

Entry Costs and the Macroeconomy

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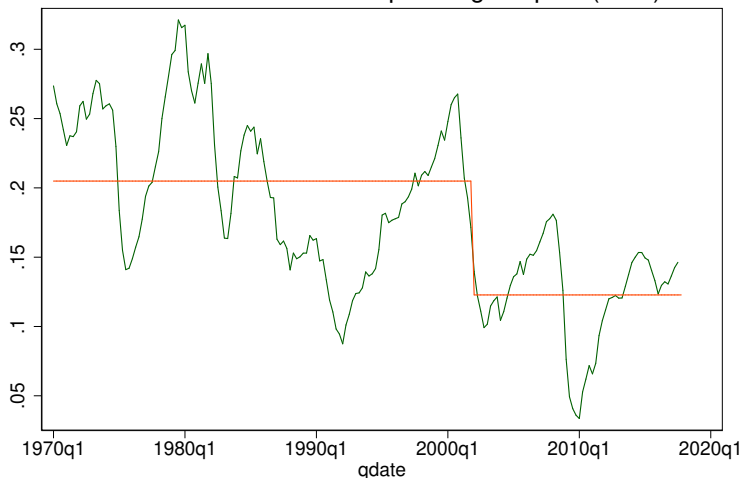
NYU, IMF¹, NBER, CEPR

December 2019

¹The views expressed herein are those of the authors and should not be attributed to the IMF, its Executive Board, or its management

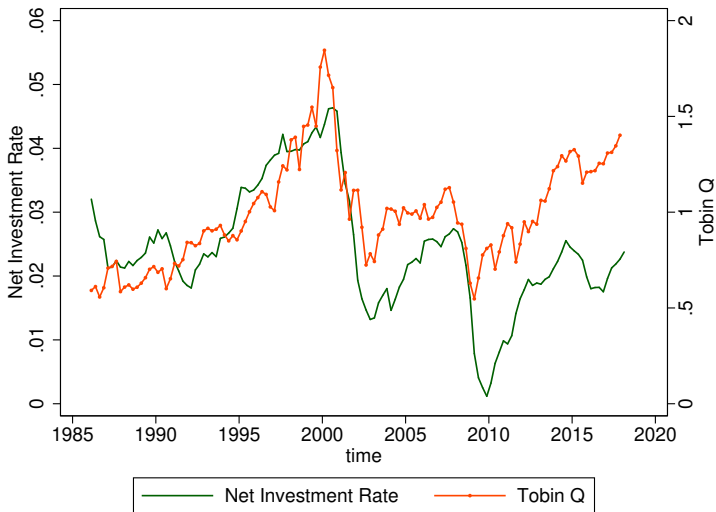
Fact 1: Investment is Low #1

Net Investment to Net Operating Surplus (NFB)



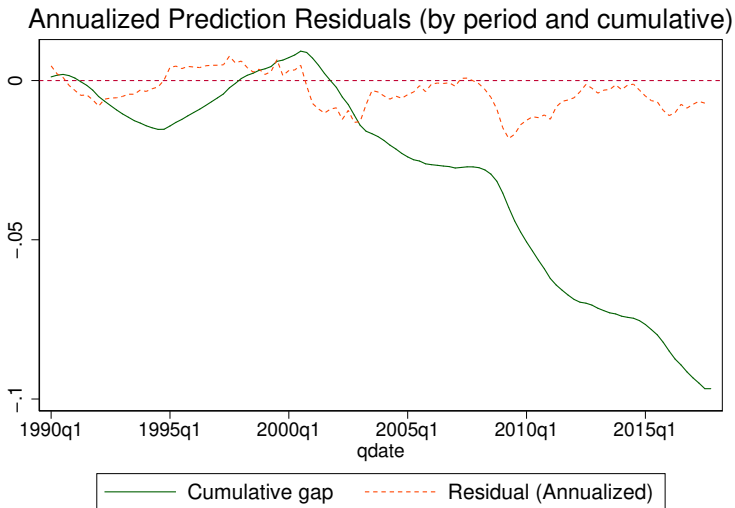
Gutiérrez and Philippon '17, and Lee et al '16.

Fact 1: Investment is Low #2

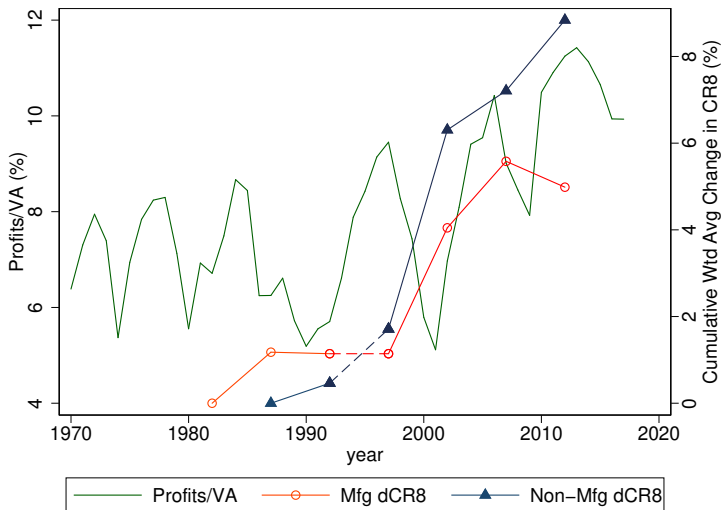


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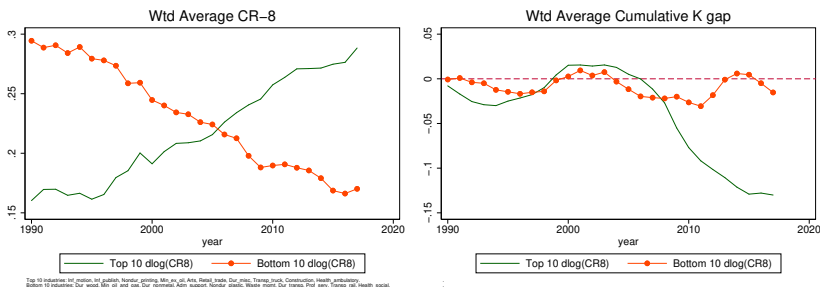
Fact 1: Investment is Low #3



Fact 2: Concentration & Profits are High



Fact 2: Concentration in Cross-Section



- More concentrating industries have larger capital gaps
- Grullon et al '18. Concentrating industries have higher profits

Fact #3: Entry Rates Have Fallen



Interpretation of the Evidence

- Interpretation remains controversial:
 - Endogeneity of profits/entry/concentration/investment
 - Need a model to interpret the evidence
 - Macro models so far focus on effect of (assumed) higher markups
- We use a fully specified model with competing drivers of facts
 - Use the data to derive a series for entry costs and study their importance
 - Provide direct empirical evidence of what these entry costs are

Approach and Findings

- Develop a model with monopolistic competition and firm entry
 - Entry decision based on expected profits
- Estimate model on industry/aggregate data, 1989-2015, to get:
 - shocks and relationship between entry, competition, investment
 - Identified entry costs correlate with regulation/M&A
- Use the model to study aggregate implications, 1989 to 2015
 - About 10% of entry driven by shocks to demand beliefs
 - An increase in aggregate firm entry costs from 2003
 - Absent this increase, C_t & K_t : 5% to 6% higher

Model

Goods Producers

- Continuum of j industries
- Industry output aggregated by a perfectly competitive firm

$$Y_t = \left(\int_0^1 (D_{j,t} Y_{j,t})^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}}$$

where $D_{j,t}$ is an industry demand shock following an AR(1)

- D_j is "expected" steady-state demand
- Production function is Cobb-Douglas

$$Y_{j,t} = K_{j,t}^{\alpha} \ell_{j,t}^{1-\alpha}$$

- Investment follows Q-theory

Goods-Producers Entry

- The number of existing firms $N_{j,t}$ evolves by

$$N_{j,t+1} = (1 - \delta^n)N_{j,t} + n_{j,t}$$

- Firms pay entry input $\kappa_{j,t}$ at price $p_{j,t}^e$ to become active in $t+1$

$$p_{j,t}^e = (\kappa_{j,t} n_{j,t})^{\phi^n}$$

- Let $V_{j,t}^e$ is the value of a firm in industry j . Firms enter until

$$\mathbb{E}_t \Lambda_{t+1} V_{j,t+1}^e = p_{j,t}^e \kappa_{j,t}$$

- Industry-level output

$$Y_{j,t} = N_{j,t-1}^{\frac{\epsilon_j}{\epsilon_j-1}} y_{j,t}$$

Households and Monetary Policy

- Households choose C_t , ℓ_t and savings to

$$\max \mathbb{E}_t \sum_{t=0}^{\infty} \beta^t \left(\frac{C_t^{1-\gamma}}{1-\gamma} - \frac{\ell_t^{1+\psi}}{1+\psi} \right)$$

subject to the budget constraint:

$$S_t + P_t C_t \leq \tilde{R}_t S_{t-1} + W_t \ell_t$$

- Add sticky prices and wages, and monetary policy:

$$r_t = \max \left[0, \phi_i r_{t-1} + \phi_p \pi_t^p + \phi_y (y_t - y_t^F) + \phi_g \ln \left(\frac{Y_t / Y_{t-1}}{Y_t^F / Y_{t-1}^F} \right) \right]$$

- r_t subject to the **ZLB**

Shocks

- Industry and aggregate shocks:
 - Entry-cost
 - Productivity
 - Inflation equations (Phillips curves)
 - Valuation of corporate assets
- Industry-specific shocks:
 - Industry demand
 - Regime shift in industry demand beliefs, between 1995 and 2000
- Aggregate-specific shocks:
 - Household discount factor
 - Monetary policy

Regime Shift in Demand Beliefs Before 2000

- Noisy entry: entry uncorrelated with future demand. Evidence:
 - Doms (2004): high dotcom growth rates
 - Hogendorn (2011): excess entry into Telecom sector
 - Substantial inflows into VC funds focused on dotcom
- We capture this as variations in beliefs about D_j , where

$$\log D_{j,t} = (1 - \rho_d) \log D_j + \rho_d \log D_{j,t-1} + \sigma_d \varepsilon_{j,t}^d$$

- Before 1995 and after 2000, $D_j = 1$ for all industries
- Between 1995 and 2000, D_j is a free parameter

Estimation

Estimation #1

- Bayesian/likelihood approach
- Data:
 - Industry: annual data, 1989 to 2015, for 43 industries on
 - Q [Details](#)
 - Concentration Ratio [Details](#)
 - Nominal Output, Capital, Prices [Details](#)
 - Aggregate: quarterly data, 1989Q1 to 2015Q1, on
 - Fed Funds rate / Inflation / Expected ZLB Durations
 - Consumption / Investment / Employment
 - Concentration Ratio [Details](#)

Estimation #2

- Calibrated Parameters
 - Elasticity ε_j calibrated to NOS_j/Y_j
- Estimated Parameters:
 - Industry:
 - Shock processes, AR(1)
 - Expected demand regimes D_j
 - ϕ^n and σ
 - Aggregate:
 - Shock processes, AR(1)
 - Taylor Rule parameters
- Three main challenges:
 - (i) ZLB, (ii) demand expectations, (iii) industry data $\times 43$

Distribution

Other Parameters

Challenge 1: Solution Method for ZLB & Trend Markup

- The ZLB and an exogenous trend markup implies a time-varying representation for our model

$$\mathbf{A}_t \mathbf{x}_t = \mathbf{B}_t \mathbf{x}_{t-1} + \mathbf{D}_t \mathbb{E}_t \mathbf{x}_{t+1} + \mathbf{F}_t \varepsilon_t$$

- This gives rise to a time-varying VAR solution

$$\mathbf{x}_t = \mathbf{Q}_t \mathbf{x}_{t-1} + \mathbf{G}_t \varepsilon_t$$

- Expected ZLB durations pin down \mathbf{Q}_t and \mathbf{G}_t
 - Jones '17, Guerreri and Iacoviello '16, Kulish et al '17
- We use survey data on durations from NYFed

ZLB Durations

Challenge 2: Solution for Demand Regime Shifts #1

- Suppose the regime which is driving the observables is:

$$\mathbf{A}x_t = \mathbf{B}x_{t-1} + \mathbf{D}\mathbb{E}_t x_{t+1} + \mathbf{F}\varepsilon_t$$

- For example, steady-state demand in industry j , D_j , is low

- But agents believe that a $*$ regime is true:

$$\mathbf{A}^* x_t = \mathbf{C}^* + \mathbf{B}^* x_{t-1} + \mathbf{D}^* \mathbb{E}_t x_{t+1} + \mathbf{E}^* \varepsilon_t.$$

- For example, steady-state demand in industry j , D_j , is high

- We seek a solution of the form

$$x_t = \tilde{\mathbf{Q}}x_{t-1} + \tilde{\mathbf{G}}\varepsilon_t$$

Challenge 2: Solution for Demand Regime Shifts #2

- To find the solution, expectations must satisfy

$$\mathbb{E}_t x_{t+1} = Q^* x_t$$

- Substitute this into $Ax_t = Bx_{t-1} + D\mathbb{E}_t x_{t+1} + F\varepsilon_t$ to get:

$$\tilde{Q} = [A - DQ^*]^{-1} B$$

$$\tilde{G} = [A - DQ^*]^{-1} F$$

- With $x_t = \tilde{Q}x_{t-1} + \tilde{G}\varepsilon_t$, we can form the state-space
- So beliefs about demand map to \tilde{Q} and \tilde{G} and the likelihood

Challenge 3: Likelihood Function With Industry Data #1

- We want to use industry-level data in identification
- Problem: Infeasible
 - 43 industries, 10+ state variables each, aggregate shocks, ZLB
- Recall our model is

$$x_t = [x_t^1, x_t^2, \dots]' = \mathbf{Q}_t x_{t-1} + \mathbf{G}_t \varepsilon_t$$

- Solution: Write the industry j level variables as

$$x_t^j = \underbrace{\mathbf{Q} x_{t-1}^j + \mathbf{G} \varepsilon_t^j}_{\text{industry-level component}} + \underbrace{\mathbf{Q}^a x_{t-1}^* + \mathbf{G}^a \varepsilon_t^*}_{\text{aggregate component}}$$

Challenge 3: Likelihood Function With Industry Data #2

- Industry j level variables are

$$x_t^j = \underbrace{\mathbf{Q}x_{t-1}^j + \mathbf{G}\varepsilon_t^j}_{\text{industry-level component}} + \underbrace{\mathbf{Q}_t^a x_{t-1}^* + \mathbf{G}_t^a \varepsilon_t^*}_{\text{aggregate component}}$$

- Express industry-level data relative to average $\bar{x}_t = \int x_t^j dj$
- Assuming average shock $\int \varepsilon_t^j dj = 0$, then

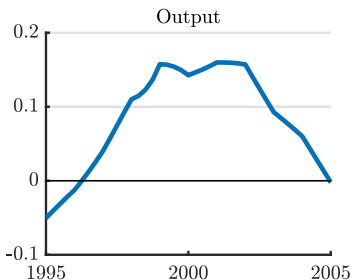
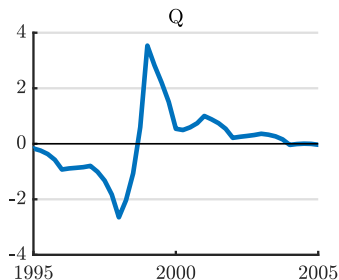
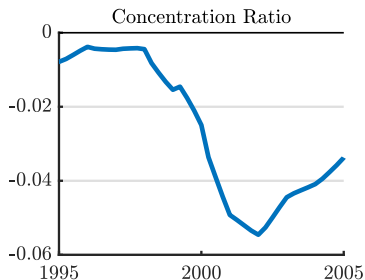
$$x_t^j - \bar{x}_t = \mathbf{Q} \left(x_{t-1}^j - \bar{x}_{t-1} \right) + \mathbf{G}\varepsilon_t^j$$

- Shocks iid: separate the likelihood into 43 industry components

Treatment of Industry-Level Data

- Express industry-level data relative to aggregate
- For each industry series
 1. Compute a full set of time effects
 2. Subtract a industry-specific fixed effect and trend
 3. Work with the residuals
- Exploit these relative changes for identification

Industry-Level Observable: Info Publishing, 1995 to 2005



Estimates

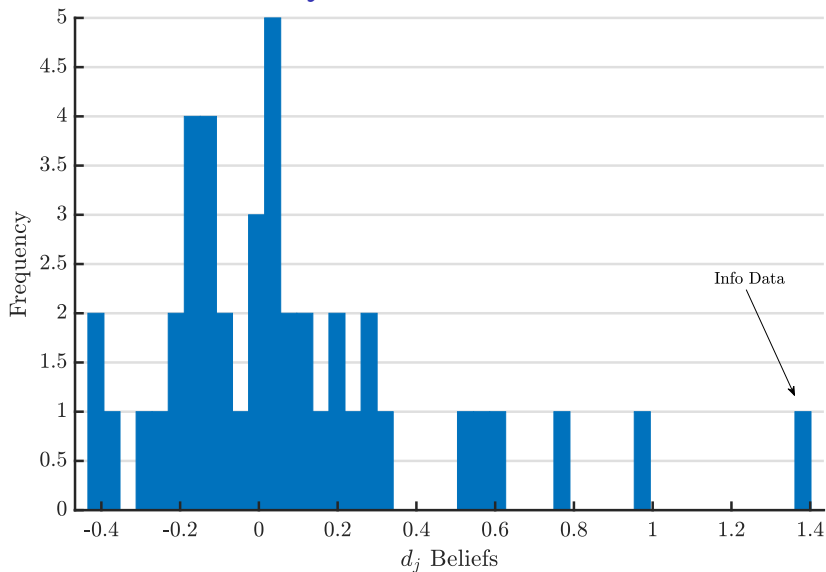
Industry-Level Estimates

Parameter	Posterior		
	Median	10%	90%
ϕ^n	1.55	1.08	2.32
σ	0.40	0.38	0.43

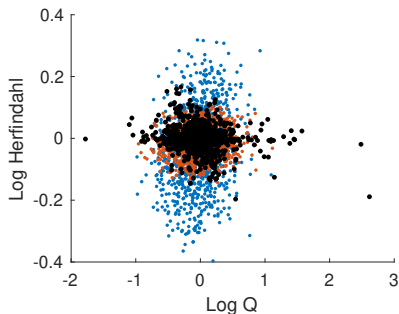
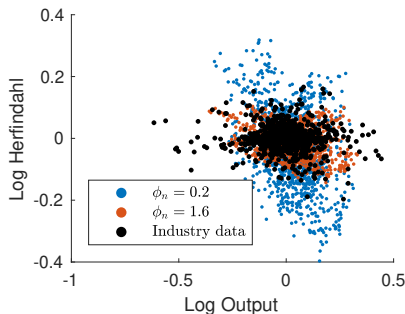
Log Demand Regimes (2 of 43)

Durable Comp.	1.6	0.2	2.9
Info Data	4.1	3.1	4.4

Mode of D_j Beliefs for 43 Industries



Industry Identification of Estimate of ϕ_n

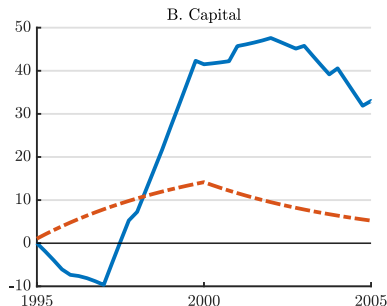
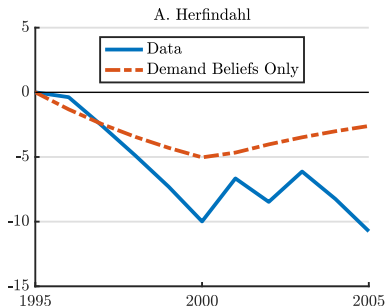


ϕ_n estimate implies:

- Following demand shock that raises Q_t to 10% after 1 year
- \Rightarrow Number of firms increases by 1.4% after 2 years

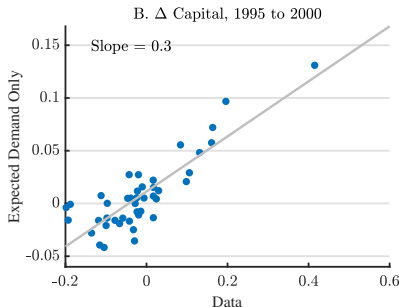
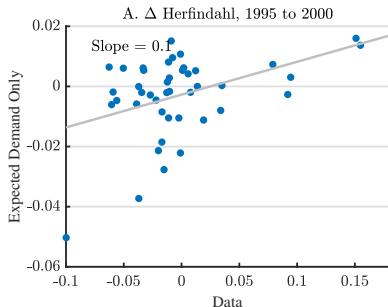
Estimate of Demand Beliefs: Specific Industry

Example for Info Data Industry



Estimate of Demand Beliefs: All Industries

- Accounts for about 10% of entry
- Absent demand beliefs, estimation compensates with larger risk premium shocks

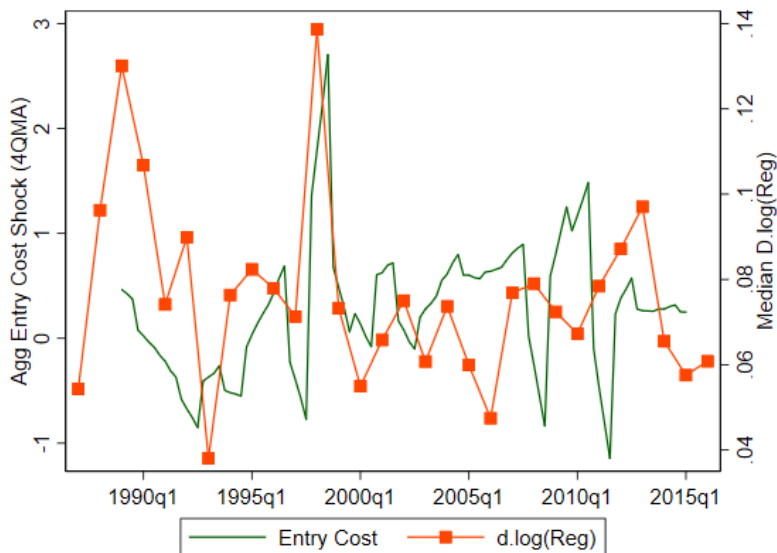


Interpretation of Entry Cost Shocks

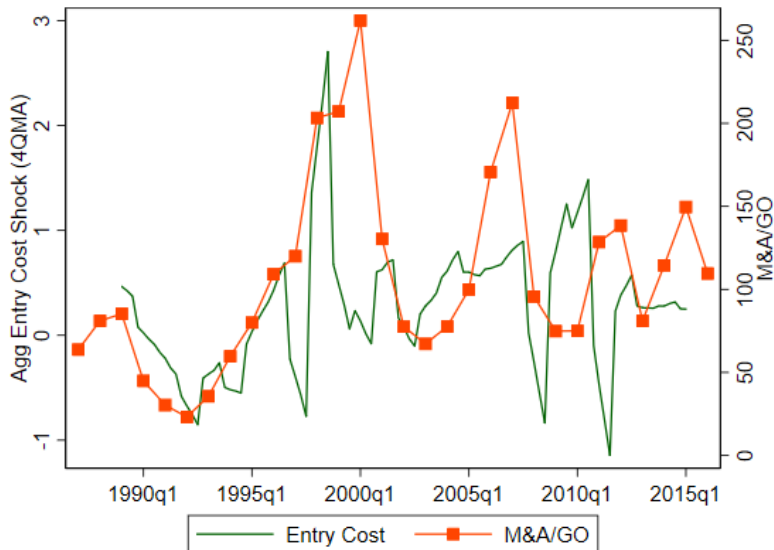
Empirical Proxies of Barriers to Entry

- Regulation Index:
 - Regulation based on RegData 3.1 from QuantGov
 - Machine learning / natural language processing techniques to construct measures of regulatory stringency at the industry level
 - Number of restrictive words or phrases such as 'shall', 'must' and 'may not' in each section of the Code of Federal Regulations
- Regulatory employment:
 - Regulatory employment from the Census Occupational Employment Statistics
- M&A activity

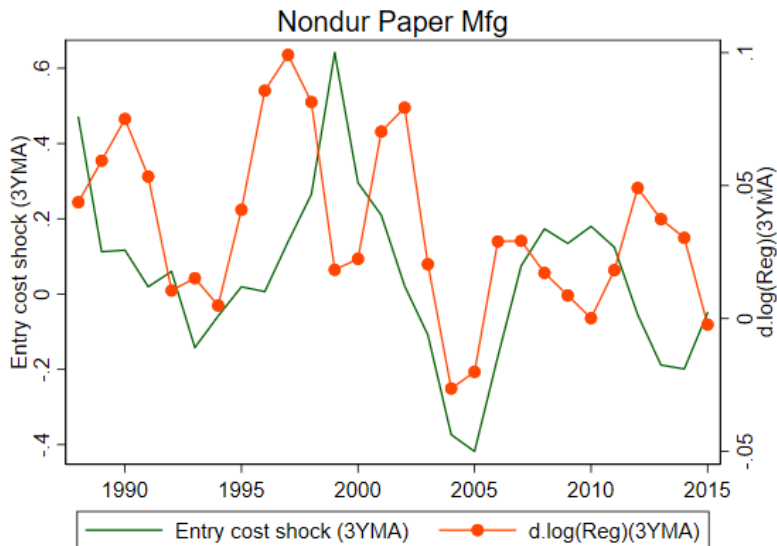
What are the Entry Cost Shocks? Aggregate



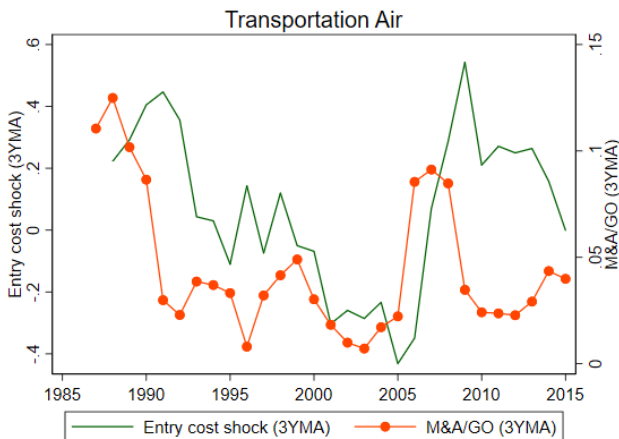
What are the Entry Cost Shocks? Aggregate



What are the Entry Cost Shocks? Non-Dur Paper Manuf



What are the Entry Cost Shocks? Air Transport



- Delta-Northwest (2008), United-Continental (2010), Southwest-AirTran (2011) and American-US Airways (2014)

Entry Costs Across All Industries

	$\zeta_{j,t}^K$					
	(1) All	(2) Post-02	(3) Post-02	(4) Post-02	(5) All	(6) Post-02
$\Delta \log(\text{Reg Index}_{t-2,t-1}^j)$	0.044** (0.014)	0.047* (0.017)			0.044** (0.014)	
$\Delta \log(\text{Reg Emp}_{t,t+1}^j)$			0.031* (0.013)			
Mean(L.dRegIndex,F.dRegEmp)				0.038** (0.009)		0.033** (0.010)
$\log(\text{M\&A}_{j,t})(2Y \text{ MA})$					0.047* (0.021)	0.087* (0.037)
Ind FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
R2	.051	.091	.085	.095	.057	.11
Observations	837	358	358	358	837	358

Aggregate Implications

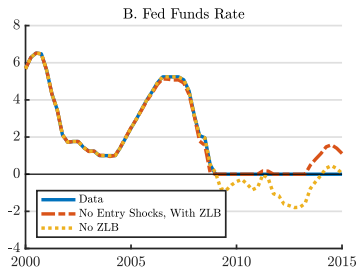
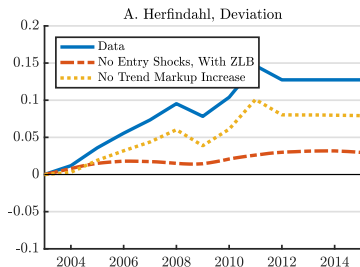
Aggregate Implications

- What are the aggregate implications of firm entry?
- Use the estimated elasticity of firm entry to Q , ϕ_n and:
 1. Estimate the aggregate model's parameters
 2. Filter the aggregate data for the shocks
- Experiments with estimated model
 1. Interpret changes in entry cost shocks
 2. Turn off aggregate entry cost shock from 2003

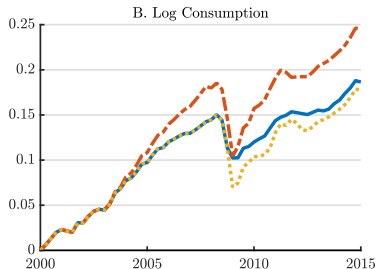
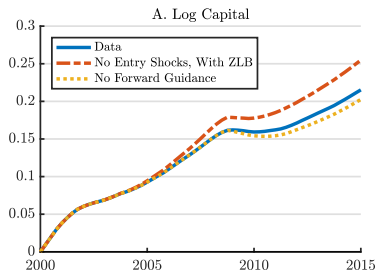
Unconditional Variance Decomposition of Agg Variables

Variable	Tech.	Pref.	P MU	Risk P.	Policy	Entry Cost
Fed Funds Rate	4.0	23.6	20.1	34.3	10.9	7.0
Output	50.3	6.9	0.1	13.2	0.0	29.4
Consumption	54.1	7.2	1.7	11.8	0.1	25.2
Net Investment	22.2	22.4	0.3	39.6	0.9	14.6
Employment	6.1	2.9	44.4	12.3	7.4	26.9
Inflation	2.8	20.2	11.2	37.6	15.9	12.3
Herfindahl	22.0	7.2	0.0	14.1	0.0	56.5
Natural Rate	1.4	20.7	0.0	37.5	0.0	40.4

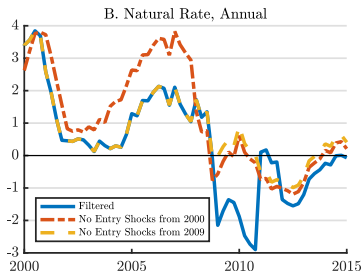
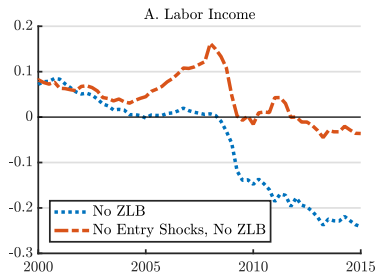
Aggregate Implications: Less entry, lower FF rate



Aggregate Implications: Less investment, consumption



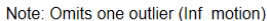
Aggregate Implications: Lower wage income, natural rate



Conclusion

- US industries have become more concentrated
 - Lack of competition leads to lower investment
 - We find an increase in entry costs
 - We link those entry costs to regulation/M&A
- Europe has trended the other way Comparison
 - Decreasing concentration
 - Low investment in Europe and low valuations/high risk premia
 - If true, then probably cyclical





How Should We Interpret These Facts?

- Drop in the price of capital?
- Intangible assets
 - Peters and Taylor '16, Alexander and Eberly '16
- Superstar firms?
 - Autor '17
- Globalization
 - Feenstra and Weinstein '17, Fresard and Valta '15, Hombert and Matray '15
- Decreasing Domestic Competition, DDC
 - Furman '15, Gutiérrez and Philippon '17

How Should We Interpret These Facts? #2

- Drop in the price of capital?
 - Timing is wrong, as fall in price of capital occurs before 2000
- Intangible assets
 - 25% of the gap between Q and N/K explained by intangible intensity, so not much
 - National accounts does include IP investment
 - Argument not necessarily true for industries like airlines
- Superstar firms?
 - Implies TFP correlated with concentration, but not so from 2000
 - Leaders are investing less, when it should be more Evidence
 - Concentration trends not observed so much in Europe
- Globalization?
 - Measurement? investment gap appears in consolidated firm-level data, which includes investment in US and outside
 - External Profits? GP (2017) BPEA show profits have increased faster than foreign sales, so profits being shifted out of the US

Firm-level FE with and w/o intangibles



Productivity: Gutierrez and Philippon (2017)

Select Discussion: Super Star

- Our interpretation of the hypothesis (Autor et al.)
 - Not simply a description of skewness.
 - But an explanation for concentration: efficiency instead of market power
- What we find: some support in the 1990s, but not after 2002.

	(1)	(3)
	Δ TFP	
	97-02	02-12 [†]
Δ Census CR4	0.481** [4.439]	0.051 [0.301]
Observations	469	297
R^2	4%	0%

Notes: T-stats in brackets. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$. [†] TFP change to 2009 due to data availability

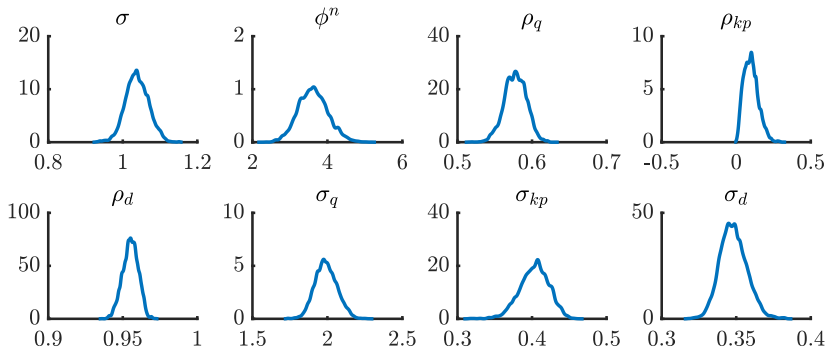
EXTRA: Measures of Concentration & Entry

- Traditional Herfindahl + Common ownership adjustment (Azar, et. al. (2016))

$$\begin{aligned} MHHI &= \sum_j s_j^2 + \sum_j \sum_{k \neq j} s_j s_k \frac{\sum_i \beta_{ij} \beta_{ik}}{\sum_i \beta_{ij}^2} \\ &= HHI + HHI^{adj} \end{aligned}$$

- Other measures including entry, share of sales by top #10 firms, etc. also significant

Posteriors for Common Industry Parameters



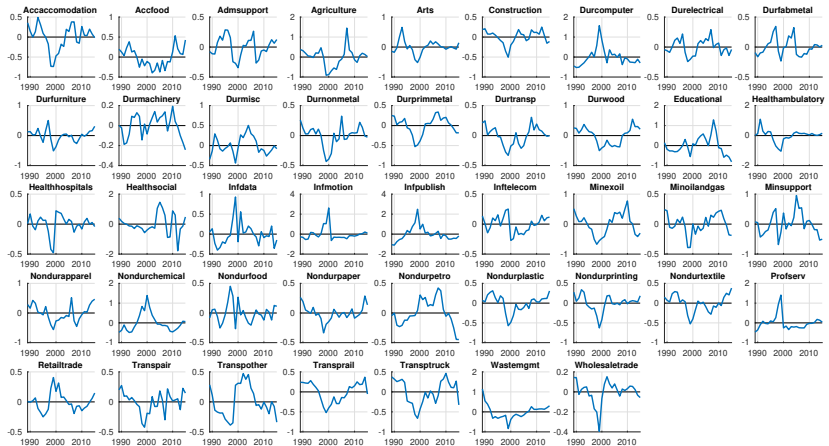
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Q Data

- Flow of funds
- Ratio of market value to the replacement cost of capital including intangibles

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Q



Concentration Ratio Data

- Compustat for BEA segments
- Patterns verified against aggregated firm-level census data
- Corrected for the import share, as in Feenstra and Weinstein '17
- Series from Compustat/BEA have a 65-70% correlation in levels and 40-50% in 5-year changes

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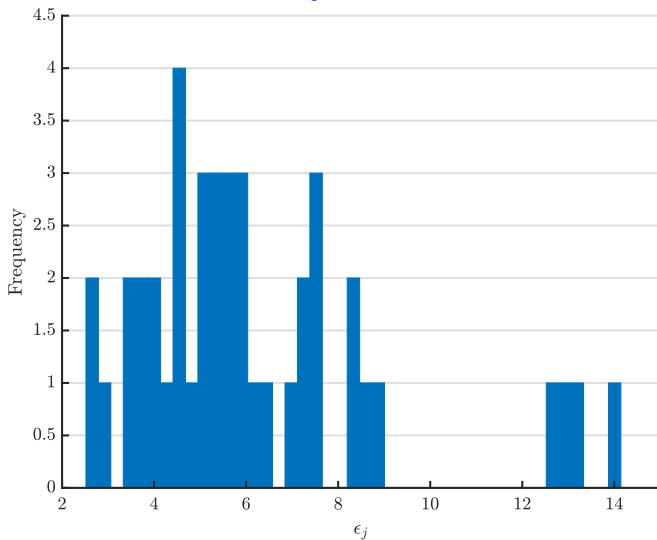
Nominal Output Data

- BEA

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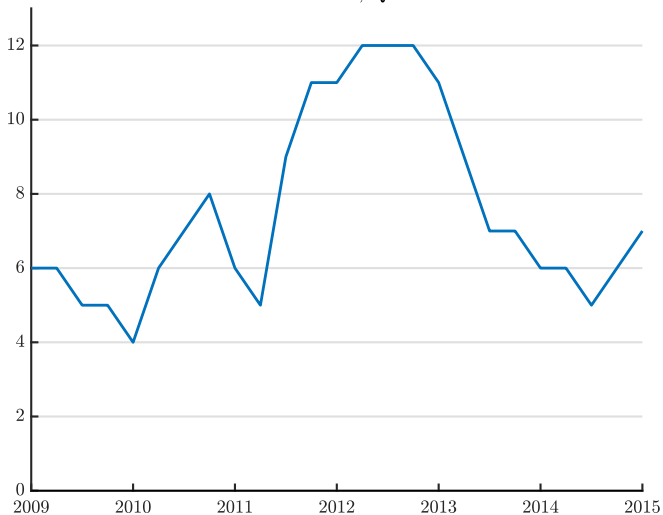


Calibrated ϵ_j for a given σ



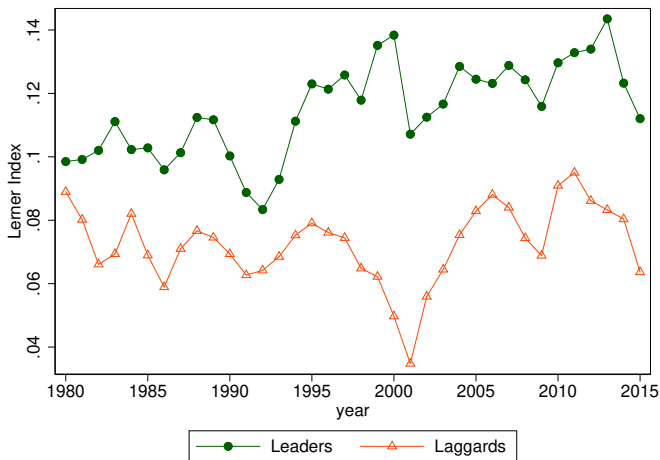
ZLB Durations in Quarters

ZLB Durations, Quarters



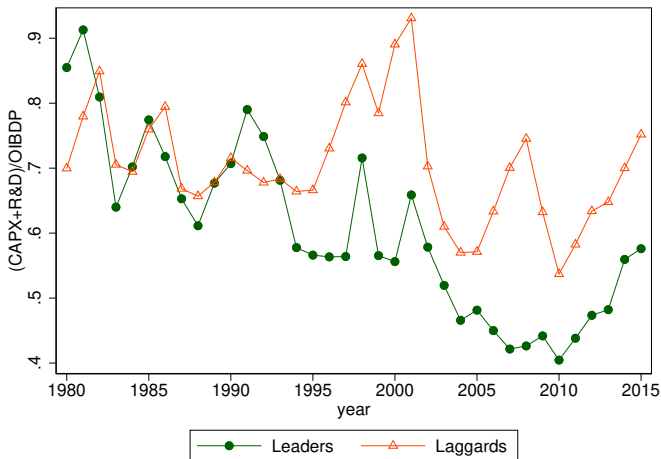
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Margins Increased for Industry Leaders



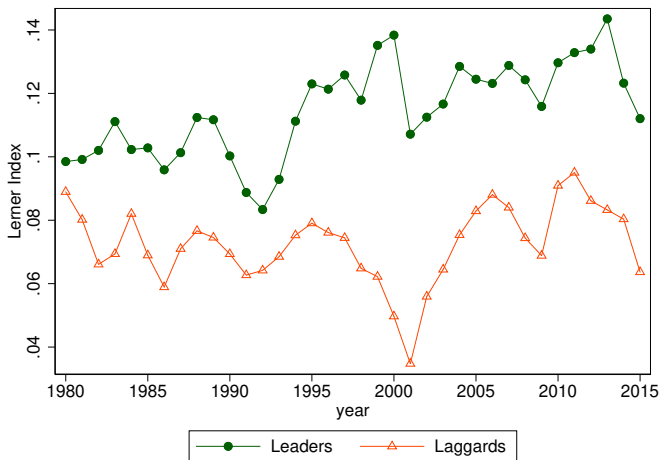
Note: Leaders includes all firms with the highest (lowest) market value (MV) that combined account for ~33% of MV within each industry and year.

Leaders Explain Investment Gap #1



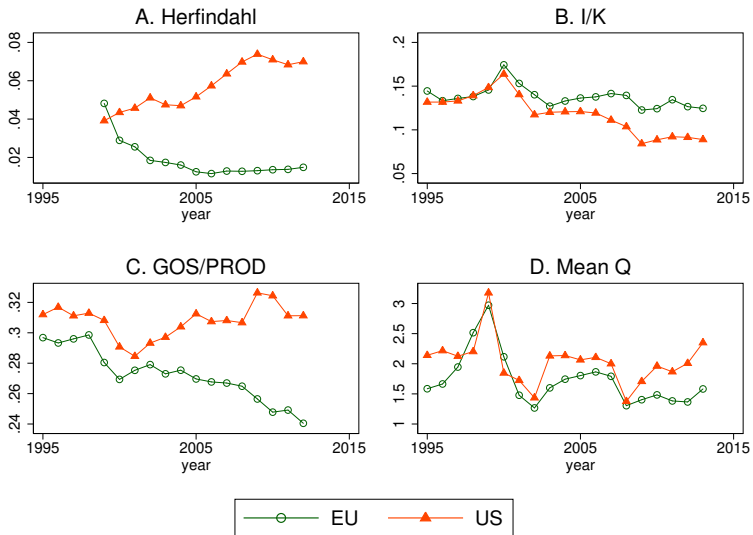
Note: Leaders (laggards) include all firms with the highest (lowest) market value (MV) that combined account for ~33% of MV within each industry and year.

Margins Increased for Industry Leaders

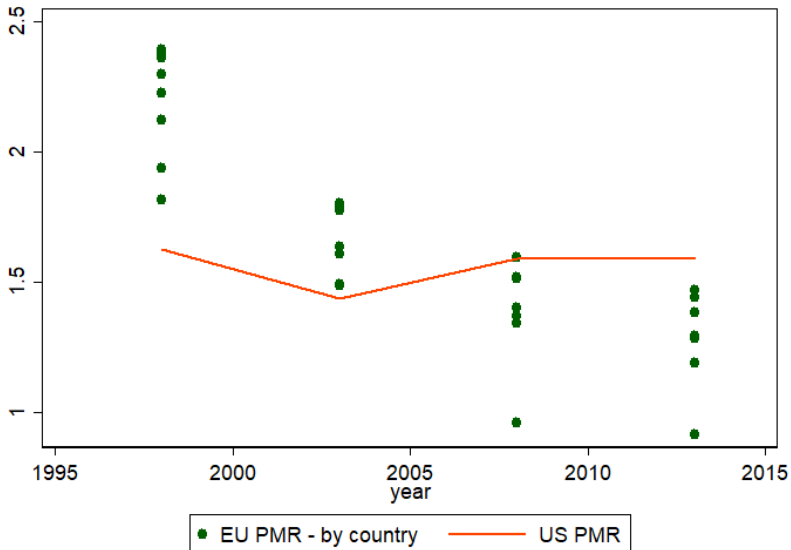


Note: Leaders includes all firms with the highest (lowest) market value (MV) that combined account for ~33% of MV within each industry and year.

EU vs US



EU vs US: OECD Product Market Regulations



A Calvo-Style Entry Specification

- Staggered entry. Pay κ today, each period there is a chance λ of entry each period

Other Parameters

δ	0.025
ϕ^k	20
β	0.99
α	1/3
δ^n	0.09/4

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I/K vs. Q

