How Destructive is Innovation?

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Sources of Innovation

Creative Destruction (Schumpeter, Aghion-Howitt, Grossman-Helpman)

Apple vs. Blackberry/Nokia

Amazon vs. independent bookstores/Borders

Boeing 777 vs. Airbus A340

Uber vs. Taxi

Google vs. Newspapers

Sources of Innovation

New Varieties (Romer)

Own-Variety Improvements

Boeing 777 vs. Boeing 747

New iPhone models vs. older iPhone models

Sources of Innovation

Entrants vs. Incumbents

How do we know?

Case Studies

Patent Citations

Accounting Decomposition

Our Approach:

Model with all three sources of innovation

Infer contribution of each type of innovation from patterns of firm growth (LBD 1976-2013)

- Firms grow when they innovate
  - Grow by “a lot” if creative destruction
  - Grow by “a little” if own innovation
- Firms shrink when innovated upon

Main Findings

Contributions to Aggregate TFP Growth

- Incumbents >> Entrants
- Quality Improvements >> New Varieties
- Own Innovation > Creative Destruction

Model: production and employment

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

Production of each variety: $y_j = l_j \propto W^{1-\sigma} q_j^{\sigma-1}$

Aggregate TFP: $\underbrace{M^{\frac{1}{\sigma-1}}}_{\textbf{Variety}} \underbrace{\left(\sum_{j=1}^{M} q_j^{\sigma-1} / M \right)^{\frac{1}{\sigma-1}}}_{\bar{\mathbf{q}} \equiv \textbf{Average Quality}}$

Key idea: Firm innovation proportional to employment growth

$$L_f \propto W^{1-\sigma} \sum_{j=1}^{M_f} q_j^{\sigma-1} = W^{1-\sigma} \cdot M_f \cdot \overline{q}_f^{\sigma-1}$$

Entrants:

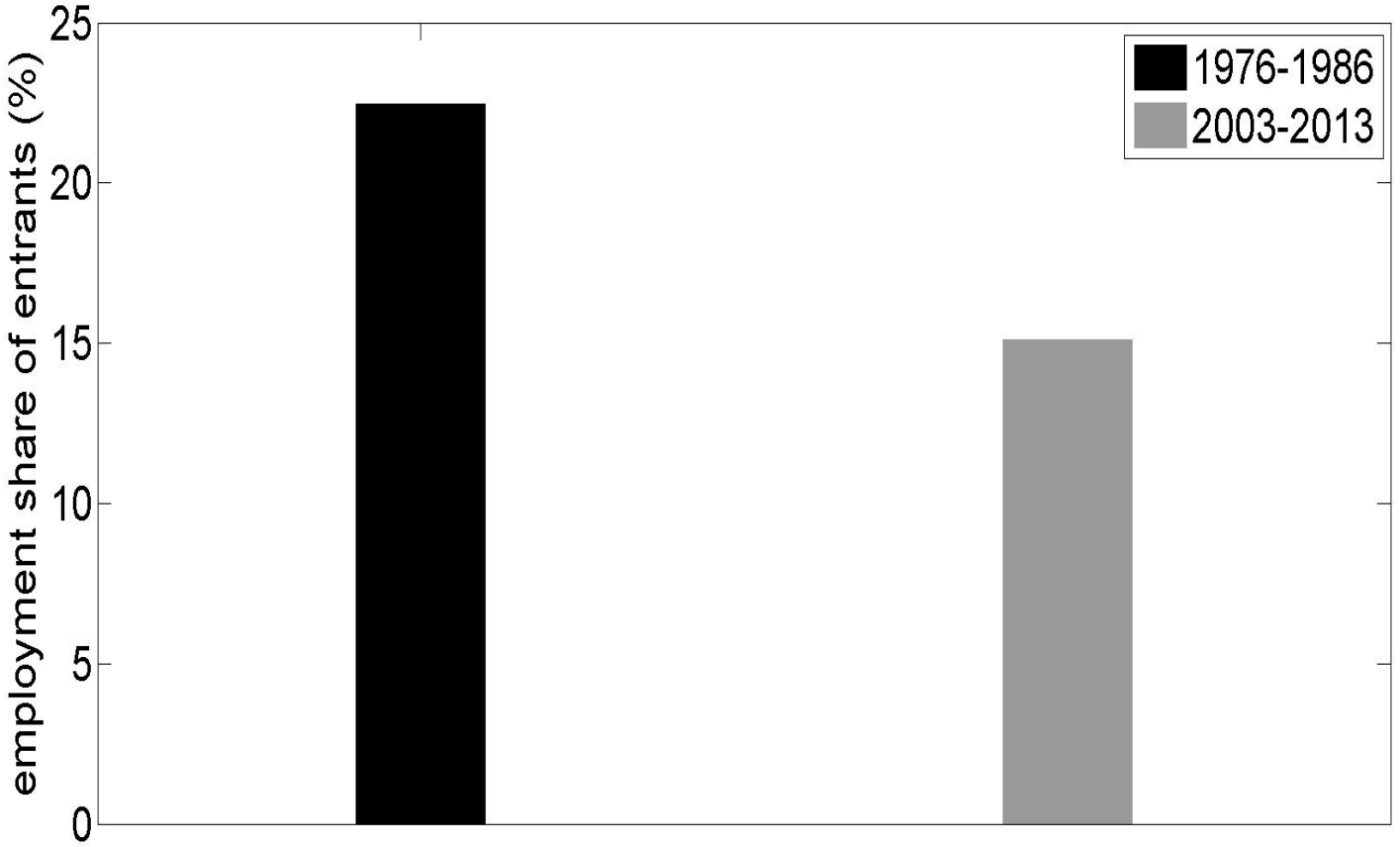
Employment of entrants pins down combination of:

Existing products improved upon by entrants

New products created by entrants

Quality of products made by entrants

DATA: Employment Share of Entrants



$$\frac{L_{f,t+1}}{L_{f,t}} \propto \left(\frac{W_{t+1}}{W_t}\right)^{1-\sigma} \cdot \frac{M_{f,t+1}}{M_{f,t}} \cdot \left(\frac{\bar{q}_{f,t+1}}{\bar{q}_{f,t}}\right)^{\sigma-1}$$

Incumbent employment grows:

Steal existing product from another firm

Improve quality of own product

Create new product

Incumbent employment falls:

Another firm steals its product

Wages rise

Incumbents: Own quality improvement vs. business stealing

$$\frac{L_{f,t+1}}{L_{f,t}} \propto \left(\frac{W_{t+1}}{W_t}\right)^{1-\sigma} \cdot \frac{M_{f,t+1}}{M_{f,t}} \cdot \left(\frac{\overline{q}_{f,t+1}}{\overline{q}_{f,t}}\right)^{\sigma-1}$$

Own-variety improvement → "modest" employment growth

Business stealing → "big" employment growth

Apple’s Employment (in the US)

2001: 11 K (iPod introduced)

2007: 23 K (iPhone introduced)

2008: 35 K

2009: 37 K

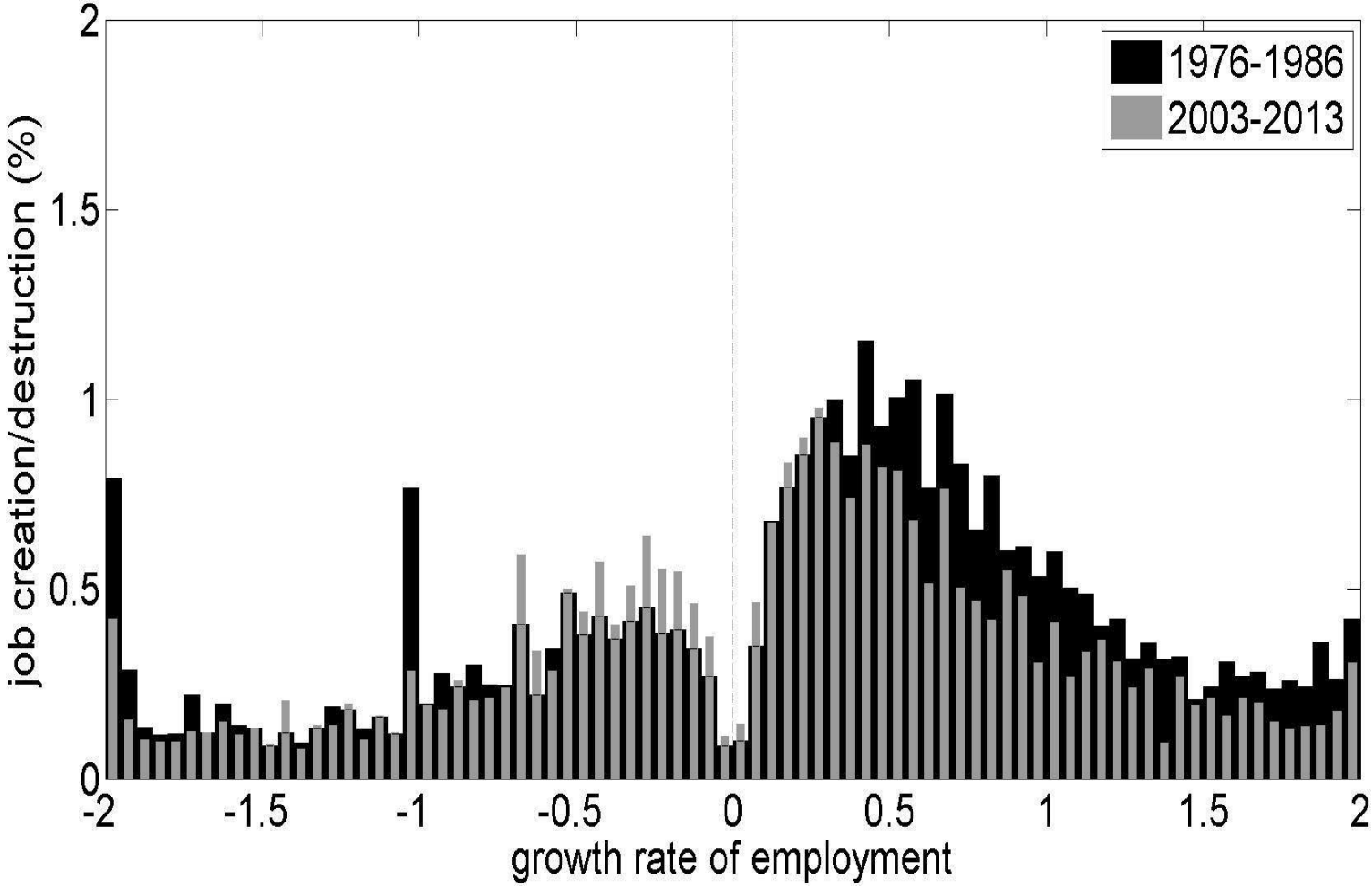
2010: 49 K (iPad introduced)

2014: 97 K

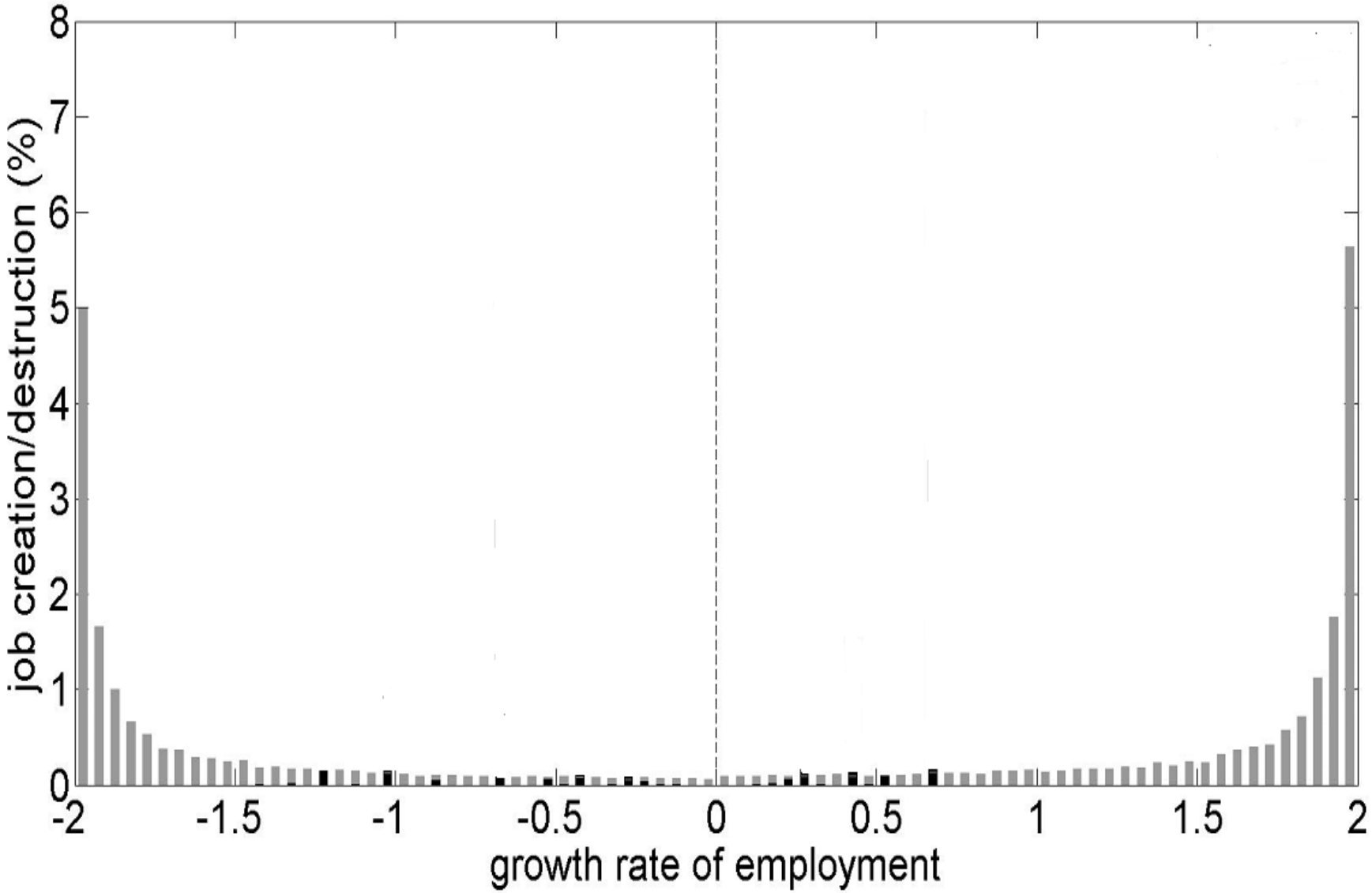
2015: 110 K

2016: 116 K

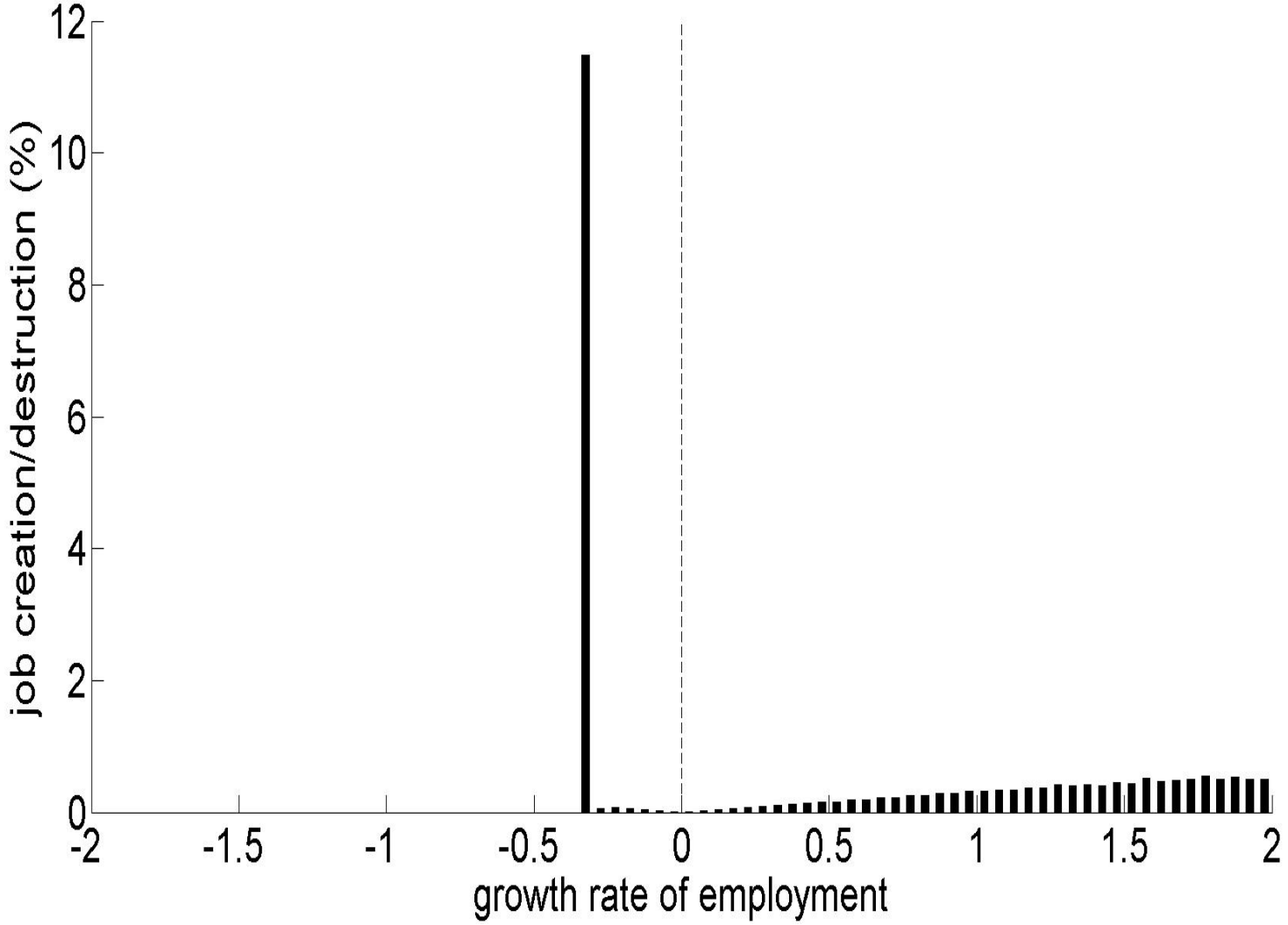
DATA: Distribution of Job Creation/Destruction



If only Creative Destruction



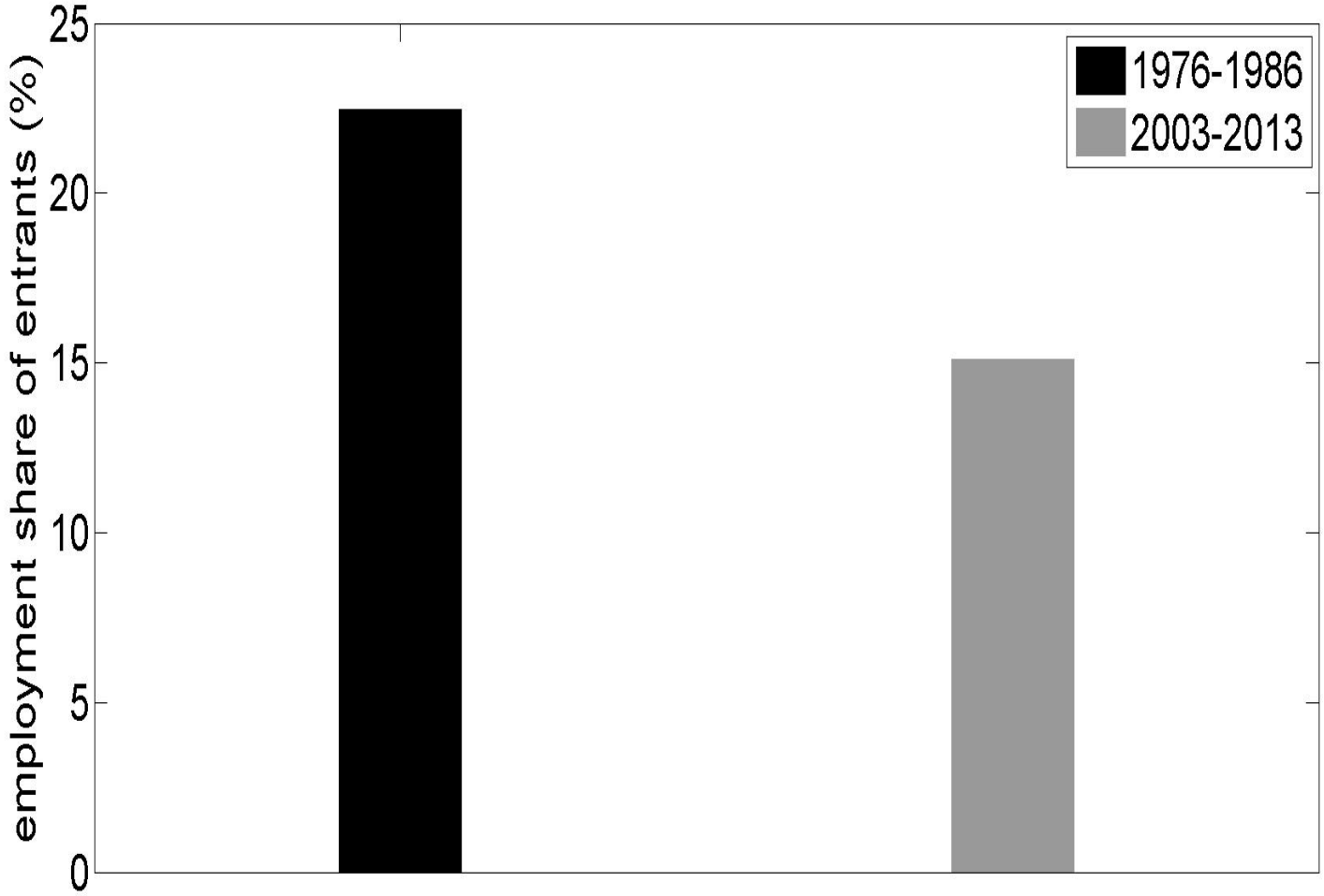
If only Own Innovation



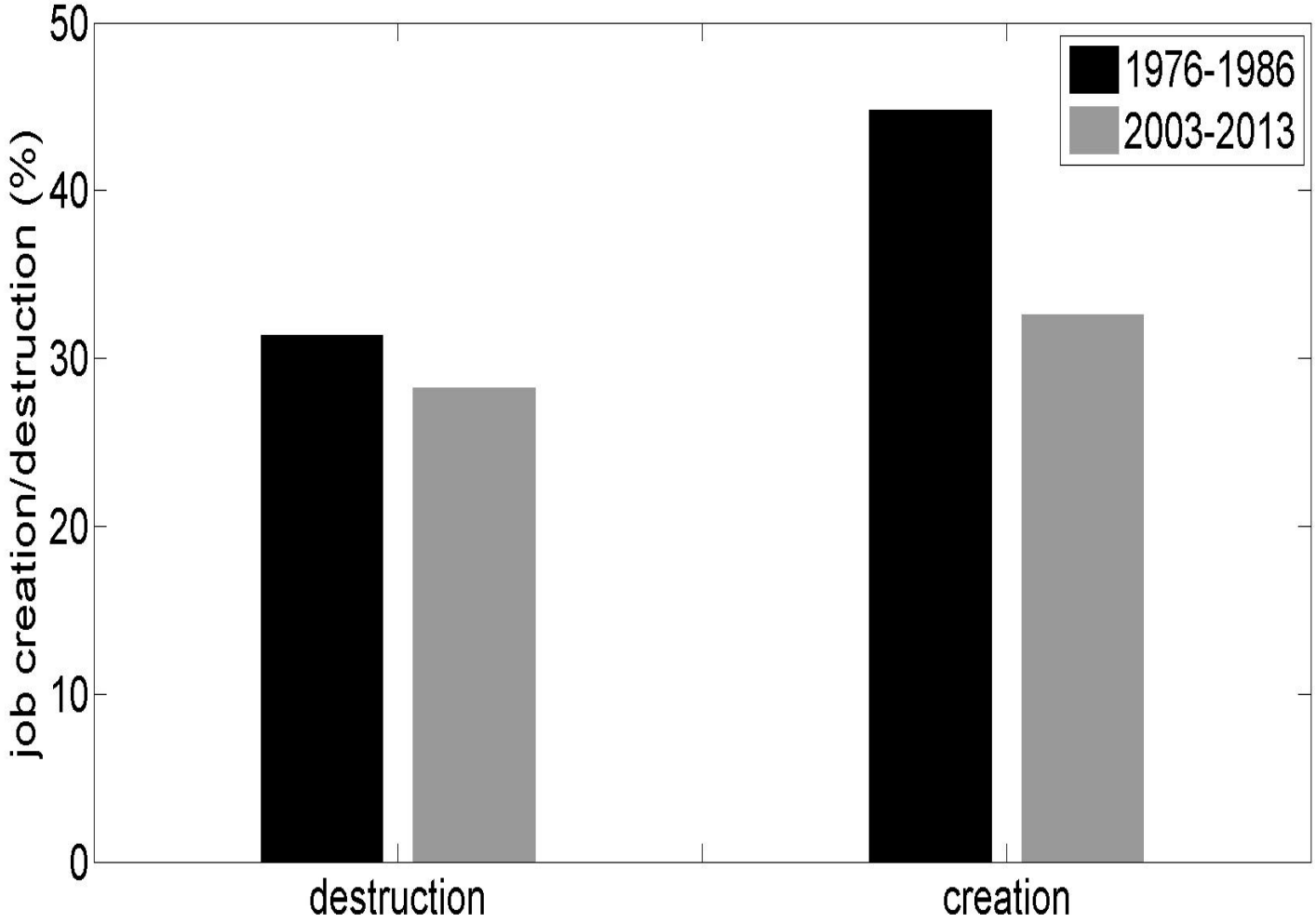
Estimated Contributions to Growth (1976-1986)

	Entrants	Incumbents	
Creative Destruction	19.1 %	8.2 %	27.3 %
Creation of New Varieties	0.0 %	7.6 %	7.6 %
Own-Variety Improvements	-	65.1 %	**65.1** %
	19.1 %	**80.9** %	

DATA: Employment Share of Entrants



DATA: Job Creation/Destruction Rates



Contributions to Growth: 1976-1986 vs. 2003-2013

	1976-1986	2003-2013
Entrants	19.1%	12.8%
Own-Variety Improvements	65.1%	76.7%