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
  - 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

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Stylized Fact 1 – Secured Debt and Financial Constraints

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

**Panel A:** Secured debt/Assets

**Panel B:** Secured debt/Total debt

**Panel C:** Unsecured debt/Assets

**Panel D:** Debt/Assets

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

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Collateral and Secured Debt
Stylized Fact 1 – Secured Debt and Financial Constraints

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

<table>
<thead>
<tr>
<th>Previous rating decile</th>
<th>0.04</th>
<th>0.02</th>
<th>0.00</th>
<th>0.02</th>
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<tr>
<td>Change in secured/unsecured leverage</td>
<td>Secured</td>
<td>Unsecured</td>
<td></td>
<td></td>
<td></td>
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Stylized Fact 1 – Secured Debt and Financial Constraints

Financial structure and assets across size deciles

Panel A: Secured debt/Assets

Panel B: Secured debt/Total debt

Panel C: Unsecured debt/Assets

Panel D: Debt/Assets

Small (financially constrained) firms high fraction secured

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Collateral and Secured Debt
Financial structure and assets across tangibility deciles

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 \(\varphi k\) 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** \(\theta_s\) and cost \(\kappa\) 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

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

subject to budget constraints for current and next period

\[
w + \sum_{j \in \mathcal{J}} b'_j \geq d + \sum_{j \in \mathcal{J}} k_j + \kappa k_s
\]  

\[
A' f\left(\sum_{j \in \mathcal{J}} k_j\right) + \sum_{j \in \mathcal{J}} k_j (1 - \delta) \geq w' + \sum_{j \in \mathcal{J}} Rb'_j
\]  

collateral constraints on secured and unsecured borrowing

\[
\theta_j k_j (1 - \delta) \geq Rb'_j, \quad \forall j \in \mathcal{J},
\]  

where $\mathcal{J} \equiv \{s, u\}$. 
Deterministic Model – First-order Conditions

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

- **First-order conditions**

  \[
  \mu = 1 + \nu_d \tag{5}
  \]

  \[
  \mu = \beta R \mu' + \beta R \lambda'_j, \quad \forall j \in J, \tag{6}
  \]

  \[
  \mu (1 + \kappa) = \beta \mu' [A' f_k(k) + (1 - \delta)] + \beta \lambda'_s \theta_s (1 - \delta) + \nu_s \tag{7}
  \]

  \[
  \mu = \beta \mu' [A' f_k(k) + (1 - \delta)] + \beta \lambda'_u \theta_u (1 - \delta) + \nu_u \tag{8}
  \]

  \[
  \beta \mu' = \beta v_w (w') \tag{9}
  \]

- **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: \( \varphi_s = 1 - R^{-1}\theta_s(1 - \delta) + \kappa; \varphi_u = 1 - R^{-1}\theta_u(1 - \delta) \)
  - Firm’s investment Euler equation (IEE)
    \[
    1 = \beta \frac{\mu'}{\mu} A' f_k(k) + (1 - \theta_j)(1 - \delta) \frac{\nu_j}{\varphi_j}, \quad \forall j \in J. \tag{10}
    \]

- **Choice between secured and unsecured debt**
  - Rewrite IEEs using Jorgenson’s (1963) frictionless user cost \( u \equiv r + \delta \)
    \[
    u + R\kappa + R \frac{\lambda'}{\mu'} \varphi_s \geq A' f_k(k) \tag{11}
    \]
    \[
    u + R \frac{\lambda'}{\mu'} \varphi_u \geq A' f_k(k), \quad (12)
    \]
    with equality if \( k_j > 0 \)
  - Trade-off between cost of encumbering assets and down payments
  - Assumption 3 implies \( \varphi_s < \varphi_u \) (otherwise secured debt dominated)
    - Secured debt enables more borrowing/higher leverage
Model with Secured and Unsecured Debt

- Using IEEs we get

\[ 1 = \beta \frac{\mu'}{\mu} \left( \theta_s - \theta_u \right) (1 - \delta) \frac{\varphi_u - \varphi_s}{\varphi_u - \varphi_s} + \frac{\nu_u}{\mu} - \frac{\nu_s}{\mu} \varphi_u - \varphi_s \]  \quad (13)

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

- **Severely constrained firms** (*w → 0*) use secured debt only
  - (2) & (4) ⇒ \( w \geq \sum_{j \in J} \varphi_j k_j \) and \( k_j \to 0, \forall j \in J \) ⇒ \( k \to 0 \)
  - IEE implies \( \beta \mu'/\mu \to 0 \); then (13) implies \( \nu_u > 0 \)

- **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 \( \nu_s > 0 \)
  - IEE: \( 1 = \beta \frac{A' f_k(k)}{\varphi u} + (1 - \theta_u) (1 - \delta) \) 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, \( 0 < w_s < \bar{w}_s < \bar{w} < +\infty \)

- **Financing policy**
  - \( w \leq w_s \): issue only secured debt
  - \( w \in (w_s, \bar{w}_s) \): substitute from secured debt to unsecured debt
  - \( w \geq \bar{w}_s \): use only unsecured debt

- **Investment** \( k \) increases in \( w \); strictly if \( w \leq w_s, w \in [\bar{w}_s, \bar{w}] \)

- **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

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

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

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

\[
A'f \left( \frac{1}{\varphi} \sum_{j \in J} k_j \right) + \frac{1}{\varphi} \sum_{j \in J} k_j (1 - \delta) \geq w' + \sum_{j \in J} Rb'_j \tag{16}
\]

and collateral constraints (4) \( \forall \{j, z'\} \in J \times Z \)
Model with Secured and Unsecured Debt

- **Investment Euler equation (IEE)**

\[
1 = E \left[ \frac{\beta \mu'}{\mu} A' f_k(k) + (1 - \varphi \theta_j)(1 - \delta) \right] z + \frac{\varphi \nu_j / \mu}{\varphi_j} \tag{17}
\]

where \( \varphi_j \equiv 1 - \varphi + \varphi \varphi_j \)

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

\[
1 \geq E \left[ \frac{\beta \mu'}{\mu} A' f_k(k) + (1 - \varphi \theta_j)(1 - \delta) \right] z 
\]

\[
\geq \beta \frac{\mu'}{\mu} A' f_k(k) + (1 - \varphi \theta_j)(1 - \delta)
\]

- Analogous argument implies \( \nu_u > 0 \)
- **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 $\rho_z$
  - $\delta = 0.1$
  - $\varphi = 0.6$: Falato/Kadyrzhanova/Sim/Steri (forthcoming)
  - Calibrated: $\theta_s = 0.8; \theta_u = 0.6; \kappa = 0.01$
Quantitative Evaluation

- **Financial structure by net worth**

  - **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)
Effect of Downgrades – Inference using Causal Forest

- **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

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Causal Forest – Heterogenous Treatment Effects

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

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

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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
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
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
Stylized Fact 1 – Secured Debt and Leasing

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-adjusted)

**Panel B:** Secured debt/Total debt (lease-adjusted)

**Panel C:** Leasing debt/Assets (lease-adjusted)

**Panel D:** Debt/Assets (lease-adjusted)

- 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**

![Graph showing change in lease-adj. secured/unsecured leverage](image_url)
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
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 \( \varphi_l \equiv R^{-1}u + m \)
  - Assumption 5. \( R^{-1}(1 - \theta_s)(1 - \delta) > m - \kappa > \frac{1 - \theta_s}{\theta_s - \theta_u} \kappa \)
  - Implies \( \varphi_s > \varphi_l \) and \( R_l \equiv \frac{(1 - \theta_s)(1 - \delta)}{\varphi_s - (R^{-1}u + m)} > R_s \)
  - Repossession advantage: Eisfeldt/Rampini (2009); R/V (2013)

- Firm’s problem

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

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

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

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

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

- Prediction: Most constrained firms lease, then borrow secured
## Average Treatment Effects from Causal Forest

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

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<th>ATT</th>
<th>ATC</th>
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<td>(-12.098)</td>
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- Treatment effect of one-notch (or more) downgrade by rating

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.)

Rating code

Rating code

Leasing and Unsecured Debt
### Average Treatment Effects from Causal Forest

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

<table>
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<th>Outcome variable</th>
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<th>ATC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Secured debt / Assets</strong></td>
<td>0.024</td>
<td>0.020</td>
<td>0.025</td>
</tr>
<tr>
<td></td>
<td>(8.753)</td>
<td>(7.415)</td>
<td>(8.719)</td>
</tr>
<tr>
<td><strong>Secured debt/Total debt</strong></td>
<td>0.016</td>
<td>0.019</td>
<td>0.015</td>
</tr>
<tr>
<td></td>
<td>(3.464)</td>
<td>(4.453)</td>
<td>(3.236)</td>
</tr>
<tr>
<td><strong>Unsecured debt/Assets</strong></td>
<td>0.012</td>
<td>0.005</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td>(3.956)</td>
<td>(1.559)</td>
<td>(4.186)</td>
</tr>
<tr>
<td><strong>Debt/Assets</strong></td>
<td>0.038</td>
<td>0.026</td>
<td>0.040</td>
</tr>
<tr>
<td></td>
<td>(10.620)</td>
<td>(8.059)</td>
<td>(10.703)</td>
</tr>
<tr>
<td><strong>Leasing debt/Assets</strong></td>
<td>0.014</td>
<td>0.016</td>
<td>0.014</td>
</tr>
<tr>
<td></td>
<td>(7.677)</td>
<td>(9.153)</td>
<td>(7.328)</td>
</tr>
</tbody>
</table>

Adriano A. Rampini and S. Viswanathan

Collateral and Secured Debt
Causal Forest – Heterogenous Treatment Effects

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

<table>
<thead>
<tr>
<th>Rating code</th>
<th>Unsecured debt/Assets</th>
<th>Total debt/Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>-0.04</td>
<td>-0.04</td>
</tr>
<tr>
<td>CCC</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>B</td>
<td>0.04</td>
<td>0.04</td>
</tr>
<tr>
<td>BB</td>
<td>0.08</td>
<td>0.08</td>
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<tr>
<td>BBB−</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AA</td>
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<td></td>
</tr>
<tr>
<td>AAA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Causal Forest – Heterogenous Treatment Effects

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

![Graph showing assets and dividends/assets by rating code](image-url)
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.)