Sophisticated Borrowing Constraints and Macroeconomic Dynamics

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Corporate Borrowing Constraints: Theory vs Practice

Traditional macro-finance models: [e.g., Kiyotaki & Moore 97; Khan & Thomas, 13; Bianchi & Mendoza, 18]

- **Hard borrowing constraints**
- Enforcement: cut credit indiscriminately to maintain borrowing limits
- **Harms performance: earnings ↓ and capital ↓**

Practice: [e.g., Roberts & Sufi, 09; Nini, Smith, & Sufi, 12; Lian & Ma, 21]

- **Sophisticated borrowing constraints** (e.g. covenants) determined by operating earnings
- Enforcement: violation triggers **creditor control**, which can reduce managerial agency frictions
- **Improves performance: earnings ↑ and capital ↓**

Macro Implications of Sophisticated Borrowing Constraints

Model and study macro implications of **sophisticated borrowing constraints**

- Before violations: manager control (e.g., borrowing and investment) s.t. agency frictions
- After violations: creditor control & no agency frictions

Micro: quantitatively matches patterns of borrowing & investment around covenant violation

Macro: **muted financial acceleration** under sophisticated borrowing constraints

- Violations $\Rightarrow$ creditor control $\Rightarrow$ improves performance & curbs financial acceleration
- Contrast with financial acceleration under hard borrowing constraints
- Consistent with the resilience of U.S. nonfinancial firms during recessions [e.g., Gertler & Gilchrist, 18]

Outline

1. Enforcement of Corporate Borrowing Constraints in Practice
2. Model
3. Matching Micro Evidence on Firm Behavior Around Covenant Violation
4. Macro Implications of Sophisticated Borrowing Constraints
5. Conclusion

Enforcement of Corporate Borrowing Constraints in Practice

Financial covenants: legally-binding requirements, typically assessed quarterly

- Commonly restrict total debt or interest payment as a function of operating earnings (EBITDA)
- EBITDA: earnings before interest, taxes, depreciation, and amortization

Violation of financial covenant: technical default

- Creditors have legal power to accelerate payments, but rarely do so
- Creditors instead use the power to **impose creditor control** and influence firms' decisions

Before violation, **capital** $\uparrow$ and **earnings** $\downarrow$, after violation, **capital** $\downarrow$ and **earnings** $\uparrow$

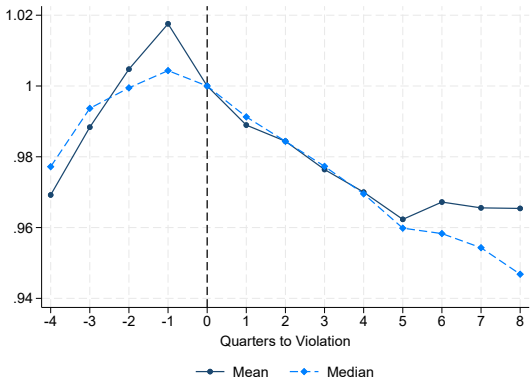
- Interpretation: managerial agency frictions lead to excessive expenditures, creditors discipline them
- Evidence suggests **creditor control reduces inefficiencies and improves performance**
  [Roberts & Sufi, 09; Nini, Smith, & Sufi, 12]

Dynamics of Capital & Earnings around Covenant Violations

R&D return recession

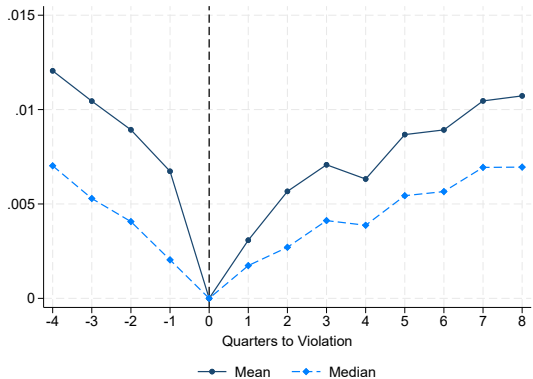
Cumulative assets growth around violation

K_{t+h}/K_t



Cumulative earnings changes around violation

$(EBITDA_{t+h} - EBITDA_t)/K_t$



t is the quarter of first reporting covenant violation

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Production Firms

Produces $z \cdot k^{\alpha_k} \ell^{\alpha_\ell}$ and generates earnings $\pi_t(z,k) = \max_\ell p_t z k^{\alpha_k} \ell^{\alpha_\ell} - w_t \ell - f_c$

- z: TFP shock
- p_t : relative price of produced goods; w_t : real wage; f_c : fix cost

Production Firms

Produces $z \cdot k^{\alpha_k} \ell^{\alpha_\ell}$ and generates earnings $\pi_t(z,k) = \max_\ell p_t z k^{\alpha_k} \ell^{\alpha_\ell} - w_t \ell - f_c$

Invests in new capital $k' - (1-\delta)k$

- $AC(k,k') = \psi_{ac} \left(\frac{k' - (1-\delta)k}{k} \right)^2 k$: capital adjustment costs
- δ : depreciation

Production Firms

Produces $z \cdot k^{\alpha_k} \ell^{\alpha_\ell}$ and generates earnings $\pi_t(z,k) = \max_\ell p_t z k^{\alpha_k} \ell^{\alpha_\ell} - w_t \ell - f_c$

Invests in new capital $k' - (1-\delta)k$

Issue new debt $b' - \gamma b$ w/ **sophisticated borrowing constraints** $q_b^{\text{face}} b' \leq \phi \pi_{t+1}(z', (1-\tau')\, k')$

- b is per-period payment of long-term debt and γ is its decaying rate
- Price schedule $q_{b,t}(\cdots)$ (competitively priced)

Production Firms

Produces $z \cdot k^{\alpha_k} \ell^{\alpha_\ell}$ and generates earnings $\pi_t(z,k) = \max_\ell p_t z k^{\alpha_k} \ell^{\alpha_\ell} - w_t \ell - f_c$

Invests in new capital $k' - (1-\delta)k$

Issue new debt $b' - \gamma b$ w/ **sophisticated borrowing constraints** $q_b^{\text{face}} b' \leq \phi \pi_{t+1}(z', (1-\tau')\, k')$

Three states governed by the **sophisticated borrowing constraints**

1. Normal state ($\omega = n$): managers make decisions to maximize their value s.t. agency frictions
2. Violation state ($\omega = v$): creditors make decisions to maximize their value & no agency frictions
3. Liquidation state ($\omega = \ell$): payoff determined by liquidation value of capital

Agency frictions: managers derive utility $e \cdot g(\tau k)$ by diverting a fraction τ of k for unproductive use

- e : shock to its attractiveness to managers; $g(x) = x^{\tilde{\alpha}_{eb}}$
- Creditors do not value the unproductive use

#1 Normal State $\omega = n$: Manager Control

Managers make decisions to maximize their value

$$V_{m,t}(n,b,k,\tau,z,e) = \max_{b',k',\tau'} \; d - AD(d) + \underbrace{e \cdot g(\tau k)}_{\text{agency friction}} + E[\Lambda_{t+1} V_{m,t+1}(\omega',b',k',\tau',z',e')|z],$$

subject to the flow budget and the **sophisticated borrowing constraint**:

$$d = \pi_t(z,(1-\tau)\,k) - b + q_{b,t}(n,b',k',\tau',z,e)(b' - \gamma b) - (k' - (1-\delta)k) - AC(k,k')$$

$$\omega' = \begin{cases} n & \text{with prob } 1-\pi_d \quad \& \quad q_b^{\text{face}} b' \leq \phi\, \pi_{t+1}(z',(1-\tau')\,k') \\ v & \text{with prob } 1-\pi_d \quad \& \quad q_b^{\text{face}} b' > \phi\, \pi_{t+1}(z',(1-\tau')\,k') \\ \ell & \text{with prob } \pi_d \end{cases}$$

- Dividend cost $AD(d) = (1 + \psi_e \mathbb{I}(d<0))\,\psi_d d^2$, ψ_e captures costly equity insurance
- Exit with prob. π_d (to liquidation), replaced by new firm from the ergodic distribution

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Creditor value (law of motion for ω',b', k' determined by manager decisions):

$$V_{c,t}(n,b,k,\tau,z,e) = \underbrace{b}_{\text{debt payment}} \underbrace{- q_{b,t}(n,b',k',\tau',z,e)(b' - \gamma b)}_{\text{debt issuance}} + E[\Lambda_{t+1} \overline{V}_{c,t+1}(\omega',b',k',\tau',z',e')|z]$$

#2 Violation State $\omega = v$: Creditor Control mature

Creditor makes decisions to maximize their value

$$V_{c,t}(v,b,k,\tau,z,e) = \max_{\tau',k'} \min \left\{ \underbrace{\pi_t(z,(1-\tau)\,k) - (k' - (1-\delta)k) - AC(k,k')}_{\text{available cash flow}}, b \right\} + E[\Lambda_{t+1} V_{c,t+1}(\omega', \gamma b, k', \tau', z', e') | z]$$

subject to (λ captures the prob of transitioning back to the normal state)

$$\omega' = \begin{cases} n & \text{with prob } \lambda\,(1-\pi_d) \\ v & \text{with prob } (1-\lambda)(1-\pi_d) \;\&\; V_{c,t+1}(v,\gamma b,k',\tau',z',e') \geq V_{c,t+1}(\ell,\gamma b,k',\tau',z',e') \\ \ell & \text{else} \end{cases}.$$

- No agency friction (no value from diversion): **choose $\tau' = 0$ & improves performance**
- Debt naturally matures & no new issuance: $b' = \gamma b$, consistent with practice.

#2 Violation State $\omega = v$: Creditor Control mature

Creditor makes decisions to maximize their value

$$V_{c,t}(v,b,k,\tau,z,e) = \max_{\tau',k'} \min \left\{ \underbrace{\pi_t(z,(1-\tau)\,k) - (k' - (1-\delta)k) - AC(k,k')}_{\text{available cash flow}}, b \right\}$$
$$+ E[\Lambda_{t+1} V_{c,t+1}(\omega', \gamma b, k', \tau', z', e') | z]$$

subject to (λ captures the prob of transitioning back to the normal state)

$$\omega' = \begin{cases} n & \text{with prob } \lambda\,(1-\pi_d) \\ v & \text{with prob } (1-\lambda)(1-\pi_d) \;\&\; V_{c,t+1}(v,\gamma b,k',\tau',z',e') \geq V_{c,t+1}(\ell,\gamma b,k',\tau',z',e') \\ \ell & \text{else} \end{cases}.$$

Manager value (law of motion for ω',b',k' determined by creditor decisions):

$$V_{m,t}(v,b,k,\tau,z,e) = \underbrace{\max\left\{\pi_t(z,(1-\tau)\,k) - (k' - (1-\delta)k) - AC(k,k') - b, 0\right\}}_{\equiv \text{div positive only if debt obligation repaid}}$$
$$+ E[\Lambda_{t+1} V_{m,t+1}(\omega', b', k', \tau', z', e') | z]$$

#3 Liquidation State $\omega = \ell$

Creditors **liquidate** the firm if its liquidation value exceeds the value of continuing operations.

Let $\xi \in [0,1]$ capture liquidation value per unit of asset. Creditor value:

$$V_{c,t}(\ell, b, k, \tau, z, e) = \min\left\{\xi k, q_b^{\text{face}} b\right\}$$

Manager value:

$$V_{m,t}(\ell, b, k, \tau, z, e) = \max\left\{\xi k - q_b^{\text{face}} b, 0\right\}$$

Liquidated firms replaced by new firms from the ergodic distribution of (b, k, τ, z, e).

The Macro Block [extend Ottonello & Winberry, 20]

Sticky price retailers

- Purchase from production firms with relative price p_t
- Differentiate it using a linear technology
- Sell it to final goods producers with a CES production function
- Subject to Rotemberg cost of price adjustment

NKPC

$$\log \Pi_t = \kappa \log \frac{p_t}{p^*} + \beta \log \Pi_{t+1}$$

The Macro Block [extend Ottonello & Winberry, 20] details

Representative household:

$$U(C_t, L_t) = \log(C_t) - \Psi L_t$$

- Determines SDF

$$\Lambda_t = \beta \frac{C_t}{C_{t+1}} = \frac{\Pi_{t+1}}{R_t^{nom}}$$

- Own all firms in the economy (inc. competitive intermediaries lending to production firms)

Monetary policy follows the **Taylor** rule:

$$\log R_t^{nom} = \log(1/\beta) + \varphi_\pi \log \Pi_t + \varepsilon_t^m$$

Contrast with a Model with Hard Borrowing Constraints

Firm problem

$$V_t^{\text{hard}}(b,k,z,e) = \max_{b',k',\tau'} \; d - AD_t(d) + E[\Lambda_{t+1} V_{t+1}^{\text{hard}}(\omega', b', k', z', e')|z]$$

subject to the flow budget and the **hard borrowing constraint**:

$$d = \pi_t(z,k) - b + q_{b,t}^{\text{hard}}(b',k',\tau',z,e)(b' - \gamma b) - (k' - (1-\delta)k) - AC(k,k')$$

$$q_b^{\text{face}} b' \leq \phi^{\text{hard}} \min_{z'} \left\{ \pi_{t+1}\left(z', k'\right) \right\}$$

- Enforcement: cut credit indiscriminately to maintain borrowing limits
- Baseline: no agency frictions $eg(\tau k)$ as in standard hard constraint model
  e.g., Bianchi & Mendoza, 18; Extension: hard constraint model with agency frictions

Rest of the economy is the same

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Match Micro-Evidence on Firm Behavior around Covenant Violation

Calibrate our model to match parameter

- Dynamics of capital & earnings around covenant violations
- Other key moments of firms
- 8*2+3 = 19 moments, 13 calibrated parameters

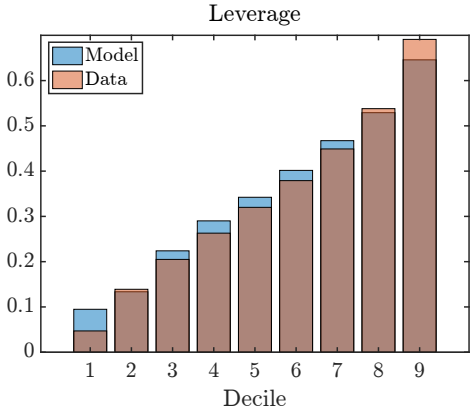
	Model	Data
Frac. in Violation	0.214	0.200
New Violation Rate	0.023	0.025
Avg. Leverage	0.374	0.320

Match Micro-Evidence on Firm Behavior around Covenant Violation

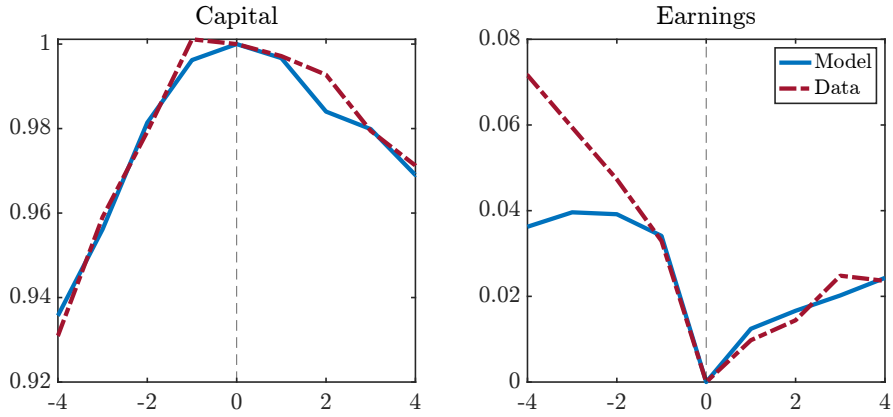
Calibrate our model to match parameter

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- Other key moments of firms
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Validation: leverage at the 10th to 90th percentiles (untargeted)

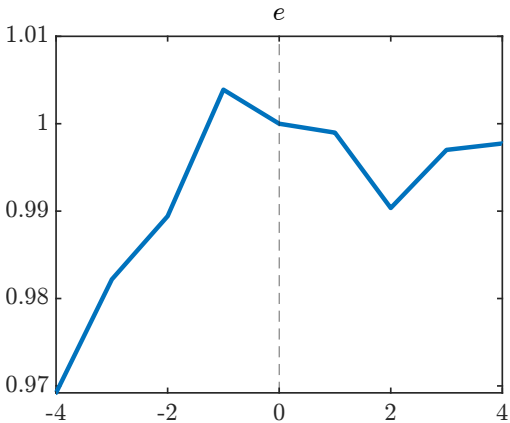


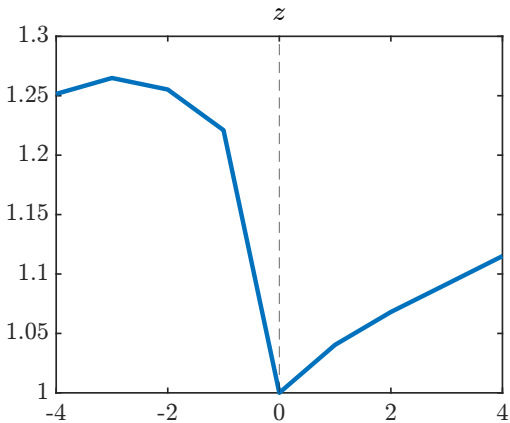
Model Fit: Capital & Earnings around Covenant Violations



- The dynamics of capital K_{t+h}/K_t and earnings $(\pi_{t+h} - \pi_t)/K_t$ around covenant violations
- Creditor control **increases earnings** by avoiding unproductive use of capital ($\tau = 0$)

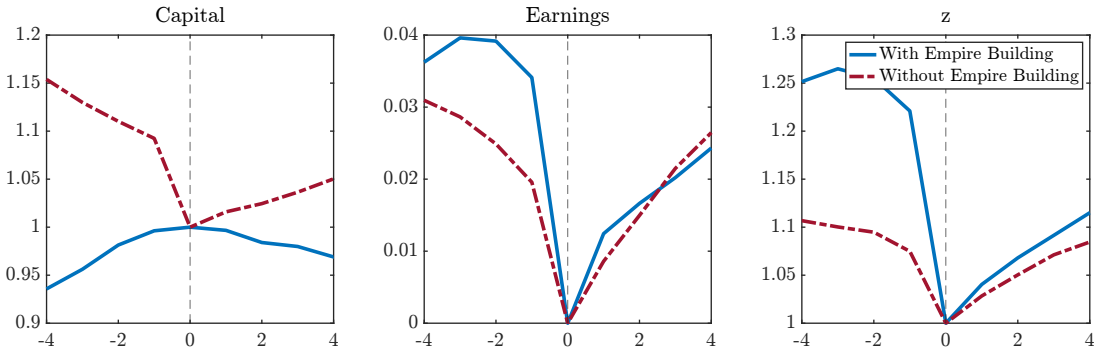
Unpacking Violations in the Model shareholder agency





- Violation driven by a combination of attractiveness of diversion $e \uparrow$ and productivity $z \downarrow$

The Role of Agency Frictions main



- Without agency frictions, capital & earnings dynamics only driven by z & can't explain empirics

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Macro Implications: the Importance of Financial Acceleration

First exercise: study macro impact of **shocks to tightness of constraint ϕ** [e.g., Khan & Thomas, 13]

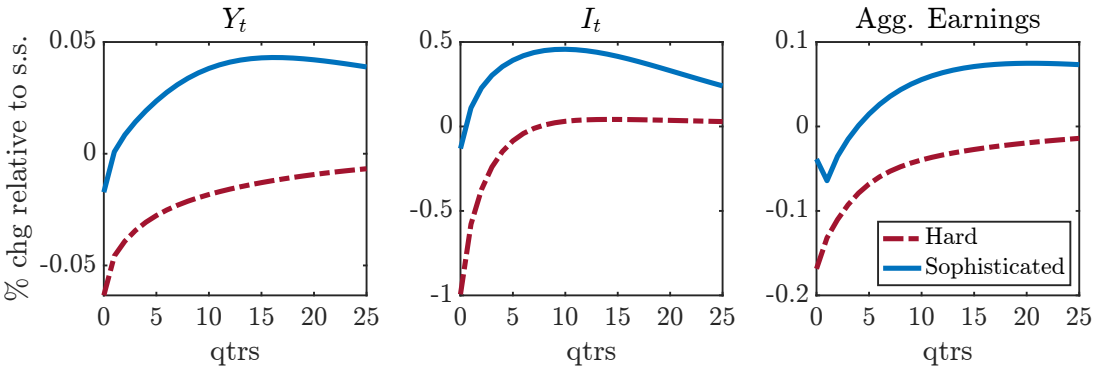
- Inform the importance of **financial acceleration** under sophisticated vs hard constraints (Relevant for all agg shocks)
- Financial acceleration: agg. outcomes $\Rightarrow$ constraint tightness $\Rightarrow$ agg. outcomes

Recalibrate ϕ^{hard} in the hard constraint model s.t.

- Fraction of firms at hard constraint = fraction of firms violating sophisticated constraints
  baseline no agency frictions as in literature, similar with agency frictions

Macro Impacts of Constraint Tightness Shock: Hard vs Sophisticated

micro



$\Delta\phi$ s.t. the initial I_t response is -1% in the hard constraint model and $\rho_\phi = 0.9$

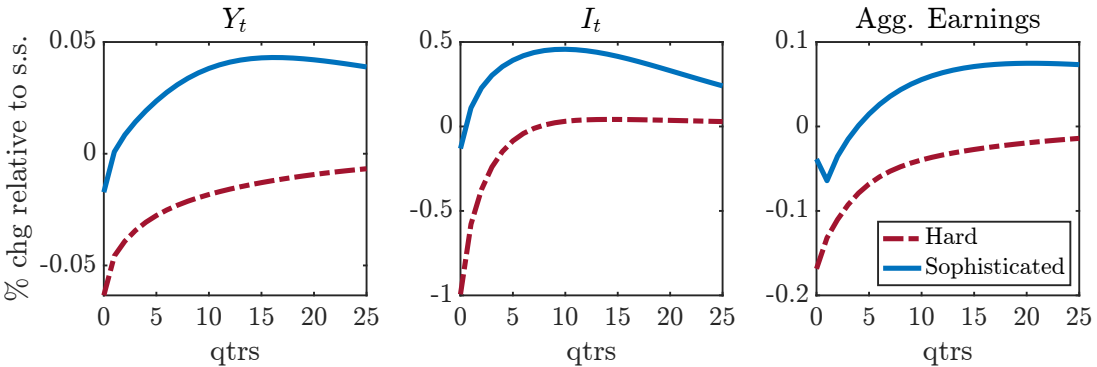
Large negative macro impacts under **hard** constraints

- Tightening of hard constraint $\Rightarrow$ cut credit indiscriminately $\Rightarrow$ financial acceleration

comparison decomposition

Macro Impacts of Constraint Tightness Shock: Hard vs Sophisticated

micro



$\Delta\phi$ s.t. the initial I_t response is -1% in the hard constraint model and $\rho_\phi = 0.9$

Mild or even positive macro impacts under **sophisticated** constraints

- Tightening of sophisticated constraint $\Rightarrow$ violations & creditor control $\Rightarrow$ reduce agency frictions

comparison decomposition

Gauge the Importance of Financial Acceleration

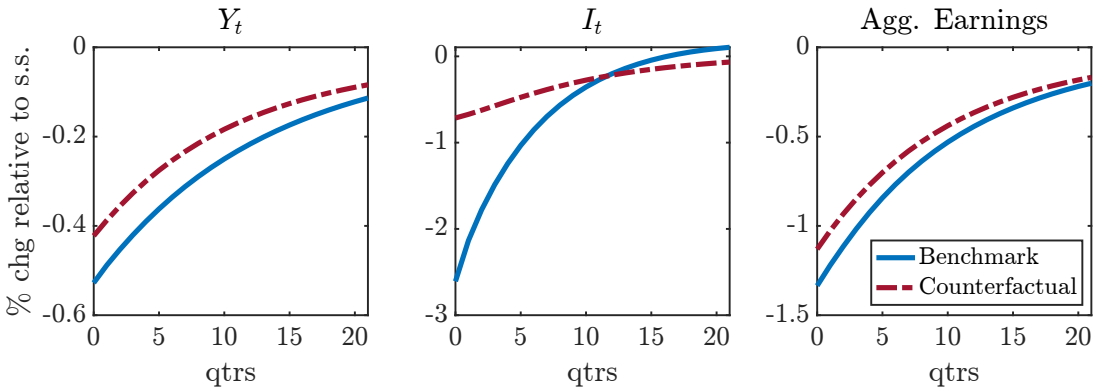
Second exercise: study macro impact of **monetary policy shocks** ε_t^m

To gauge the importance of financial acceleration, compare with a **(no acceleration) counterfactual**

$$q_b^{\text{face}} b' \leq \phi \pi_{t+1}(z', k') \Longrightarrow \; q_b^{\text{face}} b' \leq \phi \pi_{ss}(z', k') \tag{1}$$

- Financial acceleration: agg. outcomes $\Rightarrow$ constraint tightness $\Rightarrow$ agg. outcomes [KM 97; BGG, 99]
- The counterfactual shuts down GE constraint tightening (the first $\Rightarrow$ in the acceleration loop)
- Differences between **benchmark** (full GE) & **counterfactual** inform financial acceleration
  - also linked with the above impact of constraint tightness shock

Financial Acceleration under Hard Constraints hard-eb



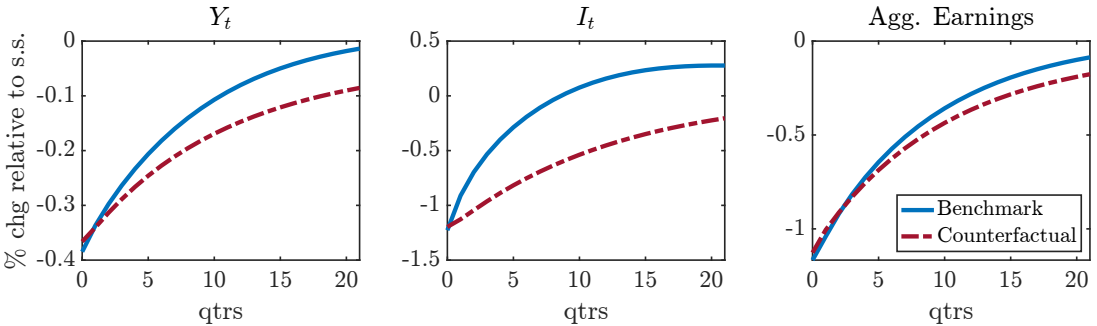
$\varepsilon_t^m = 30$bps and $\rho_m = 0.9$, counterfactual shuts down financial acceleration as in (1)

Financial acceleration: constraint tightening worsens macro impacts relative to counterfactual

- Tightening of constraint $\Rightarrow$ cut credit indiscriminately $\Rightarrow$ financial acceleration

No Financial Acceleration under Sophisticated Constraints

decomposition



$\varepsilon_t^m = 30$bps and $\rho_m = 0.9$, counterfactual shuts down financial acceleration as in (1)

No acceleration: tightening of constraint has mild or even positive macro impacts

- Tightening of constraint $\Rightarrow$ violations & creditor control $\Rightarrow$ reduce agency frictions

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Conclusion

Propose a new model of **sophisticated borrowing constraints** consistent with practice

- Enforcement: violation triggers **creditor control**, which reduce managerial agency frictions
- Quantitatively matches firm outcomes around covenant violation

Macro: **muted financial acceleration** under sophisticated borrowing constraint

- Contrast with financial acceleration under hard borrowing constraints
- Consistent with the resilience of U.S. nonfinancial firms during recessions [e.g., Gertler & Gilchrist, 18]

In financial sector, hard constraints and financial acceleration remain common

- Difficult for creditors to improve firm performance given short-term funding and regulation