Entry, Variable Markups, and Business Cycles

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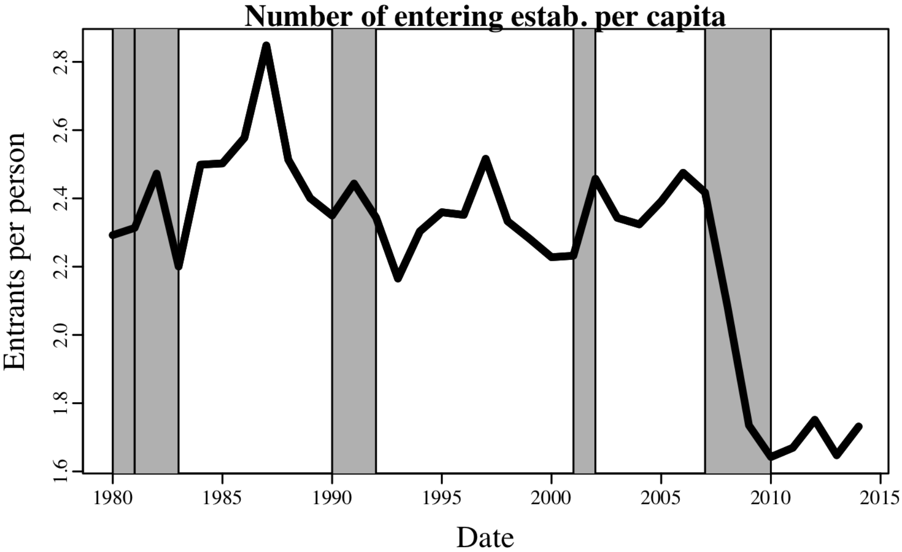
Introduction



Introduction

Business formation fell dramatically during the Great Recession

- Many potential causes: credit, uncertainty, low demand
- This paper takes the fall as given

Question: How large is the effect of falling entry on aggregate employment?

Account for: the impact of missing entrants on incumbents:

- Falling entry $\Rightarrow$ incumbent market shares rise
- Incumbents increase markups
- This leads them to reduce employment

Introduction

Method: general equilibrium business cycle model

- Heterogeneous firms, endogenous entry/exit
- Markups covary with size ("variable markups")
- Labor adjustment costs

Finding: Falling entry leads employment to fall significantly

- Markups rise & output allocated away from productive firms
- Response of aggregates twice as large as a constant markups model
- Adjustment costs amplify variable markups mechanism by 50%

This paper

Outline:

1. Quantify variable markups mechanism
   - Use panel data on large firms
   - Large elasticity of markup to rel. sales: up to 35%

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   - Kimball demand + labor adjustment costs
   - Calibrated to panel regression + employment dynamics
   - Compare to constant markups benchmark
   - Labor adjustment costs are key

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   - Kimball demand + labor adjustment costs
   - Calibrated to panel regression + employment dynamics
   - Compare to constant markups benchmark
   - Labor adjustment costs are key
3. Applications to Great Recession and secular rise in concentration
   - Generates a 70 basis point rise in $\mathcal{M}$ and 3 percent fall in L during GR
   - Effects of entry on markup $\approx$ 3-4 times larger than they used to be

Literature: Pro-competitive effects of entry

Wide range of estimates of the effect of entry on the markup:

- **Homogeneous** firms models: large effects of entry on markups and productivity ((Jaimovich and Floetotto (2008) and Bilbiie, Ghironi and Melitz (2012)).
- Accounting for **heterogeneity** greatly reduces effects (Edmond, Midrigan and Xu (2018) and Arkolakis et al (2019)).
- Why? Falling entry $\Rightarrow$ firms increase markups & employment reallocated to low-markups firms

This paper:

- Adjustment costs inhibit reallocation
- Entry matters quantitatively

Literature: Pro-competitive effects of entry

Weak reallocation mecahnism consistent with empirical evidence:

- Causal evidence on entry, markups, and employment (Suveg (2020), Felix and Maggi (2019))
- Small firms' sales are more cyclically sensitive than large firms' (Crouzet and Mehrotra (2020))

Literature: Pro-competitive effects of entry

Recent literature on Great Recession (Moreira (2017), Clementi and Palazzo (2016), Siemer (2014))

- Entrants are small relative to incumbents
- But account for a significant fraction of employment growth

$\Rightarrow$ Entry has small immediate effects on aggregates but generates slow recovery

This paper: declining entry can have large immediate effects

- Why? Large firms respond to lack of small firms.

Model: Representative household

A representative household chooses consumption and labor supply to maximize

$$\sum_{t=0}^{\infty} \beta^t u(C_t, L_t)$$

They receive wages and profits as income

$$C_t \leq W_t L_t + \Pi_t$$

Labor supply satisfies an intratemporal FOC

$$-\frac{u_L}{u_C} = W$$

Final good production

A perfectly competitive representative firm produces the final good Y_t

- Given $\{y_t(\omega)\}$ quantities of inputs, Y_t implicitly defined by:

$$\int_0^{N_t} \Upsilon\left(\frac{y_t(\omega)}{Y_t}\right) d\omega = 1$$

- Relative output q_t is

$$q_t \equiv \frac{y_t}{Y_t}$$

- This paper: Klenow-Willis (2016) specification of $\Upsilon(q)$

Klenow Willis (2016) Details

Final good production

Final goods firm's optimization $\implies$ demand system for intermediate goods

- Demand curve

$$p(q; D) = \frac{\sigma - 1}{\sigma} \exp\left(\frac{1 - q^{\frac{\epsilon}{\sigma}}}{\epsilon}\right) D$$

- Demand elasticity falls with relative output:

$$\sigma(q) = \sigma q^{-\epsilon/\sigma}$$

- Superelasticity: ϵ/σ

Intermediate goods producers

A variable measure N_t of firms each:

- Is monopolist of one differentiated intermediate variety
- Faces persistent idiosyncratic TFP $z' \sim F(z'|z)$
- Uses constant returns production function in labor
- Faces variable demand elasticity
- Must pay labor adjustment cost $c(L, L')$
- Is exogenously destroyed at rate γ + endogenous exit

Intermediate goods producers

The recursive problem of an intermediate goods producer is:

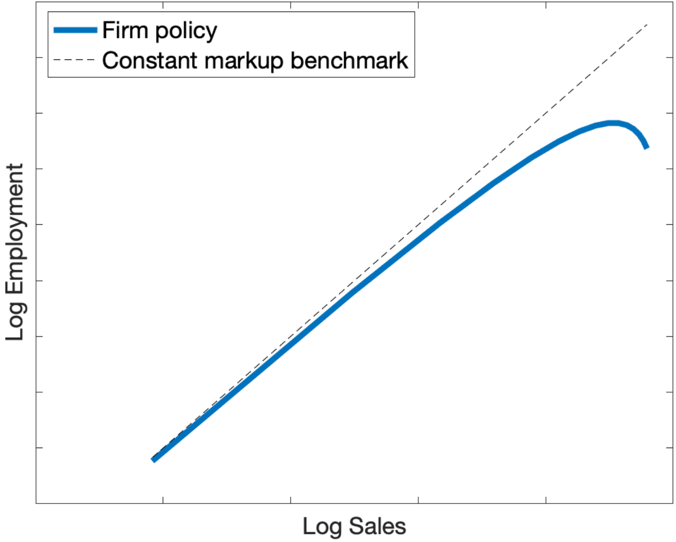
$$V(L, z; \Lambda) = \max_{p, L'} \pi(z, L', p; \Lambda) - c(L, L') + \int \max\left\{0, \tilde{V}(L', z, c_F; \Lambda)\right\} dJ(c_F)$$

$$\tilde{V}(L, z, c_F; \Lambda) = -c_F + \beta(1 - \gamma)\mathbb{E}\left[m' V(L, z'; \Lambda)\right]$$

$$\pi(z, L', p; \Lambda) = \left(p - \frac{W}{L}\right) d(p; \Lambda)$$

$$y \leq zL$$

Static policies – no adjustment cost



Entry

In each period, there is a measure M of potential entrants:

- Each draws a signal $\phi \sim G$ about future productivity
- Decides whether to pay fixed cost to enter c_E
- If enters, chooses an initial level of labor
- Produces in the following period

Entry

Value function of a potential entrant

$$V_E(\phi) = \max_L \beta(1-\gamma)\mathbb{E}\left[m' V(L,z)\middle|\phi\right]$$

The optimal policy is to enter if and only if

$$c_E \leq V_E(\phi)$$

Equilibrium definition

Aggregation

Consider an aggregate production function

$$Y_t = Z_t L_t$$

Aggregate productivity is a weighted average of idiosyncratic TFPs:

$$Z_t = \left(\int \int \frac{q_t(z, L)}{z} d\Lambda_t(z, L) \right)^{-1}$$

The aggregate markup is the inverse labor share:

$$\mathcal{M}_t = \frac{Y_t}{W_t L_t}$$

It is the cost–weighted average of firm–level markups:

$$\mathcal{M}_t = \int \int \mu_t(z, L) \frac{\ell_t(z, L)}{L_t} d\Lambda_t(z, L)$$

Empirical framework

How strongly to markups increase with market share?

This section: quantify variable markups mechanism

- Rising markups dampen employment growth for large firms
- A regression of variable input use growth on revenue growth identifies the superelasticity

Empirical framework

Firm's first order condition with respect to any **variable** input:

$$WL = \frac{PY}{\mu}\alpha \qquad \mu \equiv \frac{P}{MC}, \quad \alpha = \frac{\partial \log Q}{\partial \log L}$$

Taking logs:

$$\log WL = \log(PY) - \log \mu + \log \alpha$$

Estimate:

$$\log WL = \tilde{\alpha} + \beta \log(PY) + \epsilon$$

Dataset

Panel of US-based nonfinancial firms from Compustat:

- 1 percent of firms in the US
- 30 percent of US Nonfarm payroll
- 75 percent of Gross Domestic Income
- Organize firms into industry using Fama-French-49

Measure of variable input use:

COGS: cost of goods sold - materials, intermediate inputs, labor cost, energy

How do variable inputs vary with relative sales?

	log PY		
	(1)	(2)	(3)
log $COGS$	0.9263	0.783	0.654
	(0.0007***)	(0.002***)	(0.002***)
Specification	Log levels	Log levels	1 year log difference
Fixed Effects	Industry $\times$ Year	Firm $+$ Industry $\times$ Year	Industry $\times$ Year

Results for EMP and XLR

How do markups vary with relative sales?

Under the static assumption, the elasticity of the markup to revenue is:

$$\frac{\partial \widehat{\log \mu}}{\partial \log PY} = 1 - \hat{\beta}$$

Using the previous regression:

$\partial\mu/\partial \log PY$		
(1)	(2)	(3)
0.0737	0.217	0.346
(0.0007***)	(0.002***)	(0.002***)

Relaxing the static assumption

The quantity μ can reflect any distortion to the firm's static FOC:

- Adjustment costs on variable inputs

I allow for adjustment costs in the model:

- Estimate structural model parameters using simulated method of moments
- Pin down size of adjustment costs with external data

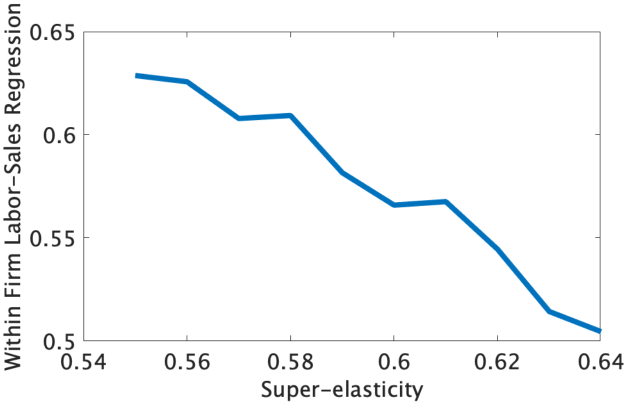
Calibration: super-elasticity

Estimate ϵ/σ using indirect inference:

- Compustat firms are a truncated sample of large firms
- Simulate panel of firms in the model
- Take a 1% sample of the largest firms
- Estimate:

$$\Delta \log L_{ft} = \alpha + \beta \Delta \log \left(P_{ft} Y_{ft} \right) + \epsilon_{ft}$$

Calibration: super-elasticity



Parameterization

- Firm specific TFP follows an AR(1) in logs:

$$\log z_{t+1} = \rho \log z_t + \sigma \epsilon_{t+1}, \;\; \epsilon_{t+1} \sim \mathcal{N}(0, 1)$$

- Entry signal q is Pareto distributed + truncated

$$\log z_{t+1} = \rho \log q_t + \sigma \epsilon_{t+1}, \;\; \epsilon_{t+1} \sim \mathcal{N}(0, 1)$$

Parameterization

- Labor adjustment cost is quadratic:

$$c(L, L') = \phi_L \left(\frac{L' - (1-\delta)L}{L} \right)^2 L$$

- GHH Preferences

$$u(C, L) = \frac{1}{1-\gamma} \left(C - \psi \frac{L^{1+\nu}}{1+\nu} \right)^{1-\gamma}$$

- Intratemporal FOC (labor supply) is:

$$W = \psi L^{\nu}$$

Calibration

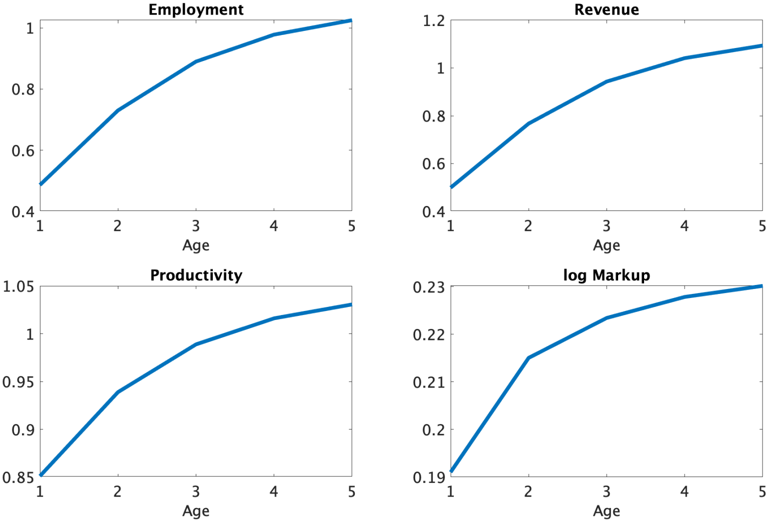
Parameter	Description	Value
β	Discount factor	0.96
σ_z	Idiosyncratic tfp innovation variance	0.53
σ	Kimball demand elasticity	10
γ	Exogenous exit rate	1.5%
M	Mass of entrants	1
ν	Inverse Frisch Elasticity	0.5
δ	Job separation rate	0.19

Calibration

Parameter	Description	Value	Targeted Moment
σ_s	Tfp innovation dispersion	0.29	Dispersion, sales growth
ϕ_L	Adjustment cost	0.0032	Dispersion, employment growth
ϵ/σ	Super-elasticity	0.6	Labor–sales regression
μ_F	Log fixed cost mean	-3.15	Entry rate
σ_F	Log fixed cost dispersion	1.65	Average size exiting firm
ξ	Signal Pareto tail	1.15	Average size entering firm
σ	Elasticity parameter	8.6	Average markup

Model fit

Lifecycle



Employment
1
0.8
0.6
0.4
1
2
3
4
5
Age
Revenue
1.2
1
0.8
0.6
0.4
1
2
3
4
5
Age
Productivity
1.05
1
0.95
0.9
0.85
1
2
3
4
5
Age
log Markup
0.23
0.22
0.21
0.2
0.19
1
2
3
4
5
Age

Experiment: entry-specific shock

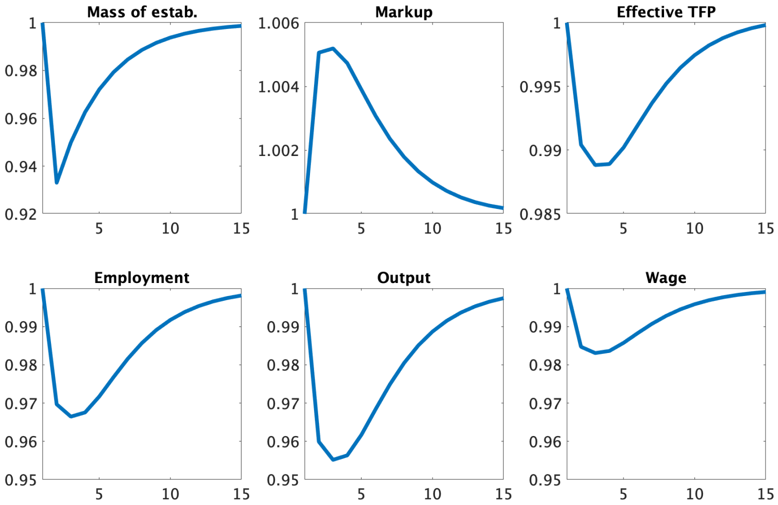
Experiment:

- One time, unexpected shock to the mass of potential entrants M
- Shock to M lasts for 1 year and then returns to steady state
- Size chosen to match the fall in the number of establishments in the Great Recession relative to trend
- Perfect foresight path back to steady state

Stochastic discount factor:

- Baseline: risk-neutral SDF
- In the paper: pro-cyclical SDF amplifies results

Entry shock response



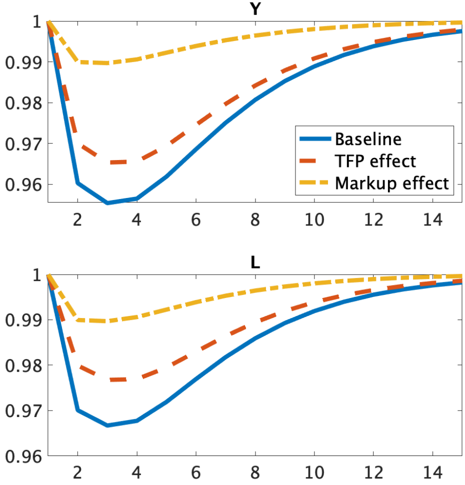
The markup and TFP

Aggregation implies:

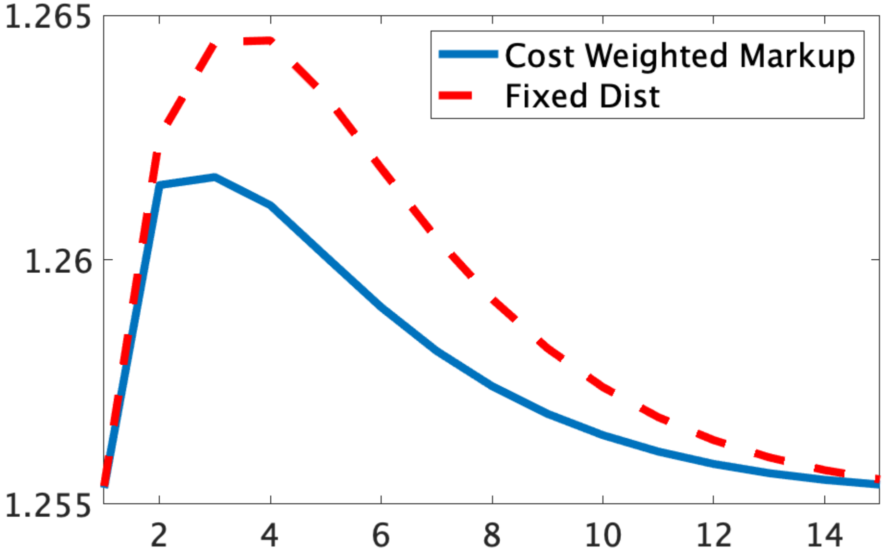
$$L_t = \left(\frac{1}{\psi}\frac{Z_t}{\mu_t}\right)^{\frac{1}{\nu}}$$

So that

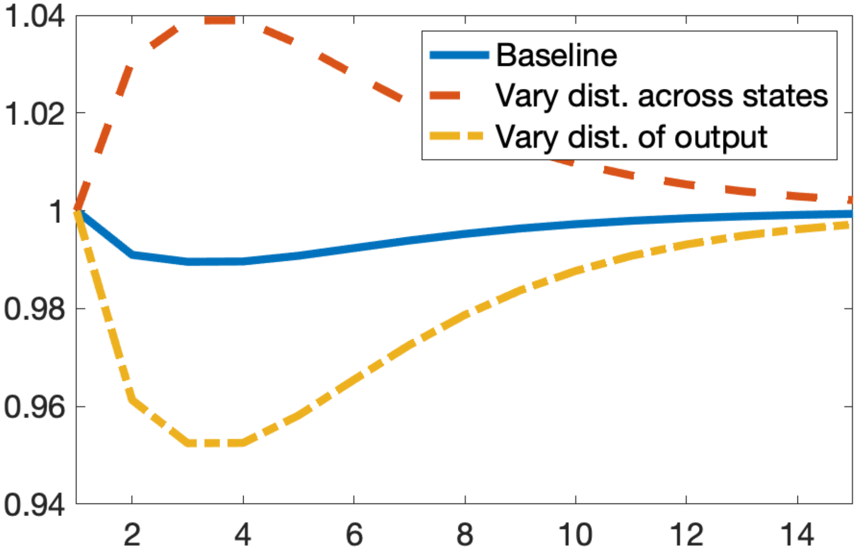
$$\Delta \log L_t = \frac{1}{\nu}(\Delta \log Z_t - \Delta \log \mu_t)$$



The markup

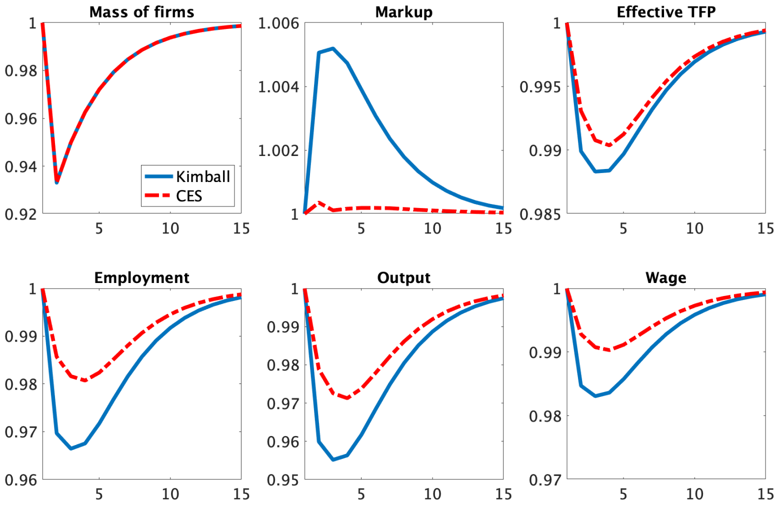


TFP



1.04
1.02
1
0.98
0.96
0.94
2
4
6
8
10
12
14
Baseline
Vary dist. across states
Vary dist. of output

The role of variable markups

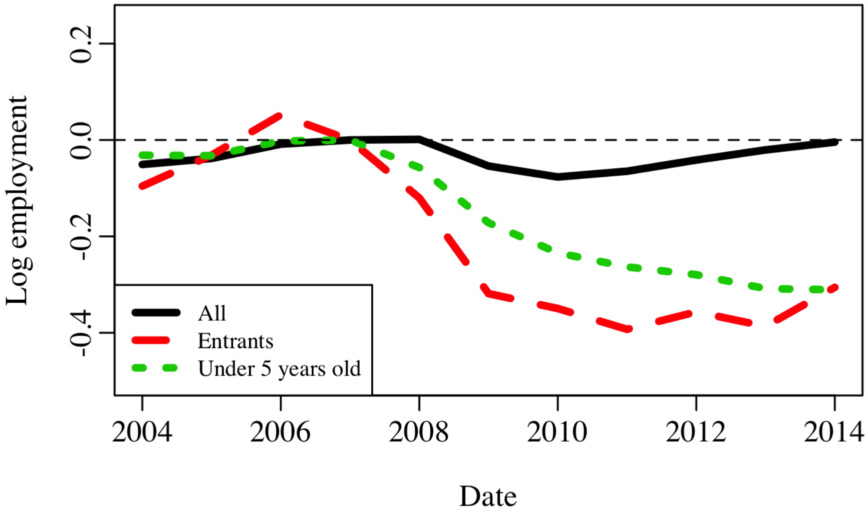


Applications

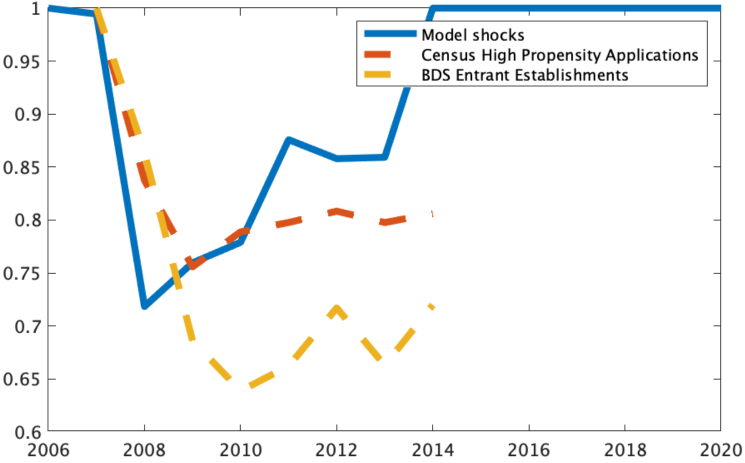
1. The Great Recession
   - Employment at entrants fell persistently during the Great Recession
   - Experiment: find a sequence of shocks that generates the path of the number of establishments in the Great Recession

2. Rising markup-size relationship amplifies effects of entry
   - The markup-size relationship has grown over time
   - How have effects of entry grown stronger over time?

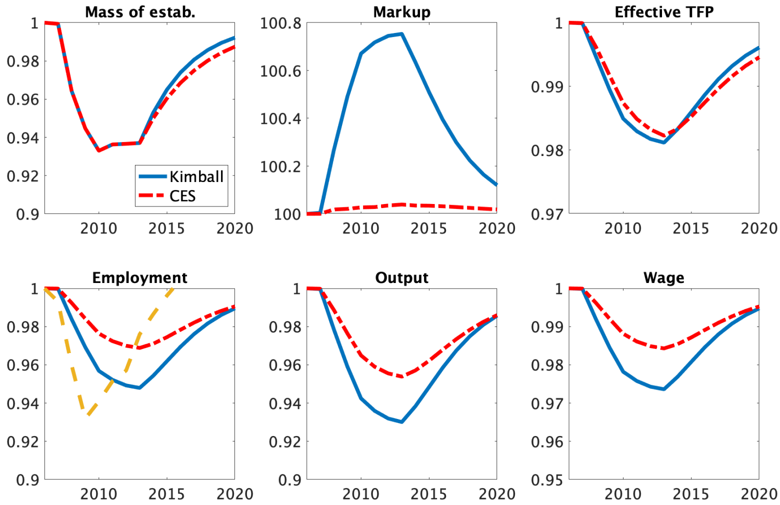
Employment at young establishments collapsed



Application: Great Recession



Application: Great Recession



How does rising market power affect business cycles?

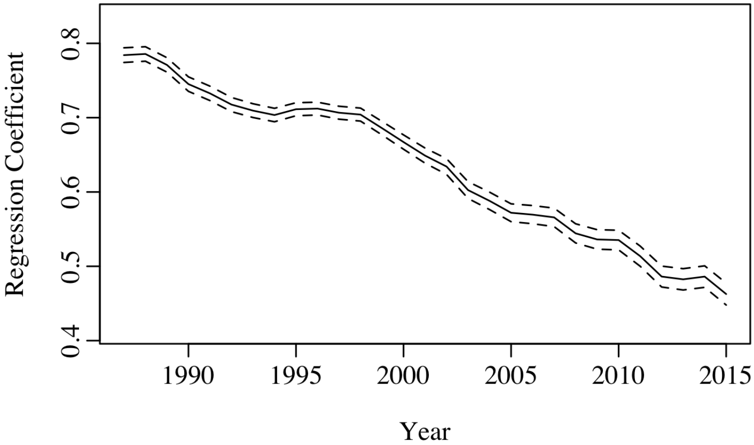
Lots of recent research into rising markups and market concentration

- How has firm behavior changed over time?
- Recall the regression I ran earlier:

$$\log WL = \tilde{\alpha} + \beta \log(PY) + \epsilon$$

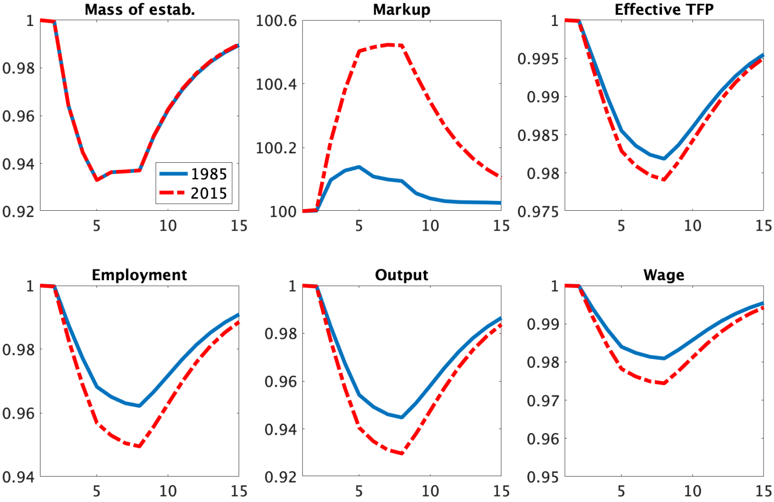
- Estimate using 5-year rolling windows

How does rising market power affect business cycles?



More specifications

How does rising market power affect business cycles?



Conclusion

Entry matters in a model with variable markups + adjustment costs

- Mechanism: incumbents increase markups
- Leads to a rise in the aggregate markup and a fall in TFP
- Doubles employment fluctuations relative to constant elasticity benchmark
- Mechanism's importance has increased over the past 30 years

Kimball demand details

The final goods production function is

$$\int_0^{N_t} \Upsilon(y/Y) = 1$$

I use the Klenow Willis (2016) specification:

$$\Upsilon(q) = 1 + (\sigma - 1)\exp\left(\frac{1}{\epsilon}\right)\epsilon^{\frac{\sigma}{\epsilon}-1}\left[\Gamma\left(\frac{\sigma}{\epsilon}, \frac{1}{\epsilon}\right) - \Gamma\left(\frac{\sigma}{\epsilon}, \frac{q^{\epsilon/\sigma}}{\epsilon}\right)\right]$$

where $\sigma > 1$ and $\epsilon \geq 0$ and where $\Gamma(s, x)$ denotes the upper incomplete Gamma function:

$$\Gamma(s, x) = \int_x^{\infty} t^{s-1}\epsilon^{-t}dt$$

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Equilibrium definition

A recursive stationary equilibrium is:

1. aggregate output Y, consumption C, labor supply L, a wage W, and a demand index D
2. policy functions $y(z, L)$ and $L(z, L)$
3. entry and production decisions
4. value functions V and V_E and
5. a distribution over states $\Lambda(z, \ell)$

such that

1. the firms' policy functions satisfy their recursive definitions
2. policy functions are optimal given value functions and aggregate quantities
3. the labor and goods markets clear and
4. consumption C and labor supply L satisfy the household first order condition
5. the stationary distribution is consistent with the exogenous law of motion of productivity and the policy functions of the firms

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Model fit

Moment	Target	Source	Model moment
Labor dynamism	7.5%	Compustat	4.97%
Sales dynamism	15%	Compustat	14.21%
Labor–sales regression	0.55	Compustat	0.57
Entry rate	11%	BDS	11.38%
Average size of exiting firm	59%	CP	58.92%
Average size of entering firm	50%	CP	49.39%
Cost–weighted average markup	1.25	DLE	1.255
Share of employment at entrants	6%	BDS	3.58%
Adjustment cost size	2.1 %	Bloom (2009)	1.81%
Share of employment at young firms	30%	BDS	37.03%

DLEU: De Loecker et al (2019), CP: Clementi and Palazzo (2016)
Untargeted moments below line

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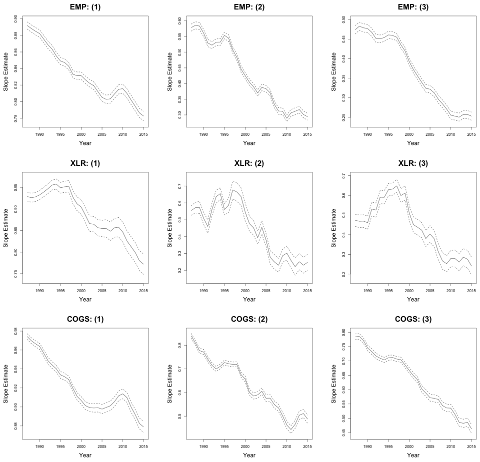
Fact 2 table

Dependent variable	log PY		
	(1)	(2)	(3)
log EMP			
1986–1990	0.888	0.585	0.483
	(0.002***)	(0.005***)	(0.005***)
2010–2014	0.802	0.312	0.250
	(0.002***)	(0.0.005***)	(0.005***)
log XLR			
1986–1990	0.926	0.57166	0.468
	(0.005***)	(0.015***)	(0.016***)
2010–2014	0.812	0.222	0.261
	(0.001***)	(0.025***)	(0.021***)
log $COGS$			
1986–1990	0.970	0.810	0.786
	(0.001***)	(0.005***)	(0.004***)
2010–2014	0.900	0.466	0.486
	(0.003***)	(0.008***)	(0.007***)
Specification	Log levels	Log levels	Log difference
Fixed Effects	Industry $\times$ Year	Firm + Industry $\times$ Year	Industry $\times$ Year

Fact 2 figures



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Full table 1

Dependent variable	log PY		
	(1)	(2)	(3)
log EMP	0.8384	0.6275	0.356
	(0.0009***)	(0.0016***)	(0.0137***)
log XLR	0.8983	0.6716	0.4266
	(0.003***)	(0.007***)	(0.007***)
log $COGS$	0.9263	0.783	0.654
	(0.0007***)	(0.002***)	(0.002***)
Specification	Log levels	Log levels	Log difference
Fixed Effects	Industry $\times$ Year	Firm + Industry $\times$ Year	Industry $\times$ Year

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