Collateral and Secured Debt

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April 5, 2024
Collateral in Macro and Finance

- **Collateral central to macro finance and corporate finance**
  - Kiyotaki/Moore (1997)
  - Rampini/Viswanathan (2013)
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- **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)
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- **Terminology**
  - No distinction between secured debt and collateral!
  - **Collateral (law):** Assets pledged to secure loan
  - **Collateral (economics):** Collateralizable assets, esp. tangible assets
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- **Punchline:** Collateral essential to understanding firm financing
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)
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- **Unsecured debt**
  - Backed by unencumbered assets, implicitly collateralized
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- **Key insights**
  - **Collateral restricts both secured and unsecured debt**
  - **Constrained firms use more secured debt within and across firms**
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- **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
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 (abridged)

(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)
  - Alternative: Long-Term Debt (DLTT) + Debt–Due in 1 Year (DD1)
- **Assets**: Assets (AT)
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Two key stylized facts

- **Fact 1**: Secured debt increases with financial constraints
- **Fact 2**: Secured and unsecured debt increase with tangible assets
Stylized Fact 1 – Secured Debt and Financial Constraints

- **Secured debt to total debt across rating deciles**

Cross section: constrained firms have more secured debt
Stylized Fact 1 – Secured Debt and Financial Constraints

- Secured debt to total LT debt across size deciles

- Small (financially constrained) firms high fraction secured

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Collateral and Secured Debt
Stylized Fact 1 – Secured Debt (Long-Term, Lease-Adj.)

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

Bulk of financing secured in all but largest firms
Stylized Fact 1 – Secured Debt and Financial Constraints

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

![Graph showing the change in secured debt ratio across different rating deciles.](image)

- Downgraded firms shift to secured debt, esp. low-rated
Stylized Fact 2 – Financial Structure and Tangible Assets

Financial structure across tangibility deciles

Total leverage increase substantially with tangibility
- Financial structure across tangibility deciles

**Panel A:** Secured debt/Assets

**Panel B:** Unsecured debt/Assets

- Both secured and unsecured debt increase with tangibility
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.
- Capital $k$ depreciates at rate $\delta \in (0, 1)$. 

Collateralized Finance with Secured and Unsecured Debt
Environment
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- Risk-neutral firm discounts at rate \( \beta \in (0, 1) \); limited liability
- Net worth \( w_0 \) at time 0
- Capital \( k \) depreciates at rate \( \delta \in (0, 1) \)

Production function \( A'f(k) \)
- 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 – Trade-off

- Capital can be financed with secured and unsecured debt
  - Encumbered capital $k_s$ explicitly pledged to secured lender
  - Unencumbered capital $k_u = k - k_s$ backs unsecured debt

Benefits of secured debt – enforcement of payment

- $\theta_s > \theta_u$
- Pledging assets explicitly facilitates enforcement
  - "increases the lender’s ability to collect the debt forcibly through liquidation of the collateral" – Mann (1997)

Law perspective

Costs of secured debt – (direct) cost $\kappa > 0$

Alternative: indirect cost – operating flexibility

- Encumbered capital less efficient: $k = k_u + \phi k_s$ with $\phi < 1$
  - "you just don’t have the same flexibility of dealing with your properties as if you owned them unencumbered" – Mann (1997)

Trade-off between secured and unsecured debt

Assumption 2.

Assumption 3.
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- Trade-off between secured and unsecured debt
  - Assumption 2. $\theta_s > \theta_u \geq 0$ and $\kappa > 0$
  - Assumption 3. $R - 1(\theta_s - \theta_u)(1 - \delta) > \kappa > (R - 1 - \beta)(\theta_s - \theta_u)(1 - \delta)$
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- Trade-off between secured and unsecured debt
  - Assumption 2. $1 > \theta_s > \theta_u \geq 0$ and $\kappa > 0$
  - Assumption 3. $R^{-1}(\theta_s - \theta_u)(1 - \delta) > \kappa > (R^{-1} - \beta)(\theta_s - \theta_u)(1 - \delta)$
Firm Financing with Secured and Unsecured Debt

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

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

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

collateral constraints on secured and unsecured borrowing

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

where \( \mathcal{J} \equiv \{s, u\} \).
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\[ w + \sum_{j \in J} b'_j \geq d + \sum_{j \in J} k_j + \kappa k_s \] (2)

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collateral constraints on secured and unsecured borrowing

\[ \theta_j k_j (1 - \delta) \geq Rb'_j, \quad \forall j \in J, \] (4)

where \( J \equiv \{s, u\} \).

Borrower incurs cost of secured debt; not reflected in interest rate
Choice between Secured and Unsecured Debt

- Down payments

\[ \phi_u = 1 - R^{-1} \theta_u (1 - \delta); \quad \phi_s = 1 - R^{-1} \theta_s (1 - \delta) + \kappa \]

- Secured debt enables higher leverage \( \phi_s < \phi_u \) (Assumption 3)
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- Write IEEs using Jorgenson’s (1963) frictionless user cost \( u \equiv r + \delta \)

\[ u + R\kappa + R\frac{\lambda'}{\mu'} \varphi_s \geq A' f_k(k) \quad (5) \]

\[ u + R\frac{\lambda'}{\mu'} \varphi_u \geq A' f_k(k), \quad (6) \]

with equality if \( k_j > 0 \), where \( \lambda' \) multiplier on collateral constraints
Choice between Secured and Unsecured Debt

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■ Trade-off: cost of encumbering assets vs. ability to lever

Proof
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  - Dividend-paying firms \((d > 0)\) use unsecured debt only

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- **Trade-off:** cost of encumbering assets vs. ability to lever

\[ \text{Proof} \]

- Dividend-paying firms \((d > 0)\) use unsecured debt only
- Severely constrained firms \((w \to 0)\) use secured debt only
Given Assumptions 1 to 3, \( \exists \) thresholds \( 0 < w_s < \bar{w}_s < \bar{w} < +\infty \)
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**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
Secured and Unsecured Debt Across and Within Firms

- Given Assumptions 1 to 3, $\exists$ thresholds $0 < w_s < \bar{w}_s < \bar{w} < +\infty$

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- **Investment** $k$ increases in $w$; strictly if $w \leq w_s$, $w \in [\bar{w}_s, \bar{w}]$
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- **Firm life cycle**
  - Over time, firms accumulate net worth, ...
  - ... increase investment,
  - ... substitute from secured debt to unsecured debt,
  - ... and eventually initiate dividends.
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)
Law Perspective on Dynamics of Secured Debt

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- **Note: 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)
  - No default in equilibrium – liquidation value not critical
Model with Secured and Unsecured Debt with Uncertainty

- Cash flow $A(z') f(k)$ with stochastic productivity $A(z')$
- $z'$ follows Markov chain with transition function $\Pi(z, z')$ on $z' \in Z$
- 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
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$$v(w, z) = \max_{\{d, k_s, k_u, w', b'_s, b'_u\} \in \mathbb{R}_+^4 \times \mathbb{R}_+^{2S}} d + \beta E[v(w', z') | z] \quad (7)$$

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

$$w + E\left[\sum_{j \in J} b'_j | z\right] \geq d + \frac{1}{\varphi} \sum_{j \in J} k_j + \kappa k_s \quad (8)$$

$$A'f\left(\frac{1}{\varphi} \sum_{j \in J} k_j\right) + \frac{1}{\varphi} \sum_{j \in J} k_j (1 - \delta) \geq w' + \sum_{j \in J} Rb'_j \quad (9)$$

and collateral constraints (4) $\forall \{j, z'\} \in J \times Z$
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- Key prediction: (Un)constrained firms borrow (un)secured

Proof

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Collateral and Secured Debt
Quantitative Evaluation

- **Baseline calibration based on Li/Whited/Wu (2016)**
  - Structurally estimated 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: $\delta = 0.04$; $\theta = 0.4$
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- **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**

  - Secured debt decrease with net worth

  ![Graph showing the decrease in secured debt ratio with net worth](image-url)
Leasing as super-collateralized finance

- Financier retains ownership affording repossession advantage
- Leasing even stronger form of collateralization than secured debt
- Eisfeldt/Rampini (2009) and Rampini/Viswanathan (2013)
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Collateralization pecking order

- As constraints decrease, lease ⇒ secured debt ⇒ unsecured debt
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Quantitative importance

- Collateralized finance understated, esp. for small/constrained firms
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)
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- **Primer on causal forest**
  - Non-parametric machine learning based estimation method
  - Intuitively: nearest neighbor matching 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
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- **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 ratio
  - Densities for treatment effects on the treated (TT) and control (TC)

![Graph showing density of secured debt ratio for treated and untreated groups.]

- Estimates of average treatment effects (ATE/ATT/ATC)

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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>Secured debt/Total debt</th>
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</thead>
<tbody>
<tr>
<td>D</td>
<td>-0.04</td>
</tr>
<tr>
<td>CCC</td>
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<tr>
<td>B</td>
<td>0.04</td>
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<tr>
<td>BB</td>
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</tr>
<tr>
<td>BBB-</td>
<td></td>
</tr>
<tr>
<td>AA</td>
<td></td>
</tr>
<tr>
<td>AAA</td>
<td></td>
</tr>
</tbody>
</table>

- Secured Debt
- 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
Conclusion

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- **Collateral** restricts both secured and unsecured debt
  - Unsecured debt backed by unencumbered assets
Conclusion

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- **Consistent with stylized facts and evidence from causal forest**
Conclusion

- **Secured debt** enables higher leverage but entails costs
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  - 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

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

Constrained firms have more/more secured debt

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

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

  **Panel E: Log assets**
  
  Firms with low ratings are smaller and pay lower (or no) dividends
  
  **Panel F: Dividends/Assets**
  
  Low rated firms seem **more constrained**
Stylized Fact 1 – Secured Debt and Financial Constraints

- Financial structure across size deciles

- Small (constrained) firms high fraction secured
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 (constrained) firms high fraction secured
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**

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Collateral and Secured Debt
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
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 low-rated firms shift to secured debt**

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Collateral and Secured Debt
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

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

### Graph Details
- **X-axis**: Previous rating decile
- **Y-axis**: Change in secured/unsecured leverage
- **Legend**:
  - Secured
  - Unsecured

### Table

<table>
<thead>
<tr>
<th>Previous Rating</th>
<th>Secured</th>
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<td>[AA-, AAA]</td>
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### Graph Analysis
- Secure debt is generally lower than unsecured debt across all rating deciles.
- The difference between secured and unsecured debt is maximized for the highest rated firms (AAA) and minimizes for the lowest rated firms (B-).
Stylized Fact 2 – Financial Structure and Tangible Assets

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

  **Panel A:** Secured debt/Assets
  ![Graph A](image)

  **Panel B:** Secured debt/Total debt
  ![Graph B](image)

  **Panel C:** Unsecured debt/Assets
  ![Graph C](image)

  **Panel D:** Debt/Assets
  ![Graph D](image)

- Secured debt/leverage increase substantially with tangibility
Law Perspective on Secured Debt

- Mann (1997) – similar to basic trade-off in our model

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”
Law Perspective on Secured Debt

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- **Benefits of secured debt: enforcement of payment**
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**Benefits of secured debt: enforcement of payment**

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**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”
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 $k \equiv \sum_{j \in \mathcal{J}} k_j$
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**

\[
\begin{align*}
\mu & = 1 + \nu_d \\
\mu & = \beta R \mu' + \beta R \lambda'_j, \quad \forall j \in J, \\
\mu(1 + \kappa) & = \beta \mu' [A' f_k(k) + (1 - \delta)] + \beta \lambda'_s \theta_s (1 - \delta) + \nu_s \\
\mu & = \beta \mu' [A' f_k(k) + (1 - \delta)] + \beta \lambda'_u \theta_u (1 - \delta) + \nu_u \\
\beta \mu' & = \beta v_w(w')
\end{align*}
\]

- **Note:** \( \lambda'_u = \lambda'_s \equiv \lambda' \)

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

- **Firm’s investment Euler equation (IEE)**

\[
1 = \beta \frac{\mu'}{\mu} \frac{A' f_k(k) + (1 - \theta_j)(1 - \delta)}{\varphi_j} + \frac{\nu_j / \mu}{\varphi_j}, \quad \forall j \in J.
\]
Model with Secured and Unsecured Debt

- Using IEEs we get

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

(16)

- Let \( R_s \equiv \frac{\left( \theta_s - \theta_u \right) \left( 1 - \delta \right)}{\varphi_u - \varphi_s} > R \) (by Assumption 2)

- Secured debt is more costly
Model with Secured and Unsecured Debt

- Using IEEs we get

\[ 1 = \beta \frac{\mu'}{\mu} \left( \theta_s - \theta_u \right) \left( 1 - \delta \right) + \frac{\nu_u/\mu - \nu_s/\mu}{\varphi_u - \varphi_s} \]  \hspace{1cm} (16)

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- Secured debt is more costly

- **Severely constrained firms** \((w \to 0)\) use secured debt only
  - \((2) \& (4) \Rightarrow w \geq \sum_{j \in J} \varphi_j k_j \text{ and } k_j \to 0, \forall j \in J \Rightarrow k \to 0 \)
  - IEE implies \( \beta \mu' / \mu \to 0 \); then (16) implies \( \nu_u > 0 \)
Model with Secured and Unsecured Debt

- Using IEEs we get

\[
1 = \beta \frac{\mu' (\theta_s - \theta_u)(1 - \delta)}{\varphi_u - \varphi_s} + \frac{\nu_u/\mu - \nu_s/\mu}{\varphi_u - \varphi_s}
\]  \hspace{1cm} (16)

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- **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 (16) implies \(\nu_s > 0\)
  - IEE: \(1 = \beta \frac{A' f_k(k) + (1-\theta_u)(1-\delta)}{\varphi_u}\) implicitly defines \(\bar{k}\)
Model with Secured and Unsecured Debt

- Using IEEs we get

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

(16)

- 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 \((w \to 0)\) use secured debt only**

- (2) & (4) ⇒ \( w \geq \sum_{j \in J} \varphi_j k_j \) and \( k_j \to 0, \forall j \in J \Rightarrow k \to 0 \)
- IEE implies \( \beta \mu'/\mu \to 0 \); then (16) implies \( \nu_u > 0 \)

**Dividend-paying firms \((d > 0)\) use unsecured debt only**

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**Firms indifferent between secured and unsecured debt**

- From (16): \( \beta \mu'/\mu = R_s^{-1} \); IEE defines \( k < \bar{k} \)
Model with Secured and Unsecured Debt

- **Investment Euler equation (IEE)**

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

where \( \phi_j \equiv 1 - \varphi + \varphi \theta_j \)
Model with Secured and Unsecured Debt

- **Investment Euler equation (IEE)**

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

(17)

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

- **Severely constrained firms \((w \to 0)\) use secured debt only**

- (8) & (4) \(\Rightarrow w \geq \frac{1}{\varphi} \sum_{j \in J} \phi_j k_j \Rightarrow k_j \to 0, \forall j \in J; k \to 0 \)

- IEE implies \(\beta \mu'/\mu \to 0, \forall z' \in Z\) since

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

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

- Analogous argument implies \(\nu_u > 0\)

- **Financially constrained firms borrow secured**
Model with Secured and Unsecured Debt

- **Investment Euler equation (IEE)**

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

where \( \phi^\phi_j \equiv 1 - \varphi + \varphi \phi_j \)

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- (8) & (4) \( \Rightarrow \) \( w \geq \frac{1}{\varphi} \sum_{j \in \mathcal{J}} \phi^\phi_j k_j \Rightarrow k_j \to 0, \forall j \in \mathcal{J}; \ k \to 0 \)

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\]

\[
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\]

- Analogous argument implies \( \nu_u > 0 \)

- **Financially constrained firms borrow secured**

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

Adriano A. Rampini and S. Viswanathan  
Collateral and Secured Debt
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
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-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**

![Graph showing change in lease-adj. secured/unsecured leverage across different rating deciles.]

- **Adriano A. Rampini and S. Viswanathan**

Collateral and Secured Debt
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: ∆ Secured LT debt ratio

Panel D: Secured LT debt ratio by tangibility

Patterns in secured LT debt still more pronounced

Adriano A. Rampini and S. Viswanathan

Collateral and Secured Debt
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)
Benefits and costs of leasing $k_l$

- Monitoring cost $m > 0$; leasing fee $\phi_l \equiv R^{-1}u + m$
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- Repossession advantage: Eisfeldt/Rampini (2009); R/V (2013)

Firm’s problem

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

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

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

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

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

- Benefits and costs of leasing $k_l$
  - Monitoring cost $m > 0$; leasing fee $\varphi_l \equiv R^{-1}u + m$
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  - Repossession advantage: Eisfeldt/Rampini (2009); R/V (2013)

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

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

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

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

  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>Outcome variable</th>
<th>ATE</th>
<th>ATT</th>
<th>ATC</th>
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</thead>
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<tr>
<td></td>
<td>(-11.329)</td>
<td>(-12.098)</td>
<td>(-10.998)</td>
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Causal Forest – Treatment Effects (Lease-adj.)

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

![Graphs showing the treatment effects of one-notch (or more) downgrade by rating.](image)

- Secured debt/Assets (lease-adj.)
- Secured debt/Total debt (lease-adj.)
## Average Treatment Effects from Causal Forest

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

<table>
<thead>
<tr>
<th>Outcome variable</th>
<th>ATE</th>
<th>ATT</th>
<th>ATC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secured debt /Assets</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>Secured debt/Total debt</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>Unsecured debt/Assets</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>Debt/Assets</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>Leasing debt/Assets</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>
Causal Forest – Heterogenous Treatment Effects

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

![Graph showing the treatment effect of one-notch (or more) downgrade by rating across different rating codes.](image)
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>0.00</td>
</tr>
<tr>
<td>CCC</td>
<td>0.00</td>
<td>0.08</td>
</tr>
<tr>
<td>B</td>
<td>0.04</td>
<td>0.00</td>
</tr>
<tr>
<td>BB</td>
<td>0.08</td>
<td>0.04</td>
</tr>
<tr>
<td>BBB−</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AA</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>AAA</td>
<td>0.08</td>
<td></td>
</tr>
</tbody>
</table>

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Collateral and Secured Debt
Causal Forest – Heterogenous Treatment Effects

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

![Graph showing assets and dividends/assets distribution by rating]

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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.)