

Striking While the Iron Is Cold: Fragility after a Surge of Lumpy Investments

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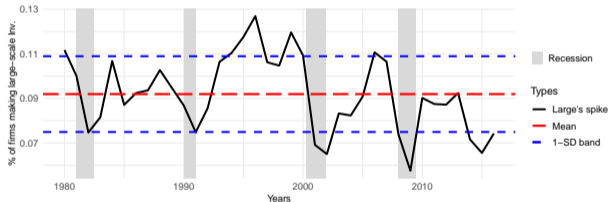
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Teaching materials for JEEA

INVESTMENT SURGES PRECEDE RECESSIONS

- ▶ Three of the last four U.S. recessions were preceded by a **surge in large firms' lumpy investments**.
- ▶ After the surge, fewer large firms are positioned to invest again.
- ▶ **Question:** does the recent investment pattern of *large* firms shape an economy's fragility to TFP shocks?



Spike ratio of large firms (NBER recessions shaded).

THIS PAPER

- ▶ **Question.** How do large firms' synchronized lumpy investments **endogenously shape an economy's fragility** to negative TFP shocks?
- ▶ **Theory.** A heterogeneous-firm RBC model with **size-dependent fixed adjustment costs** ($\zeta = 3.5$) that matches firm-level interest-rate elasticities for both large and small firms.
- ▶ **Mechanism.** Large firms' low sensitivity to general-equilibrium effects makes their lumpy investments **persistently synchronized**, generating investment surges on the RCE path.
- ▶ **Fragility index.** A simple, data-traceable index built from the recent proportion of large firms completing lumpy investments; uses only past observations of large firms.
- ▶ **Key quantitative findings.** After a surge, TFP-induced recessions are particularly severe — $\sim 23\%$ of recent recession-investment declines attributable to fragility; aggregate-investment semi-elasticity falls $\approx 3.4\%$ per s.d. of past synchronization.

WHY FOCUS ON LARGE FIRMS?

- ▶ Definition (Compustat, Zwick–Mahon 2017): large firms are those *above* the 40th capital–distribution percentile within their industry — a meaningful share of aggregate investment ($\sim 21\%$ of total investment comes from large firms' lumpy spikes alone).
- ▶ Their investments are **lumpy** (rare and large) *and* interest-inelastic in the data — the opposite of what plain Q theory predicts for big firms.
- ▶ Consequence: their timing decisions are persistent. Once a wave of large-scale investments occurs, the cross-sectional capacity to react to shocks is depleted for years.

THE FRAGILITY INDEX — DEFINITION

$$Fragility_t := \frac{\sum_i \mathbb{I}\{s_{it} \leq \bar{s}\} \mathbb{I}\{k_{it} > \bar{k}\}}{\sum_i \mathbb{I}\{k_{it} > \bar{k}\}}$$

where

s_{it} : time since firm i 's last lumpy investment.

\bar{s} : recency threshold ($\bar{s} = 3$ years).

\bar{k} : size threshold for large firms (40th capital percentile).

- ▶ In plain words: the fraction of large firms that have **recently completed** a lumpy investment.
- ▶ Uses only *past* observations of *large* firms — data-traceable from Compustat.
- ▶ Lead-lag with spike ratio: when fragility regressed on the three-year-lagged spike ratio, coefficient = **0.75** (significant at 1%).
- ▶ Empirically: a one-s.d. rise in fragility predicts a **−0.46 s.d.** drop in next-period investment growth.

THE MODEL IN ONE SLIDE

Heterogeneous-firm DSGE with lumpy investment:

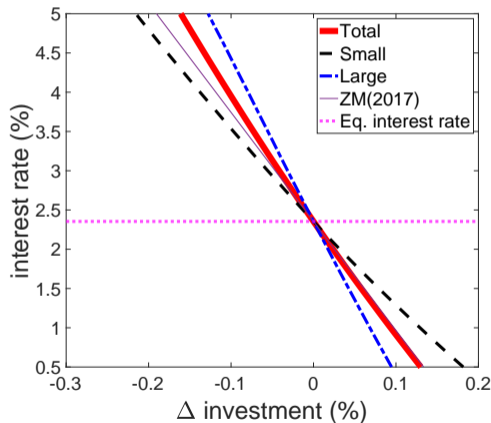
- ▶ Continuum of firms with idiosyncratic productivity z and capital k ; representative household with CRRA utility.
- ▶ Solved on the fully nonlinear equilibrium path (Repeated Transition method; Lee, 2026) — no law-of-motion approximation, no certainty equivalence.

Adjustment cost (convex + size-dependent fixed):

$$\Psi(k, I, \zeta; w) = \frac{\mu}{2} \left(\frac{I}{k} \right)^2 k + \underbrace{\zeta k^\zeta w}_{\text{fixed cost}} \mathbf{1}\{|I/k| > \nu\}$$

- ▶ Curvature $\zeta > 1$ makes the fixed cost grow faster than firm size — microfounded as coordination costs across establishments in multi-establishment firms.
- ▶ The cross-sectional firm-level interest-rate elasticity gap (Zwick and Mahon (2017) on Compustat) disciplines $\zeta = 3.5$.

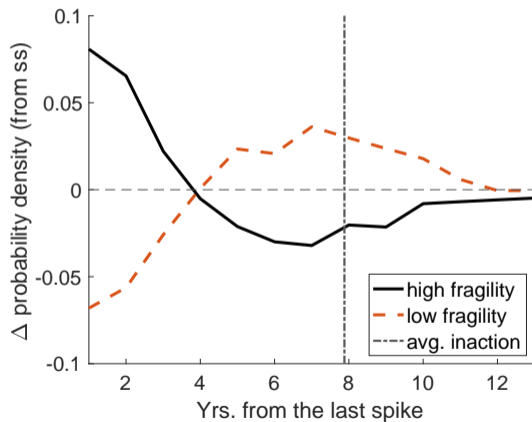
ONLY THE BASELINE MATCHES THE SIZE-ELASTICITY GAP



The three specifications differ in their adjustment-cost form:

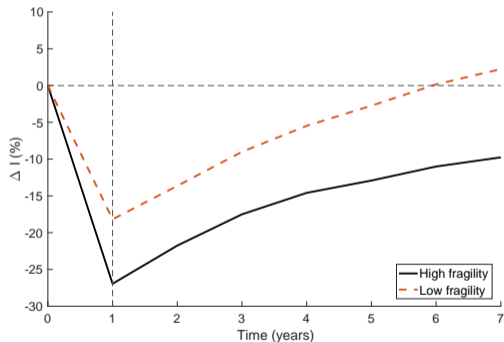
- ▶ **KT-2008** (Khan–Thomas 2008): *fixed cost only*, size-independent — uniformly inflates elasticities.
- ▶ **Convex + Fixed**: both costs, but with a *size-independent* fixed cost — *flips* the size ordering: large firms become *more* elastic.
- ▶ **Baseline**: convex + *size-dependent* fixed cost $F(k) = \zeta k^{\zeta}$ with $\zeta = 3.5$. High ζ disproportionately raises large firms' extensive-margin trigger, lowering their interest-elasticity — the correct specification that reproduces the empirical large-vs-small gap.

SYNCHRONIZATION: DISTRIBUTIONS ON THE Ss BAND



- ▶ Solid: probability density at the *highest-fragility* state; dashed: at the *lowest*.
- ▶ In high-fragility states, large firms cluster at the start of the Ss band: time since last spike is **22% lower** than the SS counterpart.
- ▶ In low-fragility states, they cluster far from the trigger: time since last spike is **16% higher**.
- ▶ Endogenous synchronization drives state dependence.

STATE-DEPENDENT GIRF OF INVESTMENT (TFP SHOCK)



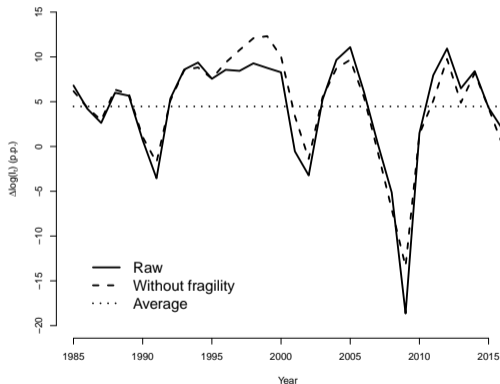
- Solid: high-fragility state (+2 s.d.); dashed: low-fragility state (−2 s.d.).
- Investment drops $\approx 1.6\times$ more after a negative TFP shock when fragility is high.
- A one-s.d. rise in past synchronization lowers the aggregate-investment semi-elasticity to the interest rate by $\approx 3.4\%$ relative to the steady-state level.
- Cumulating across recessions: $\sim 23\%$ of recent recession-period investment declines attributable to fragility.

EMPIRICAL EVIDENCE: MODEL VS. DATA

	Dependent variable: $\Delta \log(I_t)$ (p.p.)			
	(-) $OutputShock_t$		(+) $OutputShock_t$	
	Model	Data	Model	Data
$OutputShock_t$ (s.d.)	9.389 (0.066)	5.818 (1.338)	8.490 (0.064)	6.937 (1.221)
$OutputShock_t \times Fragility_t$ (s.d.)	1.537 (0.042)	2.430 (1.311)	-2.011 (0.045)	-1.486 (0.495)
Constant	Yes	Yes	Yes	Yes
Observations	2,296	16	2,705	18
R^2	0.908	0.790	0.884	0.705
Adjusted R^2	0.908	0.755	0.884	0.663

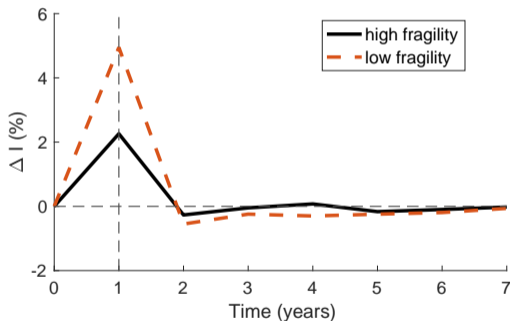
- ▶ Both model and data: high fragility amplifies a *negative* output shock. Coefficient on $OutputShock_t \times Fragility_t$: **+2.43 (data)** vs. **+1.54 (model)**.
- ▶ For *positive* shocks the interaction sign flips — same direction in model and data.
- ▶ Model qualitatively and quantitatively reproduces the fragility-dependent shock transmission.

FRAGILITY-ADJUSTED AGGREGATE INVESTMENT GROWTH



- ▶ Removing the fragility component flattens the recession troughs of 1991, 2001, and 2009.
- ▶ About **30%** of aggregate investment volatility is accounted for by the fragility-shock interaction effect ($0.30 \approx 0.018/0.060$).

STATE-DEPENDENT GIRF TO A POSITIVE SDF SHOCK



- ▶ Solid (high fragility): investment response to a positive discount-factor shock is **noticeably muted**.
- ▶ Dashed (low fragility): a large pool of investment-ready large firms responds strongly.
- ▶ Implication for **monetary policy**: a rate cut bites less when the fragility index is high — the extensive-margin response is depleted.

CONCLUSION

- ▶ Synchronized lumpy investments of large firms generate **endogenous state dependence** in aggregate investment — a precondition of an economy that makes it more fragile to negative aggregate shocks.
- ▶ After a surge of lumpy investments, large firms cluster early in their Ss cycles; fewer are positioned to react to the next shock. Quantitatively, $\sim 23\%$ of recent recession-period investment declines are attributable to fragility.
- ▶ The interest-rate elasticity of aggregate investment is itself state-dependent: $\approx 3.4\%$ lower per s.d. of past synchronization.
- ▶ **Policy implication.** The effectiveness of monetary policy can fall substantially after an investment surge — both the **timing** and the **targeting** of policy matter.