

Corporate Debt Structure, Precautionary Savings, and Investment Dynamics

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CAFRAL Annual Conference

December 8, 2017

Introduction

Key question

How do financial shocks affect aggregate investment?

- ▶ Financial frictions + 'small' firms with high default risks
- ▶ One type of debt instrument
- ▶ **Mechanism:** shock propagates via a contraction in credit supply

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- ▶ Multiple types of debt instruments
- ▶ **New mechanism:** shock propagates via firms' balance sheet adjustment

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Motivation

- ▶ Public firms substituted from loans to bonds during crisis
e.g. Becker and Ivashina (2014); Adrian, Colla and Shin (2012)
- ▶ Liquid assets to total assets: 7% (highest since 1960s)
- ▶ Account for $\approx 70\%$ of aggregate investment in the U.S.

Motivation: The Great Recession

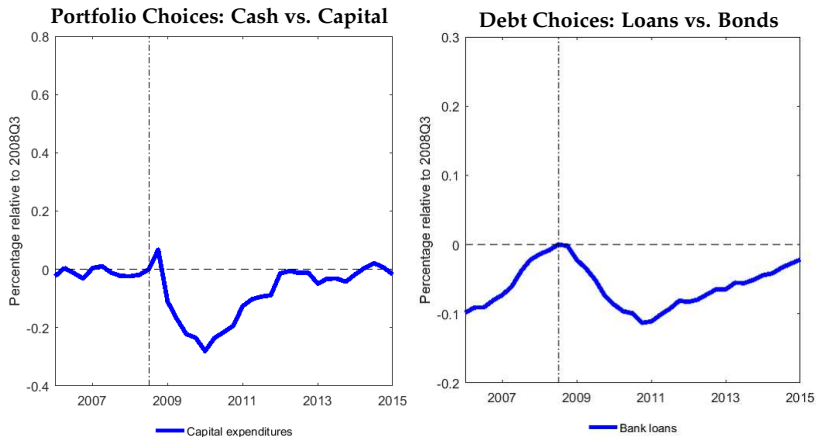


Figure: Balance Sheet Policies of U.S. Nonfinancial Corporate Businesses

Source: Compustat & Capital IQ

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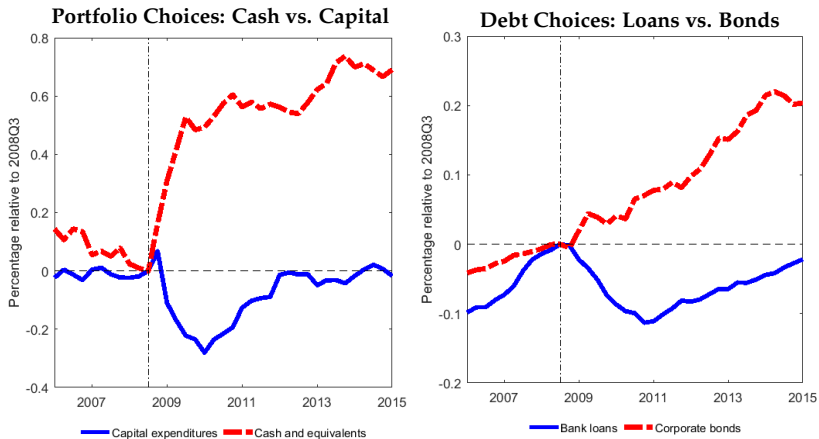


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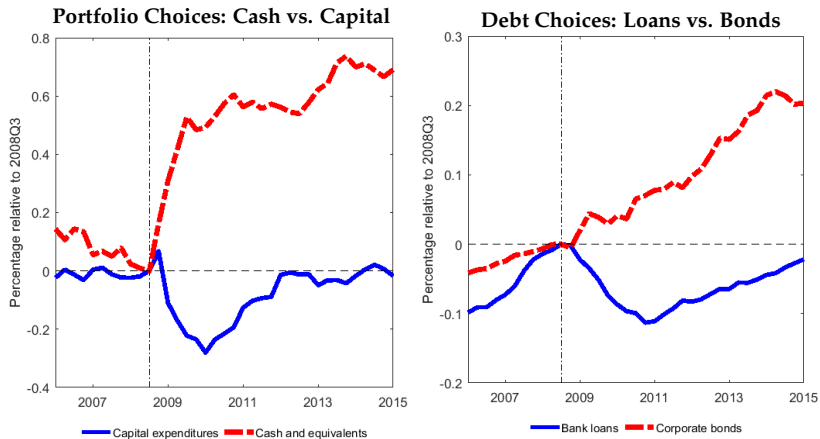
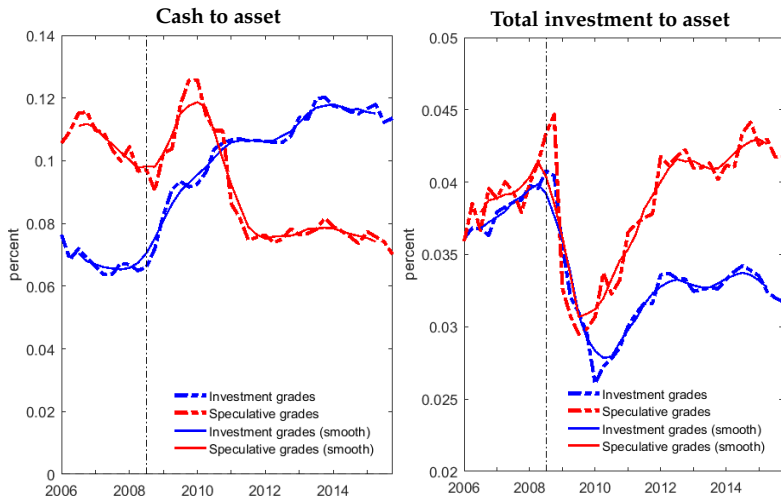


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Question: How do firms' balance sheets propagate financial shocks?

New Micro-Level Evidence (2): Firm Heterogeneity in Assets



Sources: Compustat & Capital IQ

This Paper: Overview (1)

Firm-Level Evidence

- ▶ **'Larger'** firms (investment): $\Delta\text{Leverage} \approx 0$ $\Delta\text{Investment} \downarrow\downarrow$ $\Delta\text{Cash} \uparrow\uparrow$
- ▶ **'Smaller'** firms (speculative): $\Delta\text{Leverage} \downarrow\downarrow$ $\Delta\text{Investment} \downarrow$ $\Delta\text{Cash} \downarrow$

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“Borrowing-to-Save” Mechanism

- ▶ **Risk-neutral** firms with (short-term) **defaultable** debt
- ▶ **Incomplete market**
 - Cash & capital affect default threshold differently
 - **Trade-off: growth** vs. **self-insurance** against default
- ▶ (New) environment:
 - A **sequence** of uninsurable shocks
 - Cannot adjust asset- and liability-side simultaneously at all times

This Paper: Overview (2)

... in the Context of Debt Substitution

- ▶ **Loans** vs. **bonds**: ability to **restructure** in financial distress vs. **intermediation cost** in normal times (Crouzet, 2017)

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 - Liability-side: mixed-debt structure → bond-only
⇒ **(De)leverage effect:** total borrowing ↓↓↓
 - Asset-side: risky capital → safe assets
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Quantitative Implications

- ▶ **Financial constraint channel**
Firms of **high** default risks: Total debt ↓↓↓, Investment ↓
- ▶ **Precautionary savings channel**
Firms of **intermediate** default risks: Total debt ↓↓, Investment ↓↓↓

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Quantitative Implications

- ▶ **Financial constraint channel (60%)**
Firms of **high** default risks: Total debt ↓↓↓, Investment ↓
- ▶ **Precautionary savings channel (40%)**
Firms of **intermediate** default risks: Total debt ↓↓, Investment ↓↓↓

▶ Literature

1. Introduction
2. **“Borrow-to-Save” Mechanism**
3. Structural Model of Firm Dynamics
4. Quantitative Implications
5. Conclusion

Simple Example: Timing

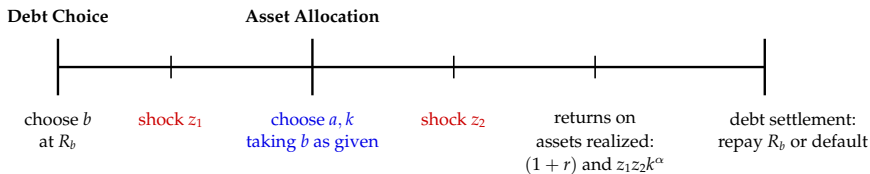


Figure: Timing in one period

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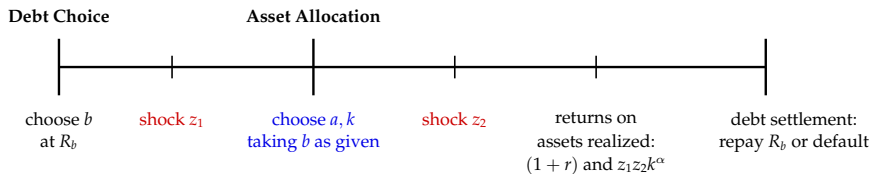


Figure: Timing in one period

- ▶ **Key assumption 1:** Firms can **reoptimize assets**, but not liabilities, after the first shock
 - **Trade-off:** higher profits conditional on survival vs. higher probability of survival ▶ evidence
- ▶ **Key assumption 2:** Liquidation value of the firm is given by $\chi \pi'$, where $0 \leq \chi < 1$

Simple Example: Asset Allocation

- ▶ Firm with net worth e
- ▶ Shock \hat{z}_1 has realized & borrowing b has been made
- ▶ Rewrite: $s = \frac{a}{N}$ and $1 - s = \frac{k}{N}$, where $N = e + b$

$$\max_{s(b, \hat{z}_1, e)} E_{z_2} \pi = \int_{z_2(\hat{z}_1, s)}^{+\infty} \left[\hat{z}_1 z_2 (1-s)^\alpha N^\alpha + (1+r)sN - (1+r_b)b \right] dF(z_2) + \int_{-\infty}^{z_2(\hat{z}_1, s)} -D dF(z_2),$$

s.t.

$$[1] \quad z_2 = \frac{(1+r_b)b - (1+r)sN}{\hat{z}_1(1-s)^\alpha N^\alpha}$$

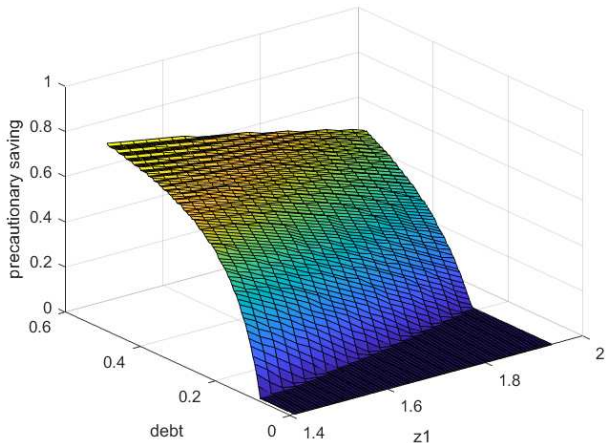
$$[2] \quad 1+r_b = \frac{(1+r)b}{\int_{z_1} [1 - F(z_2(z_1))] dF(z_1)}$$

$$[3] \quad s \in [0, 1]$$

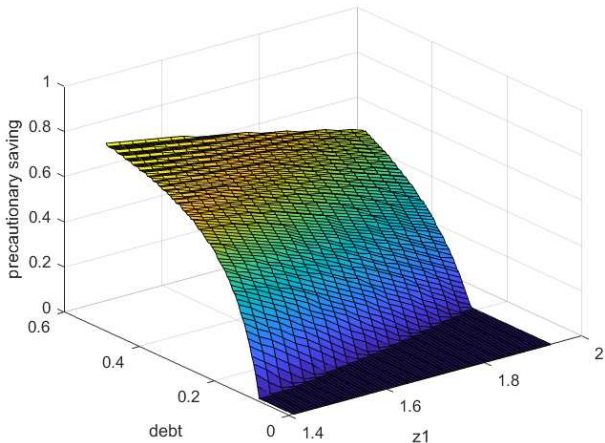
Simplification: \implies Exogenous default cost (D)

\implies DWL = 1 ($\chi = 1$)

Simple Example: Asset Allocation



Simple Example: Asset Allocation



- ▶ s^* **increasing** in debt (b) and **decreasing** in realized return on capital \hat{z}_1

Simple Example: How Much to Borrow?

- ▶ Before any shock is realized
- ▶ Substitute $s^*(b, z_1, e)$ and $r_b(b, e, s^*)$ in:

$$\begin{aligned} \max_b E_{z_1, z_2}(\pi) &= \int_{z_1}^{+\infty} \int_{z_2(z_1, s^*)}^{+\infty} \left[z_1 z_2 (1 - s^*)^\alpha N^\alpha + (1 + r) s^* N - (1 + r_b) b \right] dF(z_2) dF(z_1) \\ &+ \int_{z_1}^{z_2(z_1, s^*)} \int_0^{z_2(z_1, s^*)} -D dF(z_2) dF(z_1), \end{aligned}$$

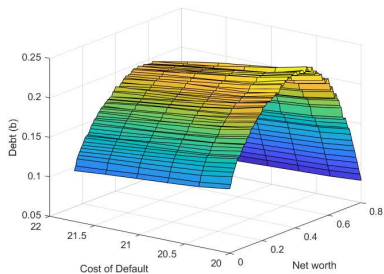
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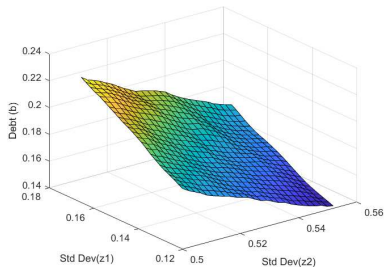
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$$[3] \quad s^*(b, z_1, e) \text{ from asset allocation stage}$$

Simple Example: How Much to Borrow?



- ▶ **non-monotonic** in net worth (e)
- ▶ **decreasing** in default cost (D)



- ▶ **increasing** in risk from z_1
- ▶ **decreasing** in risk from z_2

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3. **Structural Model of Firm Dynamics**
4. Quantitative Implications
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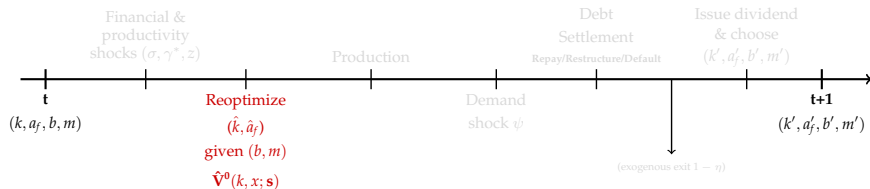
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- ▶ **Markov processes:** (z, γ^*, ψ)

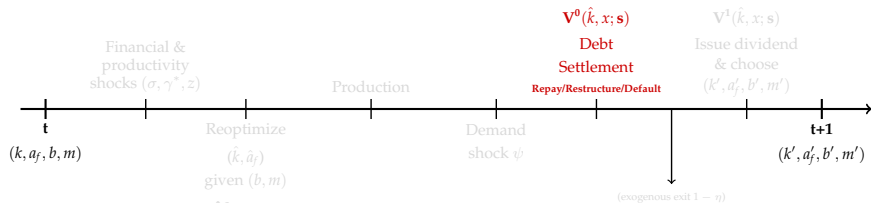
Intermediate Goods' Firms



$$\hat{V}^0(k, a_f, \psi, z; \mathbf{s}) = \max_{\hat{k}, \hat{a}_f} V^0(\hat{k}, x; \mathbf{s})$$

$$\text{subject to: } \hat{k} + \hat{a}_f + \underbrace{g(\hat{k}, k)}_{\text{Capital adj. cost}} = k + a_f,$$

Intermediate Goods' Firms



$$V^0(\hat{k}, x; \mathbf{s}) = \max \left\{ \underbrace{V_P^0(\hat{k}, x; \mathbf{s})}_{\text{Repay}}, \underbrace{V_R^0(\hat{k}, x; \mathbf{s})}_{\text{Restructure}}, \underbrace{0}_{\text{Default}} \right\}.$$

where:

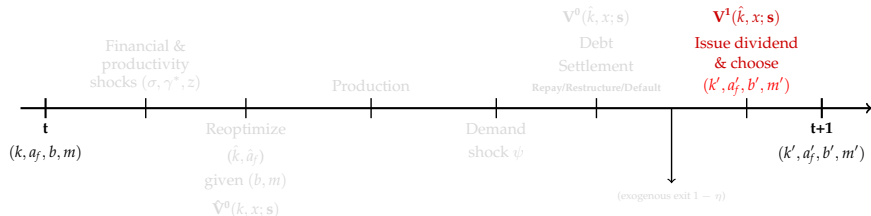
$$V_l^0(\hat{k}, x; \mathbf{s}) = \underbrace{(1 - \eta)n_l}_{\text{exogenously exit}} + \underbrace{\eta V^1(\hat{k}, x; \mathbf{s})}_{\text{survive exit shock}}$$

and $n_l = p(\psi)y + p_k^-(1 - \delta)\hat{k} - F_o\hat{k} + \hat{a}_f - b_l - m$ where $l \in \{P, R\}$

$$x = p(\psi)y(z) - F_o\hat{k} - b - m + \hat{a}_f$$

► Debt Settlement Outcomes

Intermediate Goods' Firms



$$V_i^1(\hat{k}, x; \mathbf{s}) = \max_{v, k', b', m', a'_f} \left\{ d + E \left[\lambda(\mathbf{s}, \mathbf{s}') \sum_{j=1}^N p_{i,j} \max_{\hat{k}', \hat{a}'_f} \left\{ V_{P,j}^0(\hat{k}', x'_j; \mathbf{s}'), V_{R,j}^0(\hat{k}', x'_{R,j}; \mathbf{s}'), 0 \right\} \middle| \mathbf{s} \right] \right\}$$

subject to:

Non-negative dividend constraint: Khan and Thomas (2013)

$$d = x - vg(k', \hat{k}) + q^b b' + q^m m' - q^a a'_f \geq 0$$

debt prices, capital adj. costs, and $\mathbf{s}' = \Gamma(\mathbf{s})$

▶ Entry & exit

Closing the Model: Final Goods' Firms

► **Static problem:**

$$\max_{y(s)} Y - \left(\int_s \psi y(s)^{\frac{\zeta-1}{\zeta}} \mu(ds) \right)^{\frac{\zeta}{\zeta-1}}$$

subject to:

$$Y = \left(\int \psi y(s)^{\frac{\zeta-1}{\zeta}} \mu(ds) \right)^{\frac{\zeta}{\zeta-1}}$$

► **Idiosyncratic demand:**

$$\log \psi' = \rho_\psi \log \psi + \log \epsilon'_\psi; \quad \log \epsilon'_\psi \sim N(-0.5\sigma_\psi^2, \sigma_\psi^2)$$

► **Relative demand** for good produced by firm $s = [z, \hat{k}, x, \psi]$

$$y(s) = \left(\frac{\psi}{p(s)} \right)^\zeta Y$$

► Market Clearing

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Targeted moments

Statistic	Parameter	Model	Target
Firm-level data			
[1] Fraction of bank debt	$\bar{\gamma}^*$ (Wedge in intermediation costs)	35%	31%
[2] Leverage	\bar{p}_k (Resale value of capital)	39%	37%
[3] Exit rate	F_o (Operating cost)	9.6%	8.8%
[4] Entry rate	c_e (Entry cost)	9.6%	9.6%
[5] Entrants' relative size	ω (Pareto exponent)	21%	18%
[6] Exiters' relative size	σ_ψ (Vol. of idiosyncratic demand)	39%	41%
Aggregate data			
[7] Bond spread	χ (liquidation efficiency)	2.6%	2.8%

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- ▶ Cross-sectional patterns in: cash-to-asset, debt composition, leverage

▶ Model Checks

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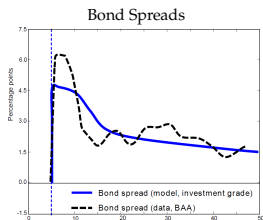
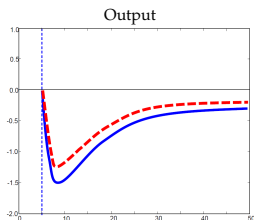
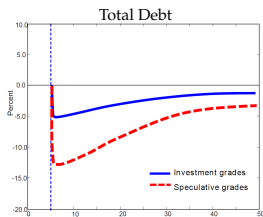
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Aggregate shock: bank credit supply

- ▶ Senior Loan Officer Opinion Survey of Bank Lending Practices (SLOOS)

Financial Shock: Baseline Results

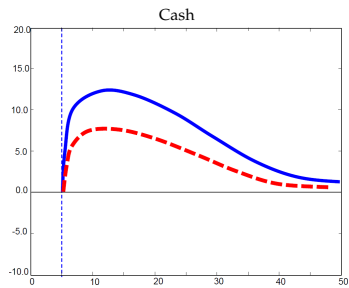
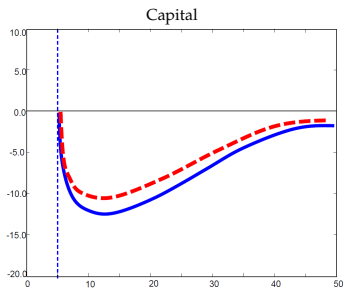
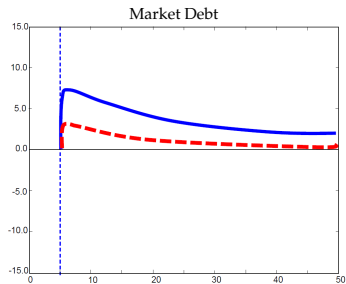
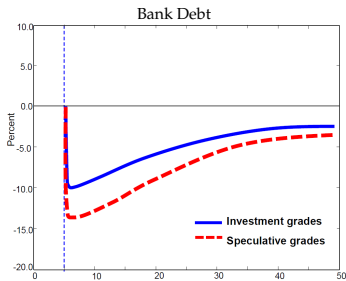


- ▶ Larger drop for **speculative grade** firms
- ▶ Less substitution towards bonds

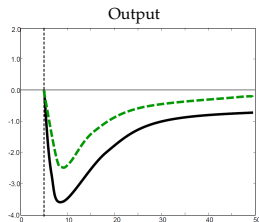
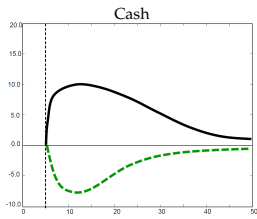
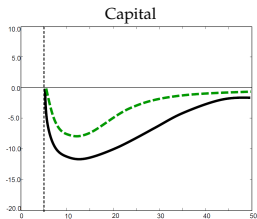
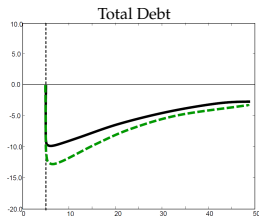
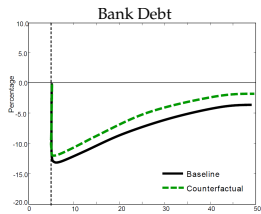
- ▶ Larger drop for **investment grade** firms
- ▶ More funds reallocated to liquid assets

- ▶ Higher spreads on both bank and market debt
- ▶ Matching bond spread to data

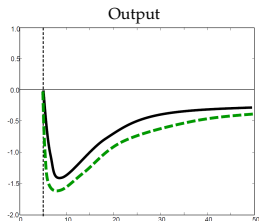
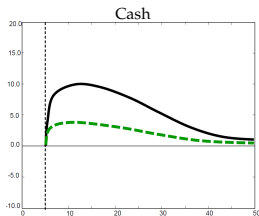
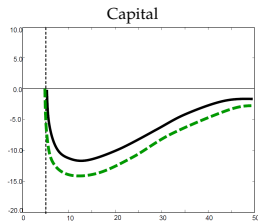
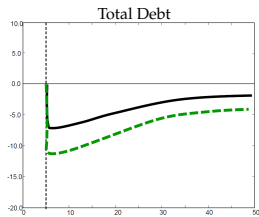
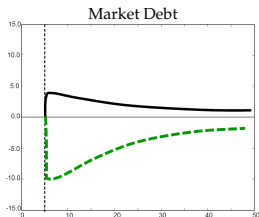
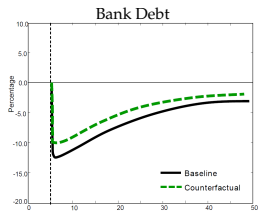
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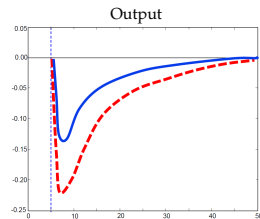
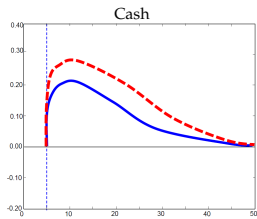
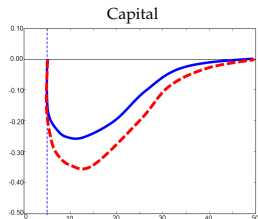
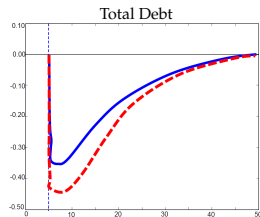
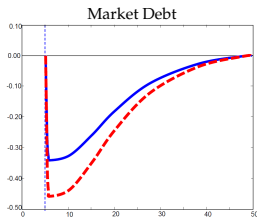
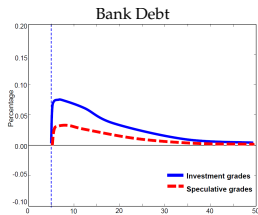
Counterfactual (1): Precautionary Savings Channel



Counterfactual (2): Role of Bond Market



Counterfactual (3): Uncertainty Shock



1. Introduction
2. “Borrow-to-Save” Mechanism
3. Structural Model of Firm Dynamics
4. Quantitative Implications
5. **Conclusion**

Conclusion

Main results

- ▶ **Evidence:** 'Larger' firms hoarded more cash and invested less
 - ▶ **Mechanism:** Precautionary savings associated with debt substitution
 - ▶ **Aggregate implication:** 40% of decline in aggregate investment
- ⇒ **Firms' balance sheet adjustment quantitatively important for understanding transmission of financial shocks**

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Other results

- ▶ Bond market can act as a "spare tyre" to bank-based intermediation
- ▶ Financial frictions relatively more important than real frictions
- ▶ Counterfactual responses to uncertainty shocks when examining the differences between 'small' and 'large' firms

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 - By size of total assets (robustness)

▶ Back

Related Literature

1. Macroeconomic implications of debt heterogeneity

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3. Financial frictions and propagation mechanisms

- **Credit constraint:** Bernanke, Gertler and Gilchrist (1999); Kiyotaki and Moore (1997)
- **Firm dynamics:** Cooley and Quadrini (2001); Clementi and Hopenhayn (2006); Hennessy and Whited (2007); Khan and Thomas (2013)
- **Debt vs. equity:** Jermann and Quadrini (2012); Covas and Den Haan (2012); Begenau and Salomao (2016)

New: Propagation through firms’ balance sheet adjustment

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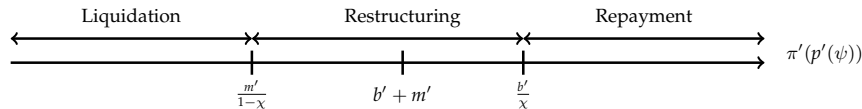
Appendix: Variations in Cash Holdings & Debt Finance

	Cash	Market debt		Bank debt		Total debt	
	$\frac{\text{stdev}}{\text{mean}}$	$\frac{\text{stdev}}{\text{mean}}$	p-value	$\frac{\text{stdev}}{\text{mean}}$	p-value	$\frac{\text{stdev}}{\text{mean}}$	p-value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Q1	0.57	0.21	(0.00)	0.43	(0.00)	0.20	(0.00)
Q2	0.53	0.24	(0.00)	0.41	(0.00)	0.18	(0.00)
Q3	0.54	0.26	(0.00)	0.39	(0.00)	0.19	(0.00)
Q4	0.58	0.31	(0.00)	0.42	(0.00)	0.22	(0.00)
Full sample	0.56	0.28	(0.00)	0.40	(0.00)	0.19	(0.00)

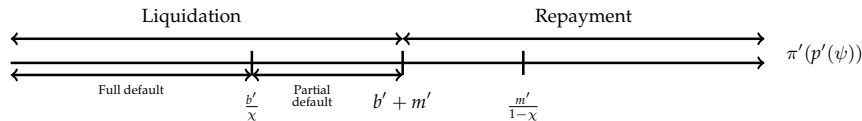
Sources: Compustat & Capital IQ

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Debt Settlement Outcomes

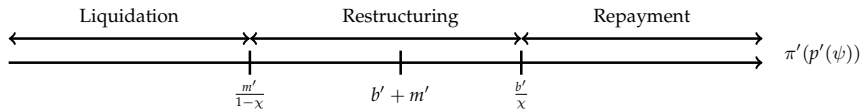


R-contract ($\frac{b'}{\chi} \geq \frac{m'}{1-\chi}$)

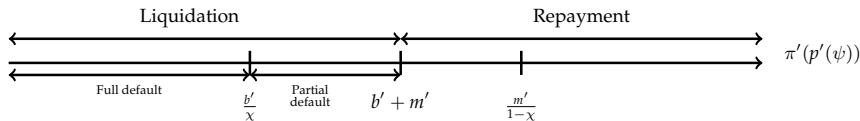


NR-contract ($\frac{b'}{\chi} < \frac{m'}{1-\chi}$)

Debt Settlement Outcomes



R-contract ($\frac{b'}{\chi} \geq \frac{m'}{1-\chi}$)



NR-contract ($\frac{b'}{\chi} < \frac{m'}{1-\chi}$)

- ▶ Restructured bank debt $b'_R = \chi\pi'$
- ▶ Firm's liquidation value $V'_L = 0$

Firm Dynamics: Entry and Exit

► Exit

$$\delta^e(\mu(s)) \equiv \int \left(\underbrace{F(\underline{\psi})}_{\text{liquidations}} + \underbrace{\eta(1 - F(\underline{\psi}))}_{\text{exogenous exits}} \right) \mu(ds)$$

where $ds = [dz, d\hat{k}, dx, d\psi]$

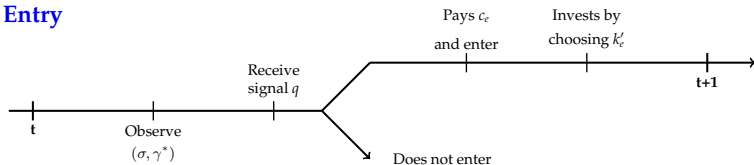
Firm Dynamics: Entry and Exit

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► Entry



Market Clearing

► Goods market clearing:

$$\begin{aligned} c(\mathbf{s}) = & Y(\mathbf{s}) - \underbrace{\int v(s; \mathbf{s}) \left[g(k'(s; \mathbf{s}), \hat{k}) + g(\hat{k}(s; \mathbf{s}), k) \right] \mu(ds)}_{\text{capital adj. costs}} - \underbrace{\gamma^b \int b'(s; \mathbf{s}) \mu(ds)}_{\text{bank intermediation costs}} \\ & - \underbrace{\gamma^m \int m'(s; \mathbf{s}) \mu(ds)}_{\text{market intermediation costs}} - \underbrace{\int c_e \mu_e(ds)}_{\text{entry costs}} - \underbrace{\int \mathbf{1}_{\psi' \leq \underline{\psi}'} \times (1 - \chi) y(s; \mathbf{s}) \mu(ds)}_{\text{default costs}} \end{aligned}$$

► Deposits market clearing:

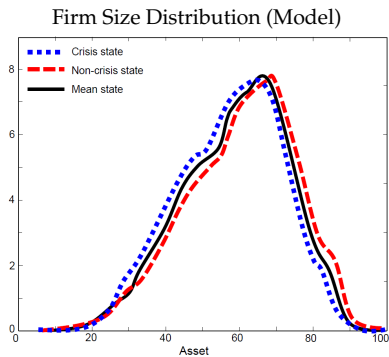
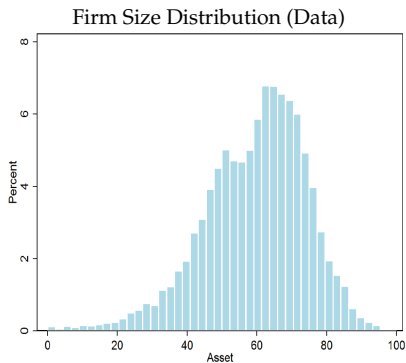
$$\underbrace{a'_h(\mathbf{s})}_{\text{households' savings}} + \underbrace{\int a'_f(s; \mathbf{s}) \mu(ds)}_{\text{firms' savings}} = a'_b(\mathbf{s}) + a'_m(\mathbf{s})$$

► Debt market clearing:

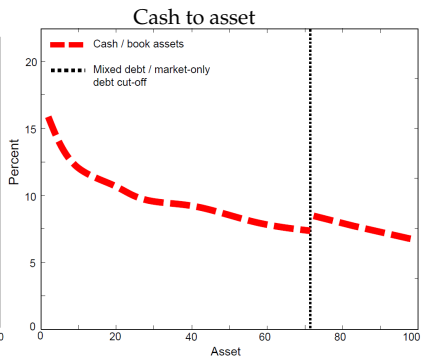
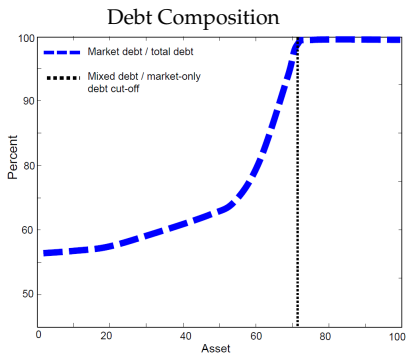
$$\int b'(s; \mathbf{s}) \mu(ds) = a'_b(\mathbf{s}) \quad \text{and} \quad \int m'(s; \mathbf{s}) \mu(ds) = a'_m(\mathbf{s})$$

► Back

Model Predictions (1): Firm Distribution



Model Predictions (2): Financial Policies in Steady State



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