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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- **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**
  - 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)
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  - Secured debt acyclical/countercyclical – Azariadis et al. (2016)
  - Limited use of secured debt by large firms – Lian/Ma (2019)
  - Secular decline in secured debt – Benmelech et al. (2019)
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- **No distinction between secured debt and collateral!**

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

(1) Stylized facts

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

(4) Evidence from causal forest
Outline

(1) Stylized facts

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   ■ Key distinction between secured and unsecured debt
   ■ Simple, deterministic model
   ■ Stochastic model with quantitative evaluation

(3) Secured debt and leasing (time permitting)

(4) Evidence from causal forest
Mann (1997a) argues that secured credit has direct benefits in terms of enforcement of payment, in that it “increases the lender’s ability to collect the debt forcibly through liquidation of the collateral,” and “enhances the lender’s remedy (so that the lender can coerce payment more quickly than it could if its debt were not secured)” (page 639).

Secured credit also has both direct costs, such as information and transactions costs, as well as indirect costs, as one borrower interviewed by the author explained “you just don’t have the same flexibility of dealing with your properties as if you owned them unencumbered” (page 665). This is very similar to the basic trade-off in our model.
Mann (1997a) also emphasizes that the 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” (page 645).

Finally, the author observes that secured credit is used only infrequently by companies with strong financial records, and argues that “as a borrower’s financial strength increases, secured credit becomes a less attractive alternative: its benefits decrease and its costs at best, remain constant” and that as a consequence “borrowers exhibit an increasing tendency toward unsecured debt as their financial strength increases” (page 674).

Schwarcz (1997) states that “unsecured creditors frequently choose to waive negative pledge covenants in exchange for a quid pro quo, such as becoming equally and ratably secured” (page 451).
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)
Stylized Facts on Secured Debt

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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 and assets 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 a lot more secured debt
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: heterogeneous effects of downgrades

Panel A: Secured debt/Assets

Panel B: Secured debt/Total debt

Panel C: Unsecured debt/Assets

Panel D: Debt/Assets

Firms that are downgraded shift to secured debt, esp. low-rated ones
Shift to secured debt, esp. low-rated firms
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

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Collateral and Secured Debt
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

- Financial constraints measure: size; small 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
Stylized Fact 2 – Financial Structure and Tangible Assets

Financial structure and assets across tangibility deciles

Panel A: Secured debt/Assets

Panel B: Secured debt/Total debt

Panel C: Unsecured debt/Assets

Panel D: Debt/Assets

Secured debt and total leverage increase substantially 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
- 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 $\delta \in (0, 1)$
Model with Secured and Unsecured Debt

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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

Benefit:
- “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)”

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.
- $\theta_s > \theta_u \geq 0$ 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 $\phi < 1$
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- 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)”
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Secured vs. Unsecured Debt

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Benefits and costs of secured and unsecured debt

- Assumption 3. \(R^{-1}(\theta_s - \theta_u)(1 - \delta) > \kappa > (R^{-1} - \beta)(\theta_s - \theta_u)(1 - \delta)\)
Secured vs. Unsecured Debt

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  - Intangible capital \((1 - \varphi)k\) internally financed
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- 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 ($\varphi = 1$)
Deterministic Model with Secured & Unsecured Debt

- Simplified model without uncertainty
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- 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)

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

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

(pot collateral constraints on secured and unsecured borrowing)

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

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

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Collateral and Secured Debt
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 $k \equiv \sum_{j \in \mathcal{J}} k_j$

First-order conditions

$\mu = 1 + \nu_d$ (5)

$\mu = \beta R \mu' + \beta R \lambda'_j$, $\forall j \in \mathcal{J}$, (6)

$\mu (1 + \kappa) = \beta \mu' \left[ A' f_k (k) + (1 - \delta) \right] + \beta \lambda' s \theta s (1 - \delta) + \nu_s$ (7)

$\mu = \beta \mu' \left[ A' f_k (k) + (1 - \delta) \right] + \beta \lambda' u \theta u (1 - \delta) + \nu_u$ (8)

$\beta \mu' = \beta v w (w')$ (9)

Envelope condition:

$v w (w) = \mu$ (marginal value of net worth) (10)
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)
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 \( k = \sum_{j \in J} k_j \)

- **First-order conditions**

  \[
  \begin{align*}
  \mu &= 1 + \nu_d \quad (5) \\
  \mu &= \beta R \mu' + \beta R \lambda'_j, \quad \forall j \in J, \quad (6) \\
  \mu(1 + \kappa) &= \beta \mu' [A' f_k(k) + (1 - \delta)] + \beta \lambda'_s \theta_s (1 - \delta) + \nu_s \quad (7) \\
  \mu &= \beta \mu' [A' f_k(k) + (1 - \delta)] + \beta \lambda'_u \theta_u (1 - \delta) + \nu_u \quad (8) \\
  \beta \mu' &= \beta v_w(w') \quad (9)
  \end{align*}
  \]

- 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)
    
    \[
    1 = \beta \frac{\mu'}{\mu} A' f_k(k) + (1 - \theta_j)(1 - \delta) \frac{\nu_j / \mu}{\varphi_j}, \quad \forall j \in J. \tag{10}
    \]

- 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

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\]

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

\[
u + R \kappa + R \frac{\lambda'}{\mu'} \varphi_s \geq A' f_k(k) \tag{11}
\]
\[
u + R \frac{\lambda'}{\mu'} \varphi_u \geq A' f_k(k), \tag{12}
\]

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

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

(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
Model with Secured and Unsecured Debt

- Using IEEs we get

\[
1 = \beta \frac{\mu' (\theta_s - \theta_u) (1 - \delta)}{\mu} \frac{\mu}{\phi_u - \phi_s} + \frac{\nu_u/\mu - \nu_s/\mu}{\phi_u - \phi_s} \quad (13)
\]

- Let \( R_s \equiv \frac{(\theta_s - \theta_u)(1 - \delta)}{\phi_u - \phi_s} > R \) (by Assumption 2)

- Secured debt is more costly

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

- Using IEEs we get
  \[ 1 = \beta \frac{\mu'}{\mu} (\theta_s - \theta_u)(1 - \delta) \frac{\varphi_u - \varphi_s}{\varphi_u - \varphi_s} + \frac{\nu_u/\mu - \nu_s/\mu}{\varphi_u - \varphi_s} \]  
  (13)

- Let \( R_s \equiv \frac{(\theta_s - \theta_u)(1 - \delta)}{\varphi_u - \varphi_s} > R \) (by Assumption 2)
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  - 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: \(1 = \beta A' f_{k}(k) + (1 - \theta_u)(1 - \delta) \frac{\varphi_u}{\varphi_s} \) implicitly defines \(\bar{k}\)
Model with Secured and Unsecured Debt

- Using IEEs we get
  \[ 1 = \beta \frac{\mu'}{\mu} \frac{(\theta_s - \theta_u)(1 - \delta)}{\varphi_u - \varphi_s} + \frac{\nu_u / \mu - \nu_s / \mu}{\varphi_u - \varphi_s} \]  
  \[ (13) \]

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

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  - IEE: \( 1 = \beta A' f_k(k) + (1 - \theta_u)(1 - \delta) / \varphi_u \) implicitly defines \( \bar{k} \)

- Firms indifferent between secured and unsecured debt
  - From \((13)\): \( \beta \mu' / \mu = R_s^{-1} \); IEE defines \( k < \bar{k} \)
Model with Secured and Unsecured Debt: Characterization

- Given Assumptions 1 to 3, \( \exists \) thresholds \( 0 < w_s < \bar{w}_s < \bar{w} < +\infty \)
Model with Secured and Unsecured Debt: Characterization

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

- 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
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- **Investment** $k$ increases in $w$; strictly if $w \leq \underline{w}_s$, $w \in [\bar{w}_s, \bar{w}]$
Model with Secured and Unsecured Debt: Characterization

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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.
Model with Secured and Unsecured Debt with Uncertainty

- Stochastic productivity

- Assumption 4. \( \forall z_+, z \in Z \exists z_+ > z, (i) A(z_+) > A(z), (ii) A(z) > 0 \)
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

$$v(w, z) = \max_{\{d, k_s, k_u, w', b'_s, b'_u\} \in \mathbb{R}_+^4 \times \mathbb{R}_+^2} d + \beta E[v(w', z')|z]$$  \hspace{1cm} (14)

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

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

$$A' f\left(\frac{1}{\varphi} \sum_{j \in J} k_j\right) + \frac{1}{\varphi} \sum_{j \in J} k_j (1 - \delta) \geq w' + \sum_{j \in J} R b'_j$$  \hspace{1cm} (16)

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

- **Investment Euler equation (IEE)**

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

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

Severely constrained firms \( w \rightarrow 0 \) use secured debt only

\[ (15) \& (4) \Rightarrow w \geq 1 - \varphi + \varphi \sum_{j \in J} \left( \varphi_j f_j(k) \right) \Rightarrow k_j \rightarrow 0, \forall j \in J; k \rightarrow 0 \]

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

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

Analogous argument implies \( \nu_j > 0 \)

Financially constrained firms borrow secured debt.

Dividend-paying firms use unsecured debt only.
Model with Secured and Unsecured Debt

- **Investment Euler equation (IEE)**

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

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

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

  - Analogous argument implies \( \nu_u > 0 \)
  
  - **Financially constrained firms borrow secured**
Model with Secured and Unsecured Debt

- **Investment Euler equation (IEE)**

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

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

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

- 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: $\delta = 0.04$; $\theta = 0.4$
Quantitative Evaluation

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    - 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 (2018)
  - 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
Stylized Fact 1 – Secured Debt with 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

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Collateral and Secured Debt
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-adjusted)

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

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

Panel D: Debt/Assets (lease-adjusted)

Secured debt, leasing, and total leverage all increase with tangibility
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)
Model with Secured and Unsecured Debt and Leasing

- Benefits and costs of leasing $k_l$
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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, $\forall z' \in Z$,

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

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

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

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

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

- Prediction: Most constrained firms lease; then borrow secured; ...
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 (2019)
Effect of Downgrades – Inference using Causal Forest

- **Estimate heterogeneous treatment effects using causal forest**
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- **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
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  - 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
## Average Treatment Effects from Causal Forest

### Panel A: Treatment Effects on Financial Structure, Investment, and Payout Policy

<table>
<thead>
<tr>
<th>Outcome variable</th>
<th>ATE</th>
<th>ATT</th>
<th>ATC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Secured debt /Assets</strong></td>
<td>0.021</td>
<td>0.016</td>
<td>0.022</td>
</tr>
<tr>
<td></td>
<td>(6.973)</td>
<td>(5.602)</td>
<td>(6.962)</td>
</tr>
<tr>
<td><strong>Secured debt/Total debt</strong></td>
<td>0.032</td>
<td>0.025</td>
<td>0.033</td>
</tr>
<tr>
<td></td>
<td>(5.629)</td>
<td>(4.914)</td>
<td>(5.563)</td>
</tr>
<tr>
<td><strong>Unsecured debt/Assets</strong></td>
<td>0.018</td>
<td>0.011</td>
<td>0.019</td>
</tr>
<tr>
<td></td>
<td>(4.753)</td>
<td>(3.23)</td>
<td>(4.829)</td>
</tr>
<tr>
<td><strong>Debt/Assets</strong></td>
<td>0.040</td>
<td>0.027</td>
<td>0.042</td>
</tr>
<tr>
<td></td>
<td>(9.74)</td>
<td>(7.34)</td>
<td>(9.803)</td>
</tr>
<tr>
<td><strong>Log assets (level)</strong></td>
<td>-0.101</td>
<td>-0.110</td>
<td>-0.099</td>
</tr>
<tr>
<td></td>
<td>(-8.746)</td>
<td>(-11.22)</td>
<td>(-8.222)</td>
</tr>
<tr>
<td><strong>Dividends/Assets</strong></td>
<td>-0.004</td>
<td>-0.003</td>
<td>-0.004</td>
</tr>
<tr>
<td></td>
<td>(-11.329)</td>
<td>(-12.098)</td>
<td>(-10.998)</td>
</tr>
<tr>
<td><strong>Positive dividends</strong></td>
<td>-0.100</td>
<td>-0.104</td>
<td>-0.099</td>
</tr>
<tr>
<td></td>
<td>(-13.709)</td>
<td>(-15.216)</td>
<td>(-13.109)</td>
</tr>
</tbody>
</table>
### Average Treatment Effects from Causal Forest

**Panel B**: 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><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>(10.62)</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>

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Collateral and Secured Debt
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)

![Graph showing densities for secured debt leverage and secured debt ratio for treated and untreated groups.](image-url)
Causal Forest – Heterogenous Treatment Effects

- Treatment effect of one-notch+ downgrade by rating

<table>
<thead>
<tr>
<th>Rating code</th>
<th>Secured debt/Assets</th>
<th>Secured debt/Total debt</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>
</tr>
<tr>
<td>BBB−</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AAA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Treatment effect of one-notch+ downgrade by rating

**Unsecured debt/Assets**

- D: -0.04
- CCC: 0.00
- B: 0.04
- BB: 0.08
- BBB-: D
- AA: 
- AAA: 

**Total debt/Assets**

- D: -0.04
- CCC: 0.00
- B: 0.04
- BB: 0.08
- BBB-: D
- AA: 
- AAA: 

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Collateral and Secured Debt
Causal Forest – Heterogenous Treatment Effects

- Treatment effect of one-notch+ downgrade by rating

![Graph of Assets](image1)

![Graph of Dividends/Assets](image2)
Causal Forest – Treatment Effects (Lease-adj.)

- Treatment effect of one-notch+ downgrade by rating

![Graph showing the impact of one-notch+ downgrade on Secured debt/Assets and Secured debt/Total debt by rating.](image-url)
Causal Forest – Treatment Effects (Lease-adj.)

- Treatment effect of one-notch+ downgrade by rating

Leasing debt/Total debt (lease-adj.)

Unsecured debt/Assets (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
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  - Unsecured debt backed by unencumbered assets
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- **Consistent with stylized facts and evidence from causal forest**
Conclusion

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- **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