From Premia to Spirals: How Financial Frictions Drive Lumpy Investments

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- Abundant evidence of investment lumpiness at the micro level.

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- Most investment decisions are externally financed.
- This creates close link between lumpiness and financial conditions.
- **Do financial frictions create a more lumpy economy?**
- **Does lumpiness leads higher financing costs?**

What we do

- Theoretical firm investment model with financial frictions:

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- Aggregate model assessing quantitative implications of the lumpiness and financial frictions interaction
- Empirical section with firm level data:
  - Are the theoretical predictions borne out by the data?

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  - Increases in external finance premium lead to higher lumpiness
  - Lumpiness leads to higher external finance premium

Literature

Literature

1. **Lumpy investment**: Caballero and Engel 1999; Cooper and Haltiwanger 2006; Khan and Thomas 2008; Winberry 2021; Lee 2022; Baley and Blanco 2021 and many others
2. **Firm investment and financial frictions**: Khan and Thomas 2013; Ottonello and Winberry 2020; Cloyne et al. 2023 and many others
3. **Interaction of lumpiness and credit decisions**: Jiao and Zhang 2022; Görtz, Sakellaris, and Tsoukalas 2022; Bazdresch 2013

Motivating evidence

Data

- Use quarterly Compustat data from 1981Q1 onwards
- **Capital**: measured using perpetual inventory method (see e.g. Bachmann and Bayer 2014)
- **Investment**: $I_{it} = K_{it} - (1-\delta)K_{it-1}$
- **Financial variables:** Leverage, liquidity and interest expenses and distance to default (Gilchrist and Zakrajšek 2012)
- **Lumpiness measures:**
  - *Cross section:* Herfindahl-Hirschman index, Gini coefficient and coefficient of variation ▸ Lumpiness measures
  - *Panel:* Spikes $\frac{I_{it}}{K_{it-1}} > 0.2$; Inaction duration

Investment concentration and distance to default

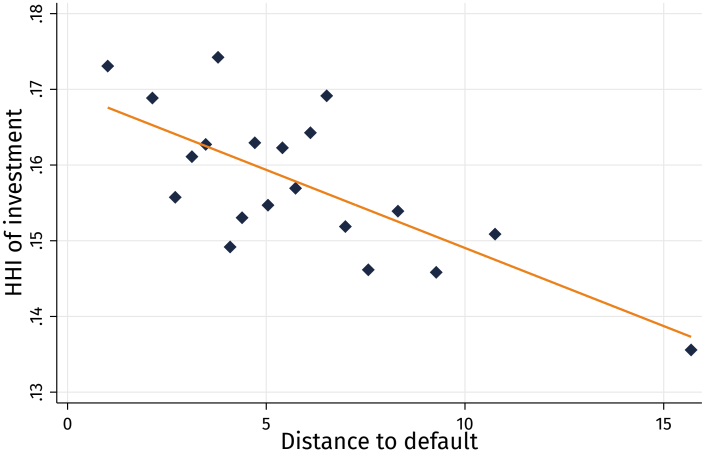

Figure 1: Investment concentration on the y-axis and distance to default on the x-axis.

A simple model of lumpy investment and financial frictions

Simple Theory: Financial intermediary

- Firm can use either internal resources, or external resources b to finance investment

- Theory of bond pricing subject to a firm's endogenous default decision

- Denote borrowing amount as $\mathcal{N}$, the liquidation value as y, and the risk-free return as R

- The bank's payoff is as follows:

$$\min\{\mathcal{N}, \max\{y, 0\}\}$$

- The bond interest rate Q^{Bond} is determined by:

$$Q^{Bond} = \frac{R}{\mathbb{E}\min\left\{1, \frac{\max\{y,0\}}{\mathcal{N}}\right\}}$$

Simple Theory: Firm

- Firm-level extensive-margin investment problem as follows:

$$J(z,k;Q) = \int_0^{\xi^*} \max\{ \underbrace{J^L(z,k,\xi;Q)}_{\text{Value of investment}} , \quad \underbrace{J^N(z,k;Q)}_{\text{Value of no investment}} \quad \} dG(\xi)$$

- Investment entails a fixed adjustment cost $\xi \sim_{iid} Unif[0, \bar{\xi}]$

- Firms uses capital to produce according to a Cobb-Douglas production technology

- Given Q and z, firm decides either to invest or not and the amount of investment I

- We define $\xi^* = \xi^*(z,k;Q)$ such that

$$J^L(z,k,\xi^*;Q) = J^N(z,k;Q)$$

Debt price

Proposition (The monotonicity of the risk premium in the real friction)

The risk premium increases in the frictional cost of investment:

$$\frac{\partial}{\partial \mathcal{N}} Q^{Bond} > 0$$

Lumpy investment

Proposition (The risk premium effect on the lumpy investments)

As the risk premium increases, the threshold rule ξ^* decreases:

$$\frac{\partial}{\partial Q}\xi^*(z, b; Q) < 0.$$

This weakly decreases the investment probability ψ^* given by

$$\psi^* = \frac{\min\{\xi^*, \bar{\xi}\}}{\bar{\xi}}.$$

Structural model

Model overview

- Heterogeneous firms model, with real and financial frictions.

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- Representative household who consumes, saves and supplies labor. ▸ Household

Model results

	Inaction	Spike prob
No fin friction	3.184	18.6%
Fin friction	3.224	19.2%

- Annual risk-free return: 2.35%
- Risk premium incremental by 0.5p.p. of the annual risk-free return.

Empirical evidence

Theoretical predictions:

1. Higher lumpiness results in larger external finance premium

Basic predictions from the model

Theoretical predictions:

1. Higher lumpiness results in larger external finance premium
2. Larger external finance premium implies larger lumpiness

Findings

1. Exogenous increase in risk premium leads to higher lumpinsess
   ▸ Premium on lumpiness
   - Use monetary policy shocks and industry elasticities to get exogenous variation ▸ Specification

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1. Exogenous increase in risk premium leads to higher lumpinsess
   ‣ Premium on lumpiness
   - Use monetary policy shocks and industry elasticities to get exogenous variation ‣ Specification
2. Lumpiness leads to higher finance premium ‣ Lump on premium
   - Local projections to assess effects of lumpiness on finance premium ‣ Specification

Conclusion

- We find a strong correlation between financial frictions and investment lumpiness.
- Theoretical model predicts a spiral:
  1. Higher lumpiness results in larger external finance premium
  2. Larger external finance premium implies larger lumpiness
- Empirical results support theory predictions
- Stronger market incompleteness increases investment lumpiness
- Where next: misallocation and business cycle implications!

Appendix

Tables

Cross-sectional correlations: Gini

Table 1: Gini coefficient of quarterly firm level investment and proxies for financing costs

Liquidity	0.041				
	(0.007)				
Distance to default		-0.006			
		(0.000)			
Leverage			-0.004		
			(0.008)		
Interest Expenses				0.090	
				(0.161)	
Age					-0.001
					(0.000)
Observations	6510	5862	6510	6401	6510

Back

Cross-sectional correlations: Coefficient of variation

Table 2: Coefficient of variation of quarterly firm level investment and proxies for financing costs

Liquidity	0.084				
	(0.020)				
Distance to default		-0.017			
		(0.002)			
Leverage			0.031		
			(0.025)		
Interest Expenses				0.712	
				(0.256)	
Age					-0.001
					(0.000)
Observations	6504	5857	6504	6395	6504

Back

Cross-sectional correlations: HHI

Table 3: HHI coefficient of annual firm level investment and proxies for financing costs

Liquidity	-0.077				
	(0.011)				
Distance to default		-0.004			
		(0.000)			
Leverage			0.048		
			(0.009)		
Interest Expenses				0.218	
				(0.044)	
Age					-0.001
					(0.000)
Observations	5342	4826	5342	5333	5342

◂ Back

Cross-sectional correlations: Gini

Table 4: Gini coefficient of annual firm level investment and proxies for financing costs

Liquidity	0.021				
	(0.010)				
Distance to default		-0.005			
		(0.001)			
Leverage			0.017		
			(0.009)		
Interest Expenses				0.221	
				(0.057)	
Age					-0.000
					(0.000)
Observations	5342	4826	5342	5333	5342

Cross-sectional correlations: Coefficient of variation

Table 5: Coefficient of variation of annual firm level investment and proxies for financing costs

Liquidity	0.059				
	(0.027)				
Distance to default		-0.011			
		(0.002)			
Leverage			0.048		
			(0.027)		
Interest Expenses				0.561	
				(0.168)	
Age					-0.000
					(0.000)
Observations	5340	4826	5340	5331	5340

Panel 1: Exogenous changes in finance premia

Table 6: Spikes (investment rate above 10%) and distance to default

	(1)
$\widehat{D2D}_{ijt-1}$	0.022
	(0.010)
Firm FE	Yes
Sector FE	Yes
Firm controls	Yes
Instrument	Mon. Pol. shock*Ind. Elast.

◂ Back

Panel 1: Exogenous changes in finance premia

Table 7: Investment rate conditional on a spike and distance to default

	(1)
$\widehat{D2D}_{ijt-1}$	0.010
	(0.002)
Firm FE	Yes
Sector FE	Yes
Firm controls	Yes
Instrument	Mon. Pol. shock*Ind. Elast.

◂ Back

Panel 1: Exogenous changes in finance premia

Table 8: Spikes and distance to default, with weight monetary policy shocks

	(1)
$\widehat{D2D}_{ijt-1}$	0.015
	(0.006)
Firm FE	Yes
Sector FE	Yes
Firm controls	Yes
Instrument	Mon. Pol. shock*Ind. Elast.

Back

Panel 1: Exogenous changes in finance premia

Table 9: Inaction duration and distance to default

	(1)
$\widehat{D2D}_{ijt-1}$	-0.504
	(0.182)
Firm FE	Yes
Sector FE	Yes
Firm controls	Yes

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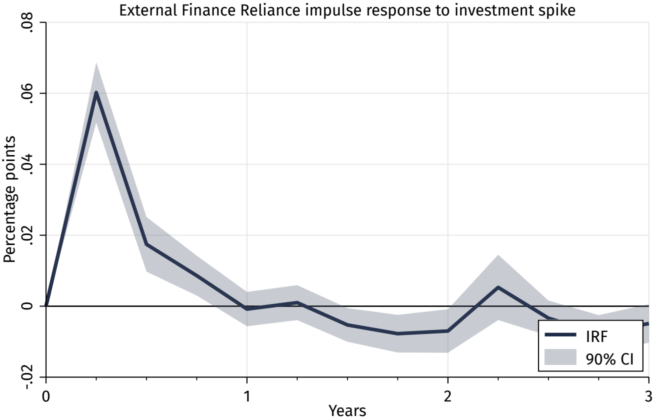
Figures

Ext. Fin. IRF



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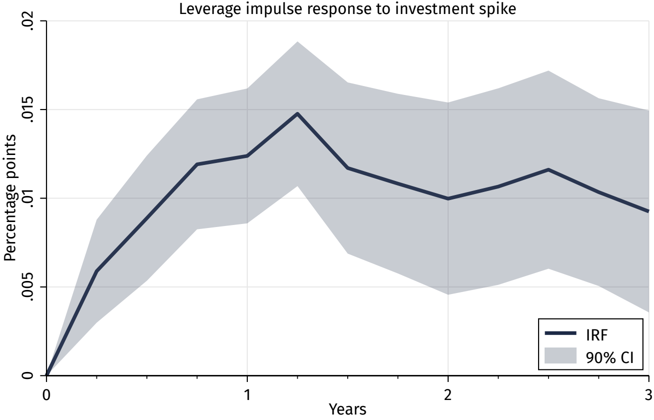
Leverage IRF



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Empirics

Lumpiness meausres

- Our main measure for firm level lumpiness over the cross section: the Herfindahl-Hirschman index

- Larger values are associated with more concentration of investment in a few periods

$$\mathrm{HHI}_i = \left(\sum_{t=1}^{T} \left(\frac{I_{it}}{\sum_{l=1}^{T} I_{il}} \right)^2 | I_{it} > 0 \right)$$

- Our findings are robust to a variety of other measures, considered in the appendix
  - Gini coefficient
  - Coefficient of variation i.e. standard deviation normalized by the mean

▸ Back

Cross-sectional correlations with investment HHI

Liquidity	-0.058			
	(0.010)			
Distance to default		-0.003		
		(0.000)		
Leverage			0.042	
			(0.008)	
Interest Expenses				0.601
				(0.184)
Observations	6511	5862	6511	6402

▸ Annual ▸ Gini ▸ Coefficient of Variation ▸ Back

Panel 1: Exogenous changes in finance premia

- How do changes in finance premia affect lumpiness?

$$y_{ijt} = \beta_1 D2default_{ijt-1} + \Gamma X_{ijt-1} + \theta Z_t + \alpha_i + \delta_j$$

- Where y_{ijt} is investment spike (investment rate¿20%)
- Distance to default endogenous to investment decisions
- Use monetary policy surprises and industry elasticities as instrument

$$D2default_{it} = \delta_1 Shock_t + \alpha_i \quad \forall \quad j$$

- High-frequency monetary policy shocks, using identification methodology from Gürkaynak et al. 2021 Back

Panel 1: Exogenous changes in finance premia

Table 10: Spikes and distance to default

	(1)
$\widehat{D2D}_{ijt-1}$	0.021
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▸ Spike 10% ▸ Inv Rate ▸ Weighted mon pol shocks ▸ Inaction

▸ Back

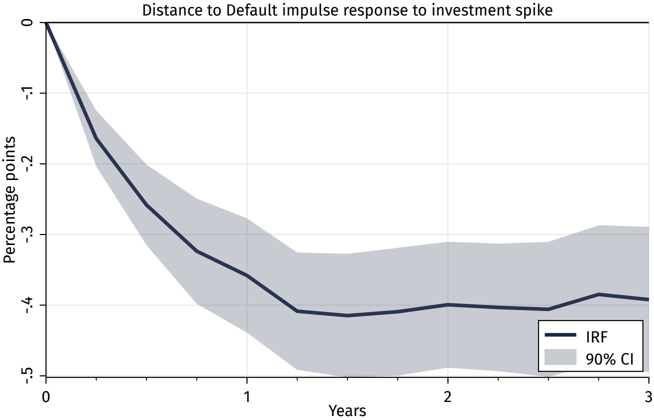
Panel 2: What happens after spikes?

- Analyse behaviour of external finance proxies after investment spike
- Run the following local projection

$$\begin{aligned} D2default_{it+h} &= \beta_h Spike_{it} + \gamma D2default_{it} + \Gamma_h X_{it-1} \\ &+ \theta_h Z_t + \alpha_i + \delta_j + u_{it} \quad \forall h = 0, \ldots, 12 \end{aligned} \tag{1}$$

- β_h is the coefficient of interest
- Including $D2default_{it}$ on the RHS guarantees that we measure the effect of an investment spike which does not move distance to default contemporaneously
- However, still not a causal statement! Back

Panel 2: What happens after spikes?



▸ Leverage ▸ External Finance Mix ▸ Back

Simple Model

Model

Production

Firms profit function given by

$$\max_{n_t} \pi(k, z, A) = A_t z_t k_t^{\alpha} n_t^{\gamma} - w_t n_t$$

where w_t is wage at period t. The logged idiosyncratic productivity follows an AR(1) process:

$$\log(z_{t+1}) = \rho_z \log(z_t) + \sigma_z \epsilon_{t+1}^z, \quad \epsilon_{t+1}^z \sim_{iid} N(0, 1).$$

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Real Constraints

- The firm incurs the fixed adjustment cost $\xi \sim_{iid} \mathcal{U}(0, \bar{\xi}]$ when it invest more than Ω, where Ω is defined as

$$\Omega = [-\nu k, \nu k]. \tag{2}$$

▸ Back

Financial Constraints

- Firm can use either internal resources, or external resources b to finance investment
- The external finance pricing schedule is given by

$$Q(I,k,z) = \begin{cases} 1 & \text{if } I \leq \Psi(k,z) \\ 1 * \frac{\Psi(k,z)}{I} + Q^{RP} * \left(1 - \frac{\Psi(k,z)}{I}\right) & \text{if } I > \Psi(k,z) \end{cases}$$

where $\Psi(k,z) = \theta(\pi(k,z;S) + (1-\delta)k)$ is cash on hand.

- We can characterize the net risk premium as follows:

$$Q(I,k,z) = Q^{RP} - (Q^{RP} - 1)\frac{\theta(\pi(k,z;S) + (1-\delta)k)}{I},$$

Back

Value Function

$$V^0(b,k,z;S) = \pi(k,z;S) + (1-\delta)k - b + \int_0^{\bar{\xi}} \max\left\{V^*(b,k,z,\xi;S), V^c(b,k,z;S)\right\} dG(\xi)$$

where

$$V^*(b,k,z,\xi;S) = \max_{k',b'} -k' + b' - \xi w(S) + E[q(S,S')V(\widetilde{Q}(b',k',z)b',k',z';S')]$$

$$V^c(b,k,z;S) = \max_{k^c\in\Omega,b^c} -k^c + b^c + E[q(S,S')V(\widetilde{Q}(b^c,k^c,z)b^c,k^c,z';S')]$$

▸ Back

Household

The recursive formulation of the household's problem is as follows:

$$V(a;S) = \max_{c,a',L} \quad \log(c) - \frac{\eta}{1+\frac{1}{\chi}} L^{1+\frac{1}{\chi}}, + \beta \mathbb{E} V(a';S')$$

$$\text{s.t. } c + \int \Gamma_{A,A'} q(S,S') a'(S') dS' = w(S) l_H + a(S)$$

$$G_\Phi(S) = \Phi', \quad \mathbb{P}(A'|A) = \Gamma_{A,A'}, \quad S = \{\Phi, A\}$$

where a is the state-contingent equity portfolio value; A is the aggregate productivity; Φ is the joint cumulative distribution of the individual state variable; q is the state-contingent price; Γ is the transition kernel of the aggregate productivity; G_Φ is the expected dynamics of the individual state distribution Φ.

▸ Back