Endogenous Uncertainty and Credit Crunches

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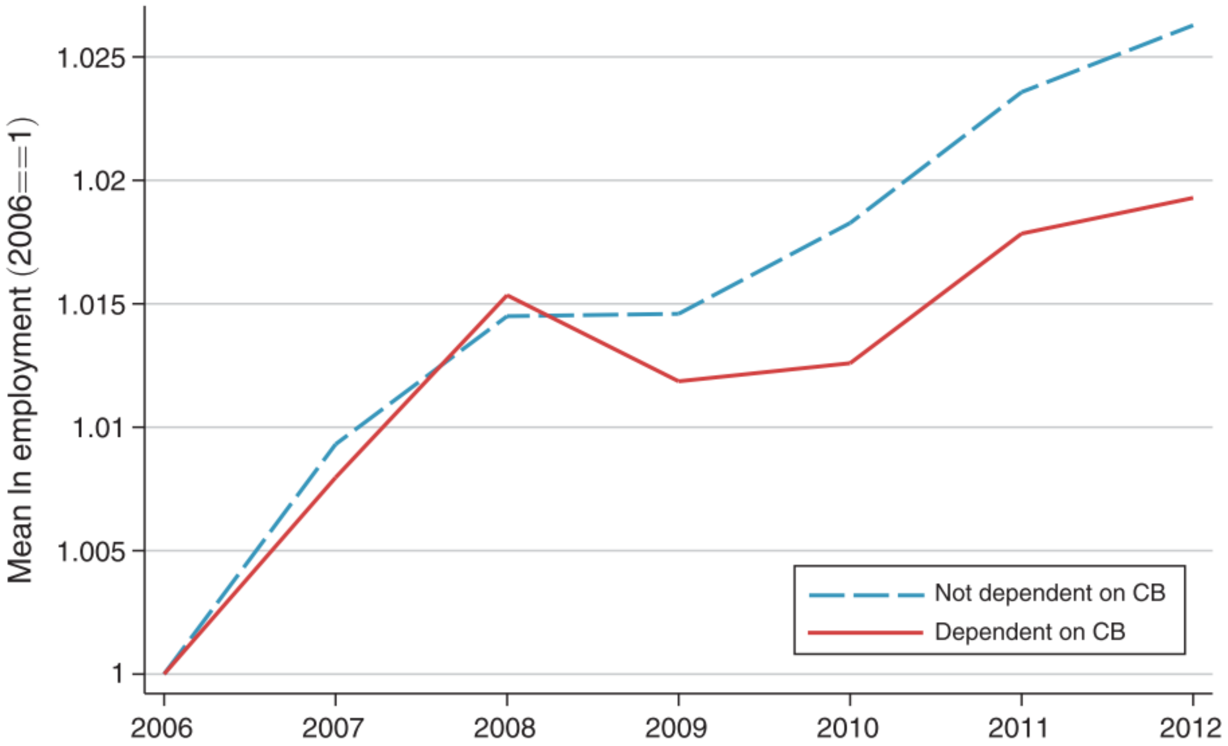
The challenging persistence of financial crises

- Large & persistent effects at macro & micro level:
  - GDP, employment, innovation ↓
  - firms exposed to lending cuts had output, employment, innovation ↓
  - more persistent than distress within financial sector itself



Source: Huber (AER, 2018)

This paper

- Presents theory resolving the challenge based on heightened uncertainty of lenders
  - financial sector is hit by a financial shock & cuts funding of firms
  - firms are forced to lay off workers, liquidate risky projects
  - causes **endogenous uncertainty** for lenders
    - are liquidated projects still profitable?
    - can constrained firms catch up with rest of economy?
  - hesitation to refund firms **even after** lenders are recapitalized
- Substantial persistence & amplification of temporary financial shock

Model

Model overview

- Neoclassical economy without capital
  - » firms and households organized into islands
  - » no aggregate uncertainty
- Financial friction
  - » wage bill must be funded up front
  - » funding restricted by limited pledgeability
- Learning friction
  - » idiosyncratic productivity observed only for funded projects
  - » noisy learning about idle projects

Households

- Household on island i

$$\sum_{t=0}^{\infty} \beta^t \frac{u_{i,t}^{1-\gamma}}{1-\gamma}$$

with GHH preferences

$$u_{i,t} = C_{i,t} - \frac{1}{1+\zeta}\left(L_{i,t}^{1+\zeta} - v\right)$$

- Trades Arrow-Debreu securities, insures beginning of date-t risks
  - » perfect insurance against all across-period risks
  - » remains exposed to within-period risks

Firms

- Productivity on island i evolves according to

$$\log A_{i,t} = \rho \log A_{i,t-1} + \epsilon_{i,t} \qquad \epsilon_{i,t} \sim \mathcal{N}(0, \sigma_\epsilon^2)$$

- Producing with $A_{i,t}$ requires fixed cost ϕ

$$Y_{i,t} = A_{i,t} \max\{L_{i,t} - \phi, 0\}$$

- Inverse demand for local product

$$P_{i,t} = \left(\frac{Y_{i,t}}{Y_t}\right)^{-1/\xi} P_t$$

Key frictions

- Working capital constraint
  - » wage bill $W_{i,t}L_{i,t}$ must be financed up-front by local household
  - » only fraction $\chi_{i,t}$ of revenues can be pledged

$$L_{i,t} \leq \bar{L}_{i,t} \equiv \chi_{i,t}Q_{i,t}/W_{i,t}$$

  - » $Q_{i,t}$ is equilibrium value of firm i's expected revenue

$$Q_{i,t} = \mathbb{E}_t\left[m_{i,t}P_{i,t}Y_{i,t}\right]$$

- Learning friction
  - » productivity $A_{i,t}$ only learned after project is funded
  - » **not** learned if unfunded

Equilibrium provision of funds

- Fixed point

$$\bar{L}_{i,t} \uparrow \implies \mathrm{rev}_{i,t} \uparrow \implies \bar{L}_{i,t} \uparrow$$

  - solution:

$$\bar{L}_{i,t}^{\xi(1+\zeta)} = \theta_{i,t}\chi_{i,t}^{\xi} \max\{\bar{L}_{i,t} - \phi, 0\}^{\xi-1}$$

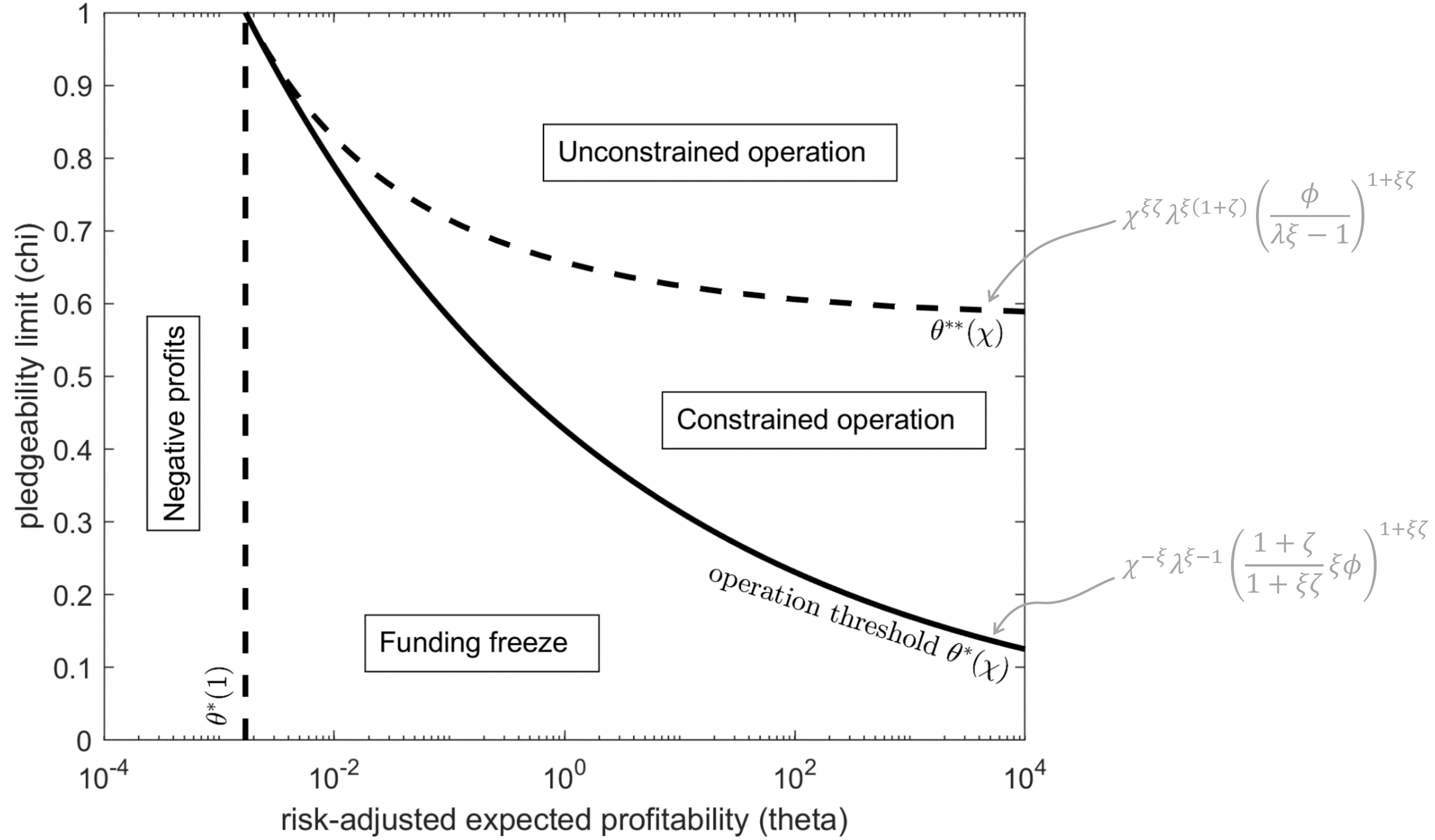
  - $\theta_{i,t}$ is risk-adjusted expected profitability

$$\log \theta_{i,t} \approx (\xi - 1)\left(\mu_{i,t} - \tilde{\gamma}\Sigma_{i,t}\right) + \log Y_t$$

- Beliefs at date t

$$\mu_{i,t} \equiv \mathbb{E}_t \log A_{i,t} \qquad \Sigma_{i,t} \equiv \mathbb{V}_t \log A_t$$

Funding thresholds



Funding Freezes

Law of motion of beliefs

- If firm is funded ($A_{i,t}$ observed at end of t)

$$\mu_{i,t+1} = \rho \log A_{i,t}$$
$$\Sigma_{i,t+1} = \sigma_\epsilon^2$$

- If firm is unfunded

$$\mu_{i,t+1} = \rho \mu_{i,t}$$
$$\Sigma_{i,t+1} = \rho^2 \Sigma_{i,t} + \sigma_\epsilon^2$$

The feedback from beliefs to funds

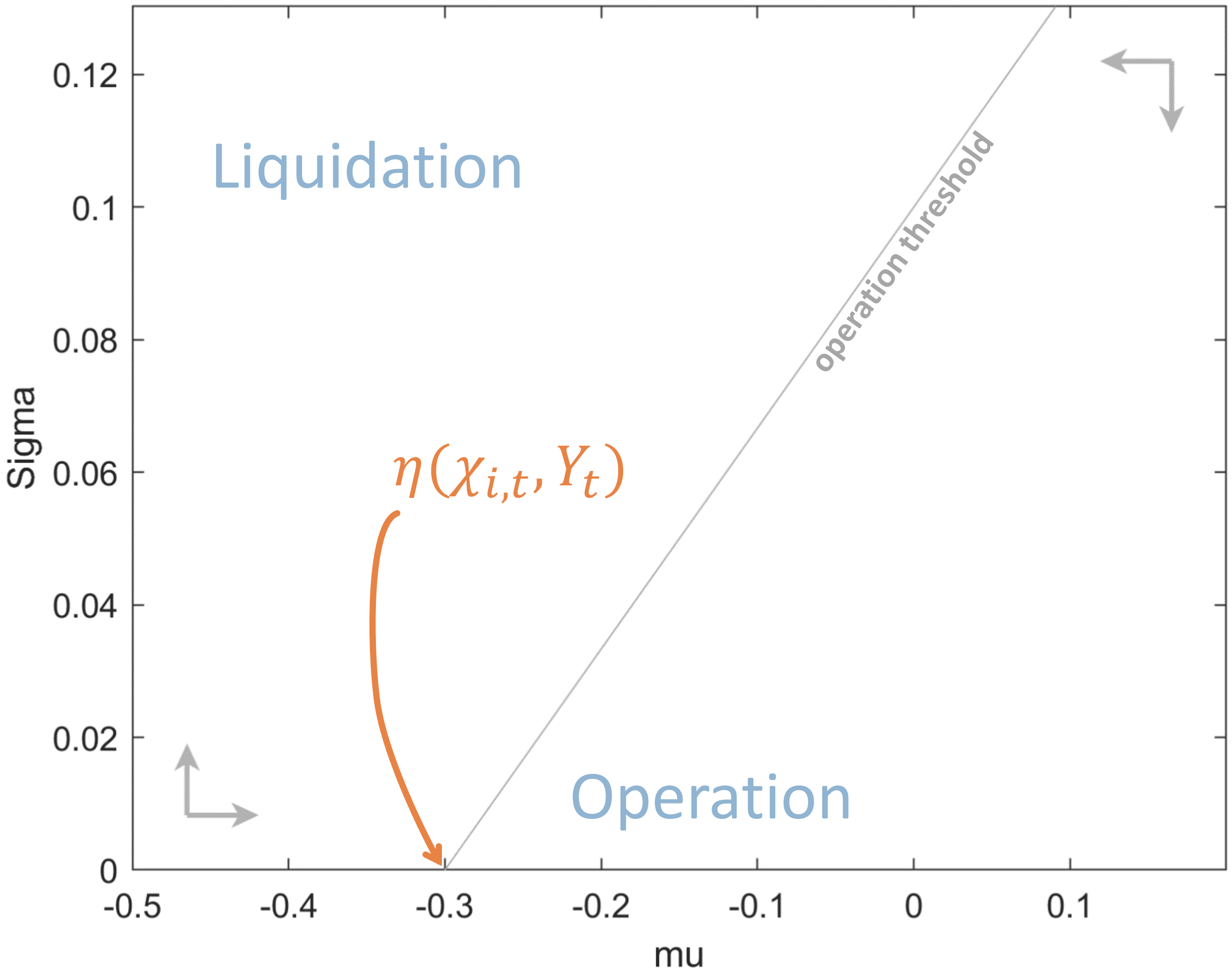
- Firm funded if

$$\log \theta_{i,t} = (\xi - 1)\left(\mu_{i,t} - \tilde{\gamma}\Sigma_{i,t}\right) + \log Y_t \geq \log \theta^*\left(\chi_{i,t}\right)$$

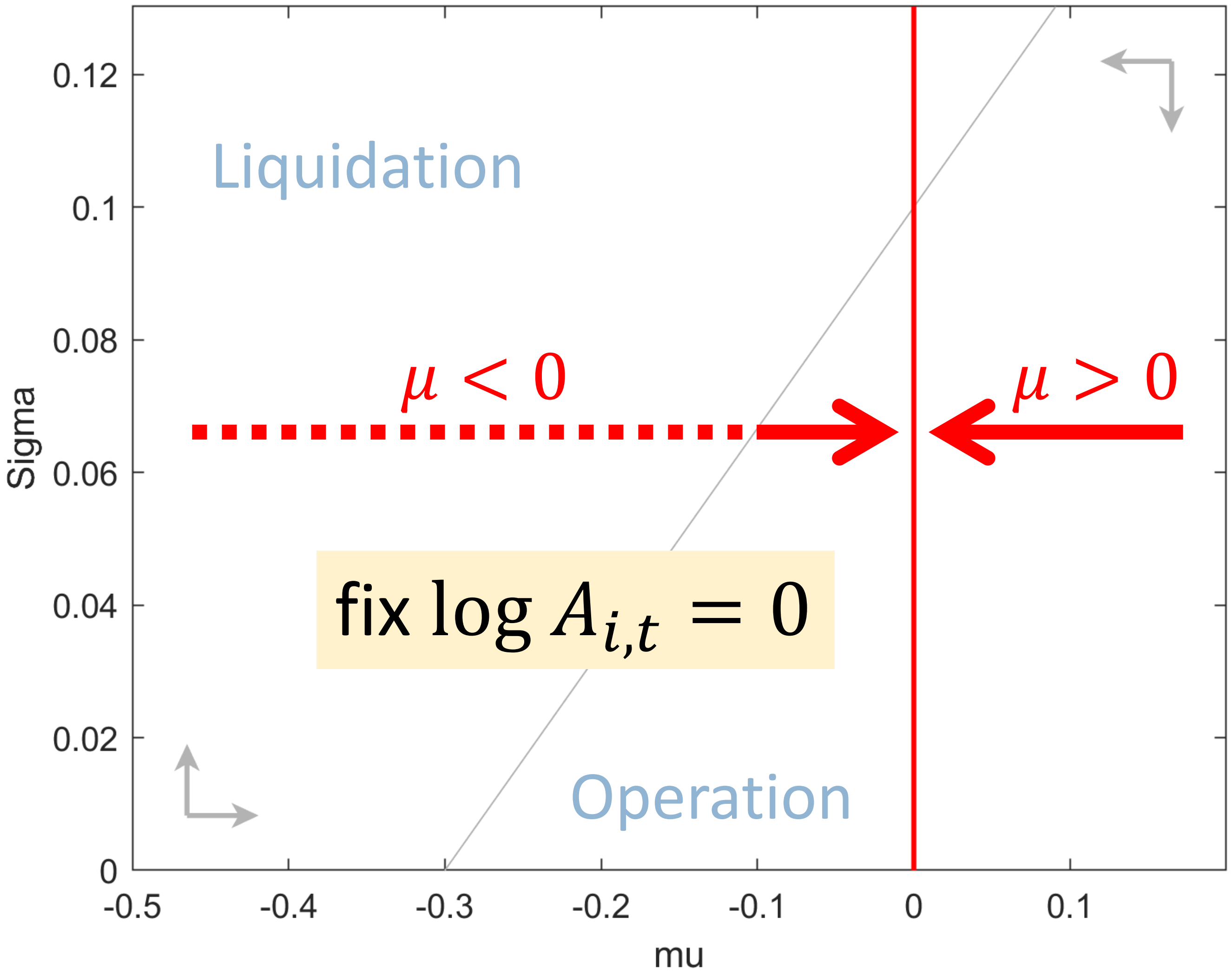
or

$$\mu_{i,t} - \tilde{\gamma}\Sigma_{i,t} \geq \eta(\chi_{i,t}, Y_t)$$

No-shock phase diagram

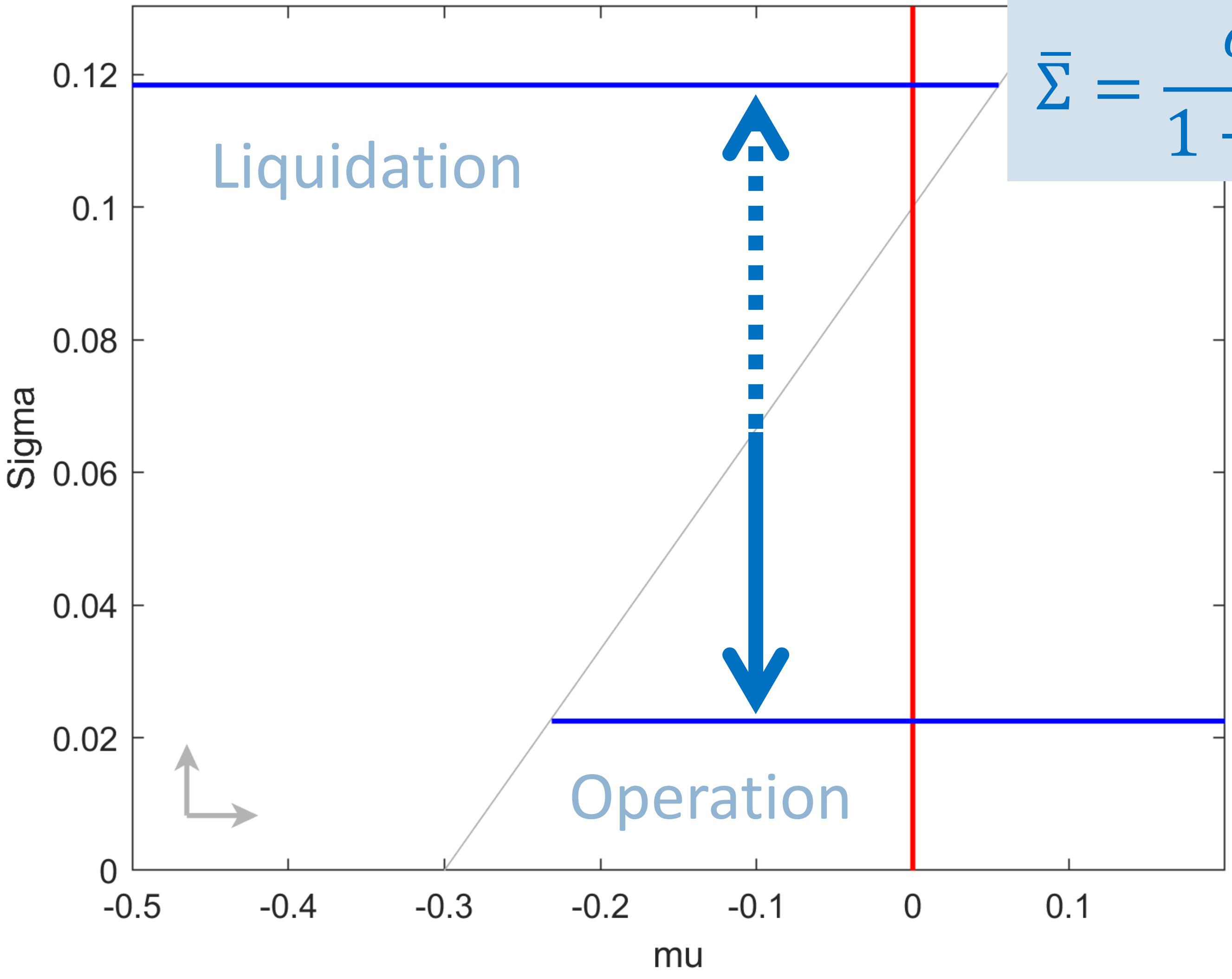


No-shock phase diagram



fix $\log A_{i,t} = 0$

No-shock phase diagram

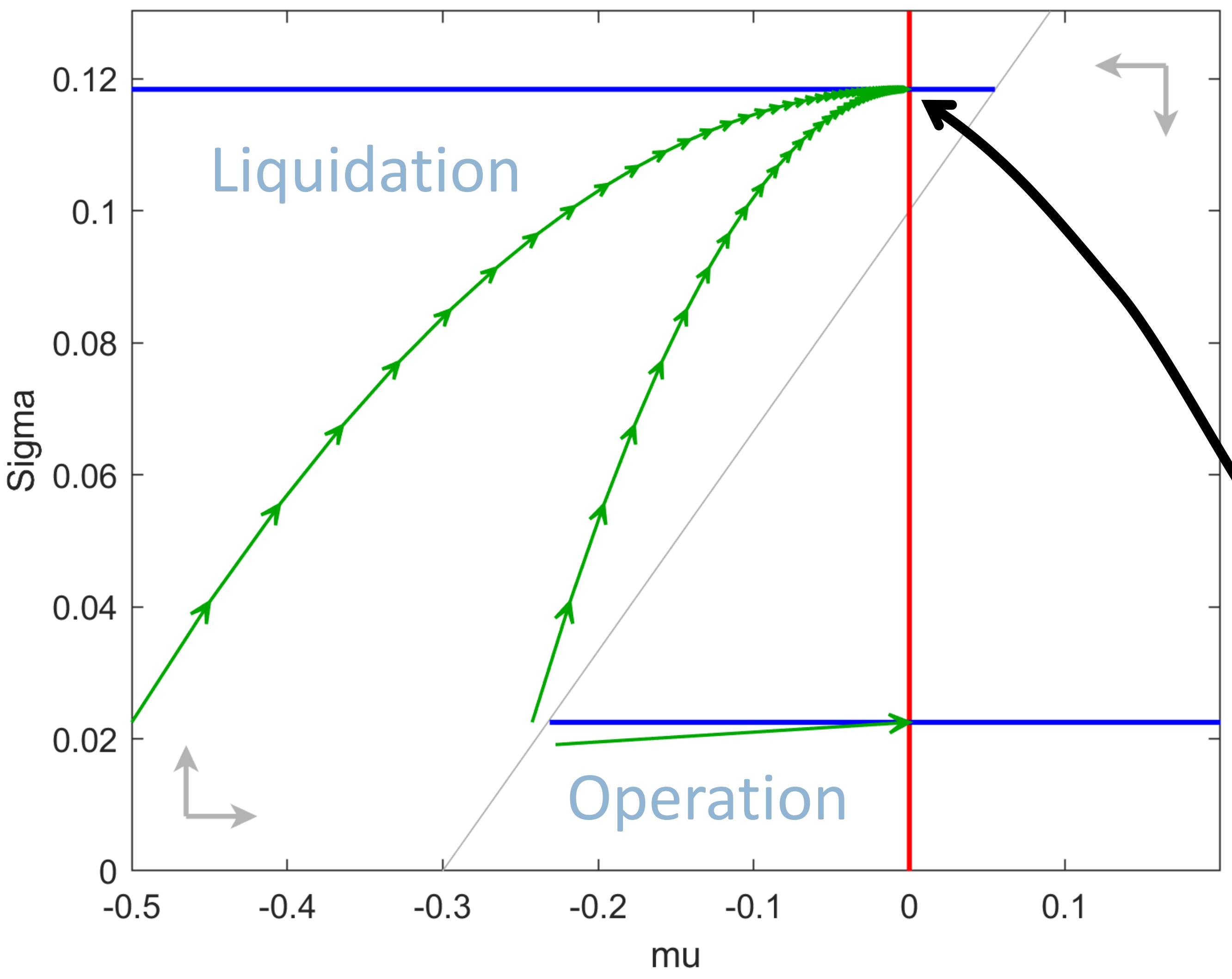


$$\bar{\Sigma} = \frac{\sigma_\epsilon^2}{1-\rho^2}$$

$$\underline{\Sigma} = \sigma_\epsilon^2$$

No-shock phase diagram

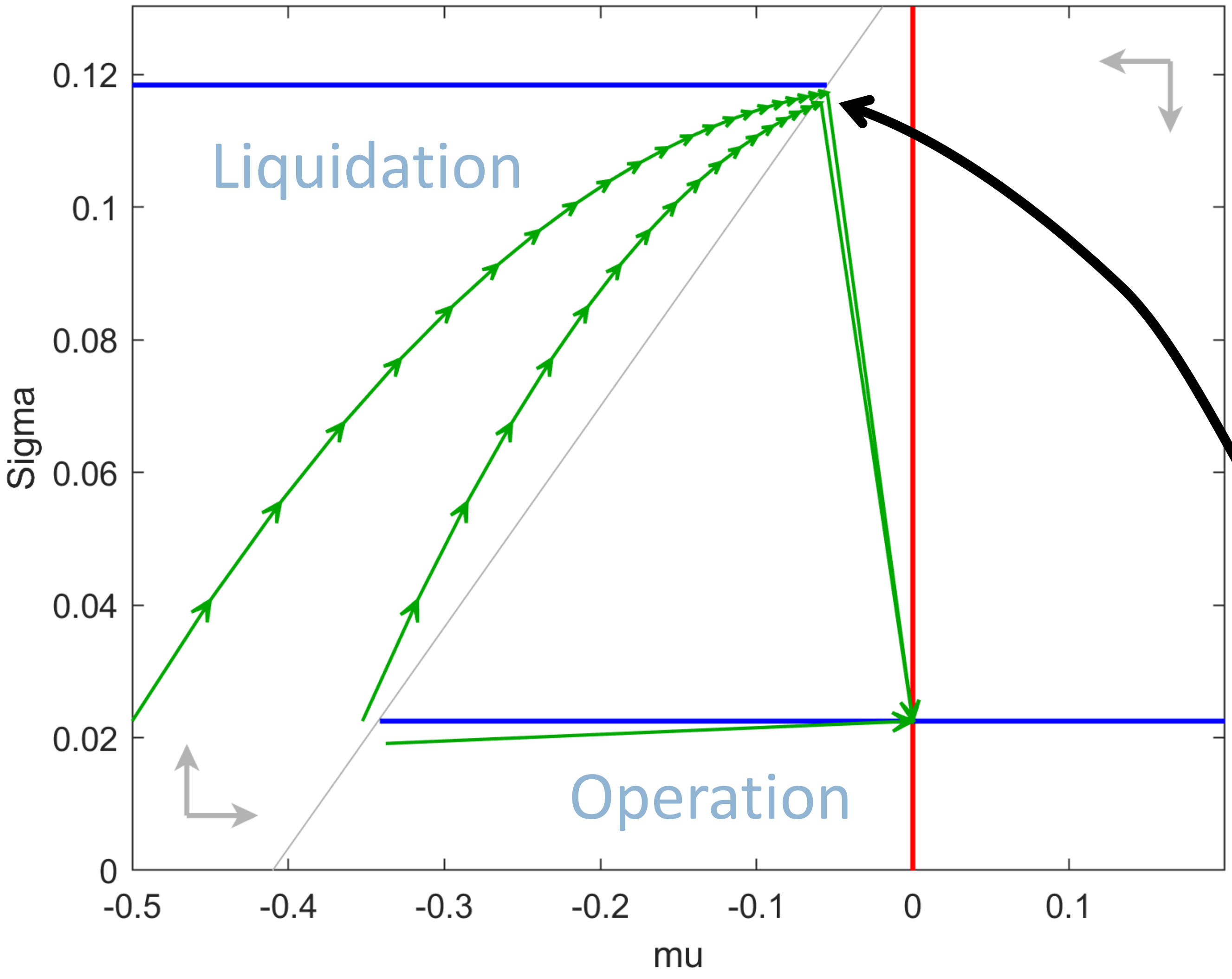
Case A:
Multiple
Steady States



Indefinite Funding Freeze

No-shock phase diagram

Case B:
Unique
Steady State



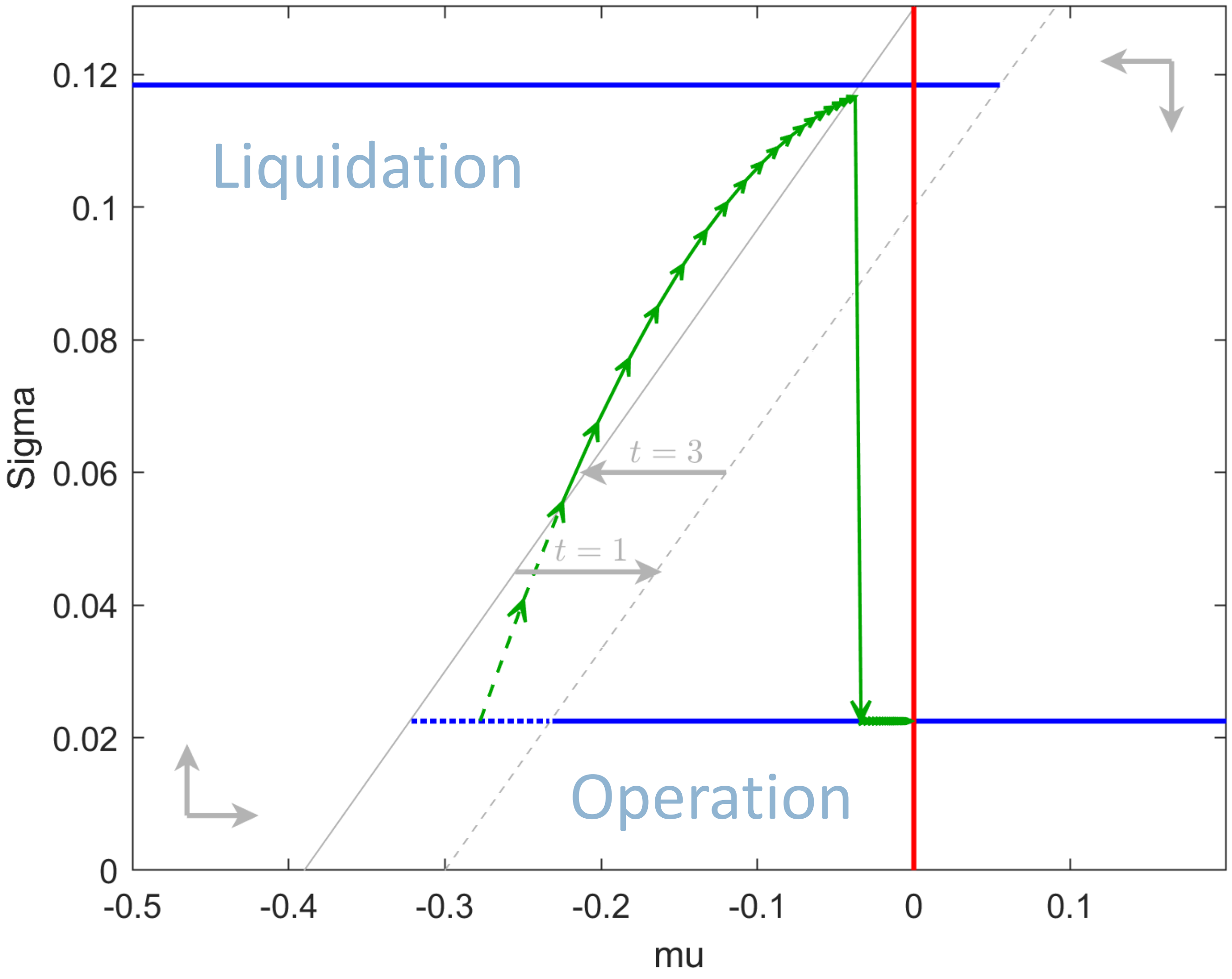
Temporary Funding Freeze

Temporary financial shock

$t = 0$:
initialize $A_{i,0}, \chi_{i,0}$
so firm is active

$t = 1$:
$\chi \downarrow \implies$ liquidation

$t = 3$:
χ back $\uparrow$



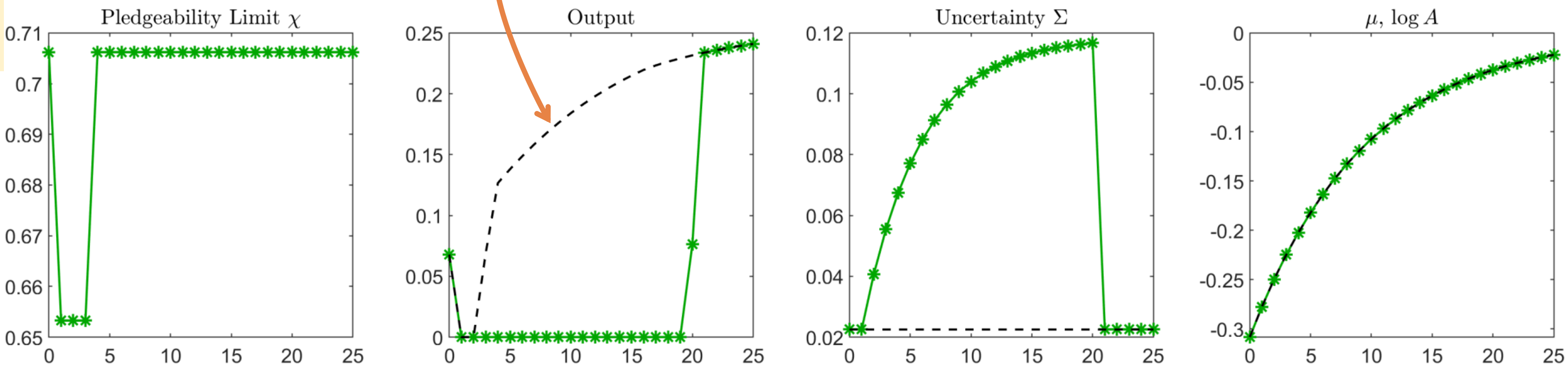
Temporary financial shock

$t = 0$:
initialize $A_{i,0}$, $\chi_{i,0}$
so firm is active

$t = 1$:
$\chi \downarrow \implies$ liquidation

$t = 3$:
χ back $\uparrow$

exogenous uncertainty
counterfactual ($\Sigma = \sigma_\epsilon^2$)



Macro-Consequences of Shutdowns

Covid-19 Shutdown

- Initialize economy at stochastic steady state
- Randomly shut down 20% of firms at $t = 0$
- Shutdown lasts 1 Quarter

Parametrization

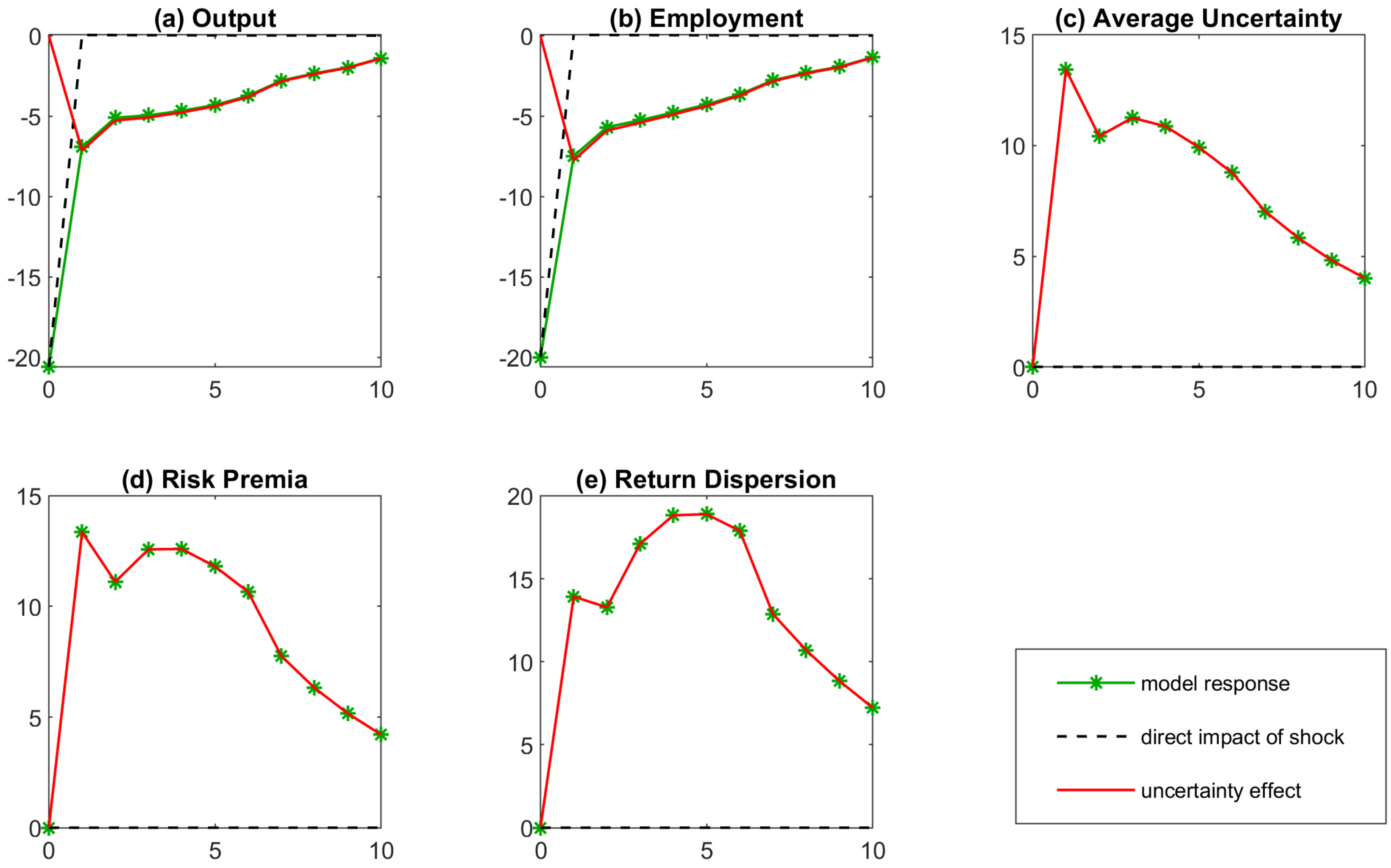
- 2-state Markov process for $\chi_{i,t}$
  - $\underline{\chi} < 1$: financially fragile firms
  - $\bar{\chi} = 1$: resilient firms (access to internal funds, collateral, …)
- Add noisy signal about liquidated projects

$$s_{i,t} = \log A_{i,t-1} + u_{i,t}$$

Parameters (preliminary!)

Parameter	Value	Description
ζ	0.5	Inverse Frisch elasticity
ξ	7.5	Elasticity between product varieties
$\tilde{\gamma}$	4.0	Relative risk aversion
ϕ	0.052	Overhead labor
p	0.07	Markov switching rate for χ
$\underline{\chi}$	0.72	Pledgeability financially fragile firms
$\bar{\chi}$	1.00	Pledgeability financially resilient firms
ρ	0.90	Persistence of productivity shocks
σ_ϵ	0.15	S.d. of productivity shocks
σ_u	0.80	S.d. of noisy investor signal
σ_ψ	0.97	S.d. of noisy forecaster signal

Dynamic response to shutdown (preliminary!)



Policy relevance

- Typical policy response to financial crisis is bank recapitalization
- Model suggests this might not be enough to restore funding
  - recapitalization $\not\Rightarrow$ more lending, unless uncertainty is resolved
- This suggests a role for public lenders to step in
  - crowding-in effect of public lending due to informational externality

Concluding remarks

- Theory of persistent shutdowns
  - shutdown → heightened uncertainty → funding freeze
  - also applies to shutdowns originating outside the financial system
- Predictions consistent with micro-data (details in paper)
  - financial constraints correlated with risk premia, return volatility/dispersion, and forecast error dispersion among IBES-analysts