Corporate Debt Structure, Precautionary Savings, and Investment Dynamics

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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

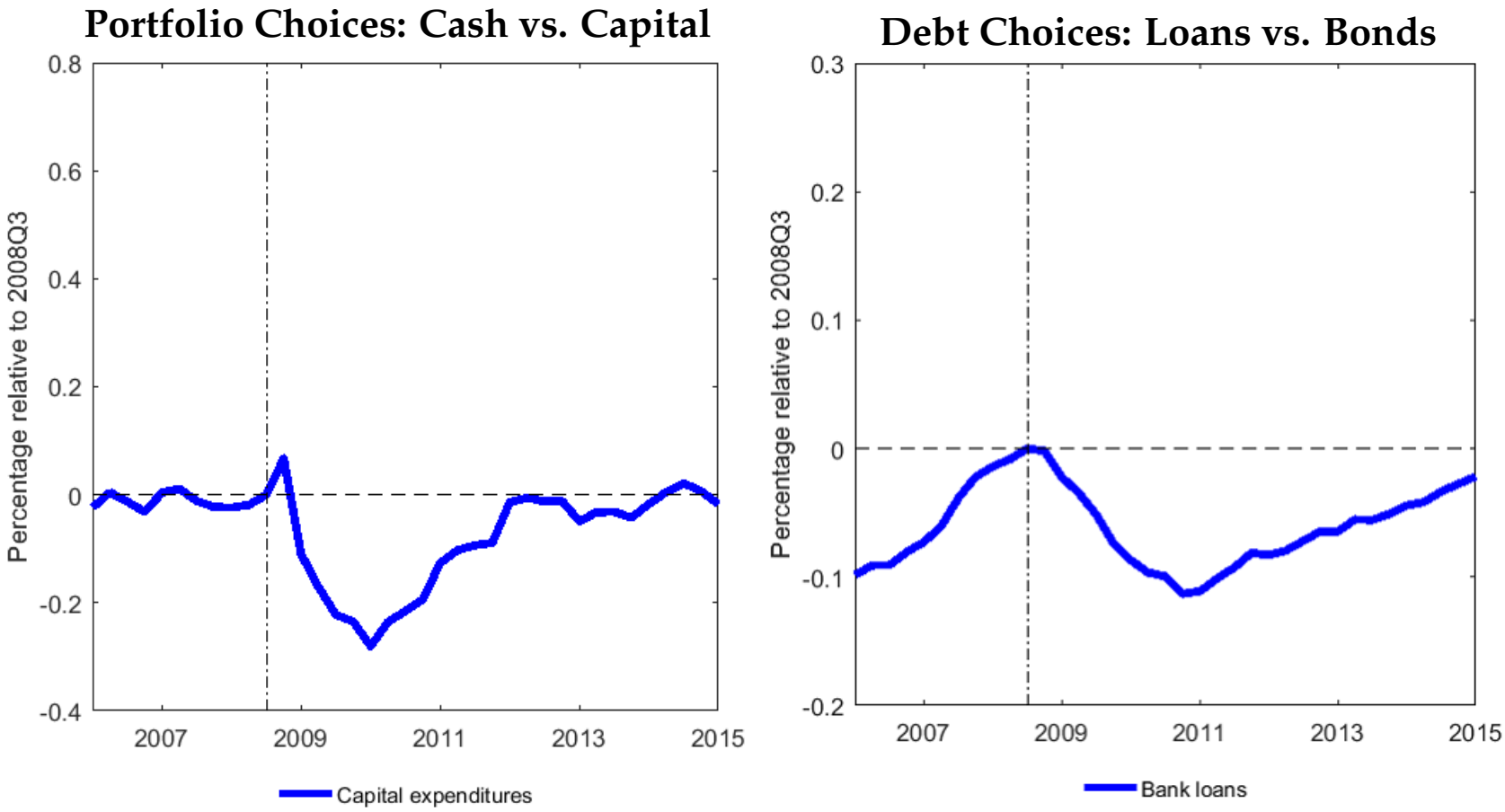

Figure: Balance Sheet Policies of U.S. Nonfinancial Corporate Businesses

Source: Compustat & Capital IQ

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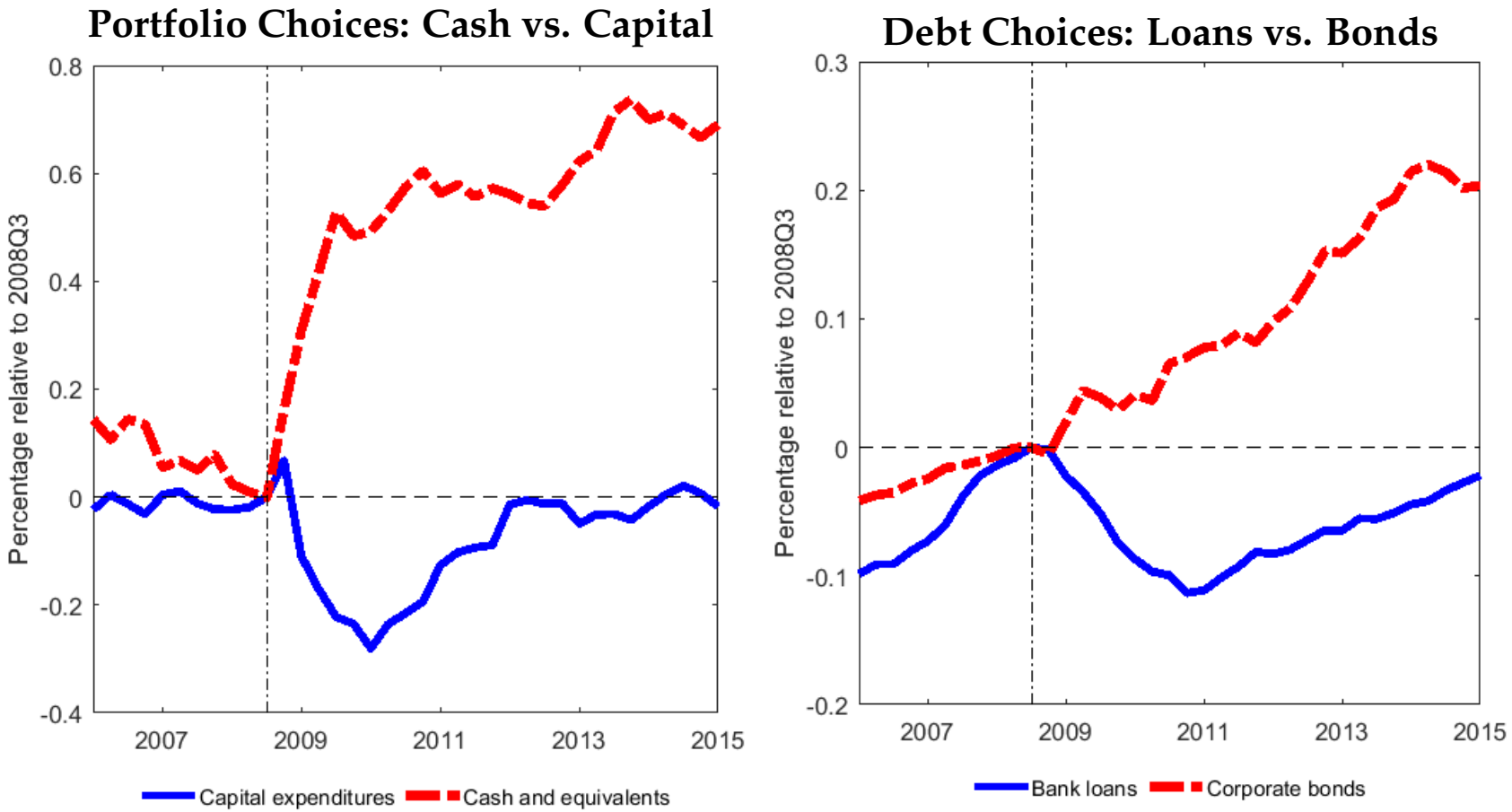

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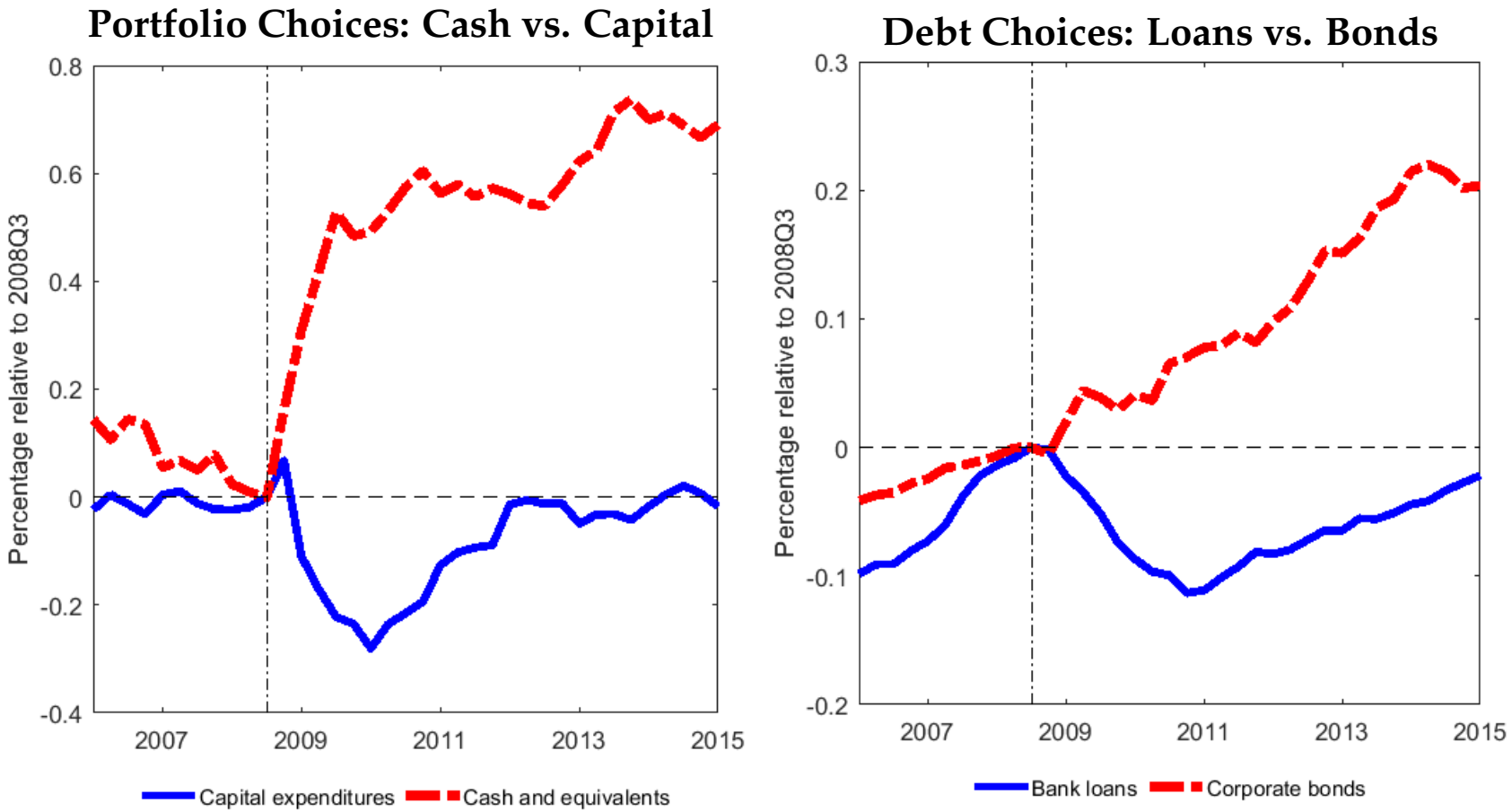

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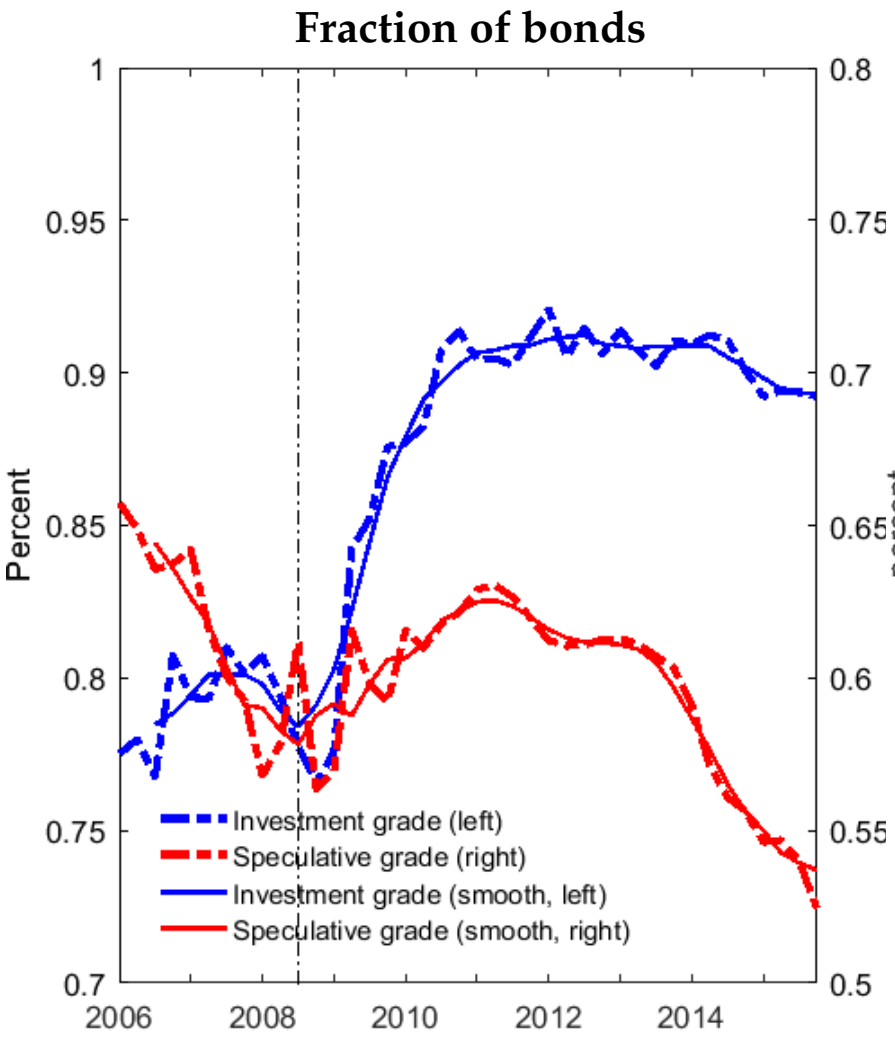
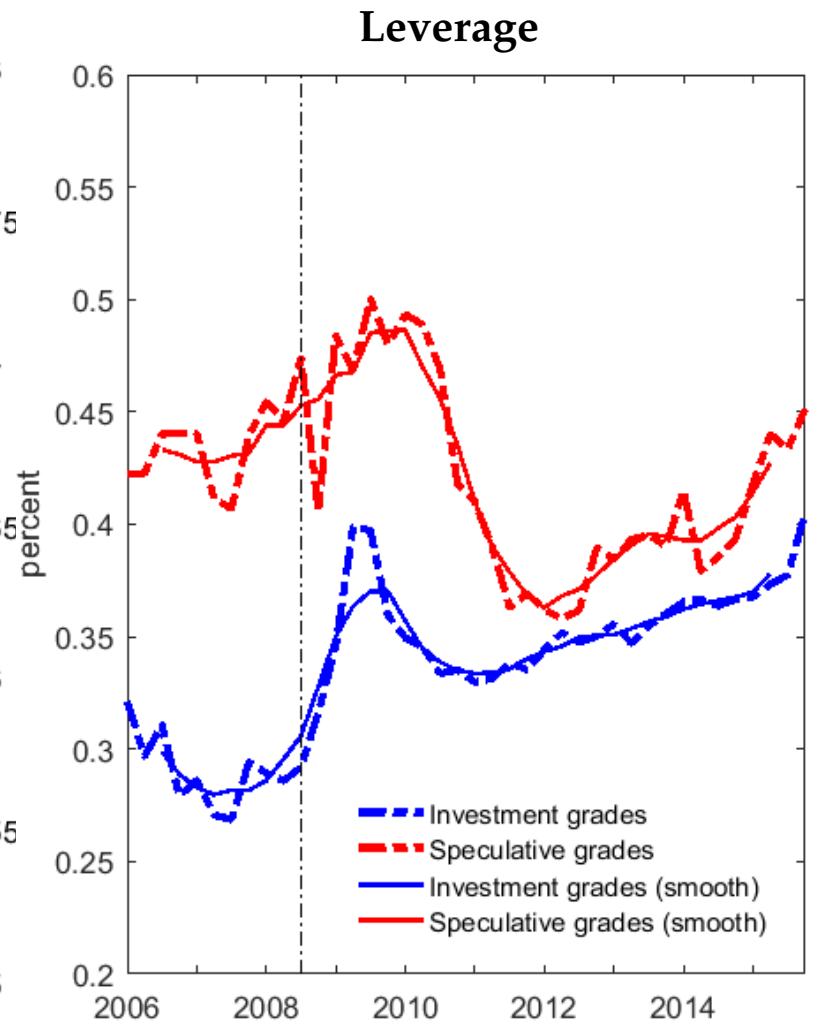
Question: How do firms' balance sheets propagate financial shocks?

New Micro-Level Evidence (1): Firm Heterogeneity in Liabilities

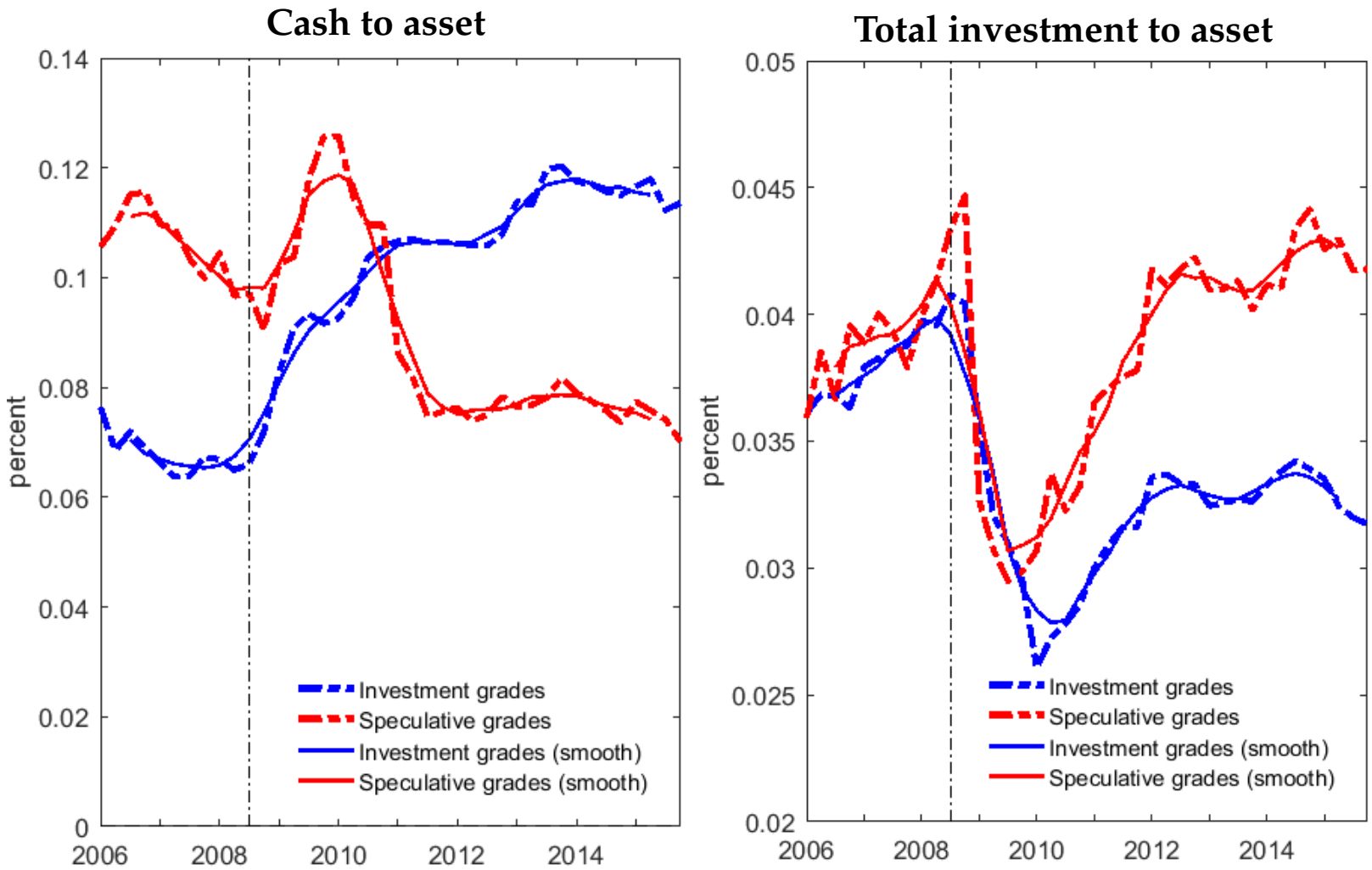




Sources: Compustat & Capital IQ

▸ Sample

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



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This Paper: Overview (1)

Firm-Level Evidence

- '**Larger**' firms (investment): ΔLeverage ≈ 0 ΔInvestment $\downarrow\downarrow$ ΔCash $\uparrow\uparrow$
- '**Smaller**' firms (speculative): ΔLeverage $\downarrow\downarrow$ ΔInvestment $\downarrow$ ΔCash $\downarrow$

$\Longrightarrow$ Change in debt and change in investment not one-to-one!

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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 $\rightarrow$ bond-only
    $\Longrightarrow$ (De)leverage effect: total borrowing $\Downarrow\Downarrow$
  - Asset-side: risky capital $\rightarrow$ safe assets
    $\Longrightarrow$ Partially offsets (de)leverage effect: total borrowing $\Downarrow\not\Downarrow$
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Quantitative Implications

- **Financial constraint channel**
  Firms of high default risks: Total debt $\Downarrow\Downarrow$, Investment $\Downarrow$
- **Precautionary savings channel**
  Firms of intermediate default risks: Total debt $\Downarrow$, Investment $\Downarrow\Downarrow$

▸ Literature

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

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Outline

Simple Example: Timing

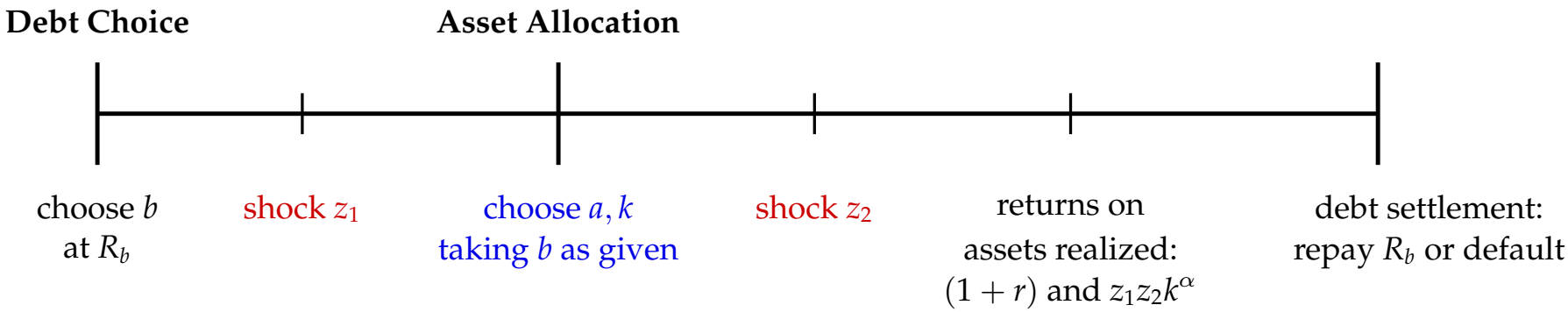

Figure: Timing in one period

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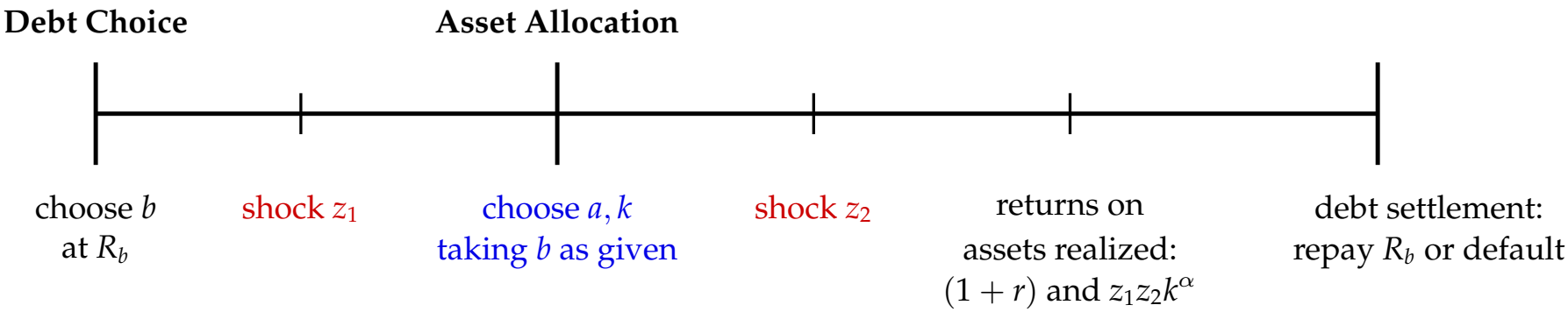

Figure: Timing in one period

- **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 $N = e + b$

$$\max_{s(b,\hat{z}_1,e)} \mathrm{E}_{z_2}\pi = \int_{\underline{z}_2(\hat{z}_1,s)}^{+\infty} \left[\hat{z}_1 z_2 (1-s)^{\alpha} N^{\alpha} + (1+r)sN - (1+r_b)b\right] dF(z_2) + \int_{-\infty}^{\underline{z}_2(\hat{z}_1,s)} -D dF(z_2),$$

s.t.

$$\textbf{[1]}\ \ \underline{z}_2 = \frac{(1+r_b)b - (1+r)sN}{\hat{z}_1(1-s)^{\alpha}N^{\alpha}}$$

$$\textbf{[2]}\ \ 1 + r_b = \frac{(1+r)b}{\int_{z_1}[1 - F(\underline{z}_2(z_1))]dF(z_1)}$$

$$\textbf{[3]}\ \ s \in [0,1]$$

Simplification: $\Longrightarrow$ Exogenous default cost (D)
$\Longrightarrow$ DWL = 1 ($\chi = 1$)

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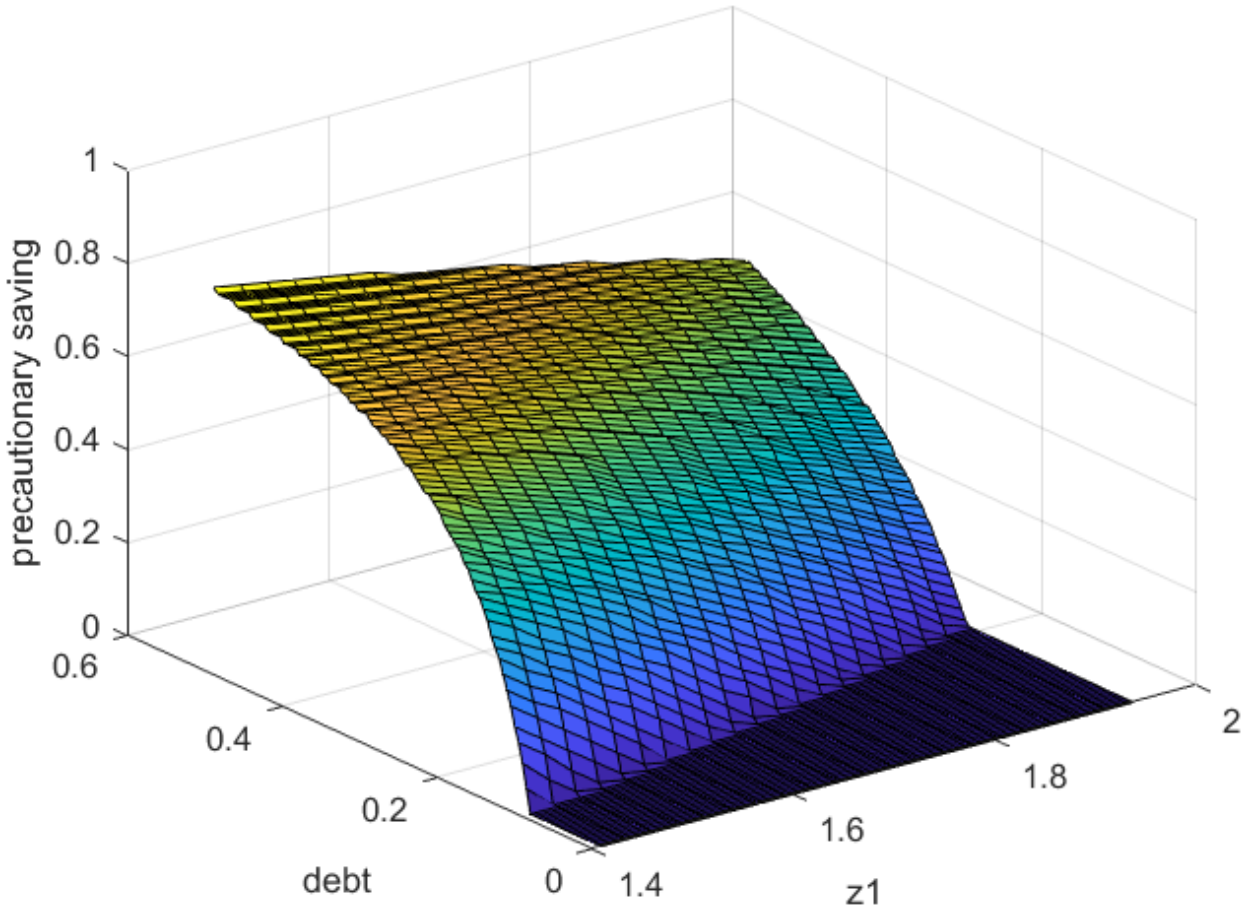

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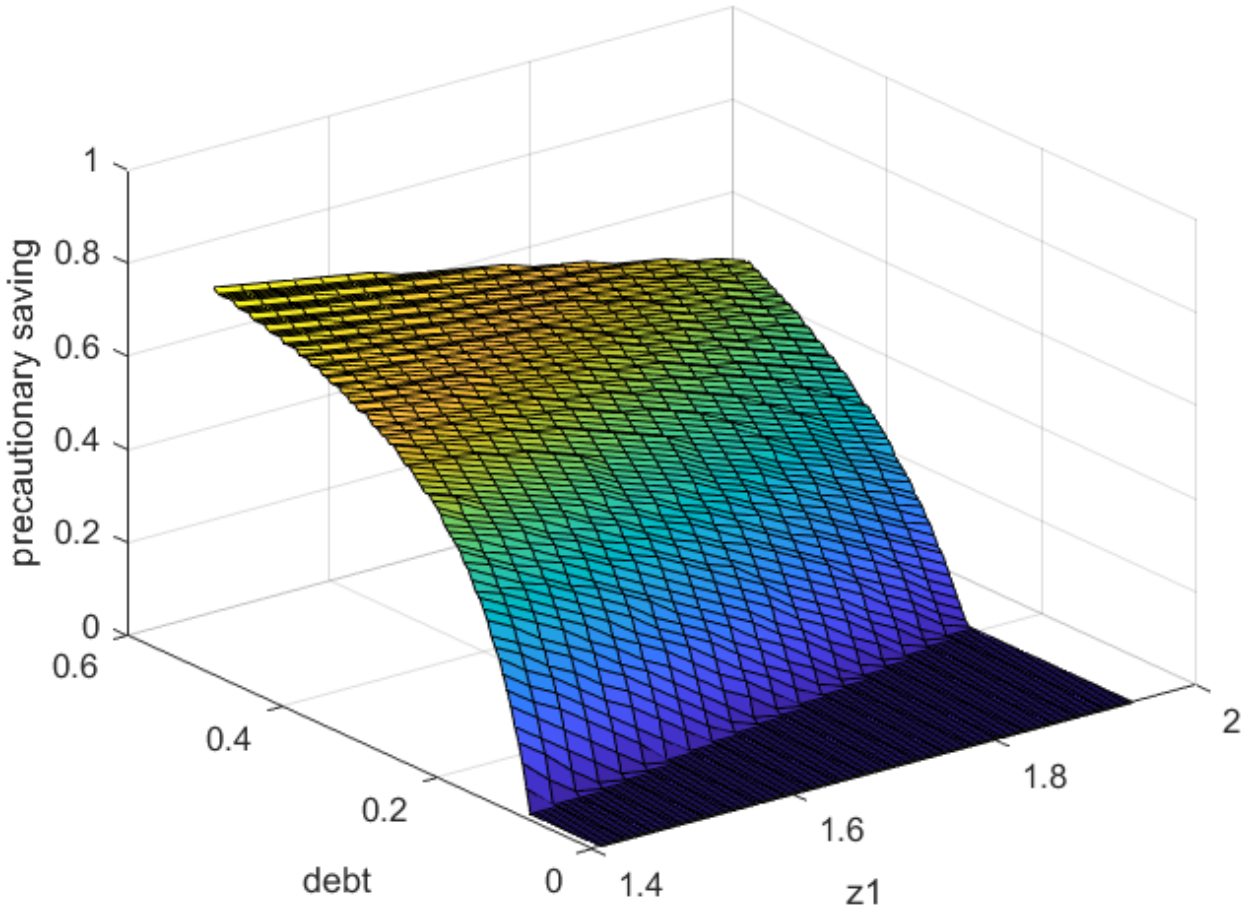

- s^* increasing in debt (b) and decreasing in realized return on capital $\hat{z}_1$

Simple Example: How Much to Borrow?

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

$$\max_b \mathrm{E}_{z_1,z_2}(\pi) = \int_{z_1}^{+\infty} \int_{\underline{z}_2(z_1,s^*)}^{+\infty} \left[z_1 z_2 (1-s^*)^\alpha N^\alpha + (1+r)s^* N - (1+r_b)b \right] dF(z_2)dF(z_1)$$
$$+ \int_{z_1}^{} \int_{0}^{\underline{z}_2(z_1,s^*)} -D dF(z_2)dF(z_1),$$

s.t.

[1] $\underline{z}_2 = \dfrac{(1+r_b)b - (1+r)sN}{z_1(1-s)^\alpha N^\alpha}$

[2] $1 + r_b = \dfrac{(1+r)b}{\int_{z_1}[1 - F(\underline{z}_2(z_1))]dF(z_1)}$

[3] $s^*(b, z_1, e)$ from asset allocation stage

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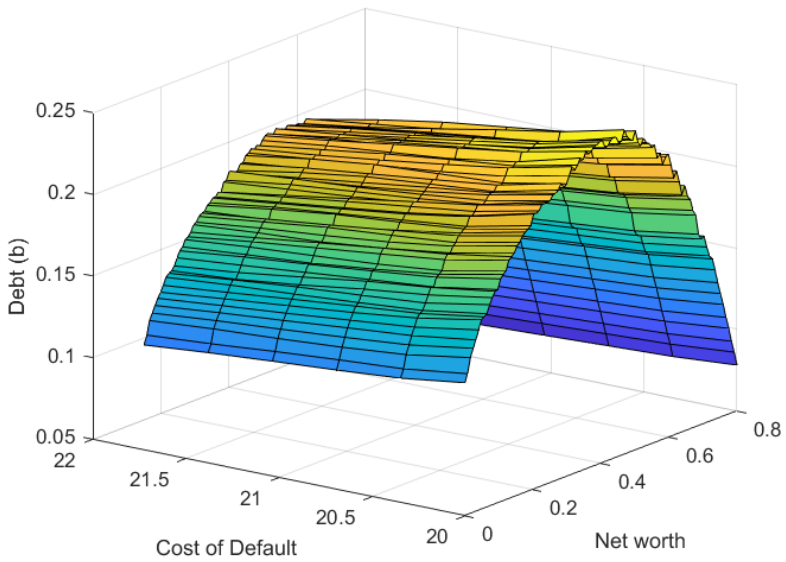

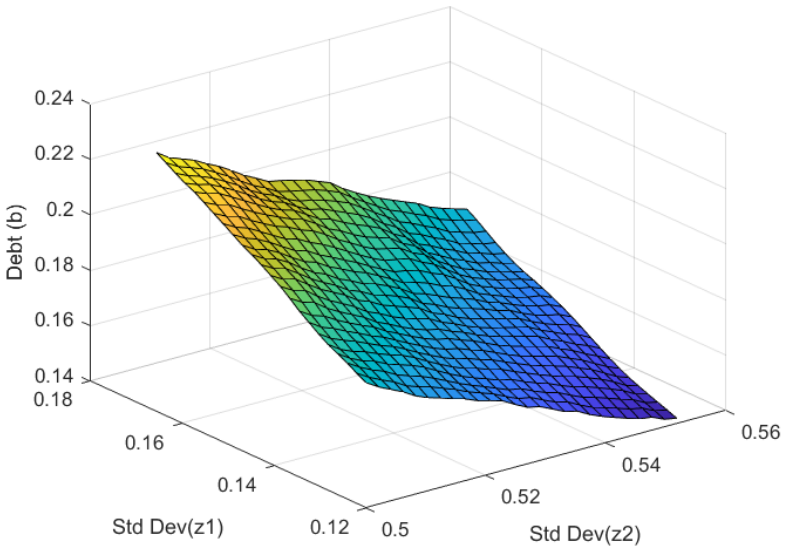

- non-monotonic in net worth (e)
- decreasing in default cost (D)

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

Outline

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- **Demography:** household, intermediate goods firms (incumbent & entrants), final goods firms, financial intermediaries (market lenders & bank lenders)

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  - Trade-off: (Crouzet, 2017)
    - → **Key assumption 3:** Only bank debt can be restructured
    - → **Key assumption 4:** Wedge in intermediation costs γ^*

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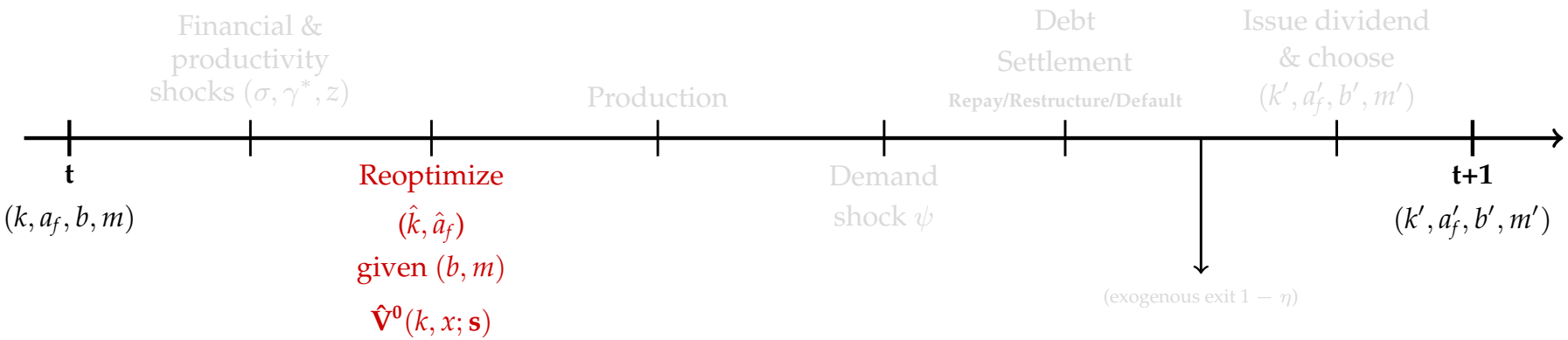
- **Markov processes:** (z, γ^*, ψ)

Intermediate Goods' Firms



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

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

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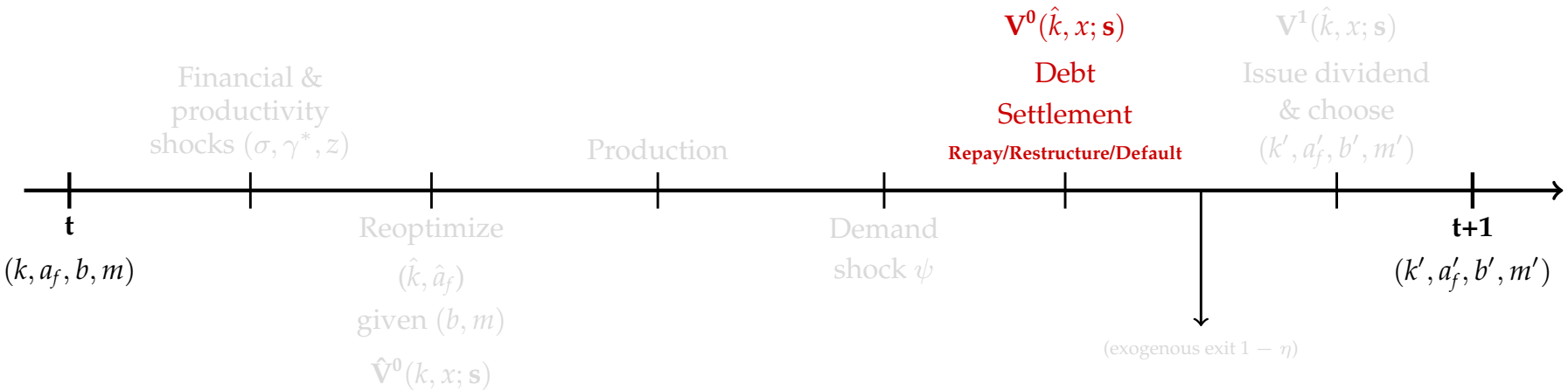


$$V^0(\hat{k}, x; \mathbf{s}) = \max\left\{ \underbrace{V_P^0(\hat{k}, x; \mathbf{s})}_{\text{Repay}}, \underbrace{V_R^0(\hat{k}, x_R; \mathbf{s})}_{\text{Restructure}}, \underbrace{0}_{\text{Default}} \right\}.$$

where:

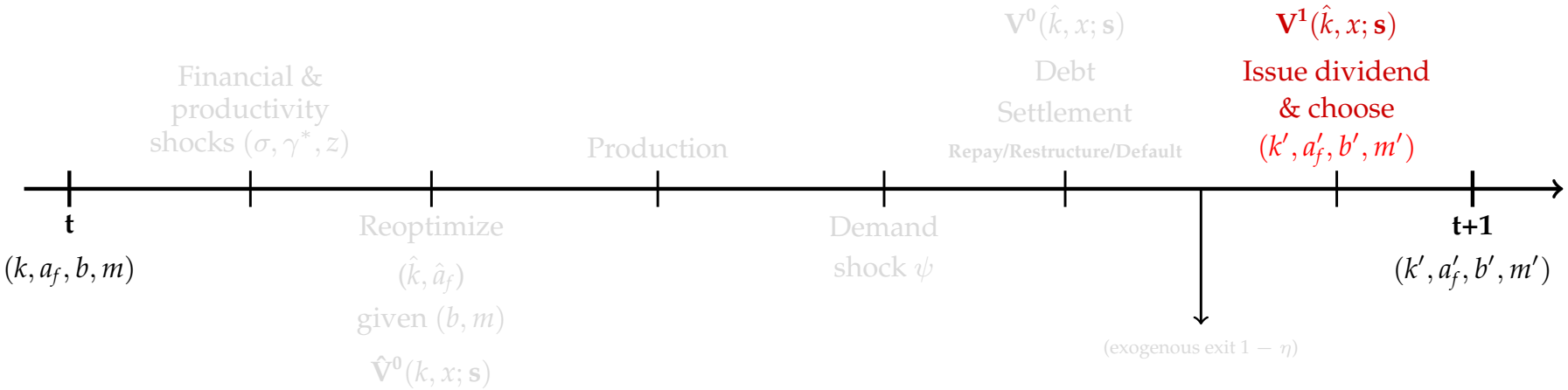
$$V_l^0(\hat{k}, x; \mathbf{s}) = \underbrace{(1-\eta)n_l}_{\text{exogenously exit}} + \underbrace{\eta V^1(\hat{k}, x; \mathbf{s})}_{\text{survive exit shock}}$$

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

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

▸ Debt Settlement Outcomes

Intermediate Goods' Firms



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

subject to:

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

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

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:**

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

- **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

Outline

Calibration

Targeted moments

Statistic	Parameter	Model	Target
Firm-level data			
[1] Fraction of bank debt	$\bar{\gamma}^*$ (Wedge in intermediation costs)	35%	31%
[2] Leverage	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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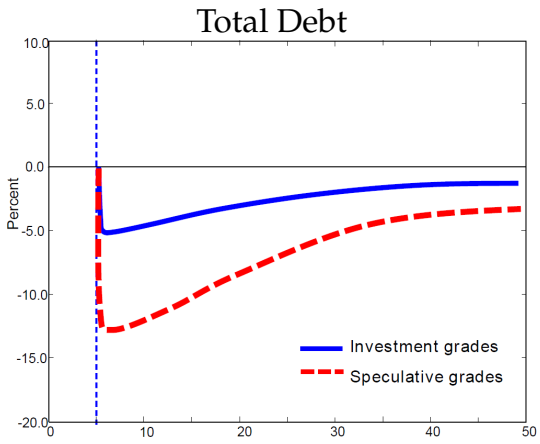
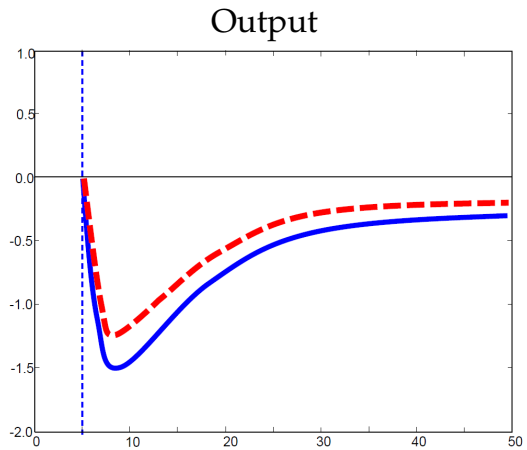
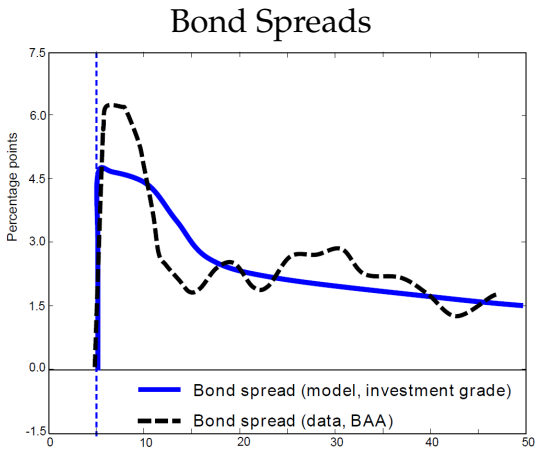
Aggregate shock: bank credit supply

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

Financial Shock: Baseline Results





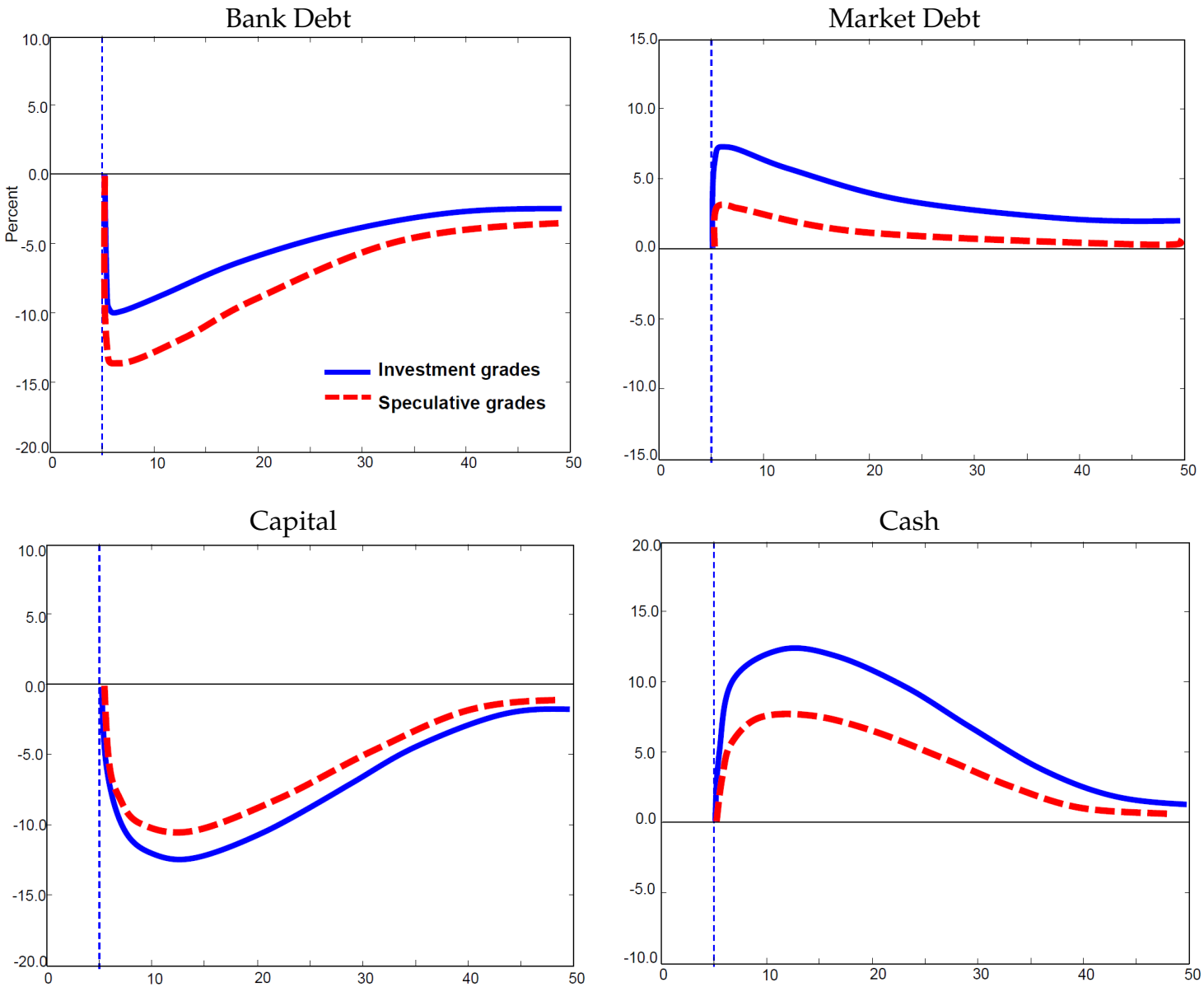


- Larger drop for speculative grade firms
- Less substitution towards bonds

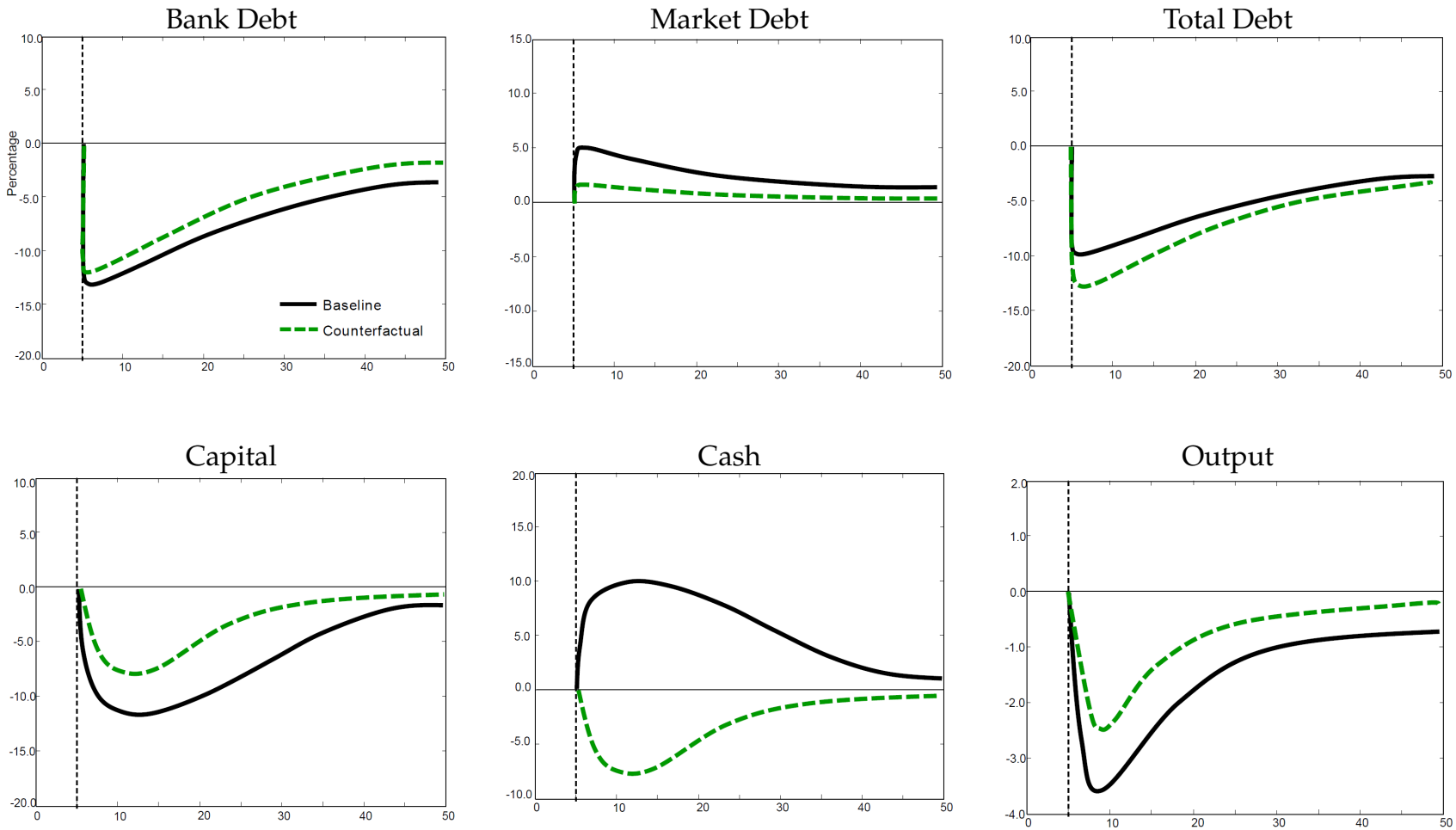
- Larger drop for investment grade firms
- More funds reallocated to liquid assets

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

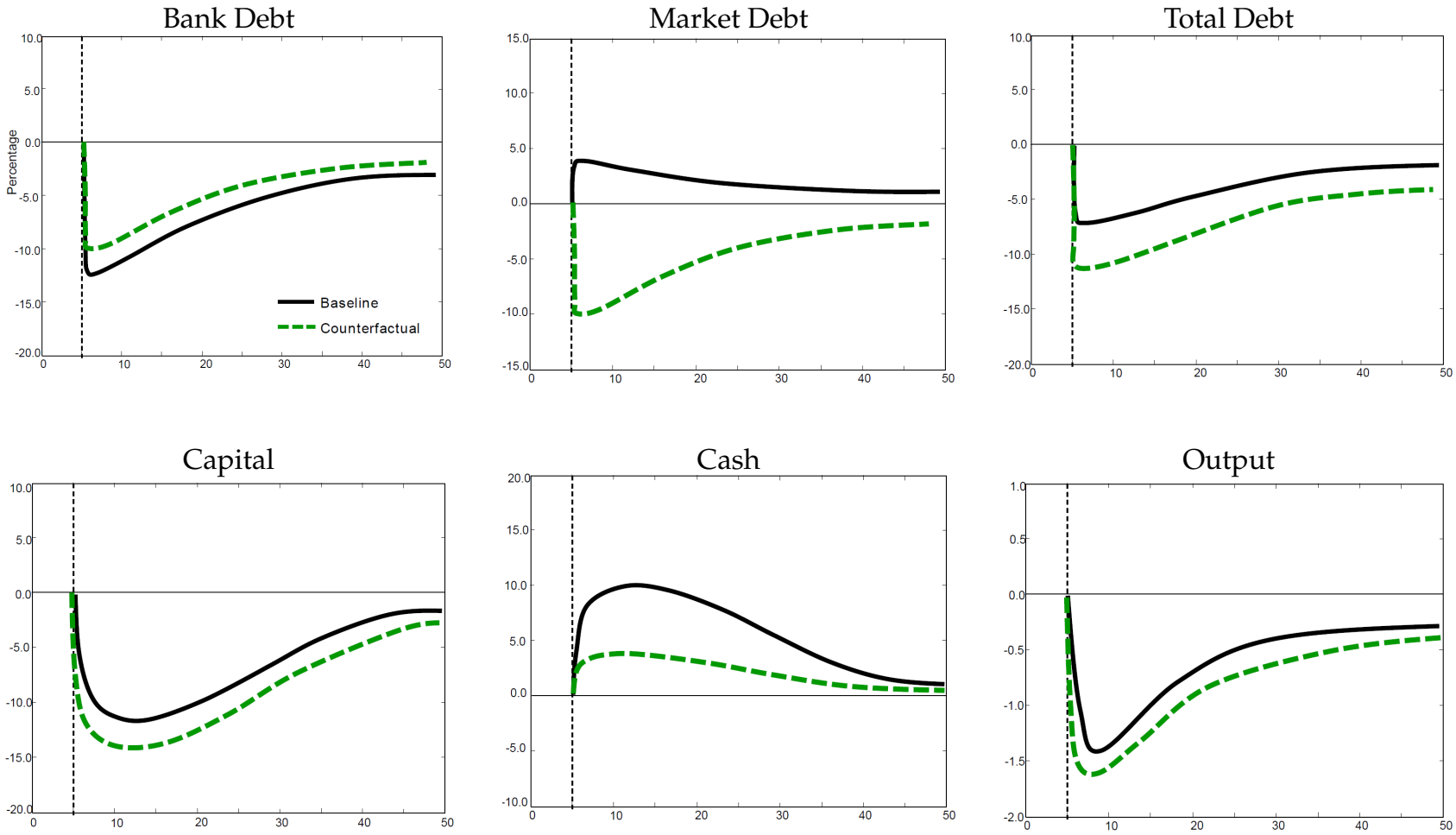
Financial Shock: Baseline Results



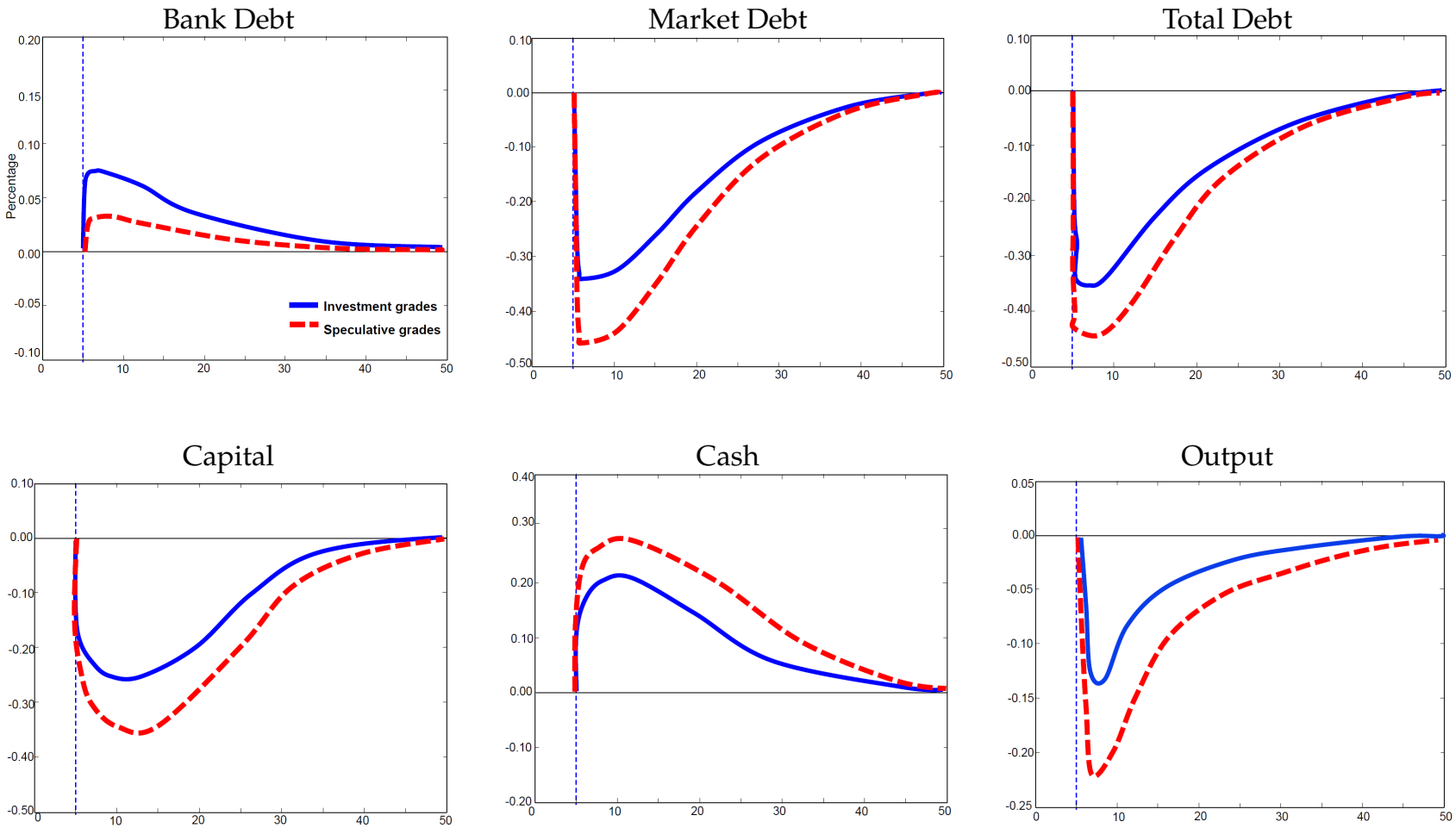
Counterfactual (1): Precautionary Savings Channel



Counterfactual (2): Role of Bond Market



Counterfactual (3): Uncertainty Shock



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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

$\Longrightarrow$ **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

Sample Description

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- **US non-financial and non-utility public firms**
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  - By size of total assets (robustness)

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Related Literature

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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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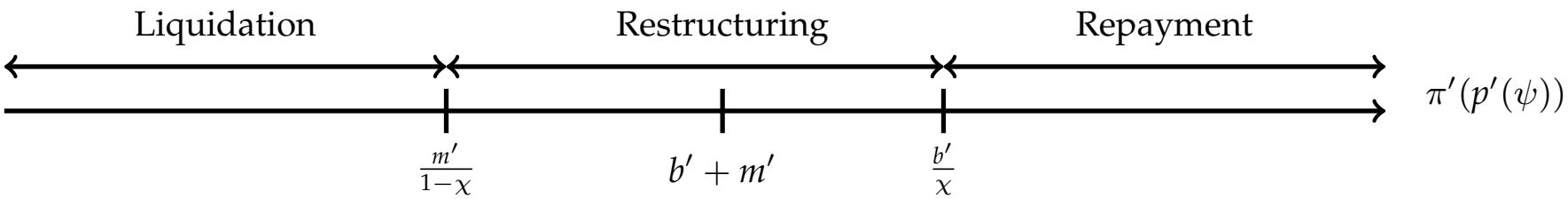
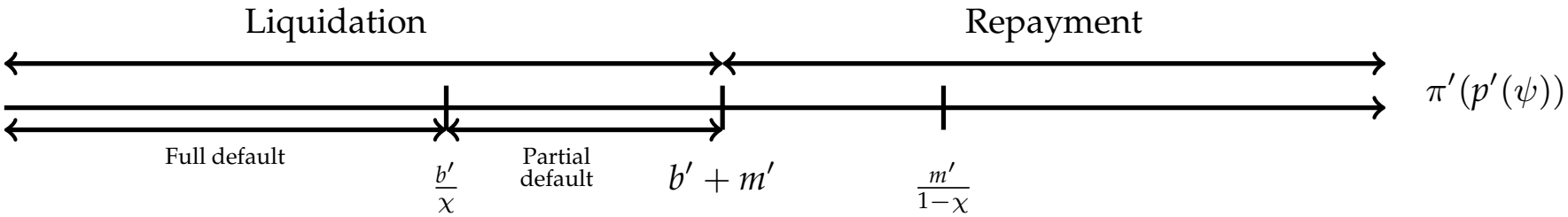
Debt Settlement Outcomes



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



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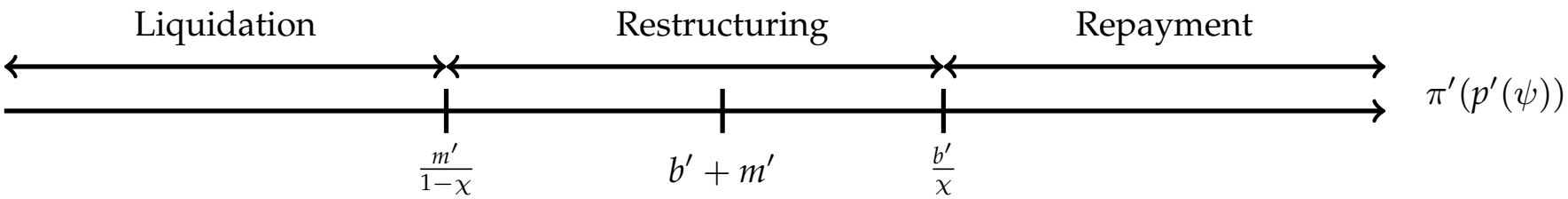

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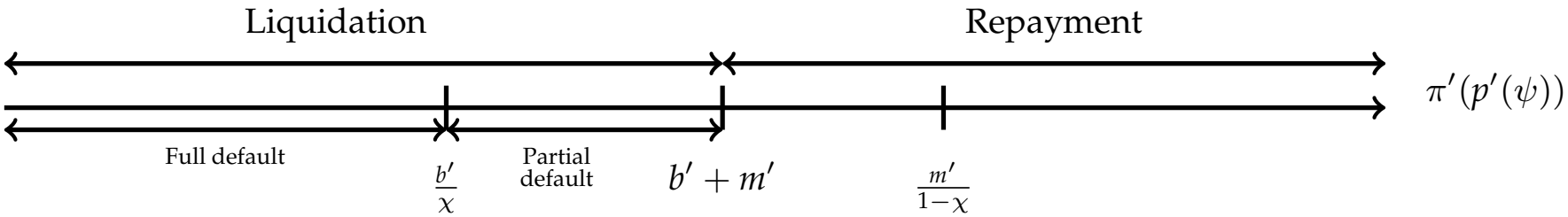

NR-contract ($\frac{b'}{\chi} < \frac{m'}{1-\chi}$)

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

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Firm Dynamics: Entry and Exit

- **Exit**

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

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

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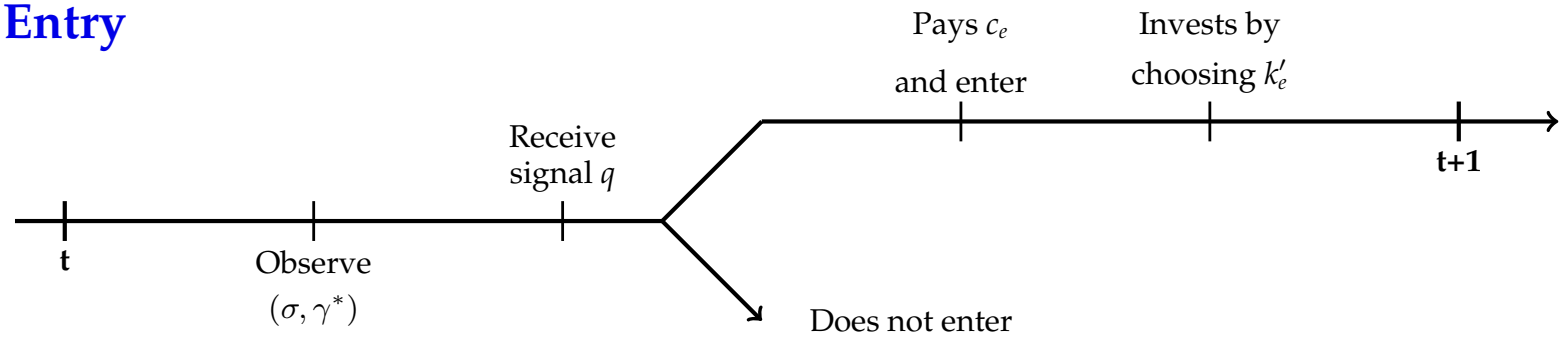

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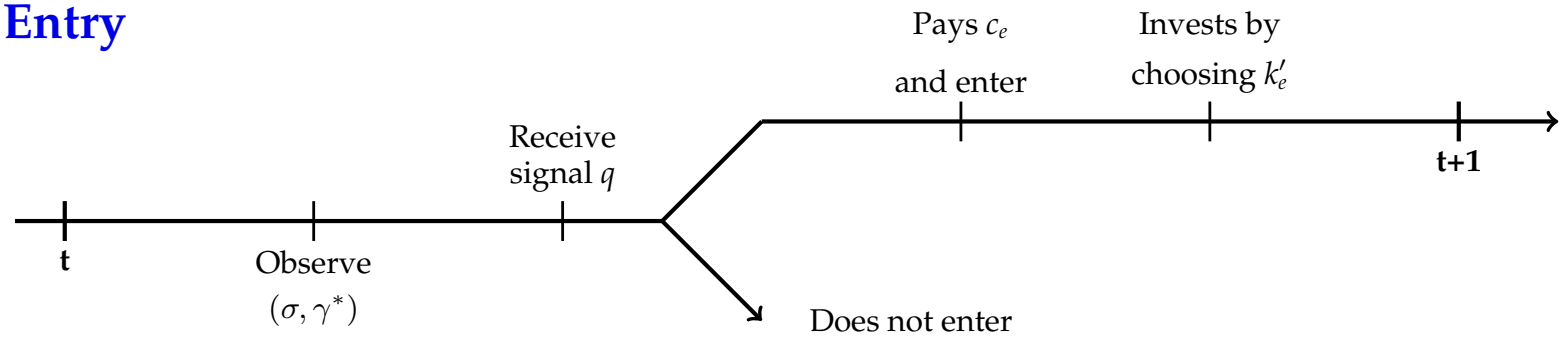

  - $t+1$ productivity and demand shocks depend on signal q
  - Value of an entrant

$$V_e(q; \mathbf{s}) = \max_{k'_e} \left\{ -\gamma^e k'_e + \mathrm{E}\left[\lambda(\mathbf{s}, \mathbf{s}') \sum_{j=1}^{N} p_{i,j} V_j^1(z', k'_e, x'_e; \mathbf{s}') \middle| \mathbf{s} \right] \right\}$$

  - **Entry condition:** $V_e(q^*; \mathbf{s}) = c_e$

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Market Clearing

- **Goods market clearing:**

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

- **Deposits market clearing:**

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

- **Debt market clearing:**

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

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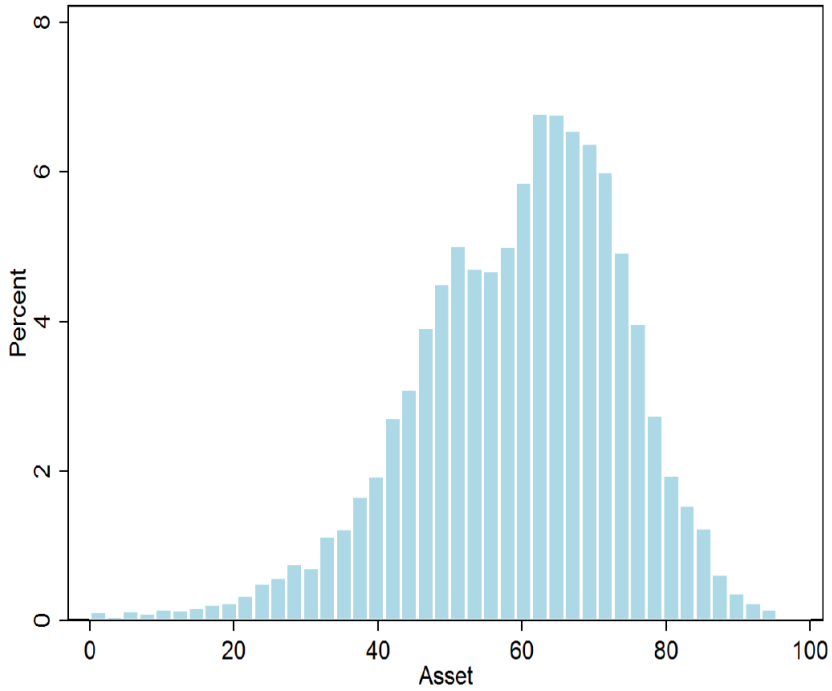
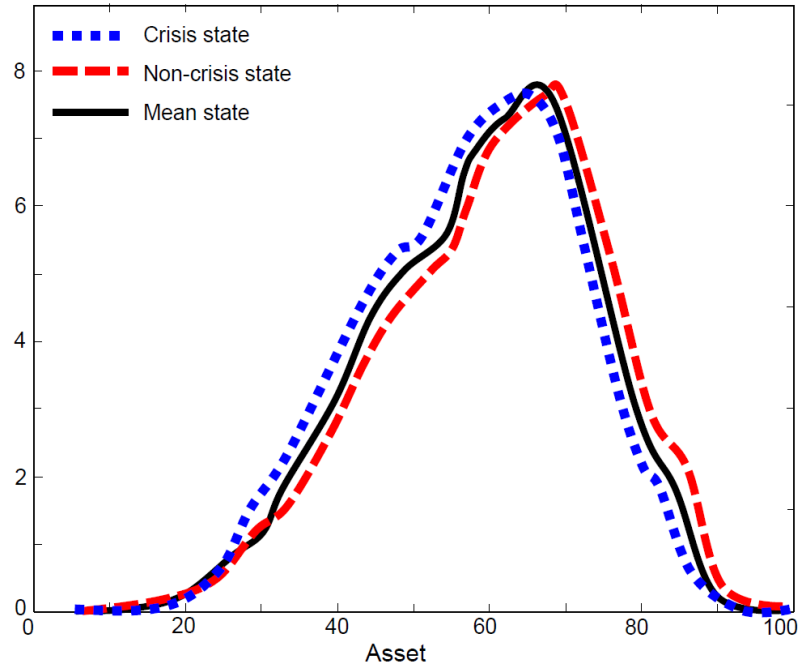
Model Predictions (1): Firm Distribution

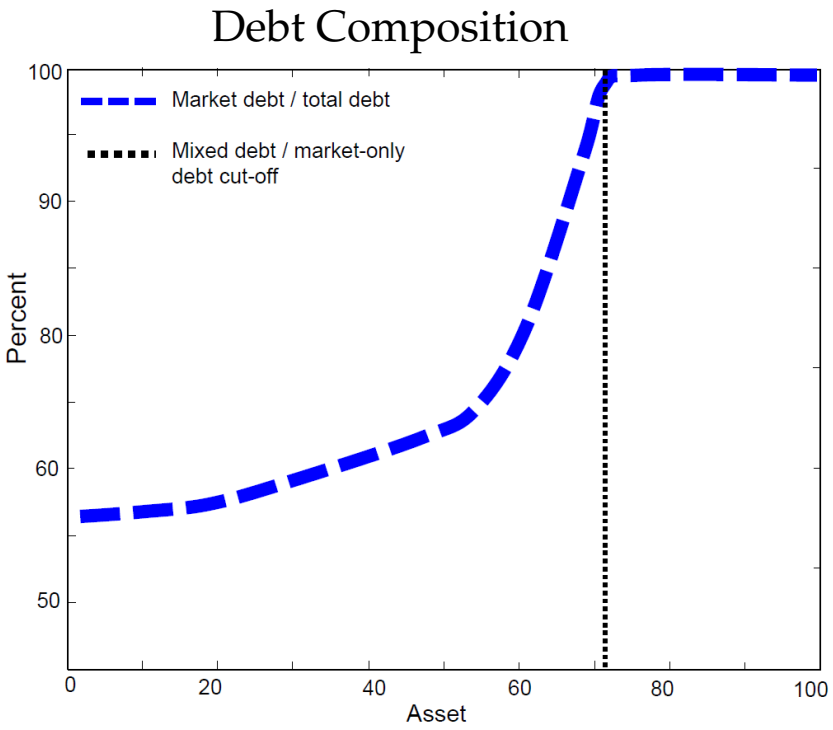
Firm Size Distribution (Data)

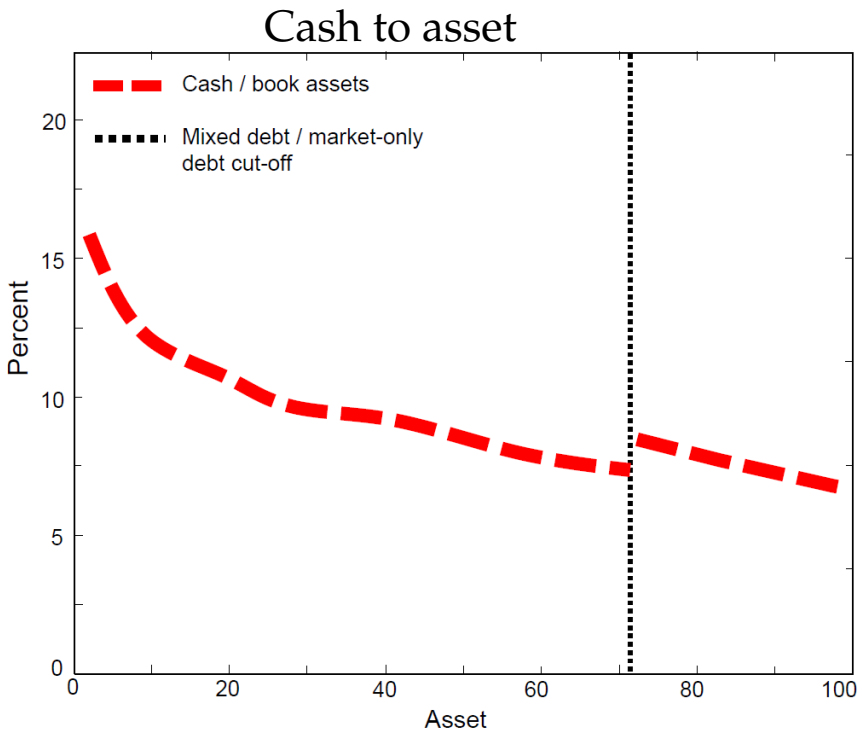


Firm Size Distribution (Model)



Model Predictions (2): Financial Policies in Steady State





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