

QUANTIFYING FIRM RUNS

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Motivation

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 - ▶ a concern for policy-makers → shape various regulations and (credit) policies
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Research question

How relevant are **firm runs**, and what are their macroeconomic and policy implications?

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- Build on GE models of heterogeneous firms with default
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- **Identify** incidence of runs exploiting heterogeneity in firm's bankruptcy outcomes
(liquidation vs restructuring)
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- **Identify** incidence of runs exploiting heterogeneity in firm's bankruptcy outcomes
(liquidation vs restructuring)
insights from Corp Law literature, e.g., Jackson 1986; Corbae D'Erasmus 2021
- Conduct **quantitative** analysis of U.S. economy to asses aggregate relevance of firm runs

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- + 1.5% firms rollover prob = $20\% \text{ exposed} \times 7\% \text{ probability}$
(more than 60% of bankruptcy events are driven by runs)
- ▶ indirect inference using bankruptcy outcomes and financial distribution of firms
- ▶ key for identification: restructuring process provides coord tool to preclude runs

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3. What are the **policy** implications?

- + credit policy can **undo runs** amplification of crises, but can **backfire**
- ▶ imperfect credit policy precludes runs, but exacerbate future debt overhang

Outline

- Theoretical Framework
- Identifying Firm Runs
- Macroeconomic Consequences of Firm Runs

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- Identifying Firm Runs
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Overview of the Model

- Quantitative GE models of heterogeneous firms with default
Khan Sengha Thomas 2017; Ottonello Winberry 2020
- Extend model to
 1. possibility of **coordination failures** among creditors á la Cole Kehoe 2000
 2. allow **debt restructuring** similar to Corbae D'Erasmus 2021
- Study unforeseen crises and policy shocks (MIT shocks)

Environment

- Infinite horizon and discrete time

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- Four types of agents
 1. **nonfinancial firms**: invest and produce to maximize their value
 2. **creditors**: lend to nonfinancial firms, and are perfectly competitive and atomistic
 3. **capital producer**: sell capital to nonfinancial firms
 4. **representative HH**: consumes, saves and works. Owns all firms in the economy

Nonfinancial Firms' Environment

- Firm i objective is to max

$$\sum_{t \geq 0} \mathbb{E}_0[\Lambda_t d_{it}]$$

with Λ_t HH's SDF and d_t firm's dividends

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 1. s_{it}^f exogenous
 2. s_{it}^{nf} exogenous non-fundamental
 3. s_{it}^e endogenous

where $s_{it} = (s_{it}^f, s_{it}^{nf}, s_{it}^e)$

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- For clarity, drop i and t subscripts

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2. **Restructure** choice
3. Investment and **new debt** issuance choice
4. **Liquidation** choice (if continue in 2)
5. Firms produce and distribute dividends (if don't liquidated in 4)

Nonfinancial Firms' Production

- Operate with technology

$$f(z, \omega, k, l) = z(\omega k)^\alpha l^\nu$$

- ▶ decreasing returns to scale $\nu + \alpha < 1$
- ▶ idiosyncratic persistent productivity shocks $\ln z' = \rho_z \ln z + \epsilon_z$ with $\epsilon_z \sim N(0, \sigma_z^2)$
- ▶ idiosyncratic capital quality shock ω iid log-normal trunc. where $\ln \omega \in [\underline{\omega}, 0]$
(fit quantitative default rate)

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(fit quantitative default rate)
- Own capital k and hire labor l at wage w , then operating profits are

$$\pi(z, \omega, k) = \max_l f(z, \omega, k, l) - wl$$

Nonfinancial Firms' Financial Resources

- **Internal** resources (cash-on-hand)
 - inherits k at price q which depreciates at $\delta \in [0, 1]$ and maturing b , and has $\pi(z, \omega, k)$

$$n = \underbrace{\pi(z, \omega, k)}_{\text{operational profits}} + \underbrace{(1 - \delta)q\omega k}_{\text{selling value of capital}} - \underbrace{b}_{\text{maturing debt}}$$

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- issues one-period debt b' at price schedule $Q(\cdot)$ and buys k' at price q

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- **Dividends**

- distributed at end of period

$$d = \underbrace{n}_{\text{cash-on-hand}} + \underbrace{Q(\cdot)b'}_{\text{new debt issuance resources}} - \underbrace{qk'}_{\text{capital purchases}}$$

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 - (a) liquidation (Chapter 7)
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 - ▶ firm exits with $V = 0$ and creditors of b recover $\alpha_7 \in [0, 1]$ of the liquidated capital

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 - ▶ firm exits with $V = 0$ and creditors of b recover $\alpha_7 \in [0, 1]$ of the liquidated capital
 - (b) restructuring (Chapter 11)
 - ▶ (Nash) bargain debt recovery rate $\alpha_{11} \in (0, 1)$ over debt b detail
 - ▶ firm pays exogenous cost $c_{11} \in [0, 1]$, which is proportional to capital
 - ▶ **precludes current firm runs** (bankruptcy provisions, Corp Law)
 - ▶ resources after restructuring are: $n_{11} = \pi(z, \omega, k) + (1 - c_{11})(1 - \delta)q\omega k - \alpha_{11}b$

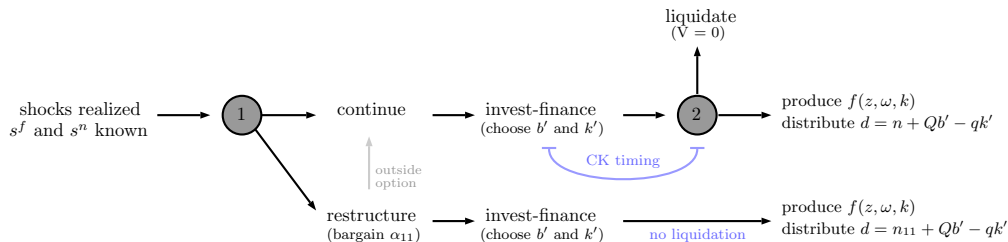
Nonfinancial Firms' Entry/Exit

Technical and quantitative assumptions

- Exogenous exit probability γ (KST 2016, stationary dist)
 - ▶ if receive shock the firm exits after production
- Entrants enter on average productivity $m\%$ below ergodic distribution average (OW 2020, life-cycle firms)

[details](#)

Within Period Timing Nonfinancial Firms' Problem



- Timing for non-exiting firms
- Cole Kehoe 2000 (CK) timing for liquidation choice

Multiple Equilibrium Intuition

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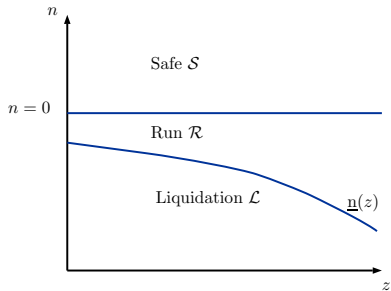
- Feedback between liquidation choice and prices today could create multiple outcomes

$$Q = 0 \iff d < 0$$

$$Q > 0 \iff d \geq 0$$

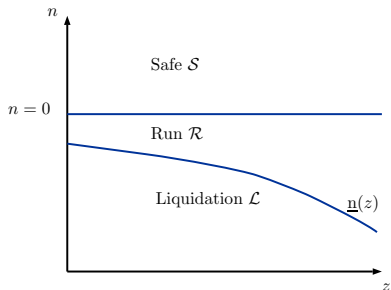
Liquidation

- **Fundamental** state-space (z, n) is divided in three regions [liquidation proposition](#)



Liquidation

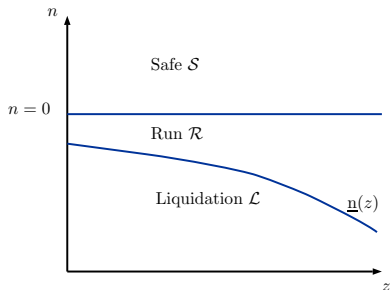
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- \mathcal{S} : $Q = 0$ then continue if $d = n + \underbrace{\max_{k'} \{-k'\}}_0 > 0$

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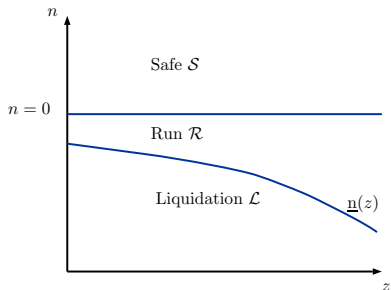
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- \mathcal{L} : $Q = \tilde{Q}$ then liquidate if $d = n + \underbrace{\max_{k', b'}\{-k' + \tilde{Q}b'\}}_{-\underline{n}(z)} < 0$

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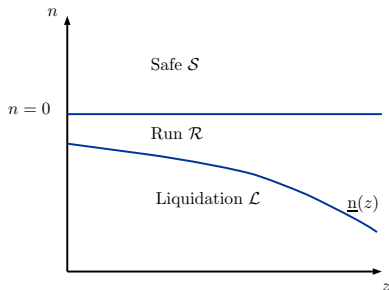
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- \mathcal{R} : liquidate if $Q = 0$, continue if $Q = \tilde{Q} > 0$

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- \mathcal{R} : liquidate if $Q = 0$, continue if $Q = \tilde{Q} > 0$

- Define idiosyncratic sunspot shock $\phi \sim^{\text{iid}} \mathcal{U}[0, 1]$ draw every period, such that if $(z, n) \in \mathcal{R}$ and $\phi < \eta$ then coord in $Q = 0$ (run)

more general setup costly equity issuance

Restructure

Bargain outside option is to continue [bargain protocol](#) then conditions are

- necessary condition: firms are under a run (in \mathcal{R} with $\phi < \eta$) or insolvent (in \mathcal{L})
- sufficient condition: both better-off participating
 1. creditors: $\alpha_{11} > \min\{1, \alpha_7 \frac{(1-\delta)q\omega k}{b}\}$
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observation

if c_{11} large and $(1 - \alpha_{11})$ low \Rightarrow
firms with rollover problems **restructure**

Nonfinancial Firm's Recursive Problem

- V value of firm before exit shock and restructure choice with $s = (z, \omega, \phi, k, b)$

$$V(s) = (1 - \gamma) \left[1_{\{\text{ch11}\}}(s) \tilde{V}(z, n_{11}) + 1_{\{\text{cont}\}}(s) \tilde{V}(z, n) + 1_{\{\text{ch7}\}}(s) \times 0 \right] + \gamma V_{\text{exit}}(s) \quad (1)$$

where indicators follow from previous results, $V_{\text{exit}}(s)$ value of exiting firm [details](#) and

$$\begin{aligned} n &= \pi(z, \omega, k) + (1 - \delta)q\omega k - b \\ n_{11} &= \pi(z, \omega, k) + (1 - c_{11})(1 - \delta)q\omega k - \alpha_{11}(s)b \end{aligned}$$

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- $\tilde{V}(z, n)$ value of the solvent firm and without run is

$$\tilde{V}(z, n) = \max_{d, k', b'} d + \mathbb{E}_{(z' | z; \omega'; \phi')} \left[\Lambda V(s') \right] \quad (2)$$

subject to $d = n - qk' + \tilde{Q}(z, b', k')$ $b' \geq 0$, where $\tilde{Q}(\cdot)$ debt price without coord failure

Corporate Debt Prices

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- $Q = [1 - \mathbf{1}_{\text{Ch7}}(s)]\tilde{Q}$ from creditor's no profit condition
- \tilde{Q} determined by (discounted) $\mathbb{E}[\text{prob tomorrow's bankruptcy events}]$

$$\begin{aligned}\tilde{Q}(z, k', b') &= (1 - \gamma) \mathbb{E}_{(z'|z, \omega', \phi')} \left[\Lambda 1_{\{\text{continue}\}}(s') \times 1 \right] \\ &\quad + (1 - \gamma) \mathbb{E}_{(z'|z, \omega', \phi')} \left[\Lambda 1_{\{\text{Ch11}\}}(s') \times \alpha_{11}(s') \right] \\ &\quad + (1 - \gamma) \mathbb{E}_{(z'|z, \omega', \phi')} \left[\Lambda 1_{\{\text{Ch7}\}}(s') \times R(k', b', \omega') \right] \\ &\quad + \gamma \tilde{Q}_{\text{exit}}(z, k', b')\end{aligned}$$

where

- $\alpha_{11}(s)$ recovery rate of creditors if restructure bargain protocol
- $R(k, b, \omega) = \min \{1, \alpha_7 (1 - \delta) q \omega k / b\}$ recovery rate if liquidated
- $\tilde{Q}_{\text{exit}}(z, k', b')$ debt price conditional on exit shock Q with exogenous exit

Other Agents and Equilibrium

Agents

1. **HH's** choices are determined by Euler eq, SDF Λ and labor supply eq [detail](#)
2. **K producer** problem sells capital at price q and has a standard aggregate capital adjustment function [detail](#)
3. **Creditors** price debt through no-profit condition (SDF Λ) [detail](#)

Equilibrium

- Steady-state (law of motion fixed point) [full definition](#) [law of motion firm distribution](#)

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Steps

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Data sources

- NIPA, Compustat, Federal Judicial Center-IDB, LBD, related papers

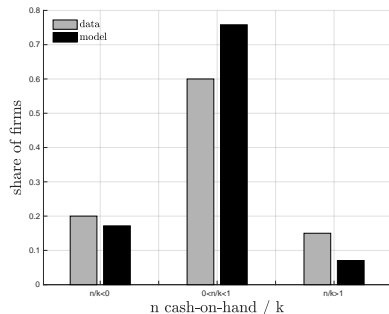
Calibration Standard Parameters

	Parameter	Value	Calibration
Calibration strategy	<i>Fixed</i>		
	$\beta = 1/(1 + r)$	0.99	fixed to $r = 0.05$ annual
• 9 fixed and 4 fitted parameters not related to runs or bankruptcy	Φ	1.16	fixed to match 58% emp rate
	ν	0.64	fixed labor share
	α	0.21	fixed capital share
• params: pref, techno, stoch proc, entry/exit	δ	0.025	fixed to match BEA quarterly
	ρ_z	0.90	fixed
	γ	0.02	fixed to exit rate w/o default
• fit moments: emp, invest, balance sheet, life-cycle	ψ	2	agg AC fixed to lit standard
	b_0	0	fixed to no net debt entrants
	<i>Fitted</i>		
	σ_z	0.032	internally calib
	$\underline{\omega}$	-0.33	internally calib
	k_0	0.16	internally calib
	m	-0.24	internally calib

Relevant Moments

Moment	Data	Model
<i>Aggregates</i>		
K/Y	3.00	2.59
I/Y	0.17	0.15
gross debt: $\mathbb{E}[1_{b>0}b]/Y$	1.05	1.79
<i>Credit spreads</i>		
cred spread: $\mathbb{E}[r^Q - r]$	2.2%	0.7%
<i>Investment heterogeneity</i>		
avg invest rate: $\mathbb{E}[i/k]$	0.12	0.17
sd invest rate: $SD[i/k]$	0.34	0.36
<i>Life-cycle</i>		
share exit	0.10	0.11
(L age 1) / L	0.03	0.04
# firms age 1 / # firms	0.10	0.11
# firms age 2 / # firms	0.08	0.09

Moment	Data	Model
<i>Balance sheet</i>		
avg leverage: $\mathbb{E}[1_{b>0}b'/k']$	0.37	0.72
correl (n, k')	0.74	0.23
n distribution		



measurement

Identification of η

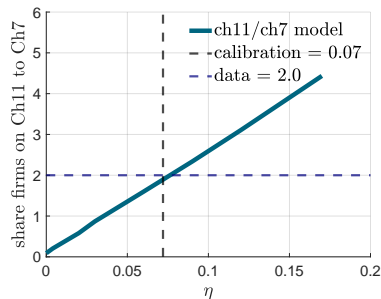
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Param.	Value	Moment targeted	Data	Model
α_7	0.38	$\mathbb{E}[R]$	0.27	0.29
ψ_{11}	0.89	$\mathbb{E}[\alpha_{11}]$	0.69	0.82
c_{11}	0.40	$\mathbb{E}[b'/k' \mid \text{Ch 11}]$	0.73	0.67

Identification of η

- $(\alpha_7, \psi_{11}, c_{11})$ match debt haircut under Ch 11 and Ch 7, and leverage in Ch 11

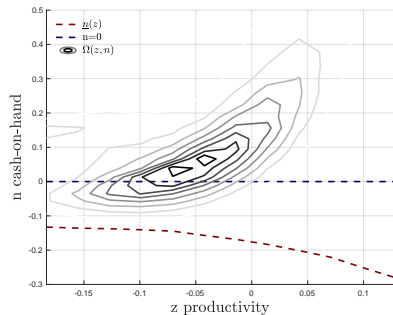
Param.	Value	Moment targeted	Data	Model
α_7	0.38	$\mathbb{E}[R]$	0.27	0.29
ψ_{11}	0.89	$\mathbb{E}[\alpha_{11}]$	0.69	0.82
c_{11}	0.40	$\mathbb{E}[b'/k' \mid \text{Ch 11}]$	0.73	0.67
η	0.07	$\mathbb{E}[\text{Ch11}]/\mathbb{E}[\text{Ch7}]$	2.0	1.9



- Untargeted moments: distribution of leverage in Ch 11 and predictors of Ch 11 validation

Incidence of Rollover Problems

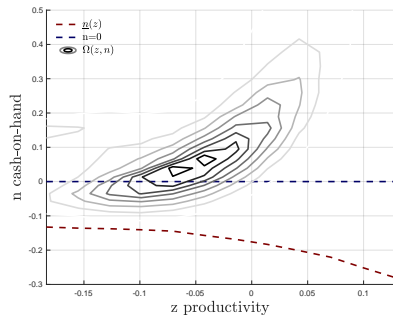
Steady state distribution $\Omega(z, n)$
before bankruptcy choice



$$\underbrace{\int_{(z,n) \in \mathcal{R}} d\Omega(z, n)}_{\substack{\text{share of firms exposed} \\ 0.20}} \times \underbrace{\eta}_{\substack{\text{run likelihood} \\ 0.07}} = 1.5\%$$

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$$\underbrace{\int_{(z,n) \in \mathcal{R}} d\Omega(z, n)}_{\substack{\text{share of firms exposed} \\ 0.20}} \times \underbrace{\eta}_{\substack{\text{run likelihood} \\ 0.07}} = 1.5\%$$

Result I: 1.5% of firms are subject to runs
 \Rightarrow >60% of bankruptcy events are driven by runs

Outline

- Theoretical Framework
- Identifying Firm Runs
- **Macroeconomic Consequences of Firm Runs**

Macroeconomic Consequences

1. Crises
2. Policies

Crisis Shock

- 3 types of short-lived unexpected aggregate shocks (η fixed):
 1. tfp
 2. cash shock ($n \downarrow$)
 3. credit shock ($\alpha_{11} \downarrow$)

detail shocks

Crisis Shock

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 1. tfp
 2. cash shock ($n \downarrow$)
 3. credit shock ($\alpha_{11} \downarrow$)

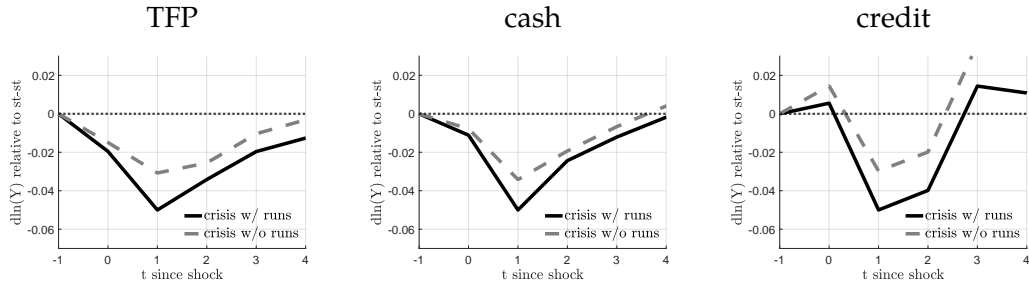
detail shocks

Questions

- contribution of runs to crises impact?
- investment heterogeneity in crises

st-st comparison

Crisis Shock Counterfactuals



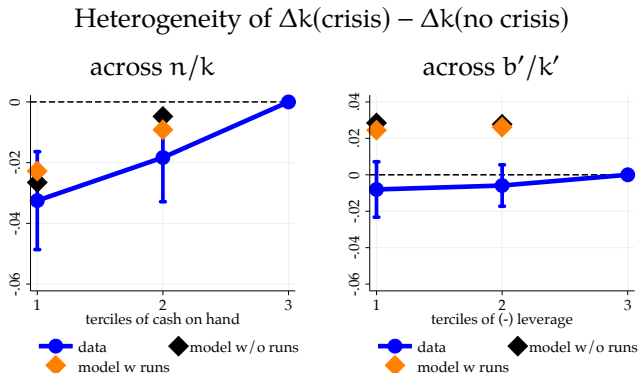
detail shocks

- Firm exit: cash and TFP shocks \uparrow ; credit shock \downarrow [details](#)

Result II: runs amplify significantly the impact of crises

Crisis Shock Heterogeneity

- Estimate heterogeneity in Δk adjustments during crises empirical specification measurement
- Data and model simulation for Great Recession and Covid episodes



note: simple average of both episodes for cash shock individual episode empirical results other shocks

Credit Policy Intervention

- **Direct lending** policy: gov promises an alternative $Q^g(.)$ to a set of eligible firms. Then eligible firms new debt issuance resources are

$$\max\{Q_{\text{market}}(s, b', k'), Q_{\text{government}}^g(.)\} \times b'$$

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 - ▶ faces $Q = 0$ then borrow from government at Q^g
 - ▶ If $d = n + \max_{k', b'} \{-k' + Q^g b'\} > 0$ then creditors know the firm could borrow from the gov to rollover the debt \Rightarrow **preclude run**

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 - parametrization announcement and implementation direct lending vs credit guarantees

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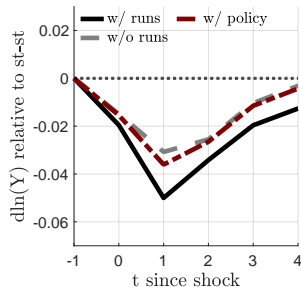
parametrization announcement and implementation direct lending vs credit guarantees

Question: policy effectiveness during crises

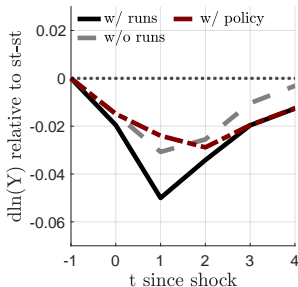
Credit Policy Implications

- Policy active for first two periods and cash shock driven crisis TFP shock results fiscal losses by scale

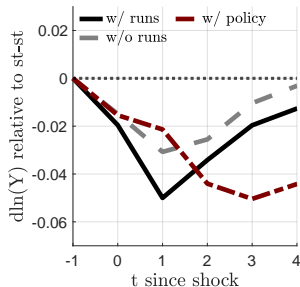
low scale



medium scale

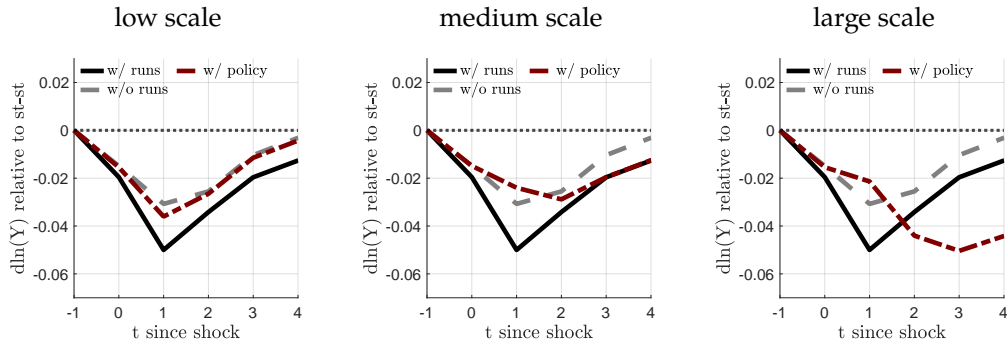


large scale



Credit Policy Implications

- Policy active for first two periods and cash shock driven crisis TFP shock results fiscal losses by scale



Result III: imperfect credit policy benefits are ambiguous

- (i) low scale policy is very potent
- (ii) high scale policy could backfire through future debt overhang

Concluding remarks

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- Framework where rollover problems can be identified and quantified
- Results
 1. runs are relevant for firms' failure
 2. runs can amplify significantly aggregate impact of crises
 3. role for credit policies to prevent runs, even if imperfect

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Further research avenues

- Extensions: (i) manage liability structure (ii) heterogeneous investors
liab structure data ex-ante cost of runs
- Other applications: e.g., sovereign debt bankruptcy procedures and self-fulfilling crises

Thank you!

Extra Slides

Related Papers

Brief and non-exhaustive review

- **Quantitative macro models of firms:** heterogeneous firms with corporate finance frictions
Khan Sengha Thomas 2017; Ottonello Winberry 2020 default risk; and Corbae D'Erasmus 2021 bankruptcy
- **Rollover (coord) problems in macro:** creditor's coord problems (run) in banks/firms/countries
Gertler Kiyotaki 2015 banks; Cole Kehoe 2000; Bocola Dovis 2020 sov debt; Morris Shin 2004 CFin theory;
Jackson 1986 CLaw bankruptcy [more detail](#)
- **Investment heterogeneity during crises (empirical):** heterogeneity across financial distribution
Kalemli-Özcan Laeven Moreno 2020; Almeida Campello Laranjeira Weisbenner 2012; Ebsim Faria-e-Castro Kozlowski 2021
- **Credit policy and C-borrowing in crisis:** credit policies implemented to address nonfinancial firms' financing problems in crises
Crouzet Tourre 2021; Elenev Landvoigt Nieuwerburgh 2021; Ebsim Faria-e-Castro Kozlowski 2021

Related Papers on Coordination Failures

- **Bank runs:** Diamond Dybvig 1983; Gertler Kiyotaki 2015; Gertler Kiyotaki Prestipino 2020
- **Int'l. macro:** Cole Kehoe 2000; Bocola Dovis 2020; Obstfeld 1994 and 1996
- **Sunspots and business cycles:** Benhabib Wong 2014; Schmitt-Grohe Uribe 2020
- **Corporate finance (theoretical):** Morris Shin 2004; Acharya Gale Yorulmazer 2011; He Xiong 2012; Halac Kremer Winter 2020; Zhong 2021; Zhong Zhou 2021
- **Corporate law:** Jackson 1986; Baird Jackson 1990; Ayotte Skeel 2013

[back related papers](#) [back to paper](#)

US Bankruptcy Code

Bankrupt firms use chapter 11 (11 U.S.C.) or 7 (7 U.S.C.) of US bankruptcy code

- Chapter 7
 - associated with firm's liquidation
 - case impartial trustee appointed to sell the bankrupt firms assets to pay creditors
- Chapter 11
 - associated with firm's restructure (or reorganization)
 - large firms also use to piecemeal liquidate the firm ("363 sale", 11 U.S.C. § 363(a))
 - debtor presents plan, and needs to be approved by judge and, ultimately, negotiated with and voted by creditors
 - provisions to preclude creditor's coordination problem
 1. automatic stay 11 U.S.C. § 362(a): prevents creditors demand payment
 2. debtor-in-possession protection 11 U.S.C. § 1101: allows new financing
 3. creating creditors' committees 11 U.S.C. § 341

Bankruptcy Procedure

- Only firms that are insolvent or under a run may restructure their debt
- Recovery rate $\alpha_{11}(\cdot)$ determined by

$$\alpha_{11}(z, k, b, \omega) = \arg \max_{\alpha_{11}} \left[\underset{\text{firm's surplus}}{V(z, n^{11}) - 0} \right]^{1-\Xi} \left[\underset{\text{creditor's surplus}}{\alpha_{11}b - R(k, b, \omega)b} \right]^{\Xi}$$

where $\Xi \in [0, 1]$ barg power of creditors, we need that $n_{11} > \underline{n}(z)$ and $\alpha_{11} > R(k, b, \omega) = \min \{1, \alpha_7 (1 - \delta) q \omega k / b\}$

- For computational reasons I approx the barg. Max recov rate $\{\alpha_{11}^{\max} : n_{11} = \underline{n}(z)\}$ and min recov rate $\alpha_{11}^{\min} = \alpha_7^{\min} = R(k, b, \omega)$, then recov rate linear comb of those rates with $\psi_{11} \in (0, 1)$ the weight to creditors

Entry and Exit

Exogenous exit

- Firms receive exog exit shock with prob γ
- Exiting firms allowed to restructure and liquidate before producing then

$$V^{\text{exit}}(s) = 1_{\{\text{continue} \mid \text{exit}\}}(s) n + 1_{\{\text{ch11} \mid \text{exit}\}}(s) n_{11}^{\text{exit}}$$

- Liquidate if $n < 0$ and $n_{11}^{\text{exit}} > 0$ not feasible; restructure if $n < 0$ and $n_{11} > 0$ feasible
- Price of debt conditional on exit is

$$\begin{aligned} \tilde{Q}_{\text{exit}}(z, k', b') &= \mathbb{E}_{(s' \mid s)} \left[\wedge \left\{ 1_{\{\text{continue} \mid \text{exit}\}}(s') + 1_{\{\text{ch11} \mid \text{exit}\}}(s') \alpha_{11}^{\text{exit}} \right\} \right] \\ &\quad + \mathbb{E}_{(s' \mid s)} \left[\wedge 1_{\{\text{ch7} \mid \text{exit}\}}(s') R(\omega', b', k') \right] \end{aligned}$$

Entry

- Mass $\bar{\mu}$ enter each period replacing exiting firms (for all reasons)
- Enter with capital $k = k_0$, $b = 0$ and $z \sim \Omega^e(z)$

Liquidation Choice: Characterization

Proposition (Liquidation Choice)

Continuing firms liquidation choice $\tilde{1}_{ch7}(s, b', k') \equiv 1_{ch7}(s)$ where

$$\tilde{1}_{ch7}(s) = \begin{cases} 1 & \text{if } n < \underline{n}(z) \\ 1 & \text{if } n \in [\underline{n}(z), 0) \text{ and } \phi < \eta \\ 0 & \text{if } n \geq 0 \text{ or } n \in [\underline{n}(z), 0) \text{ and } \phi > \eta \end{cases}$$

with $\underline{n}(z) \equiv -\max_{k', b'} \{-k' + \tilde{Q}(z, b', k') b'\}$ where \tilde{Q} debt price if $[1 - \tilde{1}_{ch7}(s)] = 1$ (i.e., no liquidation today conjectured)

- Firms with $n < 0$ are exposed to runs independently of their productivity z
- If \tilde{Q} increasing in z then $\underline{n}(z)$ decreasing in z

Liquidation Choice: More General Setup

Long-term debt

- assume portion debt m matures each period (randomly) and nonmatured pays coupon c
- cash-on-hand: $n = \pi + q\omega(1 - \delta)k - [m + (1 - m)c]b$
- external funds: $Q(.) [b' - (1 - m)b] - qk'$
- default threshold: if $n \in [\underline{n}(z, b), 0)$ exposed to runs and $n < \underline{n}(z, b)$ insolvent
- (recursive) debt prices (simplified = no bkruptcy, no exit, no discount, $c = 0$, $\alpha_7 = 0$):

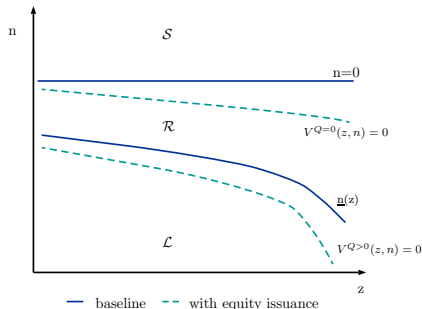
$$\tilde{Q}(z, k', b') = \mathbb{E}_{z'|z} \left[\left\{ 1_{n' \geq 0} + (1 - \eta) 1_{n' \in [\underline{n}(z', b'), 0)} \right\} \left\{ (1 - m) \tilde{Q}(z', k'', b'') + m \right\} \right]$$

More general (assume $c = 0$ for exposition)

- profits $\pi(z, k)$ gral z process, invest $\iota(k, k')$ allow for idio k frictions and long-term debt
- dividends (if no run) are $d = \pi(z, k) - \iota(k, k') - bm + \tilde{Q}(.) [b' - (1 - m)b]$
- multiple eq if $\max_{k', b'} d \geq 0$ and $n \equiv \pi(z, k) - bm - \iota(k, 0) < 0$ hold

Liquidation Choice: Costly Equity Issuance

- Firms can issue equity $e < 0$ at cost $\phi(e)$, which is decreasing in e and unbounded.



- $\mathcal{S} : V^{Q=0}(z, n) \geq 0$
- $\mathcal{L} : V^{Q>0}(z, n) < 0$
- $\mathcal{R} : V^{Q>0}(z, n) \geq 0$ and $V^{Q=0}(z, n) < 0$

- Where $V^{Q=0}$ firm problem with costly equity issuance where $Q = 0$ and $V^{Q>0}$ same but with $Q > 0$

HH Problem

HH in equilibrium determines

$$\begin{aligned}\Lambda' &= \beta \frac{u_C(C', L')}{u_C(C, L)} \\ 1 &= E \left[\beta \frac{u_C(C', L')}{u_C(C, L)} (1 + r) \right] \\ w &= - \frac{u_L(C, L)}{u_C(C, L)}.\end{aligned}$$

with utility function $u_C(C, L) = \ln C - \Omega L$

Capital Producer

There is a representative aggregate capital producer that maximizes

$$\max_I q \Phi \left(\frac{I}{K} \right) - I$$

where I is the amount of final goods used to produce capital, K is the aggregate k stock, and $\Phi(.)$ is the aggregate capital adjustment cost function. FOC:

$$q = \frac{1}{\Phi' \left(\frac{I}{K} \right)}$$

- time-varying q and $\mathcal{R}(\cdot) \rightarrow$ financial accelerator mechanism (Bernanke, Gertler & Gilchrist 1999).

Steady-State Equilibrium

Steady-state equilibrium in this economy is Vfunctions of continuing firms $\{V, \tilde{V}\}$, decision rules $\{b', k', l\}$, aggregates $\{Y, C, I\}$, price schedule $Q(\cdot)$, interest rate r , prices $\{q, w\}$, default choices $1(\cdot)$, recov rates $\alpha_{11}(\cdot)$ and distribution of firms $\{\Omega(\cdot)\}$

- HHs choices are determined by Euler eq, SDF and labor supply eq [detail](#)
- price of capital q determine in K producer problem [detail](#)
- debt price satisfy no-profit condition of fin intermediaries [detail](#)
- given prices, firm's dec. rules solve the producing firm's problem [detail](#) and default choices are consistent with Default Propositions
- recovery rates satisfy bargaining protocol
- markets clear (labor, resources)
- distribution of firms **fixed point** in law of motion [detail](#)

Law of Motion States

Let Ω be the distribution of firms that produce which they a mass of 1, $\tilde{\Omega}$ the distribution of incumbent firms at the beginning of the period, g and \hat{g} the pdf of ω and ϕ respectively, p the conditional pdf of the productivity shocks ϵ_z , and Ω^e the distribution of entrant firms. To define the equilibrium first we need to determine the law of motion of the distribution. Distribution of firms that produce is

$$\begin{aligned}\Omega(z, n) = & (1 - \gamma) \int \left[1_{\{\text{ch11}\}}(s) 1_{\{n^{11}(z, k, b, \omega) = n\}} + 1_{\{\text{cont}\}}(s) 1_{\{n(z, k, b, \omega) = n\}} \right] d\tilde{\Omega}(s) \\ & + \bar{\mu}(1 - \gamma) \int \left[1_{\{\text{ch11}\}}(s) 1_{\{n^{11}(z, k_0, 0, \omega) = n\}} + 1_{\{\text{cont}\}}(s) 1_{\{n(z, k_0, 0, \omega) = n\}} \right] \hat{g}(\phi) g(\omega) d\phi d\omega d\Omega^e(z) \\ & + \text{lom} \mid \text{exit}\end{aligned}$$

The distribution of incumbent firms at the beginning of the period $\tilde{\Omega}(z, \omega, k, b, \phi)$ is

$$\tilde{\Omega}(s') = \int 1_{\{k'(z, n) = k'\}} 1_{\{b'(z, n) = b'\}} \hat{g}(\phi') g(\omega') p(\epsilon_z \mid \rho_z z + \epsilon_z = z') d\epsilon_z d\Omega(z, n)$$

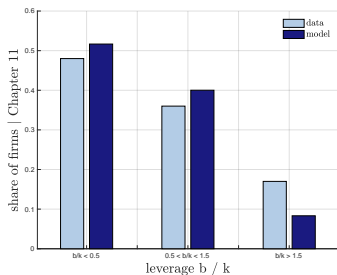
Data Sources, Sample and Some Definitions

Compustat

- Two samples (accounting changes after 2018, see Ma's online notes)
 - ▶ Pre-covid = 1980-2017 (n=179k annual, n=426 k quarterly)
 - ▶ Covid = 2019-2020 (n=14k quarterly)
- Sample selection: nonfinancial, $k > 0$, assets > 0 , drop outliers and short-spell (< 20 q spell)
- Key definitions:
 - ▶ n = profits + liq value capital – net liquid liabilities
 - ▶ profits = $F1.oiadpq$ where $F1$ = one period ahead in the data
 - ▶ net liquid liabilities = $1ctq - cheq$
 - ▶ liq value capital = $inv tq \times \omega_{inv} + rectq \times \omega_{rec} + ppentq \times \omega_{ppentq} + acoq$ where ω_x is liq value rate (from Kermani Ma 2020) of asset class x
- Identify bankrupt firms that operate following Corbae D'Erasmus 2021. Use footnote to total assets and deletion information ($d1rsn$ and $d1dte$). Bankrupt firms:
 1. report adoption accounting under Ch11, or bankrupt and not deleted
 2. data available next period

Untargeted Moments of Bankruptcy

Distribution of leverage b'/k'
firms in Chapter 11



Predictors of Chapter 11

	dependent variable: $1_{i,t}^{ch11}$					
	(1)		(2)		(3)	
	data	model	data	model	data	model
$n_{i,t-1}/k_{i,t}$	-0.39 (0.03)	-0.05			-0.39 (0.10)	-0.45
$b_{i,t}/k_{i,t}$			0.11 (0.04)	0.03	-0.29 (0.09)	-0.41
$\log(k_{i,t-1})$	-0.50 (0.12)	-0.06	-0.52 (0.12)	-0.06	-0.49 (0.12)	-0.10
$d \log(\text{sales}_{i,t-1})$	-0.04 (0.00)	-0.03	-0.04 (0.00)	-0.02	-0.04 (0.00)	-0.01
Sector FE	Y		Y		Y	
Firm FE	Y	Y	Y	Y	Y	Y
Year FE	Y		Y		Y	
Observations	370,973		373,362		370,973	

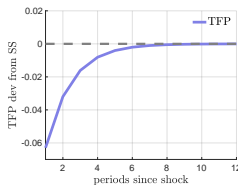
$$\text{empirical specification: } 1_{i,t}^{ch11} = \beta X_{i,t-1} + \alpha_t + \alpha_i + \alpha_s + \epsilon_{i,t}$$

Crisis Shocks

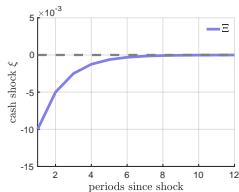
- Shocks unexpected and perfect foresight of path
- Temporary with persistence 0.5
- Definition of shocks:
 - ▶ TFP A: prod funct $Az f(k, \omega, l)$
 - ▶ Cash ξ : reduction in n by ξk
 - ▶ Credit: recov rate if liquidated α_7

MIT shocks path

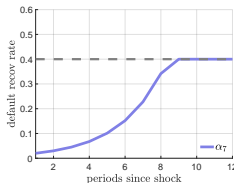
TFP A



Cash ξ

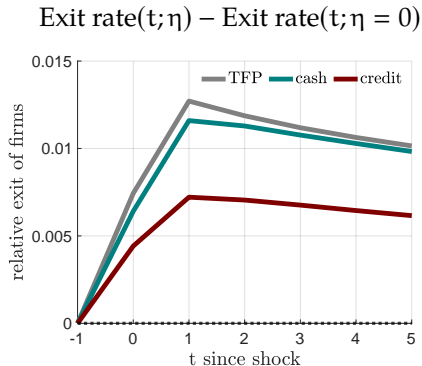
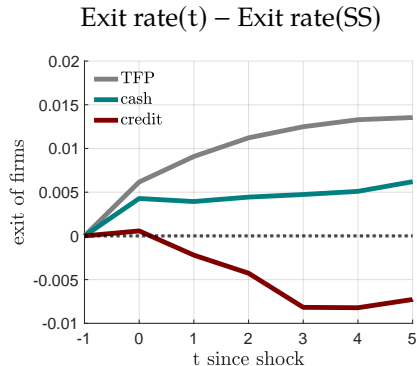


Credit (Recovery liquidation) α_7



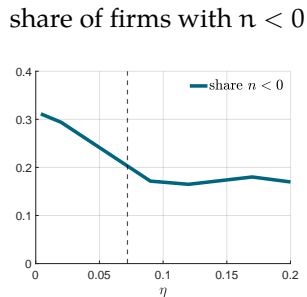
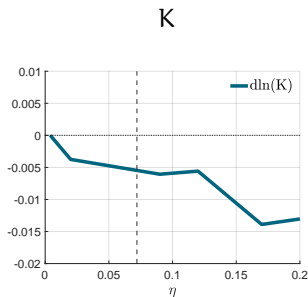
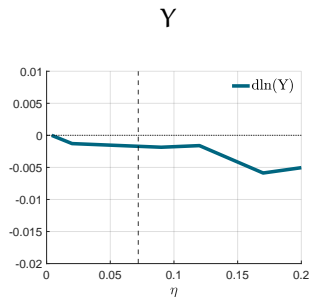
Steady State Comparison

- Firm exit dynamics during crisis experiments



Steady State Comparison

- Variables: aggregate income Y , capital, K and share of firms with $n < 0$
- Comparison: steady state for different η



notes: log difference relative to st-st with $\eta = 0$ for Y and K and levels for share of firms

[back](#)

Heterogeneous Investment Response

Empirical Specification

- Diff-in-diff crisis event estimate
similar to Kalemli-Özcan Laeven Moreno 2020

$$\Delta \log(k_{it}) = \underbrace{\sum_{j=1}^J \beta_j^n \left(Q_{it}^{nj} \times \text{crisis}_t \right)}_{\text{heterogeneity across } n/k} + \underbrace{\sum_{j=1}^J \beta_j^b \left(Q_{it}^{bj} \times \text{crisis}_t \right)}_{\text{heterogeneity across } b/k} + \underbrace{\Lambda' Z_{it}}_{\text{controls}} + \varepsilon_{it}$$

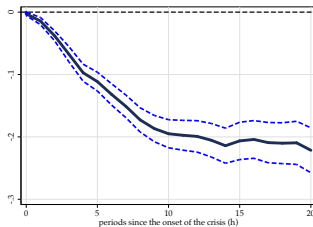
let $x_{it} = \{b_{it}, l_{it}\}$ firm i at period t with

- demeaned by sector $\hat{x}_{it} = x_{it} - \mathbb{E}_s[x_{it}]$.
- $\Delta \log(k_{it}) = \log(k_{it+h}) - \log(k_{it})$ with h peak-to-trough length
- crisis_t indicates if a crisis happens during the period considered
- $Z_{i,t}$: sales growth, log firm size, firm FE, sector FE

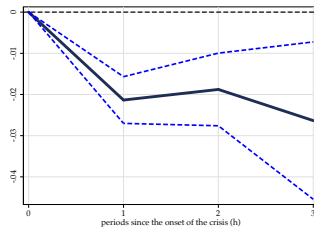
Recent Crisis Episodes in U.S.

Δ Capital Accumulation

(a) Great Recession



(b) Covid-19 Crisis



$$\beta_h : \log(k_{it+h}) - \log(k_{it}) = \alpha_i + \beta_h \text{crisis}_t + \varepsilon_{it+h}$$

[back](#)

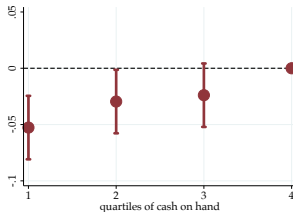
Investment Adjustment Heterogeneity

Recent Crisis Episodes in U.S.

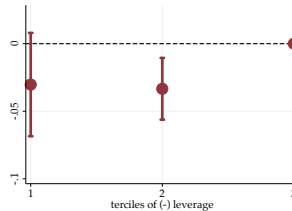
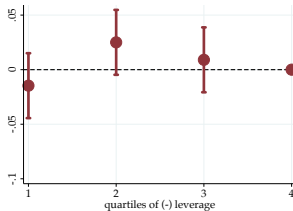
Great Recession

Covid-19 Crisis

Across n/k

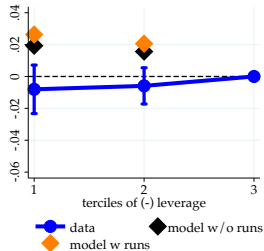
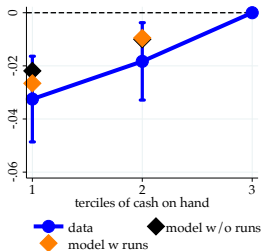


Across b/k

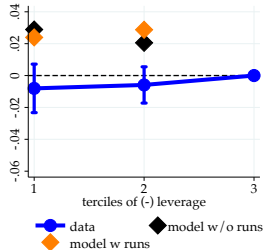
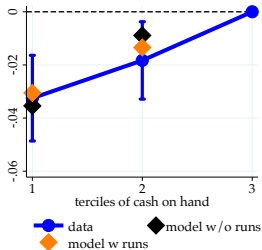


Crisis Shock Heterogeneity: Other Shocks

TFP shock



Credit shock



Credit Policy Setup

- Announced unexpectedly at $t = 0$ (same period of shocks) for $T \geq 0$ periods and implemented at $j \in [0, T]$
- Eligible firms $(z, n) \in \mathcal{P}$ offer sequence of $\{Q_t^g(.)\}$
- Policy \mathcal{P} and labor taxes τ fixed across time
- Budget constraint from $t \geq 1$

$$\tau w_t L_t + B_t + B_{t-1,t}^g = B_t^g + (1 + r_{t-1}) B_{t-1}$$

B_t^g amount lent, $B_{t-1,t}^g$ lent at $t - 1$ and recovered at t

[back](#)

Credit Insurance Policy: First Best and Trade-off

Proposition (Credit Insurance Policy)

Assume that the government implements the credit insurance policy next period and is predictable today:

- 1. First best policy: $Q^g = \tilde{Q}$ then no risk of runs and qualified firms indifferent between using public or private credit.*
- 2. No screening: fix z^g such that $Q^g = \tilde{Q}(z^g, k', b')$ with firms qualified for credit those with $0 > n > \underline{n}(z^g)$. This policy faces a trade-off between lowering firm run risk and greater misallocation.*

- 1st best policy eliminates runs and firms don't use the program's credit
- W/o screening greater z^g will preclude more runs, but firms with $z < z^g$ will draw funds (zombification)

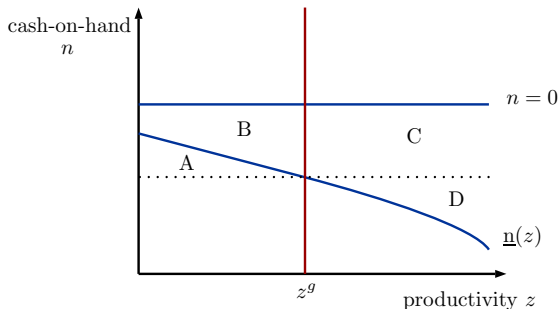
Direct Lending vs. Credit Guarantees

- Examples: direct lending \approx Fed's PMCCF SMCCF and credit guarantee \approx PPP
- In the theory policies are
 - ▶ direct lending (DL): alternative $Q^g(.)$ [detail theory](#)
 - ▶ credit guarantee (CG): repay $\alpha_g^r \geq \alpha^r$ in case of default
- Workings relative to runs
 - ▶ DL affects payoffs (outside eq) and could coord creditors in good eq
 - ▶ CG relaxes $\underline{n}(z)$ but doesn't *directly* preclude runs

Credit Policy Trade-off

Stylized example of 1 period policy in PE and two extreme cases

1. *Perfect screen of z* : $Q^g = \tilde{Q}$ and then remove coord failures for "free"
2. *No screen of z* : gov lends to eligible firms $n \in (0, \underline{n}(z^g)]$ firms at $\tilde{Q}(z^g, k', b')$, with z^g parameterizing policy scope



$A \cup B \cup C$: eligible

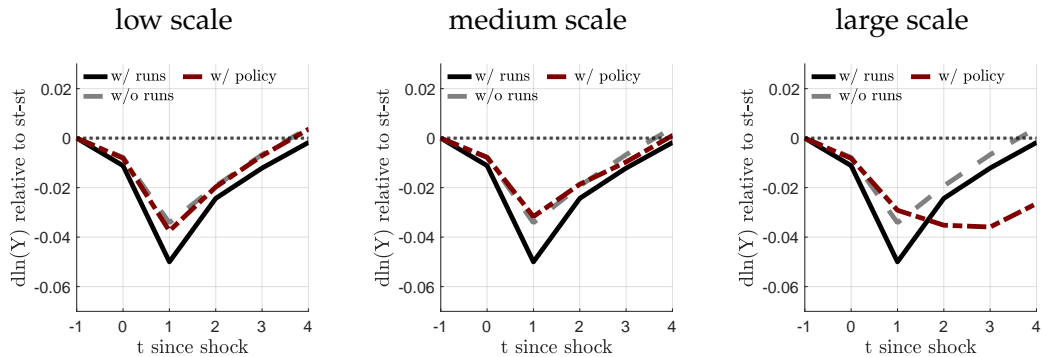
D: excluded

$A \cup B$: subsidized credit

$B \cup C$: runs precluded

Credit Policy Implications: TFP shock

- Policy active for first two periods and TFP shock driven crisis [back cash shock results](#)

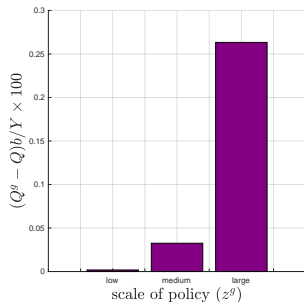


Credit Policy Implications: TFP shock

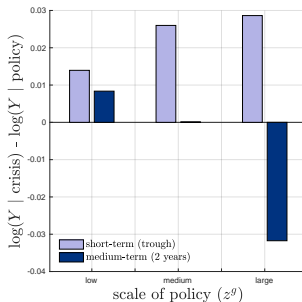
- Compute fiscal costs, short and long term benefits [back](#)

Costs and benefits

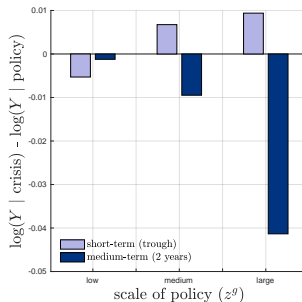
Fiscal costs



Benefits with runs



Benefits without runs



Liability Structure Data

- Debt maturity (Compustat)

	Time to mature (share)		
	< 1 year	1 to 4 years	≥ 5 years
Debt	0.29	0.33	0.38
	< 1 year	> 1 years	
	0.61	0.39	

- Number of creditors from bankruptcy filings to Chapter 11 (FJC-IDB)

	# Creditors		
	1 to 100	101 to 1,000	>1,000
Medium (> 50 million and < 1 billion assets)	0.16	0.19	0.65
Large (> 1 billion assets)	0.03	0.04	0.93

How Costly are Firm Runs?

- (ex-ante) Cost computed as $\tilde{Q}(z, k', b'; \eta) - \tilde{Q}(z, k', b'; 0)$
- Only 2.2% of the firms face a cost of runs higher than intermediation spread

Cost of runs (in annual spread terms) distribution

