

Firms and Growth

Pete Klenow

Stanford University

10th Sir Richard Stone Lecture

University of Cambridge

May 2019

1984 Nobel citation

for having made fundamental contributions to the development of systems of national accounts and hence greatly improved the basis for empirical economic analysis

- 1 Why *firms* and growth?
- 2 Types of firm innovation?
 - ▶ creative destruction vs. new varieties vs. own innovation
- 3 Which firms?
 - ▶ entrants vs. incumbents
 - ▶ fast-growing incumbents vs. slow-growing incumbents
- 4 What shows up in official statistics?

Garcia-Macia, Hsieh and Klenow (2019)

How Destructive is Innovation?

Aghion, Bergeaud, Boppart, Klenow and Li (2019)

Missing Growth from Creative Destruction

Hsieh and Klenow (2017)

The Reallocation Myth

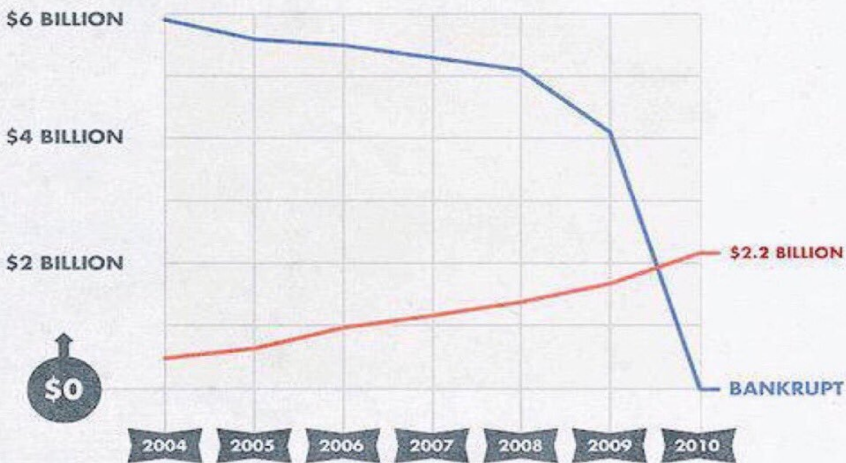
Examples of creative destruction

- Mini-mills vs. integrated steel mills
- Wal-Mart vs. K-Mart, Sears
- Apple/Samsung vs. Blackberry/Nokia
- Amazon vs. Borders, Circuit City
- Uber vs. taxi companies
- Google vs. newspapers

NETFLIX VS. BLOCKBUSTER (2004-2010)

■ BLOCKBUSTER REVENUE

■ NETFLIX REVENUE



Examples of own innovation by incumbents

- New car model years
- Generations of Intel microprocessors
- Successive versions of Apple iPhones
- Hospitals reducing mortality by introducing checklists
- Big Pharma?

Walmart 



Google

facebook

amazon 

Why do we care which firms drive growth?

- spillovers may be bigger from entrants
- entrants may face financial constraints
- business stealing from creative destruction
 - ▶ see Atkeson and Burstein (2019)

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$$Y = K^\alpha (A \cdot H)^{1-\alpha} \Rightarrow \frac{Y}{L} = \left(\frac{K}{Y}\right)^{\frac{\alpha}{1-\alpha}} \left(\frac{H}{L}\right) \cdot A$$

- $Y = \text{GDP}$
- $K = \text{physical capital}$
- $H = \text{human capital}$
- $L = \text{worker hours}$
- $\alpha = \text{elasticity of output wrt } K$
- $Y/L = \text{labor productivity}$
- $A = \text{Total Factor Productivity (TFP)}$

U.S. growth accounting

	Y/L	A
1948–2017	2.34%	1.95%
1948–1973	3.28	3.21
1974–1995	1.55	0.81
1996–2005	3.08	2.58
2006–2017	1.21	0.90

Source: U.S. Bureau of Labor Statistics (BLS)

Possible drivers of U.S. TFP growth

Human capital?

BLS already netted it out, albeit imperfectly

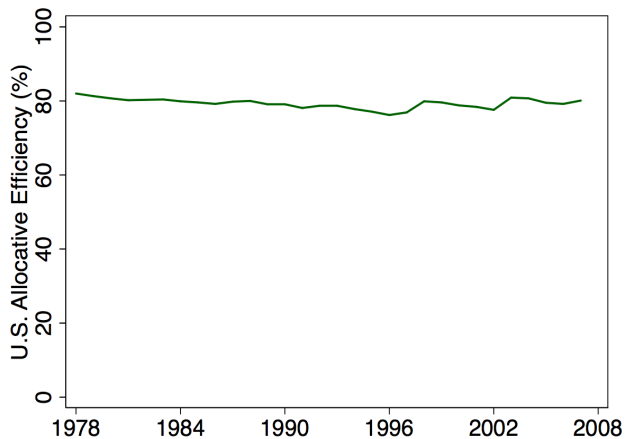
Allocative efficiency?

Evidence is limited to manufacturing and Compustat firms

Firm-led innovation

This is promising and will be my focus

Allocative efficiency in U.S. manufacturing



Source: Bils, Klenow and Ruane (2018)

Allocative efficiency *does* appear to be important for:

- levels of development
 - ▶ China, India, Mexico vs. the U.S.
- transitional growth
 - ▶ China, Spain, Eastern Europe

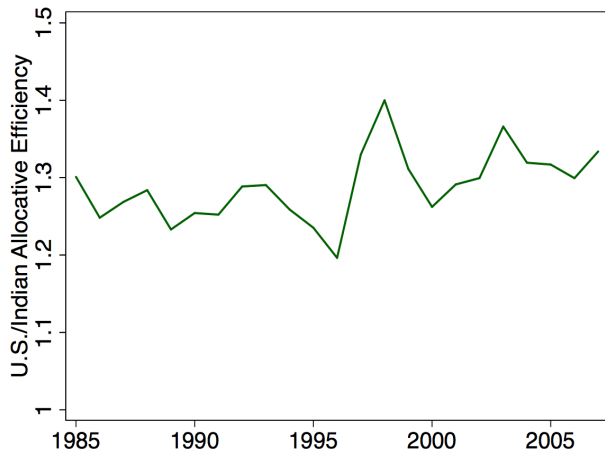
References

Hsieh and Klenow (2009, 2014)

Bartelsman, Haltiwanger and Scarpetta (2013)

Gopinath, Kalemli-Ozcan, Karabarbounis, Villegas-Sanchez (2017)

U.S. vs. Indian allocative efficiency



Source: Bils, Klenow and Ruane (2018)

- Patents and R&D?
- TFP growth decompositions?
- My approach: market shares

Manufacturing share of:

Patents	90%
R&D	69%
GDP	12%
TFP growth	11%

Sources: USPTO, NSF, BEA, BLS

Shares are in 2012 except for TFP growth (1987–2014)

TFP growth decompositions

- TFP of entering vs. exiting firms
- Reallocation of inputs from low to high TFP surviving firms
- TFP growth within surviving firms

Atheoretical (which is both good and bad!)

Need output and input data so limited to manufacturing in the U.S.

Lack of firm-level deflators (unit prices do not reflect quality, variety)

Use employment as a proxy for sales (market share).

The key idea:

- Entrant employment share reflects entrant innovation
- If survivors innovate, they add workers
- If creative destruction, thick tails for firm job growth
- If own innovation, modest employment gains

Total Apple Employees



Rectangular Snip

iPad Launches

iPhone Launches

iPod Launches

Jobs Returns

1994

1996

1998

2000

2002

2004

2006

2008

2010

Year

55K

50K

45K

40K

35K

30K

25K

20K

15K

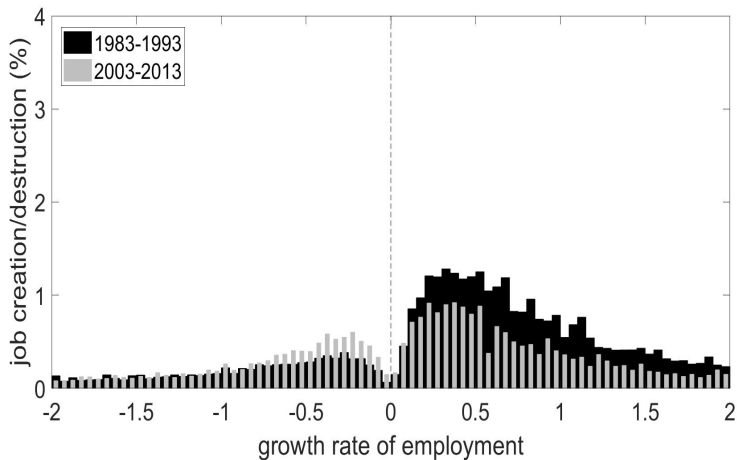
10K

5K

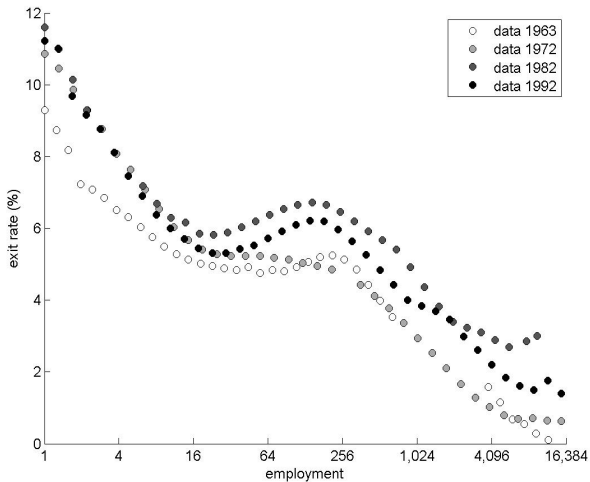
0K

- U.S. Census micro data on firms and plants
- All firms with paid employees (excludes sole proprietors)
- All sectors other than agriculture, government
- Covers $> 80\%$ of all employment
- 1983–2013 and decades within

Job creation and destruction in the U.S. LBD



Exit rate by firm size



Source: U.S. Census of Manufacturing

$$Y = \left[\sum_{j=1}^M (q_j y_j)^{1-\frac{1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$

$$y_j = l_j = \left(\frac{\sigma-1}{\sigma} \right)^{\sigma-1} L W^{1-\sigma} q_j^{\sigma-1}$$

$$L_f \equiv \sum_{j \in M_f} l_j = \left(\frac{\sigma-1}{\sigma} \right)^{\sigma-1} L W^{1-\sigma} \sum_{j \in M_f} q_j^{\sigma-1}$$

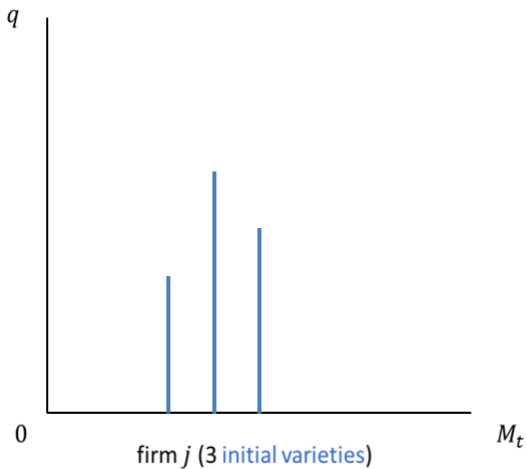
$$W \propto Y/L = M^{\frac{1}{\sigma-1}} \left[\sum_{j=1}^M \frac{q_j^{\sigma-1}}{M} \right]^{\frac{1}{\sigma-1}}$$

Arrival rates of innovation

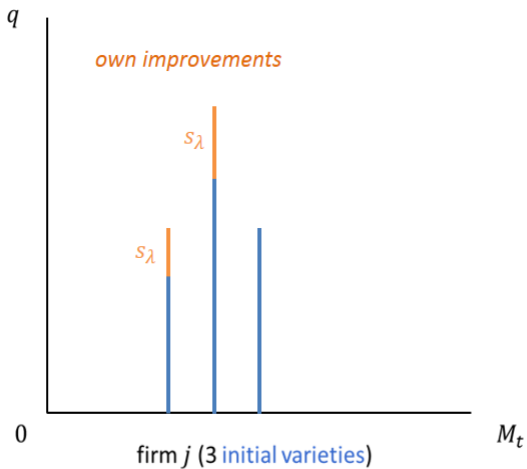
Own-variety improvements by incumbents	λ_i
Creative destruction by entrants	δ_e
Creative destruction by incumbents	δ_i
New varieties from entrants	κ_e
New varieties from incumbents	κ_i

The average step size for quality improvements for own innovation s_λ and creative destruction s_δ are both $s_q = \left(\frac{\theta}{\theta - (\sigma - 1)}\right)^{1/(\sigma - 1)} \geq 1$. New varieties are drawn from the quality distribution of existing products times s_κ .

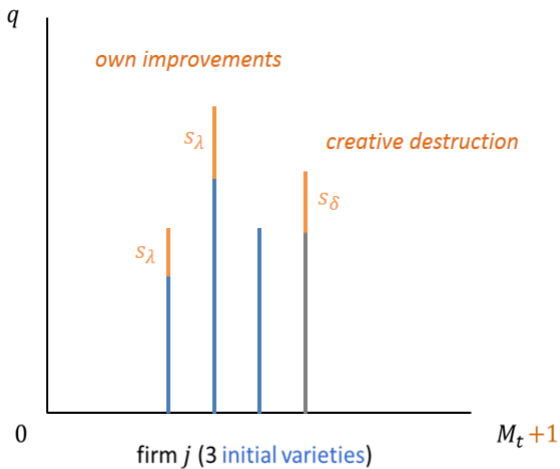
quality level



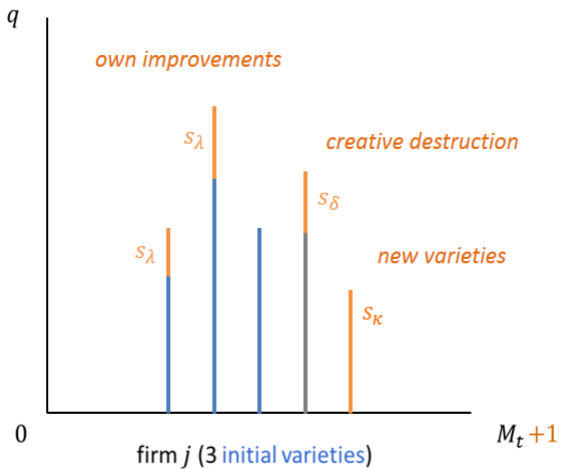
quality level



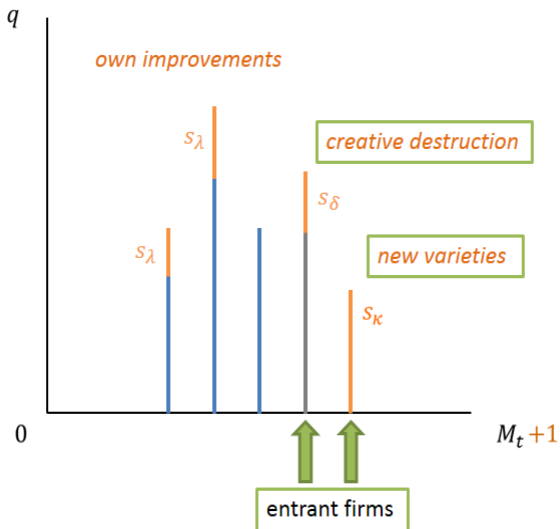
quality level



quality level



quality level

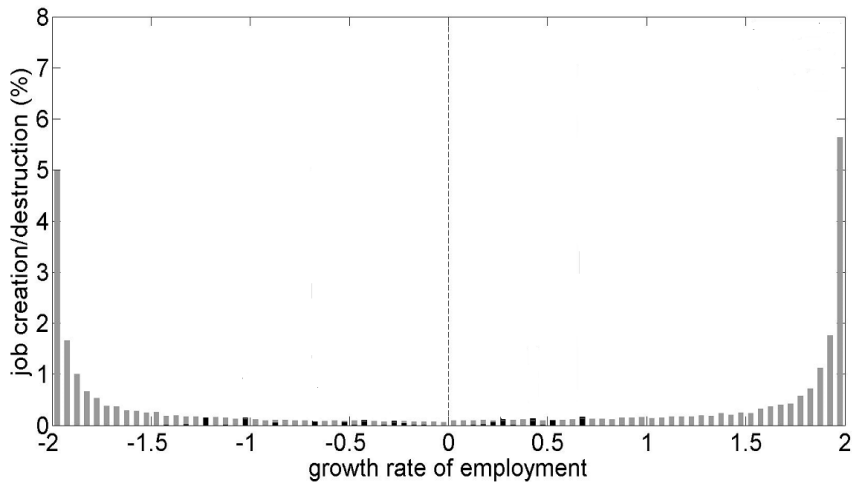


Two ways of decomposing the gross growth rate $(1 + g)^{\sigma-1}$:

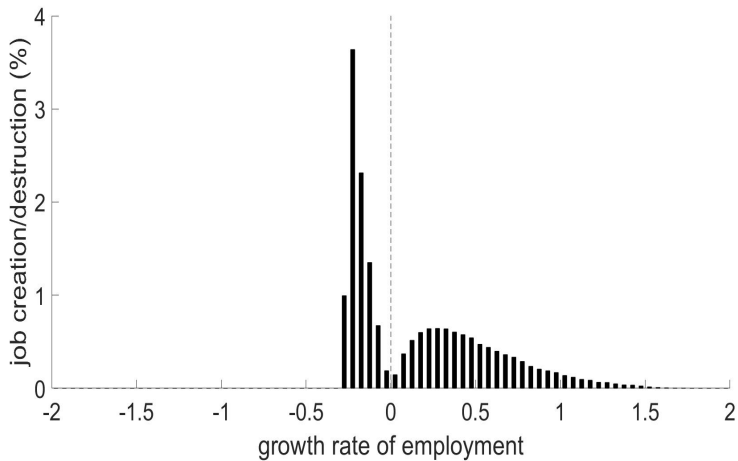
$$1 + \underbrace{s_{\kappa}(\kappa_e + \kappa_i)}_{\text{new varieties}} + \underbrace{(s_q^{\sigma-1} - 1)\lambda_i}_{\text{own innovation}} + \underbrace{(s_q^{\sigma-1} - 1)(\tilde{\delta}_e + \tilde{\delta}_i)}_{\text{creative destruction}}$$

$$1 + \underbrace{s_{\kappa}\kappa_e + (s_q^{\sigma-1} - 1)\tilde{\delta}_e}_{\text{entrants}} + \underbrace{s_{\kappa}\kappa_i + (s_q^{\sigma-1} - 1)(\lambda_i + \tilde{\delta}_i)}_{\text{incumbents}}$$

Model JC/JD with *only* Creative Destruction



Model JC/JD with *only* Own Innovation



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Sources of U.S. TFP growth, 1983–2013

	basis points per year	% of growth
Own Innovation	115	65%
Creative Destruction	46	26%
New Varieties	16	9%
All sources	176	100%

Estimates from Garcia-Macia, Hsieh and Klenow (2019)

Sources of the U.S. speedup and slowdown

Basis points per year

	<u>1983–1993</u>	<u>1993–2003</u>	<u>2003–2013</u>
Creative Destruction	44	64	29
New Varieties	23	19	6
Own Innovation	99	147	98

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Entrants and gazelles drive job creation ...

Employment growth	% of gross job creation	% of net job creation
Entrants	50%	800%
Incumbents > 20%	13%	208%

Source: Hsieh and Klenow (2017) from LBD 2003–2013

... but not TFP growth

Employment growth	% of gross job creation	% of TFP growth
Entrants	50%	13%
Incumbents > 20%	13%	4%
Incumbents 0 to 20%	37%	65%
Incumbents < 0%	0%	18%

Source: Hsieh and Klenow (2017) from LBD 2003–2013

Young firms vs. Old firms

	<u>% of Job Creation</u>	<u>% of TFP Growth</u>
Age < 1	31%	9%
Age 1–5	13%	14%
Age 5–10	11%	14%
Age 10–15	9%	12%
Age > 15	36%	51%

Source: Garcia-Macia, Hsieh and Klenow (2019)

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Creative destruction is a key source of growth

- See the survey by Aghion, Akcigit and Howitt (2014)
- 26% of growth in Garcia-Macia, Hsieh and Klenow (2019)

Does it show up in *measured* growth?

- standard measurement assumes new producers have the *same* quality-adjusted price as producers they replace
- but creative destruction \Rightarrow new producers have a *lower* quality-adjusted price

Numerical example

- 80% of items: 4% inflation (no innovation)
- 10% of items: -6% inflation (innovation w/o CD)
- 10% of items: -6% inflation (CD)
- True inflation = 2%, True growth = 2%
- Imputed inflation due to CD = $\frac{8}{9} \cdot 4\% + \frac{1}{9} \cdot (-6\%) = 2.9\%$
- Measured growth = 1.1%, Missing Growth = 0.9%

- 1 How much is U.S. growth understated, on average, because of creative destruction?
- 2 Has such “missing growth” increased in recent years?

- 1 How much is U.S. growth understated, on average, because of imputation for creative destruction?

~ **0.5 ppt per year** between 1983–2013

- 2 Has “missing growth” increased a lot in recent years?

No

Sources of bias from Creative Destruction:

$$(\delta_e + \delta_i) \left\{ \underbrace{(1 - \hat{\lambda}_i) \log \hat{s}_\lambda}_{\text{not all incumbents innovate}} + \underbrace{\log s_\delta - \log \hat{s}_\lambda}_{\text{different stepsize for CD}} \right\}$$

CES demand \Rightarrow market share isoelastic with respect to price

$$\text{Missing Growth} = \left(\frac{S_{I_t,t+1}}{S_{I_t,t}} \right)^{\frac{1}{1-\sigma}}$$

$S_{I_t,t}$ = market share in t of all goods sold in both t and $t + 1$

$S_{I_t,t+1}$ = market share in $t + 1$ of all goods sold in t & $t + 1$

Shrinking share of non-CD goods \Rightarrow missing growth

If existing plants carry out OI but not CD or NV:

$$\text{Missing Growth} = \left(\frac{S_{I_t,t+1}}{S_{I_t,t}} \right)^{\frac{1}{1-\sigma}}$$

$S_{I_t,t}$ = t share of all establishments operating in t and $t + 1$

$S_{I_t,t+1}$ = $t + 1$ share of all establishments operating in t and $t + 1$

Missing growth implied by survivor employment shares

basis points per year

1983–2013	54
1983–1995	52
1996–2005	48
2006–2013	65

Adding in the Missing Growth

basis points per year

	Measured	“True”
1983–2013	187	241
1983–1995	180	232
1996–2005	268	316
2006–2013	98	163

Sectors contributing to Missing Growth

Hotels & Restaurants	34%
Retail Trade	29%
Professional services	9%
⋮	
Manufacturing	2%

Why do we care if some growth is missed?

- business stealing
- relating growth to policy
- whether ideas are getting harder to find (Gordon, Jones)
- how many people are better off than their parents (Chetty)
- setting the Fed's inflation target
- indexing Social Security and tax brackets

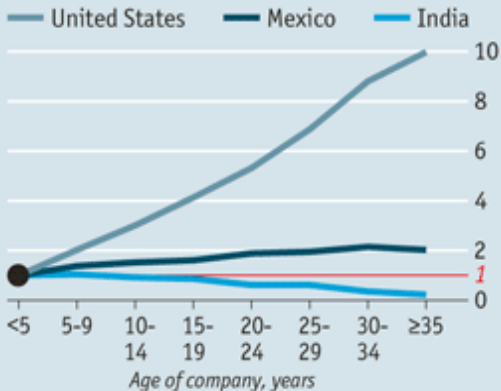
Focused on U.S. growth today

But issues are just as relevant for other countries:

- Firms everywhere are innovating and growing (or not)
 - ▶ See India and Mexico vs. the U.S.
- Same issues arise with growth statistics outside the U.S.

Age shall wither them

Index of employee numbers at average company
Employment at company's birth=1



Source: World Bank

- How big are externalities?
 - ▶ entrants vs. incumbents
 - ▶ domestic vs. international
- Sources of firm-level innovation outside the U.S.?
- Missing growth outside the U.S.?
- Reasons for declining dynamism and growth?
- Creative destruction, trade, and inequality?