forall z' \in Z$ since

$$\begin{aligned} 1 &\geq E\left[\beta\frac{\mu'}{\mu}\frac{A'f_k(k)+(1-\varphi\theta_j)(1-\delta)}{\wp_j^{\varphi}}\middle| z\right] \\ &\geq \beta\frac{\mu'}{\mu}\frac{A'f_k(k)+(1-\varphi\theta_j)(1-\delta)}{\wp_j^{\varphi}} \end{aligned}$$

  - Analogous argument implies $\underline{\nu}_u > 0$
  - **Financially constrained firms borrow secured**

- **Dividend-paying firms use unsecured debt only**

Quantitative Evaluation

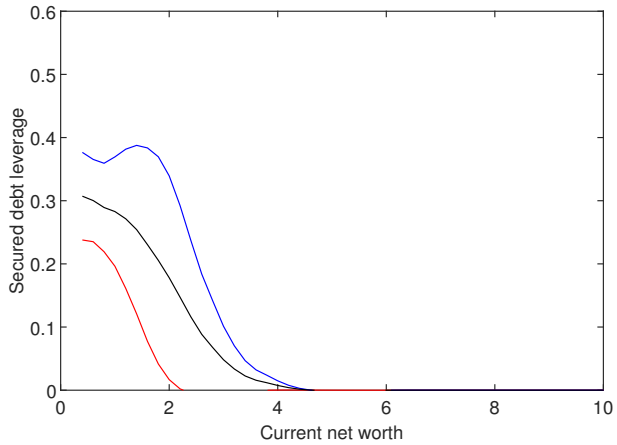
- **Baseline calibration based on Li/Whited/Wu (2016)**
  - Structural estimate version of R/V (2013) model using SMM
  - Calibrated parameters:
    - $\beta = 0.985$ – avg. real 3m T-bill rate 1965-2012: 1.5%
    - $R^{-1} = 0.988$ – difference due to tax wedge with $\tau = 20\%$
  - Estimated parameters:
    - $f(k) = k^{\alpha}$ and $\alpha = 0.6$
    - $A(z') = \exp(z')$ with $\sigma_z = 0.5$ and $\rho_z = 0.5$
    - Not used: $\delta = 0.04$; $\theta = 0.4$

- **Our parametrization**
  - Symmetric two-state Markov chain with $\Pi(z, z) = 0.75$ to match ρ_z
  - $\delta = 0.1$
  - $\varphi = 0.6$: Falato/Kadyrzhanova/Sim/Steri (forthcoming)
  - Calibrated: $\theta_s = 0.8$; $\theta_u = 0.6$; $\kappa = 0.01$

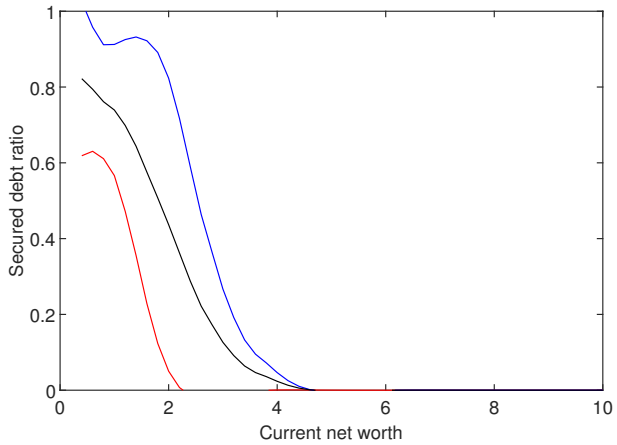
Quantitative Evaluation

- **Financial structure by net worth** ▸ Data ▸ Causal Forest

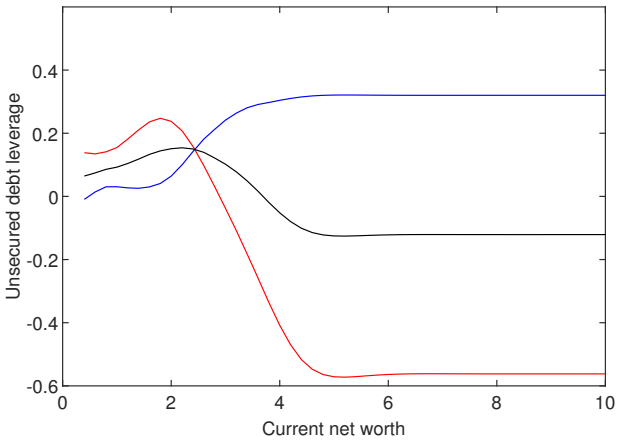
Panel A: Secured debt/Assets



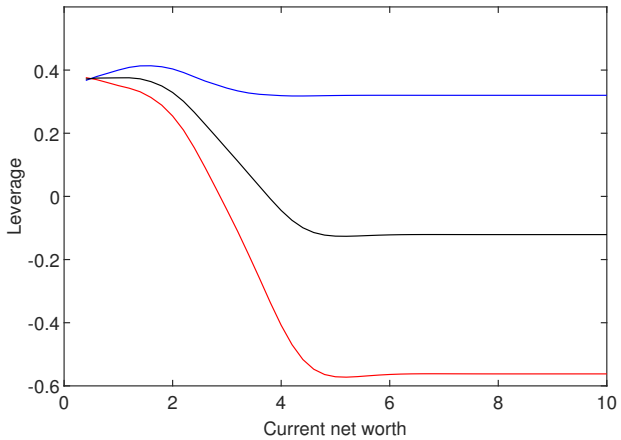
Panel B: Secured debt/Total debt



Panel C: Unsecured debt/Assets



Panel D: Debt/Assets



- Secured debt and leverage decrease with net worth

Secured Debt and Leasing (skipped today)

▸ Leasing

Effect of Downgrades – Inference using Causal Forest

Skip

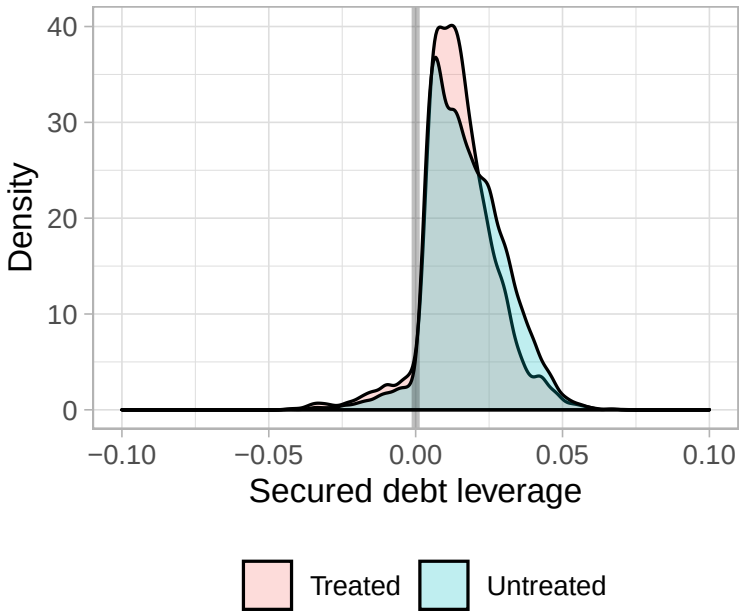
- **Estimate heterogeneous treatment effects using causal forest**
  - Method: Wager/Athey (2018); Athey/Wager (2019)
  - Application to covenant violations: Gulen/Jens/Page (2021)

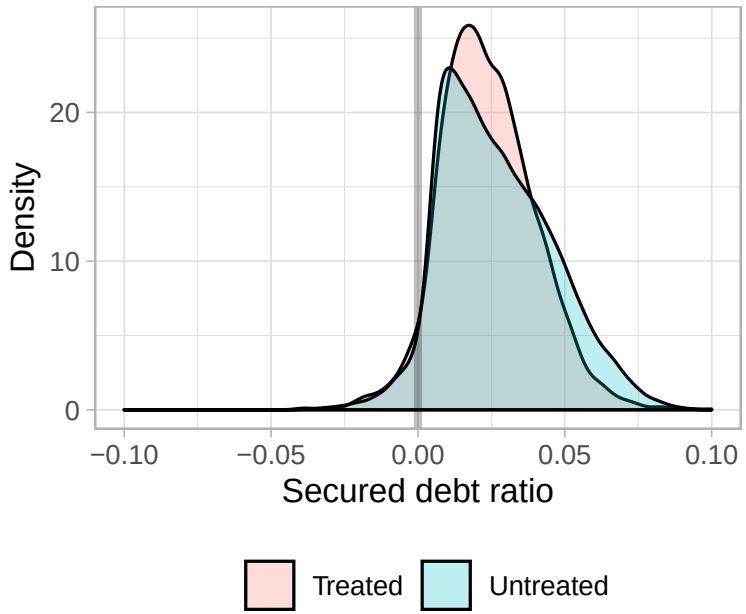
- **Primer on causal forest**
  - Non-parametric machine learning based estimation method
  - Intuitively: nearest neighbor method with adaptive neighborhood
  - Classification and regression trees (CARTs): tree with leaves
    - Grow tree by recursively splitting sample by covariates
    - Maximize variance of treatment effects across leaves
  - Honest (causal) tree splits sample into training and estimation set
  - Causal forest aggregates causal trees to allow inference
    - Obtain consistent, asymptotically normal treatment effect

- **Our causal forest:** 4000 trees using 50% of sample, 50% honesty
  - Outcome var: financial structure, assets, and payout policy; treatment: downgrade
  - Covariates: SecDebt, UnsecDebt, Debt, NetInc, MktCap, Div (all /Assets); SecDebt/Debt; Rating; MktCap; Assets; Tangibility

Causal Forest – Treatment Effect Densities

- **Density of conditional avg. treatment effects (CATEs)**
  - Treatment: ratings downgrades by one notch (or more)
  - Effect on secured debt leverage and secured debt ratio
  - Densities for treatment effects on the treated (TT) and control (TC)



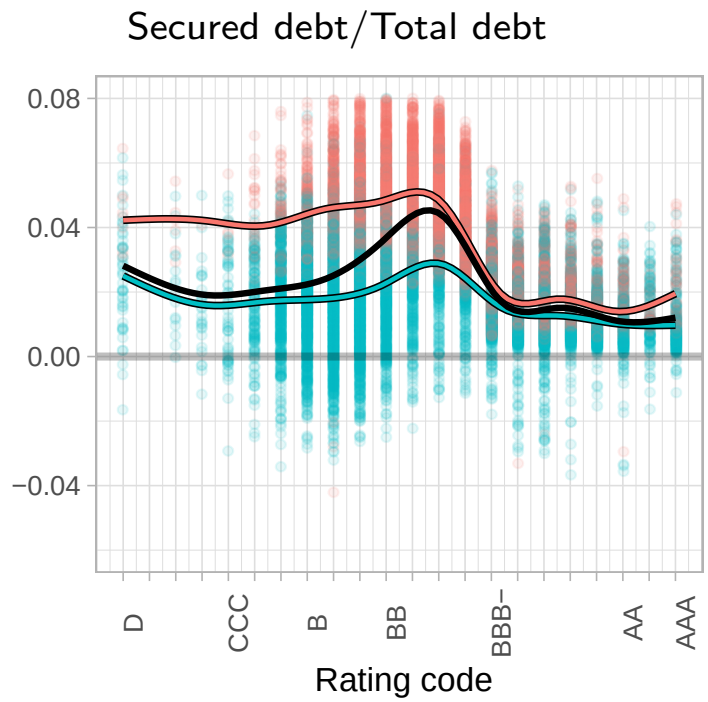


- Estimates of average treatment effects ▸ ATE/ATT/ATC

Causal Forest – Heterogenous Treatment Effects

▸ Model

- **Treatment effect of one-notch (or more) downgrade by rating**



▸ Unsecured and Total Debt ▸ Assets and Dividends ▸ Secured Debt (Lease-adj.)

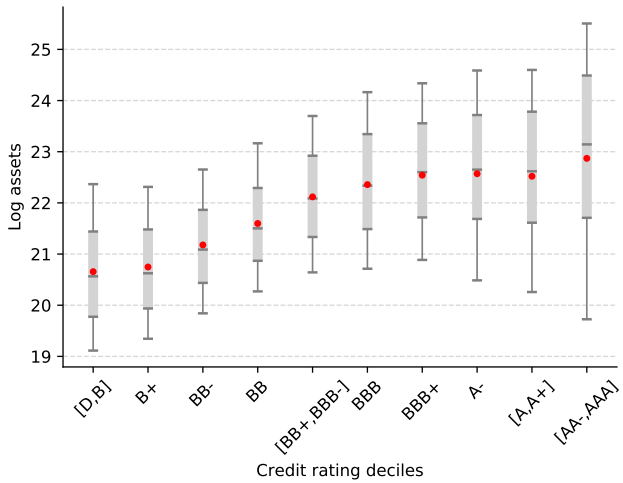
Conclusion

- **Secured debt enables higher leverage but entails costs**
  - Explicit collateralization gives secured lender strong claim on assets
  - More constrained firms use more secured debt within and across firms
- **Collateral restricts both secured and unsecured debt**
  - Unsecured debt backed by unencumbered assets
- **Consistent with stylized facts and evidence from causal forest**
- **Collateral is essential to understanding capital structure**
  - Collateral constraints matter despite large firms borrowing unsecured
  - Firms shift to secured debt when constrained
  - Bulk of debt secured for small firms and lease-adj. for most firms
  - Unsecured debt implicitly collateralized

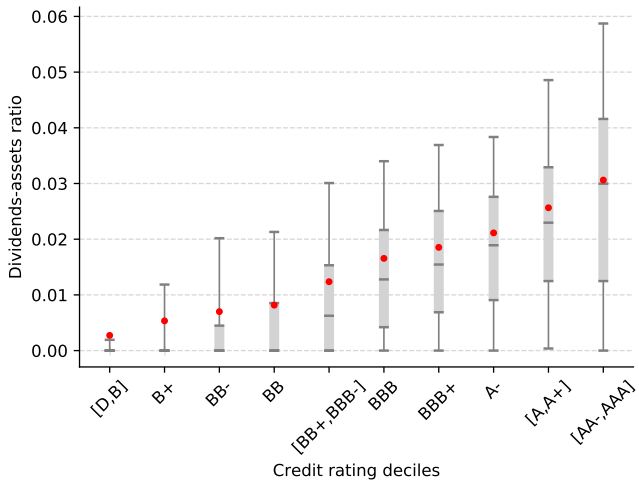
Stylized Fact 1 – Secured Debt and Financial Constraints

- **Assets and dividend payout across rating deciles**

Panel E: Log assets



Panel F: Dividends/Assets



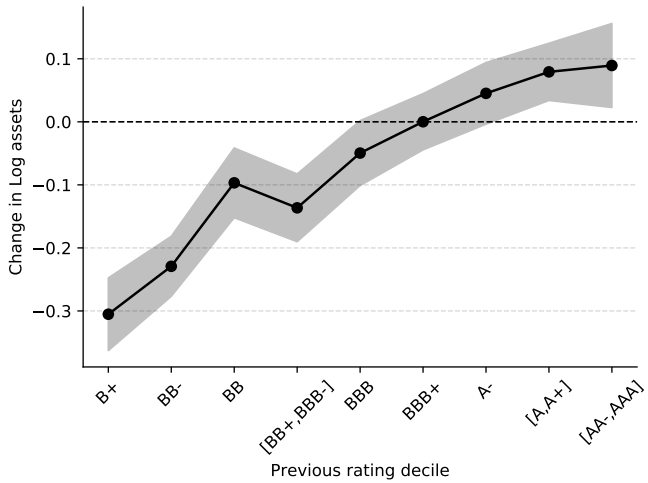
- Firms with low ratings are smaller and pay lower (or no) dividends
  - Low rated firms seem **more constrained**

Back

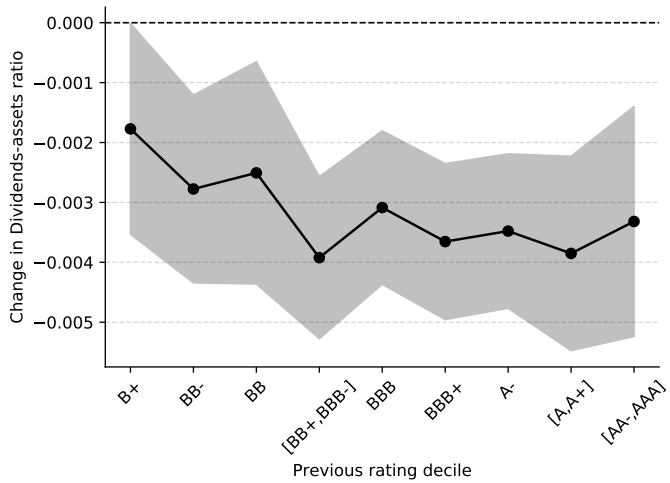
Stylized Fact 1 – Secured Debt and Financial Constraints

- **Within-firm variation: Assets & payout effect of downgrades**

Panel E: Log assets



Panel F: Dividends/Assets



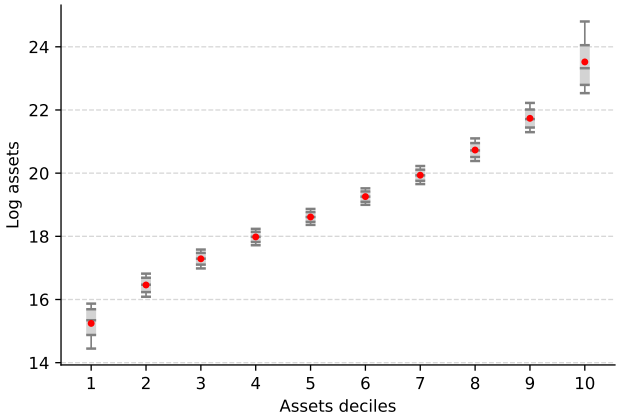
- Downgraded firms downsize and reduce payout substantially

Back

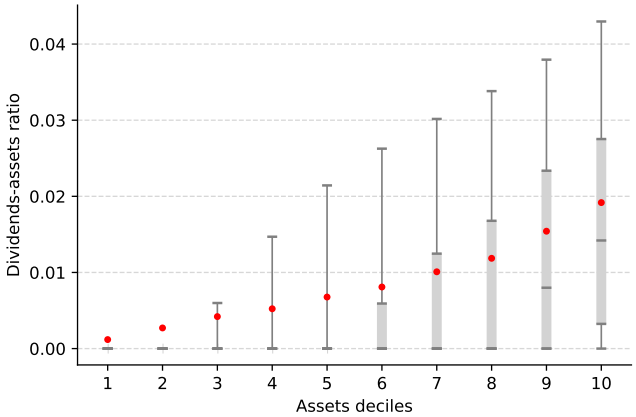
Stylized Fact 1 – Secured Debt and Financial Constraints

- **Assets and dividend payout across size deciles**

Panel E: Log Assets



Panel F: Dividends/Assets



- Dramatic size pattern in dividends

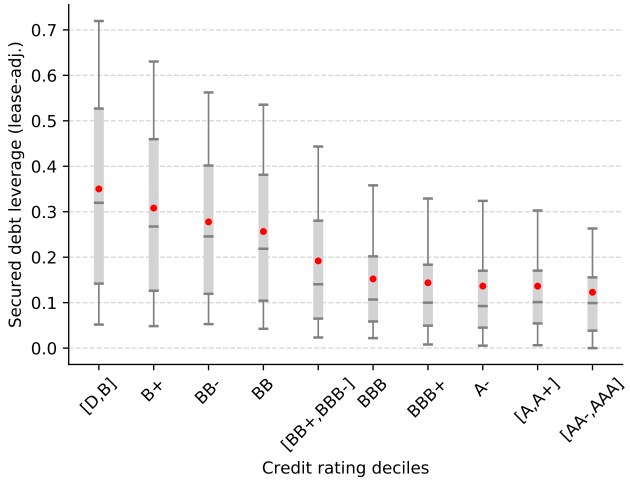
Back

Stylized Fact 1 – Secured Debt and Leasing

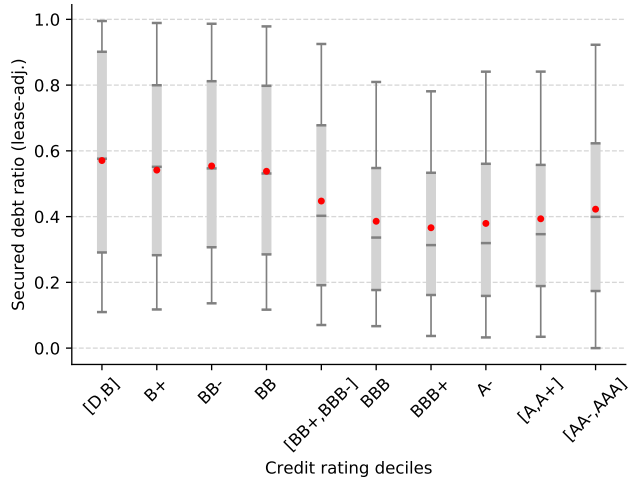
Skip

- **Financial structure and leasing across rating deciles**

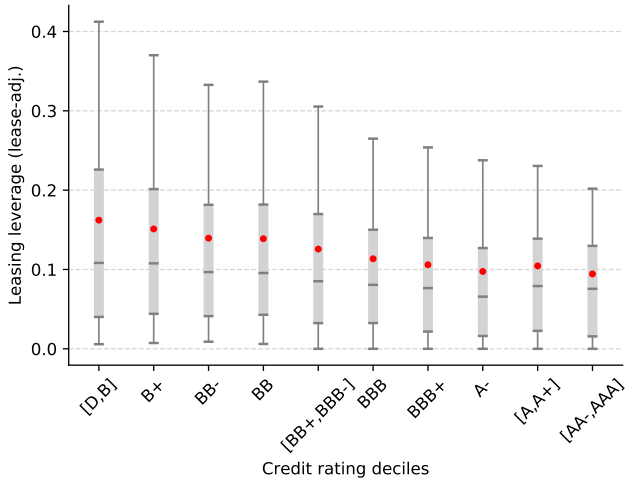
Panel A: Secured debt/Assets (lease-adj.)



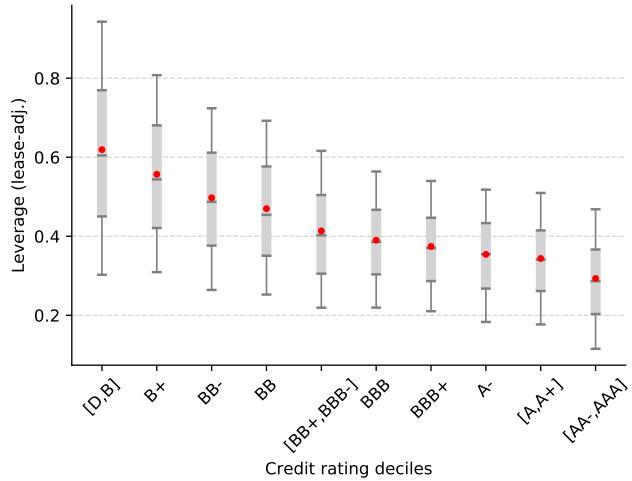
Panel B: Secured debt/Total debt (lease-adj.)



Panel C: Leasing debt/Assets (lease-adj.)



Panel D: Debt/Assets (lease-adj.)

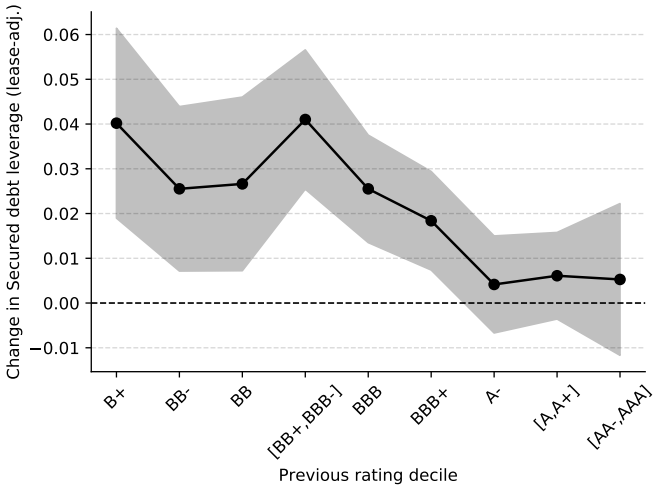


- **Cross section:** accentuated patterns and higher level

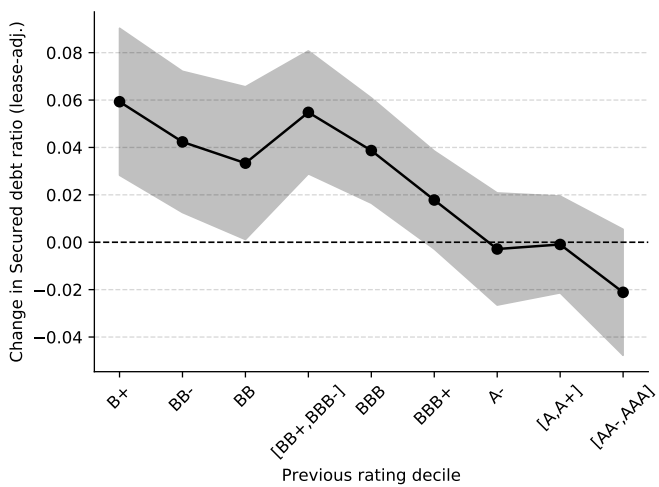
Stylized Fact 1 – Secured Debt and Leasing

- **Within-firm variation: heterogeneous effects of downgrades**

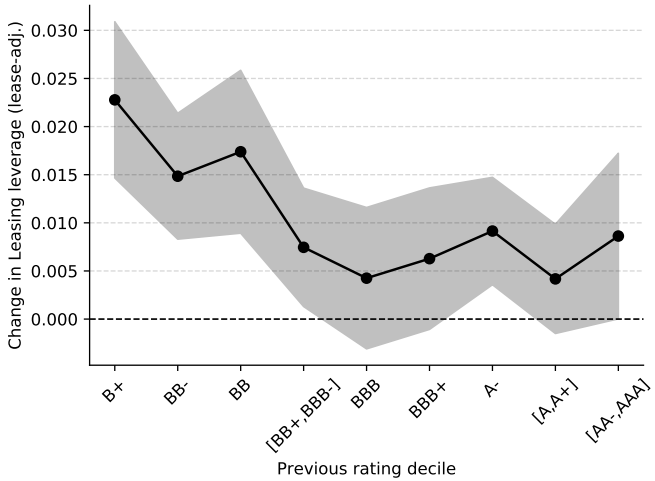
Panel A: Secured debt/Assets (lease-adj.)



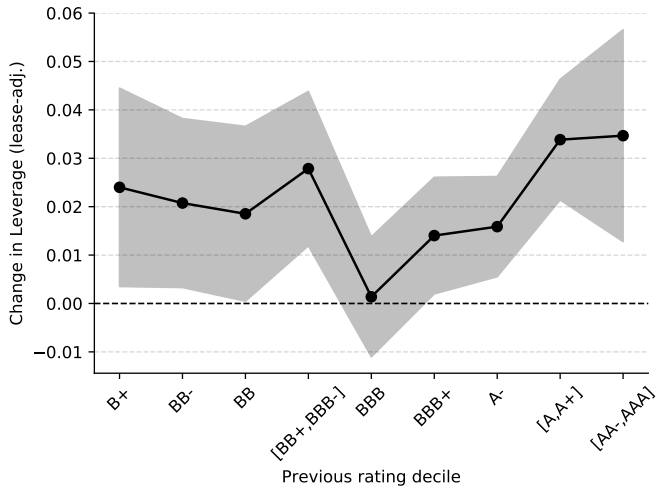
Panel B: Secured debt/Total debt (lease-adj.)



Panel C: Leasing debt/Assets (lease-adj.)



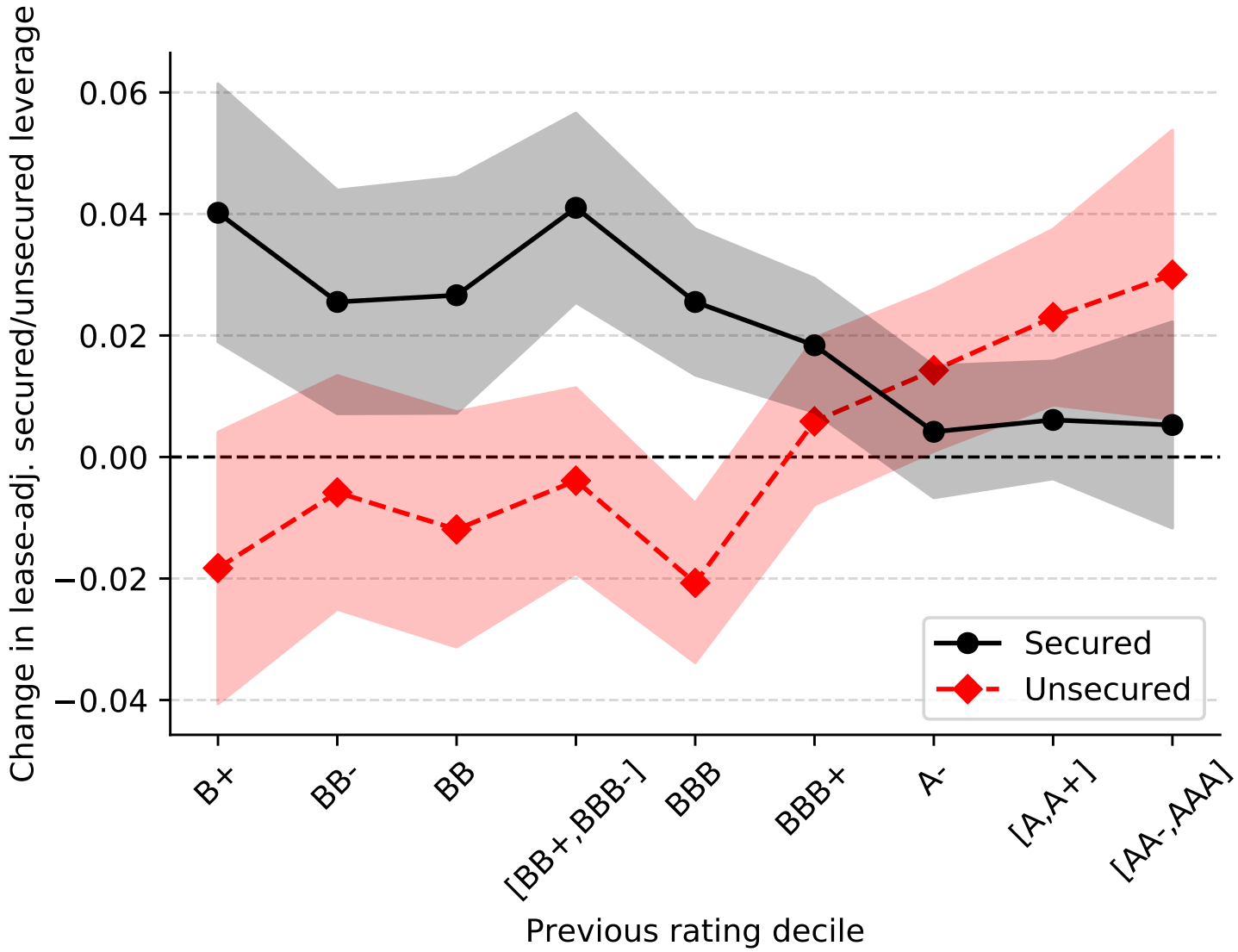
Panel D: Debt/Assets (lease-adj.)



- Firms that are downgraded shift to secured debt and leasing

Stylized Fact 1 – Secured Debt and Leasing

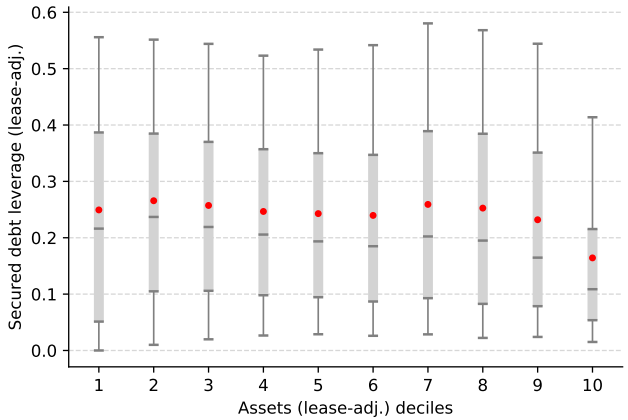
- **Shift to secured debt (incl. leasing), esp. low-rated firms**



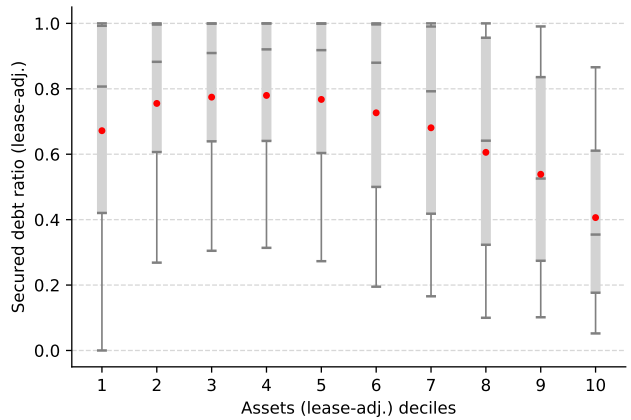
Stylized Fact 1 – Secured Debt and Leasing

- **Financial structure and leasing across size deciles**

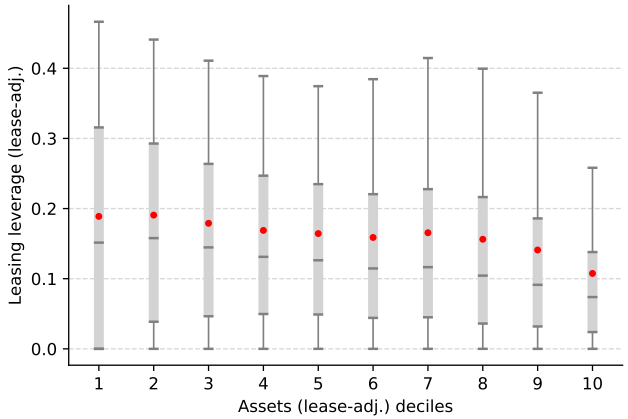
Panel A: Secured debt/Assets (lease-adj.)



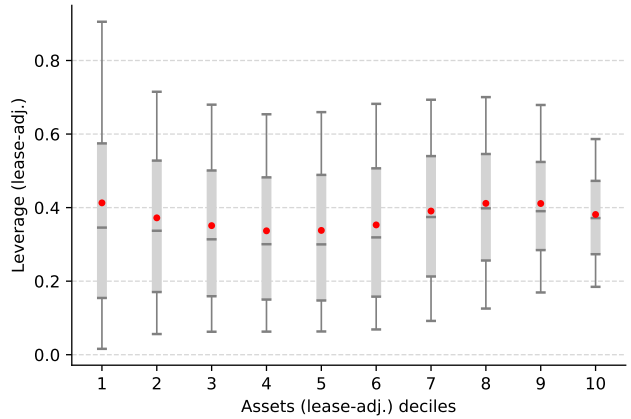
Panel B: Secured debt/Total debt (lease-adj.)



Panel C: Leasing debt/Assets (lease-adj.)



Panel D: Debt/Assets (lease-adj.)

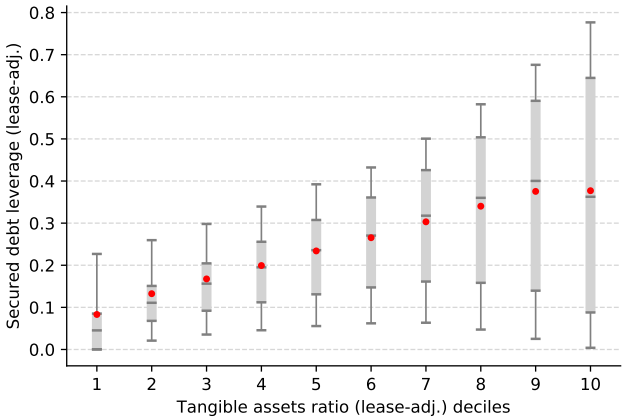


- Bulk of financing secured in all but largest firms

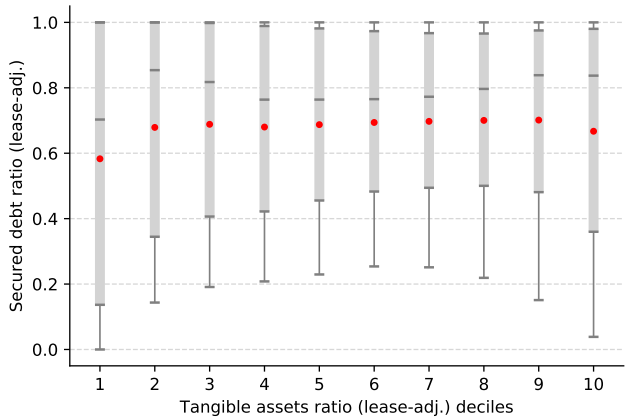
Stylized Fact 2 – Financial Structure and Tangible Assets

- **Financial structure and leasing across tangibility deciles**

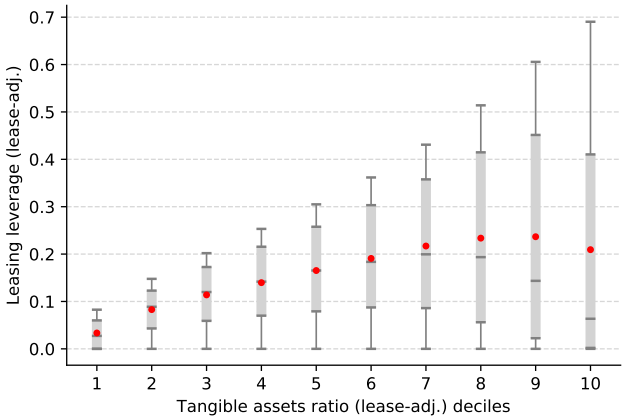
Panel A: Secured debt/Assets (lease-adj.)



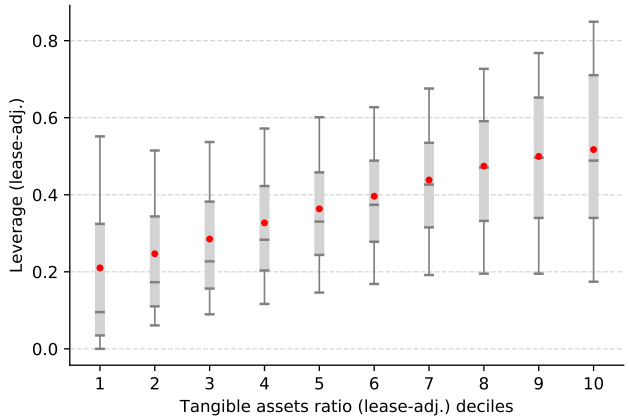
Panel B: Secured debt/Total debt (lease-adj.)



Panel C: Leasing debt/Assets (lease-adj.)



Panel D: Debt/Assets (lease-adj.)

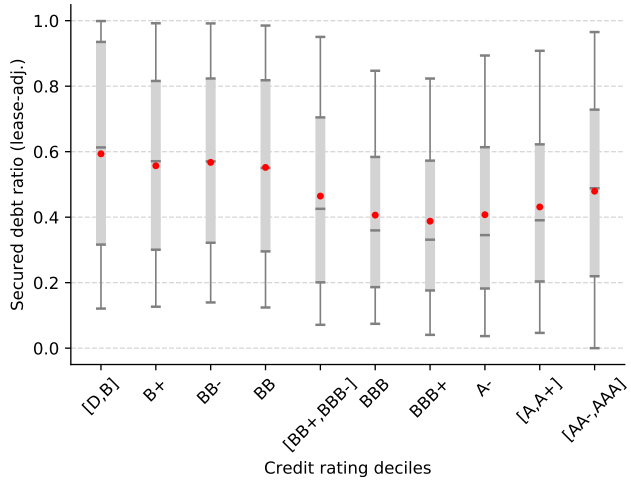


- Secured debt, leasing, and total leverage all increase with tangibility

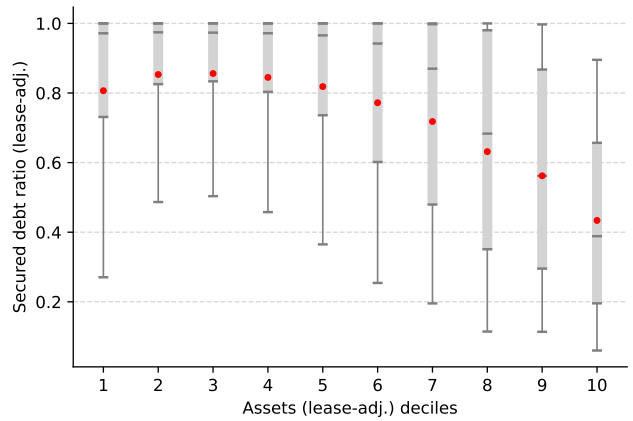
Stylized Facts – Secured LT Debt Ratio (Lease-Adj.)

- **Ratio of secured debt to long-term debt (lease-adj.)**

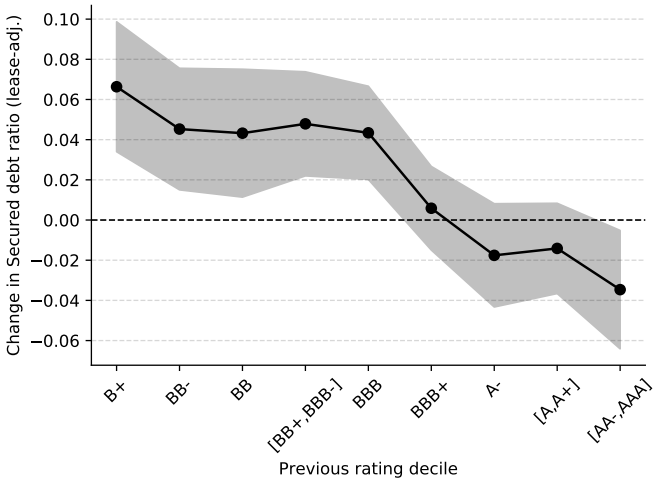
Panel A: Secured LT debt ratio by ratings



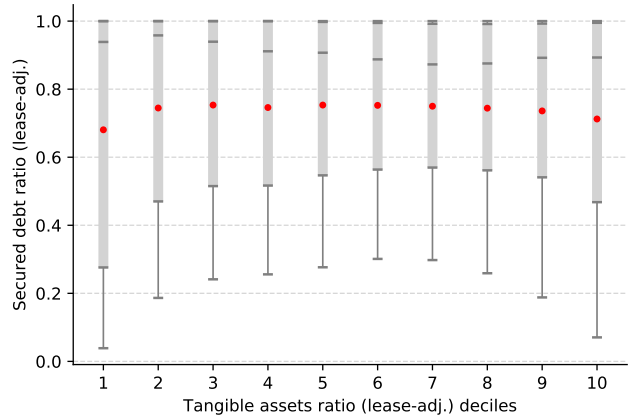
Panel B: Secured LT debt ratio by assets



Panel C: Δ Secured LT debt ratio



Panel D: Secured LT debt ratio by tangibility



- Patterns in secured LT debt still more pronounced

Model with Secured and Unsecured Debt and Leasing

- Benefits and costs of leasing k_l
  - Monitoring cost $m > 0$; leasing fee $\wp_l \equiv R^{-1}u + m$
  - Assumption 5. $R^{-1}(1-\theta_s)(1-\delta) > m - \kappa > \frac{1-\theta_s}{\theta_s - \theta_u}\kappa$
  - Implies $\wp_s > \wp_l$ and $R_l \equiv \frac{(1-\theta_s)(1-\delta)}{\wp_s - (R^{-1}u+m)} > R_s$
  - Repossession advantage: Eisfeldt/Rampini (2009); R/V (2013)
- Firm's problem

$$v(w,z) = \max_{\{d,k_s,k_u,k_l,w',b'_s,b'_u\} \in \mathbb{R}^5_+ \times \mathbb{R}^{2S}} d + \beta E[v(w',z')|z] \qquad (18)$$

subject to budget constraints for current and next period, $\forall z' \in Z$,

$$w + E\Big[\sum_{j\in\mathcal{J}} b'_j \Big| z\Big] \geq d + \frac{1}{\varphi}\sum_{j\in\mathcal{J}} k_j + \kappa k_s + \frac{1-\varphi+\varphi(R^{-1}u+m)}{\varphi}k_l$$

$$A'f\Big(\frac{1}{\varphi}\Big(\sum_{j\in\mathcal{J}} k_j + k_l\Big)\Big) + \frac{1}{\varphi}\Big(\sum_{j\in\mathcal{J}} k_j + (1-\varphi)k_l\Big)(1-\delta) \geq w' + \sum_{j\in\mathcal{J}} Rb'_j$$

and collateral constraints (4) $\forall\{j,z'\} \in \mathcal{J}\times Z$

- Prediction: Most constrained firms lease, then borrow secured

Back

Average Treatment Effects from Causal Forest

- Effects on financial structure, investment, and payout policy
- ATE/ATT/ATC: Average Treatment Effect; on Treated; on Control

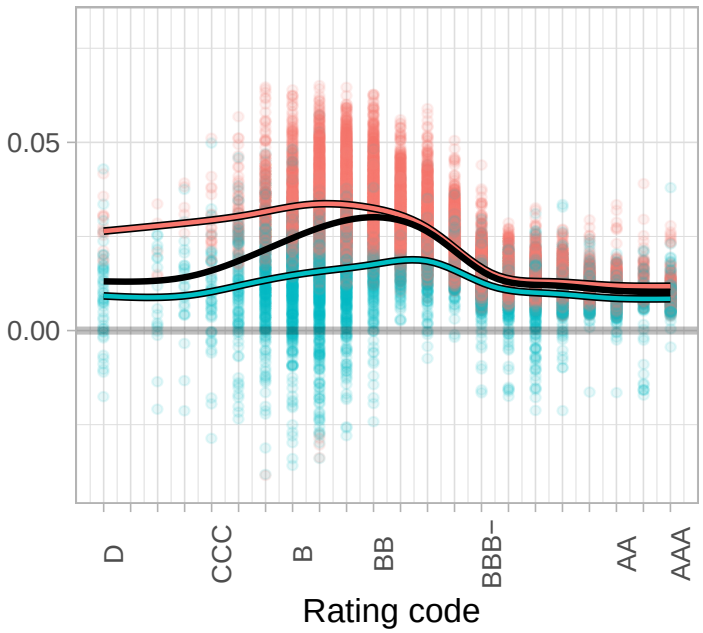
Outcome variable	ATE	ATT	ATC
Secured debt /Assets	0.021	0.016	0.022
	(6.973)	(5.602)	(6.962)
Secured debt/Total debt	0.032	0.025	0.033
	(5.629)	(4.914)	(5.563)
Unsecured debt/Assets	0.018	0.011	0.019
	(4.753)	(3.230)	(4.829)
Debt/Assets	0.040	0.027	0.042
	(9.740)	(7.340)	(9.803)
Log assets (level)	-0.101	-0.110	-0.099
	(-8.746)	(-11.220)	(-8.222)
Dividends/Assets	-0.004	-0.003	-0.004
	(-11.329)	(-12.098)	(-10.998)

Back

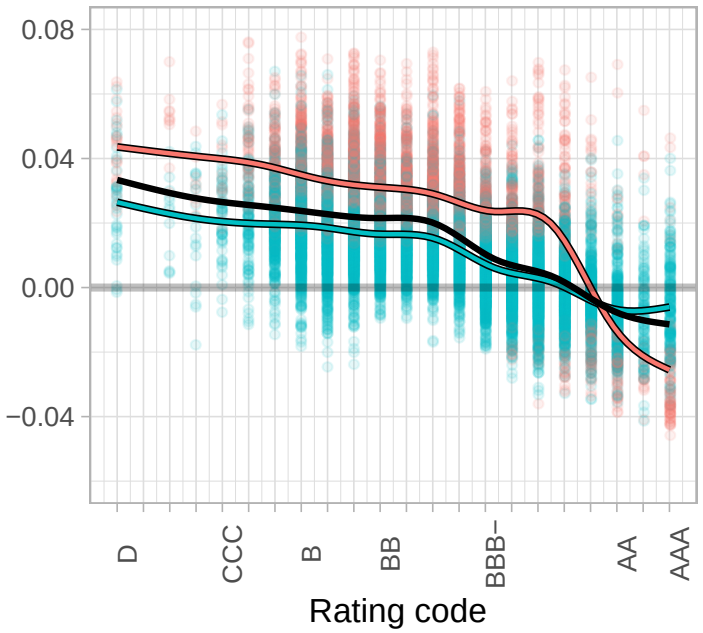
Causal Forest – Treatment Effects (Lease-adj.)

- **Treatment effect of one-notch (or more) downgrade by rating**

Secured debt/Assets (lease-adj.)



Secured debt/Total debt (lease-adj.)



▸ Leasing and Unsecured Debt ◂ Back

Average Treatment Effects from Causal Forest

- Treatment Effects on Financial Structure (Lease-adj.)

Outcome variable	ATE	ATT	ATC
Secured debt /Assets	0.024	0.020	0.025
	(8.753)	(7.415)	(8.719)
Secured debt/Total debt	0.016	0.019	0.015
	(3.464)	(4.453)	(3.236)
Unsecured debt/Assets	0.012	0.005	0.013
	(3.956)	(1.559)	(4.186)
Debt/Assets	0.038	0.026	0.040
	(10.620)	(8.059)	(10.703)
Leasing debt/Assets	0.014	0.016	0.014
	(7.677)	(9.153)	(7.328)

Back

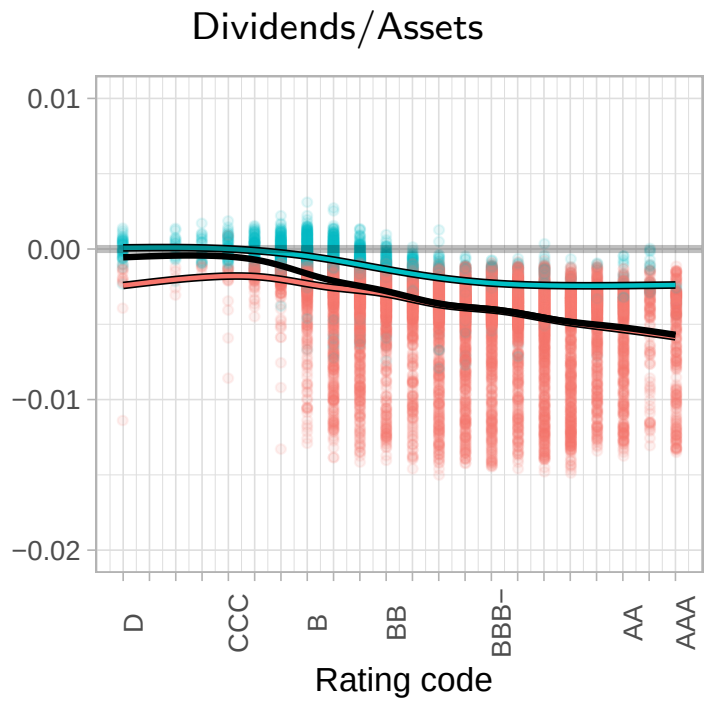
Causal Forest – Heterogenous Treatment Effects

- **Treatment effect of one-notch (or more) downgrade by rating**

▶ Assets and Dividends ◀ Back

Causal Forest – Heterogenous Treatment Effects

- **Treatment effect of one-notch (or more) downgrade by rating**

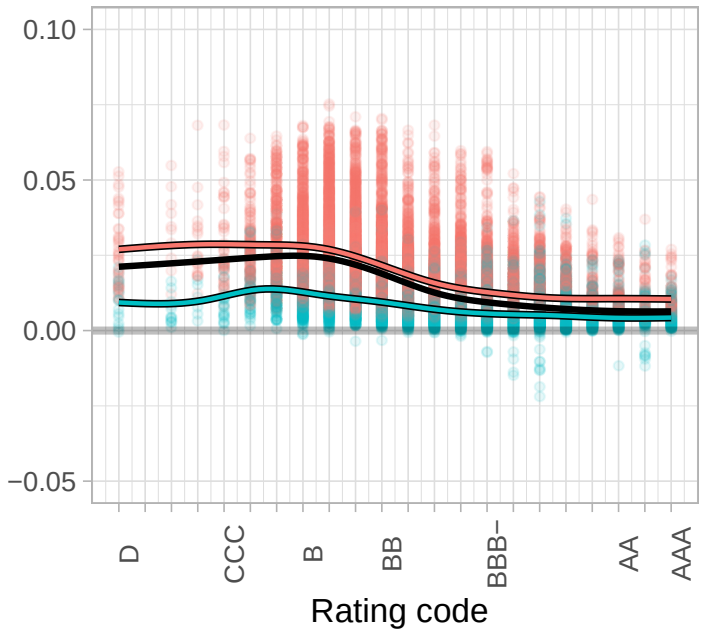


Back

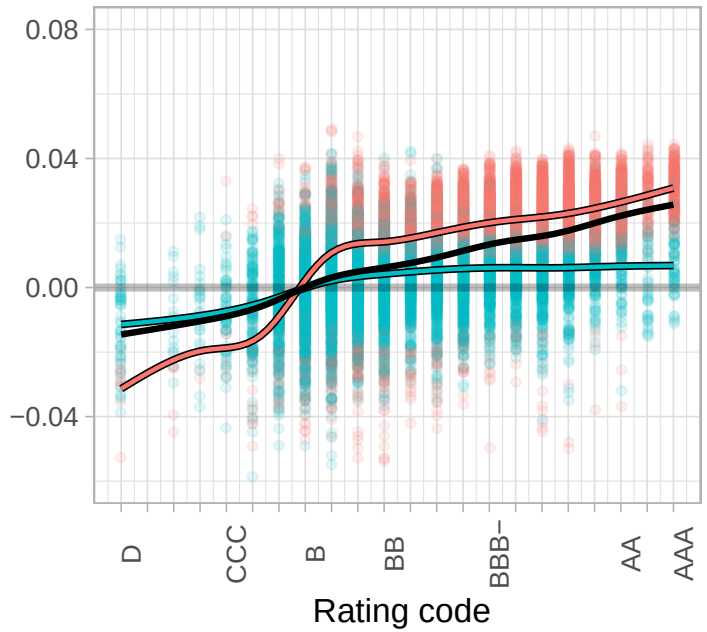
Causal Forest – Treatment Effects (Lease-adj.)

- **Treatment effect of one-notch (or more) downgrade by rating**

Leasing debt/Total debt (lease-adj.)



Unsecured debt/Assets (lease-adj.)



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