Firm Size Distortions and the Productivity Distribution: Evidence from France

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NBER Entrepreneurship Group,
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LSE

CENTRE *for* ECONOMIC PERFORMANCE

Or……. “Lucas in France”

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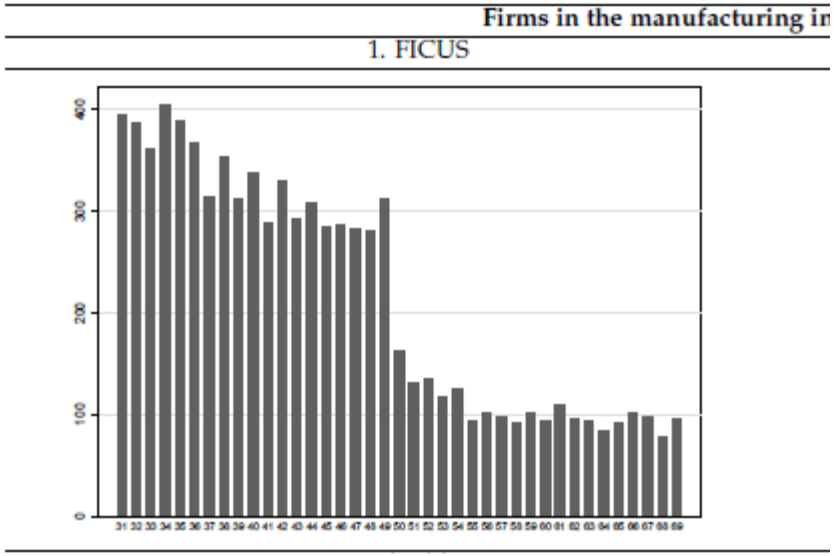


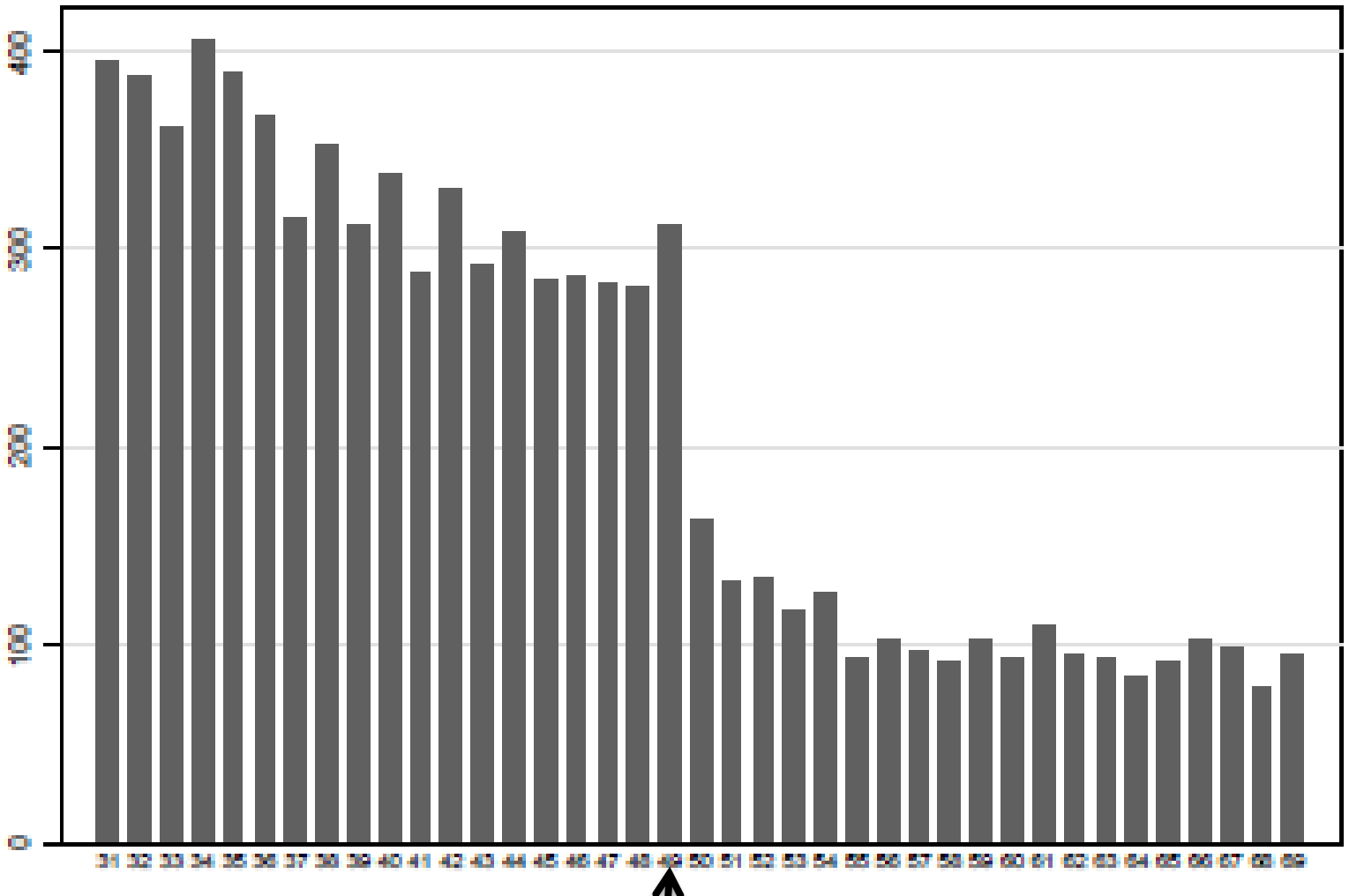
MOTIVATION

- **Reallocation**: bigger share of economic activity to more efficient firms. Important in understanding:
  - Aggregate productivity across countries (Hsieh & Klenow, 2009; Restuccia & Rogerson, 2008; Bartelsman et al, 2009)
  - Aggregate productivity changes over time within countries (e.g. Bailey et al, 1992) & within industries (e.g. Olley & Pakes, 1996)
  - Trade with heterogeneous firms (Pavcnik, 2002; Mellitz, 2003; Bloom, Draca & Van Reenen, 2011)
- What are sources of misallocations/frictions?
  - Taxes, subsidies, product & financial markets
  - **Labor market regulation**. How do we estimate the cost of labor regulations? e.g. OECD or World Bank Employment Protection Legislation Index

CONTRIBUTION

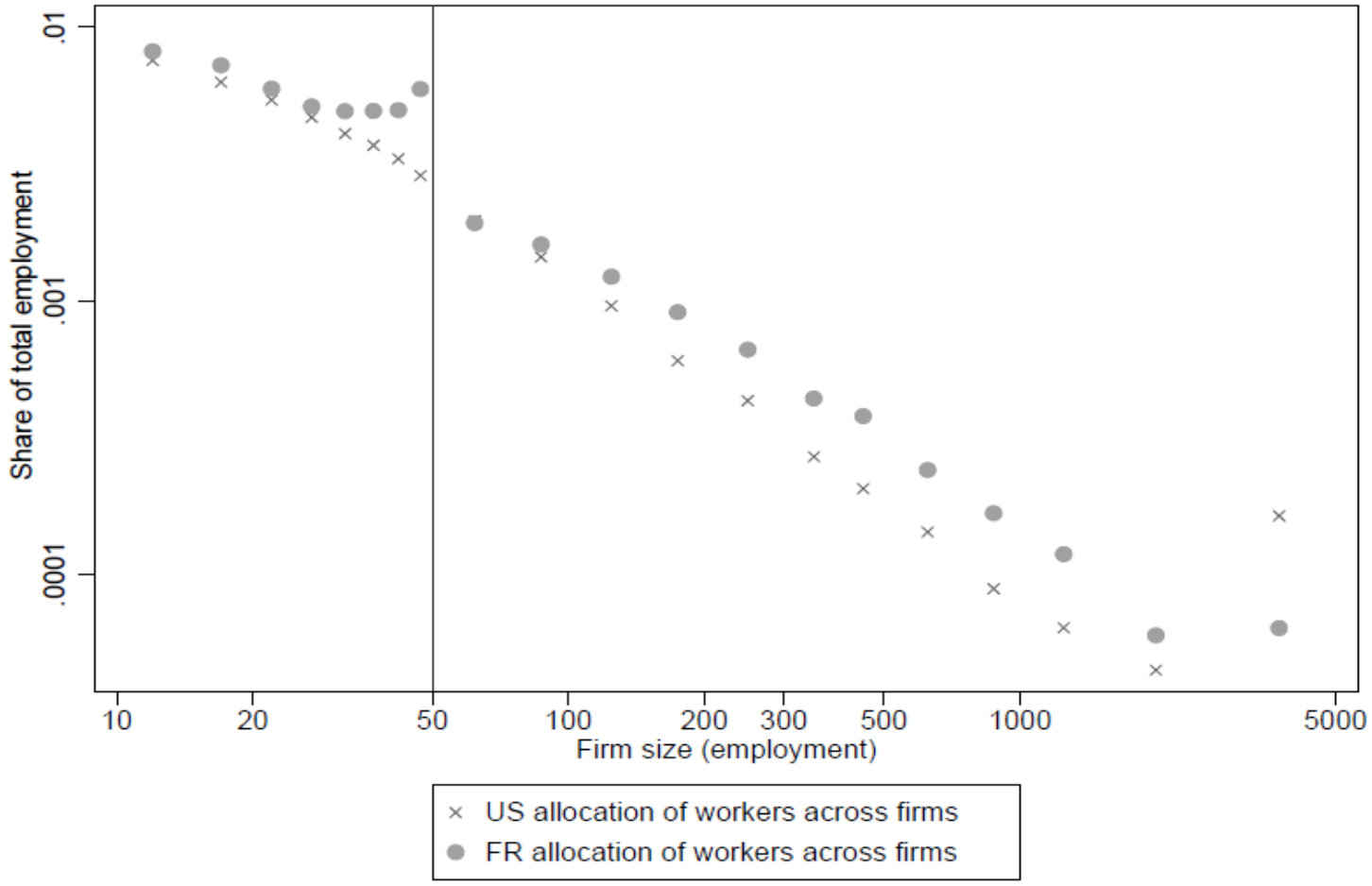
- Focus on one major labor regulation in a general equilibrium setting:
  - Big firing cost for **French** firms when they have 50 or more employees
- Combine two sources of variation
  - Firm size distribution (“broken power law”)
  - Productivity distribution
- General methodology for estimating costs of (ubiquitous) size-related regulations
  - Discontinuity, power law plus theory aids econometric identification

RAW DATA ON NUMBER OF FIRMS BY EACH SIZE CLASS (NUMBER OF EMPLOYEES)



Exactly 49 employees

FIRM SIZE DISTRIBUTION IN US AND FRANCE – A "BULGE" OF EMPLOYMENT IN FRENCH FIRMS WITH JUST UNDER 50 WORKERS



WHY THE BULGE?

- Sharp increase in regulation at 50 workers in France
  - Labor legislation sharply increases firing costs
  - If firm with 50 or more employees wants to dismiss some workers it must formulate a “social plan” to facilitate re-employment through training, job search, etc.
  - “Social Plan” must be negotiated with (& monitored by) unions, lawyers & Labor Ministry
  - High fines in labor courts for violation
  - Managerial time costs, etc.

OUTLINE

1. **Theory: “Lucas in France”**
2. Empirical Implementation
3. Data
4. Results
   - Main findings
   - Robustness/Extensions

THEORY

- One input, one sector.
- Distribution of managerial ability measured by Total Factor Productivity (TFP)
- **Ability**: how much an agent can raise a team's output:
  - a manager with ability $\boldsymbol{\alpha}$ and $\boldsymbol{n}$ workers produces
  - $\mathbf{y = \alpha f(n)}$,
  - $f'(n)>0$, $f''(n)<0$ from managerial span of control problem (e.g. $f(n)=n^{\theta}$, $\theta<1$)

INDIVIDUAL OPTIMIZATION

- Determination of firm size (employment) **n**:
- Economy-wide wage, **w**

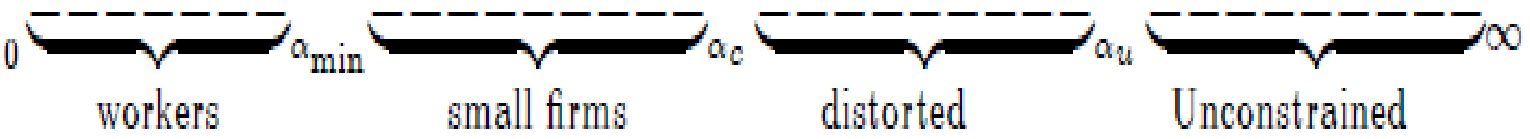
$$\pi(\alpha) = \max_n \alpha f(n) - w\overline{\tau}n \quad \begin{cases} \overline{\tau} = 1 & \text{if } n < N \\ \overline{\tau} = \tau & \text{if } n \geq N \end{cases}$$

- Labor regulation an implicit tax,τ , switching on at N=50
- First order condition:

$$\alpha f'(n^*) - \overline{\tau}w = 0,$$

EQUILIBRIUM (1)

1. An economy-wide wage level **w**
2. an allocation **n(α):** firm size (*n*) function of ability (*α*)
3. a triple of cutoffs: {α_{MIN}, α_C, α_U}



EQUILIBRIUM (2)

1. No agent wishes to change occupation from manager to worker or to change from unconstrained to constrained

2. The choice of **n(α)** for each manager is optimal given their skills **α**, taxes **τ** and wages **w**

3. Labor supply = labor demand

EQUILIBRIUM (3)

- Firm size & productivity:

$$n(\alpha) = 0 \quad \text{if } \alpha < \alpha_{\min}$$

Workers

$$n(\alpha) = f'^{-1}\left(\frac{w}{\alpha}\right) \quad \text{if } \alpha_{\min} < \alpha < \alpha_c$$

`Small Firms'

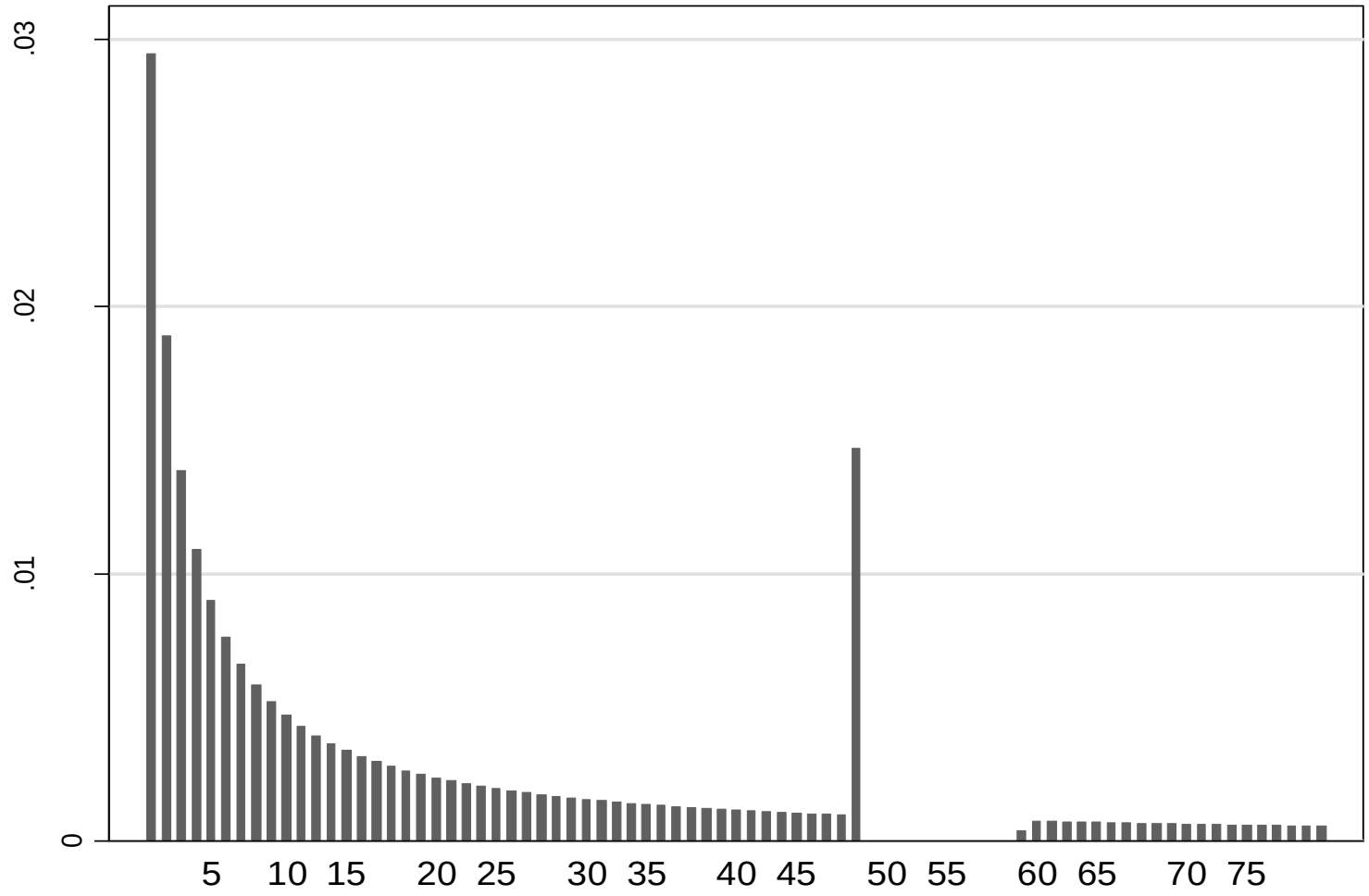
$$n(\alpha) = N - 1 \quad \text{if } \alpha_c < \alpha < \alpha_u$$

`Constrained'

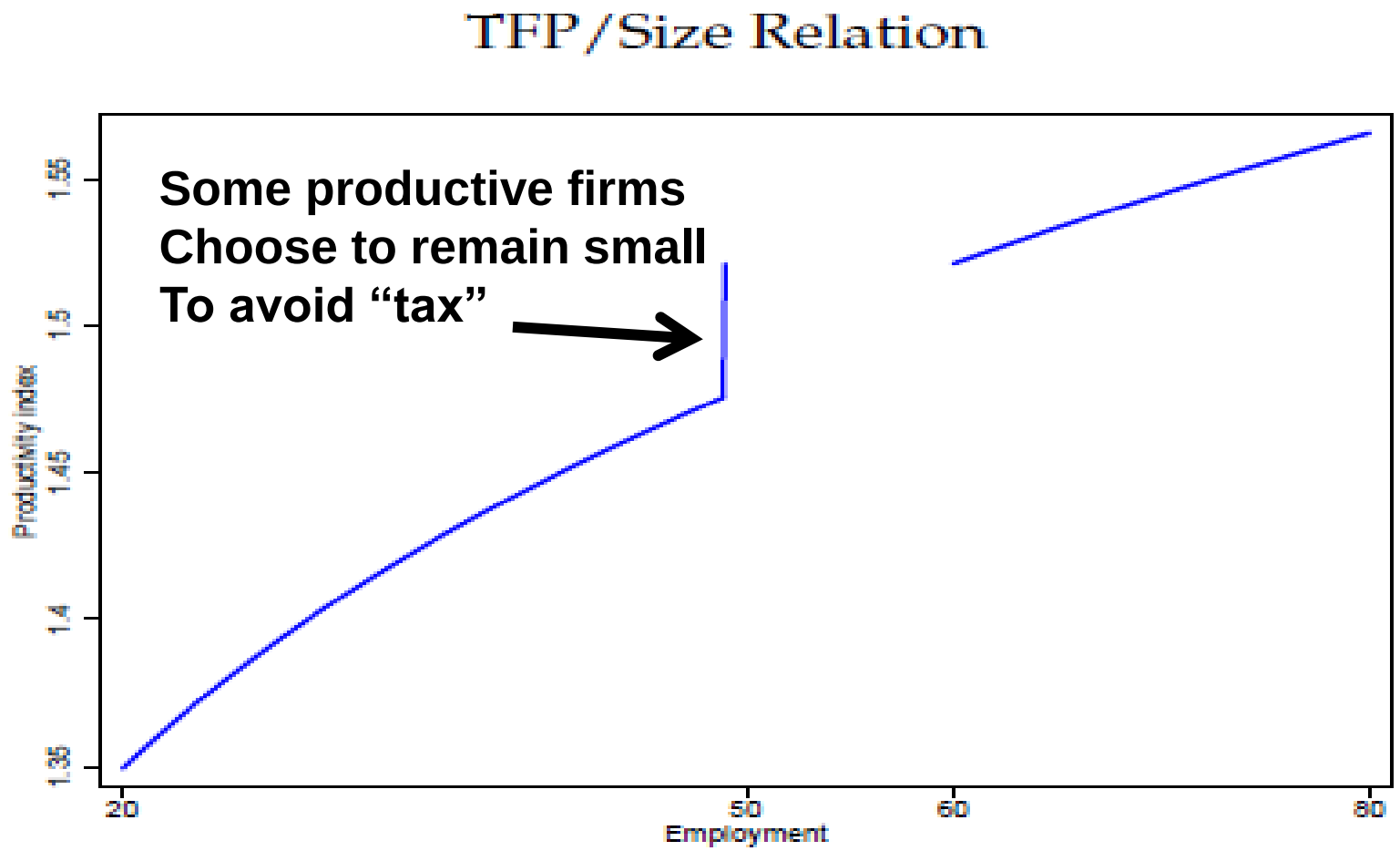
$$n(\alpha) = f'^{-1}\left(\frac{\tau w}{\alpha}\right) \quad \text{if } \alpha_u < \alpha < \infty$$

`Unconstrained'

THEORY: FIRM SIZE DISTRIBUTION (FIG 4)



THEORY: SIZE AND PRODUCTIVITY



LABOR REGULATIONS GENERATES `TOO MANY' SMALL FIRMS FOR 2 REASONS

- Firms choosing to remain small to avoid the regulation

- Equilibrium wage lower as workers bear some of the incidence of tax
  - This encourages low ability managers to form firms instead of remaining workers

- Too many entrepreneurial small firms in Southern Europe (e.g. Italy, Portugal – see Braguinsky, Branstetter & Regateiro, 2011)

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EMPIRICAL IMPLEMENTATION

- Lucas (1978) shows that Gibrat's law implies that:
  - The managerial returns to scale function must have a constant `elasticity' form. We assume $f(n) = n^{\theta}$
  - A power law in firm size requires a power law in the ability distribution. Assume pdf of ability is:

$$\phi(\alpha) = c_{\alpha} . \alpha^{-\beta_{\alpha}}$$

EMPIRICAL IMPLEMENTATION

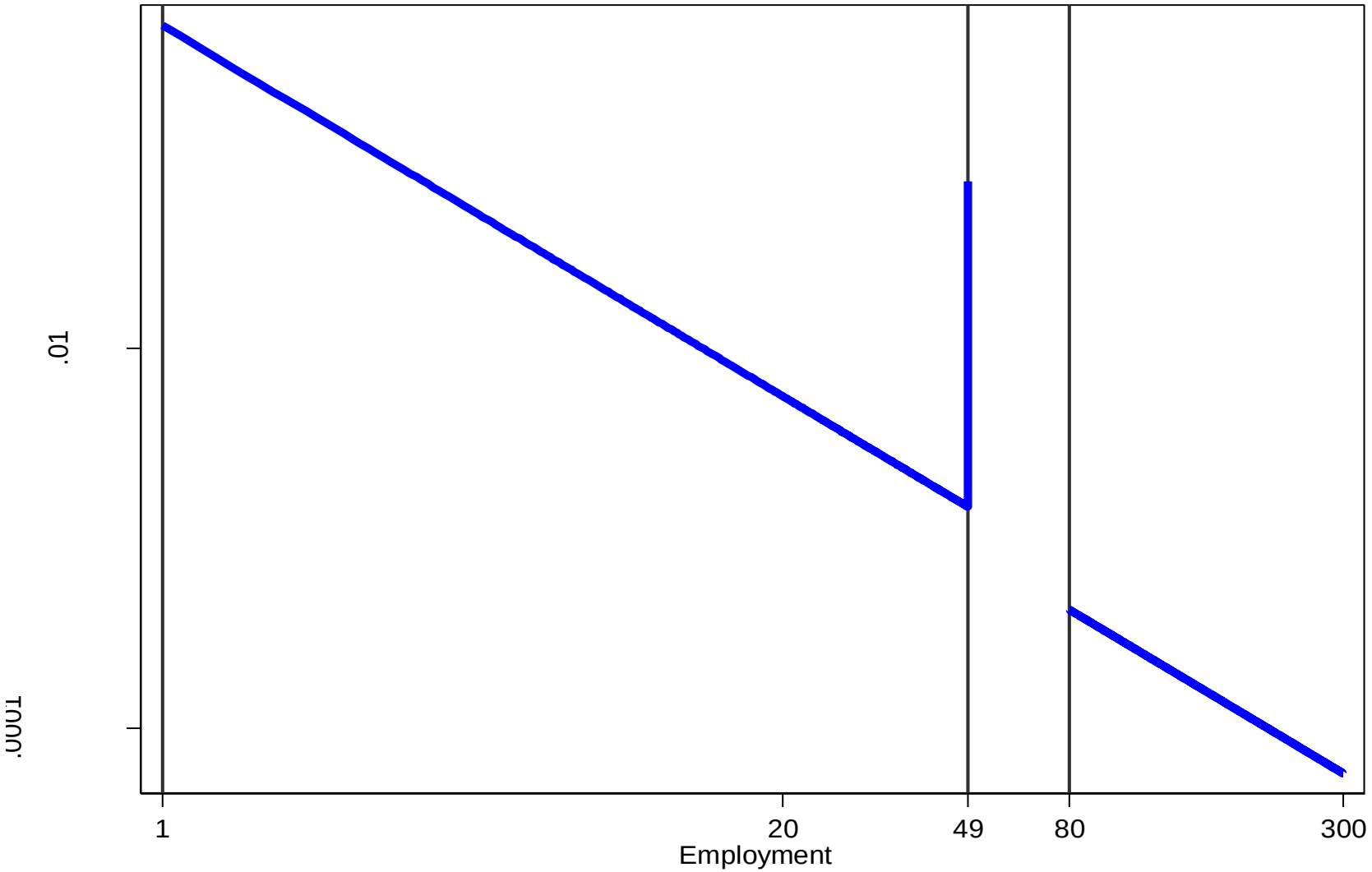
- **Equilibrium Firm size distribution (pdf of n*):**

$$\chi^*(n) = \begin{cases} (\beta-1).n^{-\beta} & \text{if} \quad n < 49 = n_1(\alpha_c) \\ 49^{1-\beta} - T.n_u^{1-\beta} & \text{if} \quad n = 49 = n_1(\alpha_c) \\ 0 & \text{if} \quad 49 < n < n_u = n_2(\alpha_u) \\ (\beta-1).T.n^{-\beta} & \text{if} \quad n_2(\alpha_u) = n_u \leq n \end{cases}$$

- **β = "slope" of power law in firm size = $\beta_\alpha(1-\theta) + \theta$**
- **Tax affects change in intercept & size of the `bulge' and `dip'**

$$T = \tau^{-\frac{\beta-1}{1-\theta}}.$$

EMPIRICAL IMPLEMENTATION (FIG. 6)



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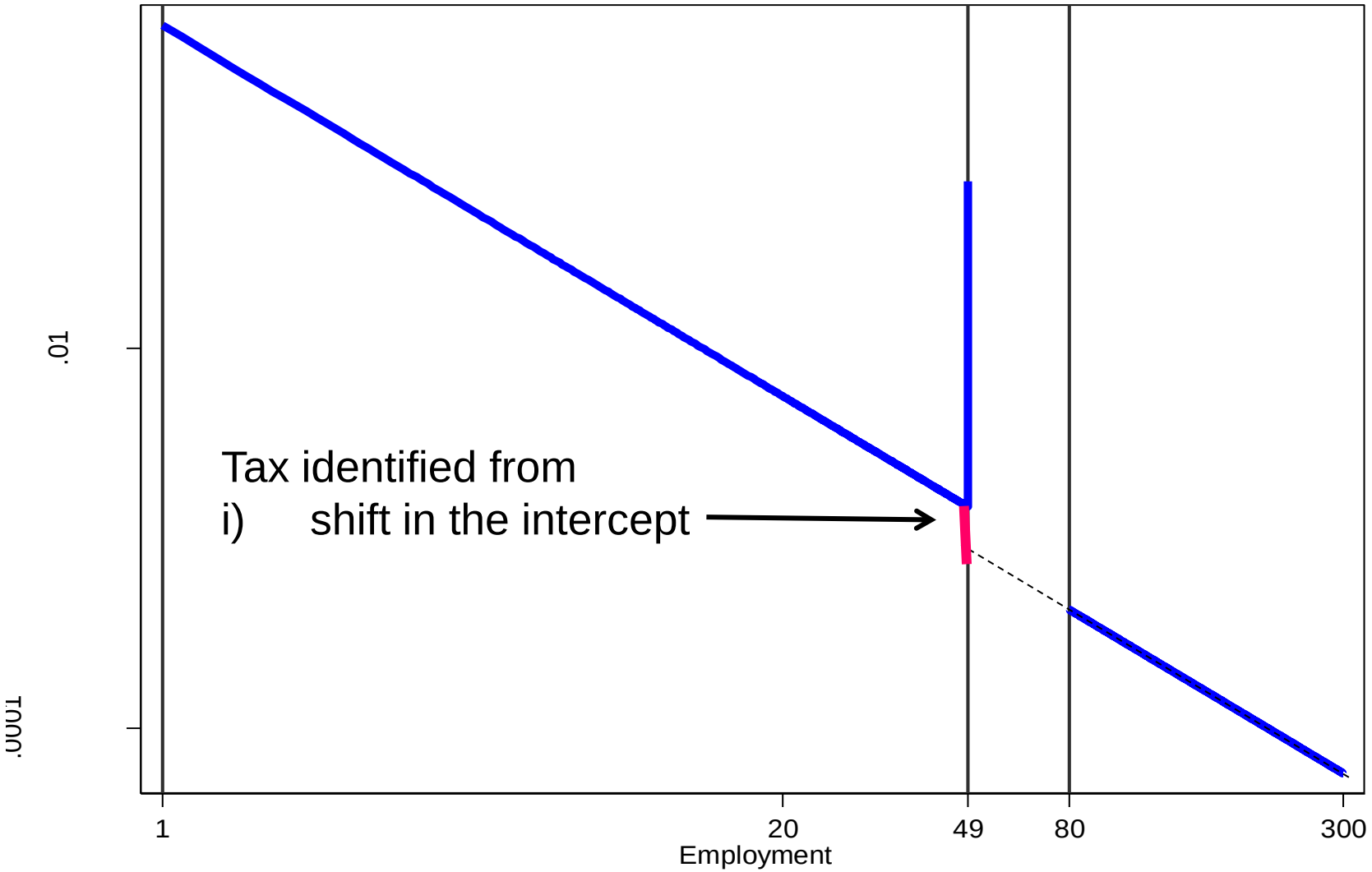

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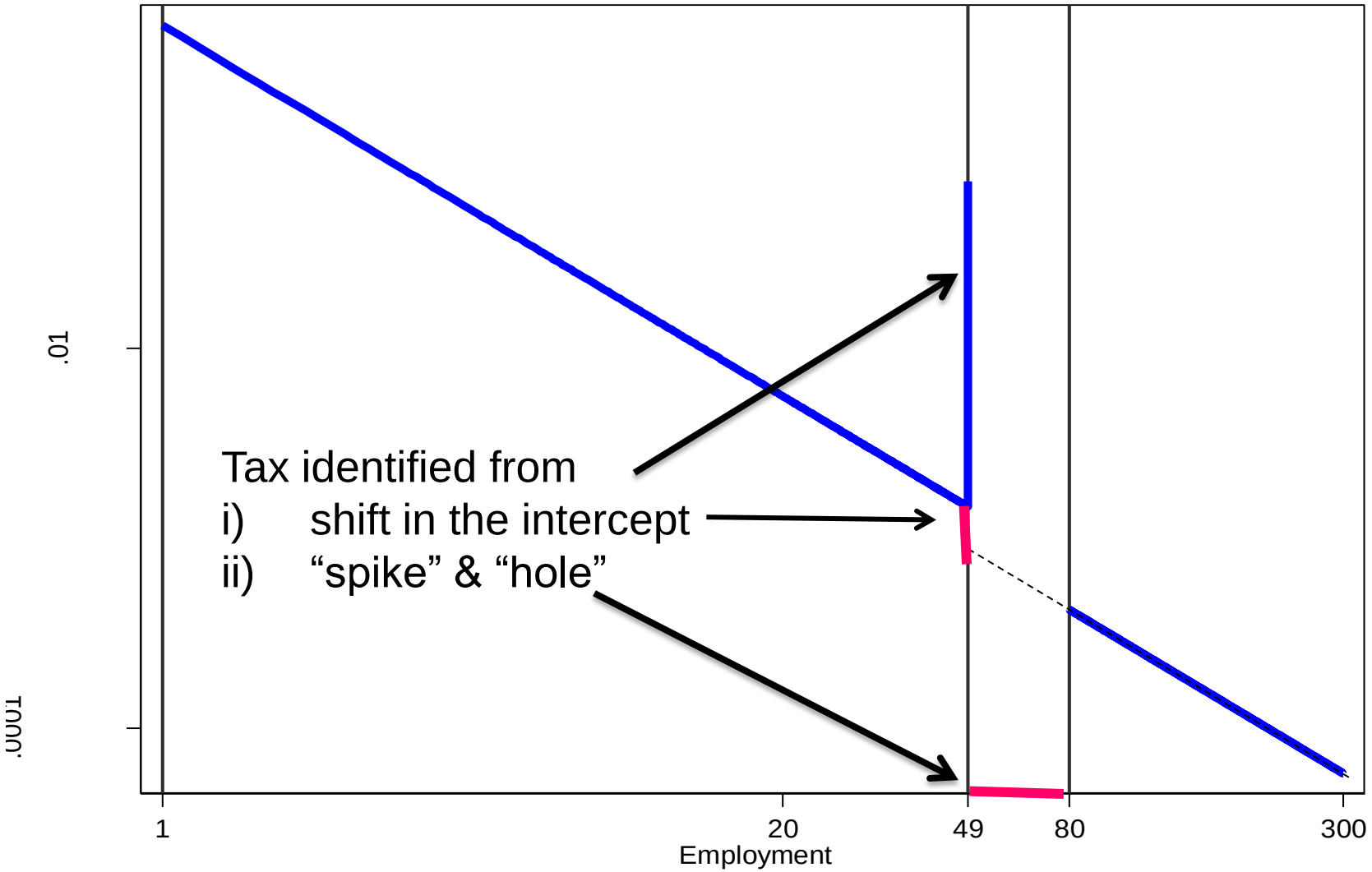


FIRM SIZE MEASURED WITH ERROR

- Observed size (allow for measurement error)

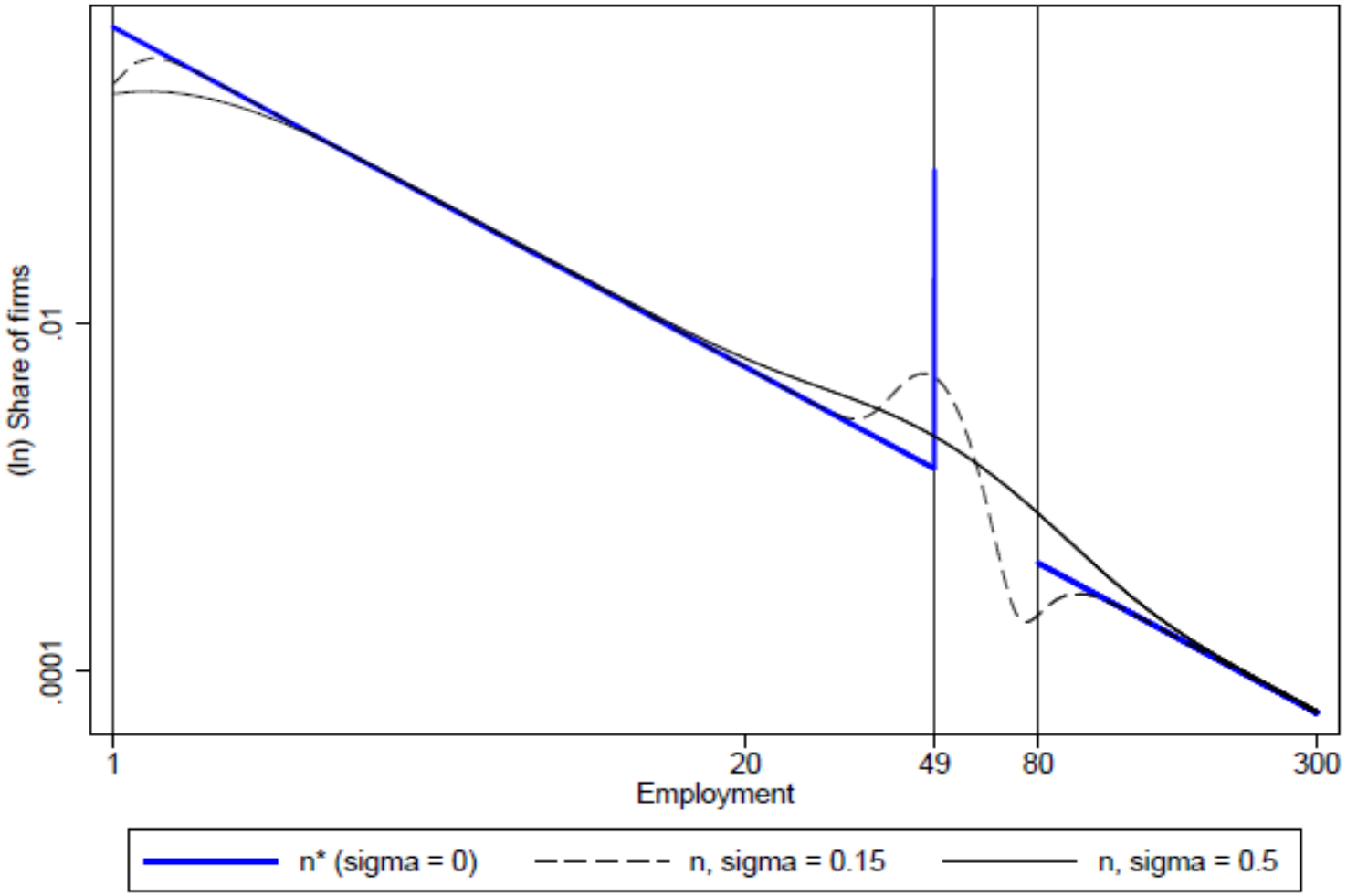
$$n(\alpha, \varepsilon) = n^*(\alpha).e^{\varepsilon}$$

- Conditional cdf

$$\mathbb{P}(x < n|\varepsilon) = \begin{cases} 0 & \text{if} \quad \ln(n) < \varepsilon \\ 1 - (n.e^{-\varepsilon})^{1-\beta} & \text{if} \quad \ln(n) - \ln(49) < \varepsilon \leq \ln(n) \\ 1 - T.n_u^{1-\beta} & \text{if} \quad \ln(n) - \ln(n_u) < \varepsilon \leq \ln(n) - \ln(49) \\ 1 - T.(n.e^{-\varepsilon})^{1-\beta} & \text{if} \quad \varepsilon \leq \ln(n) - \ln(n_u) \end{cases}$$

- Obtain pdf of *n* & estimate parameters by ML to obtain **β, T(τ, β,θ), n_U.**
- θ from production function estimation to recover implicit **τ**.

THEORETICAL FIRM SIZE DISTRIBUTION (WITH MEASUREMENT ERROR)



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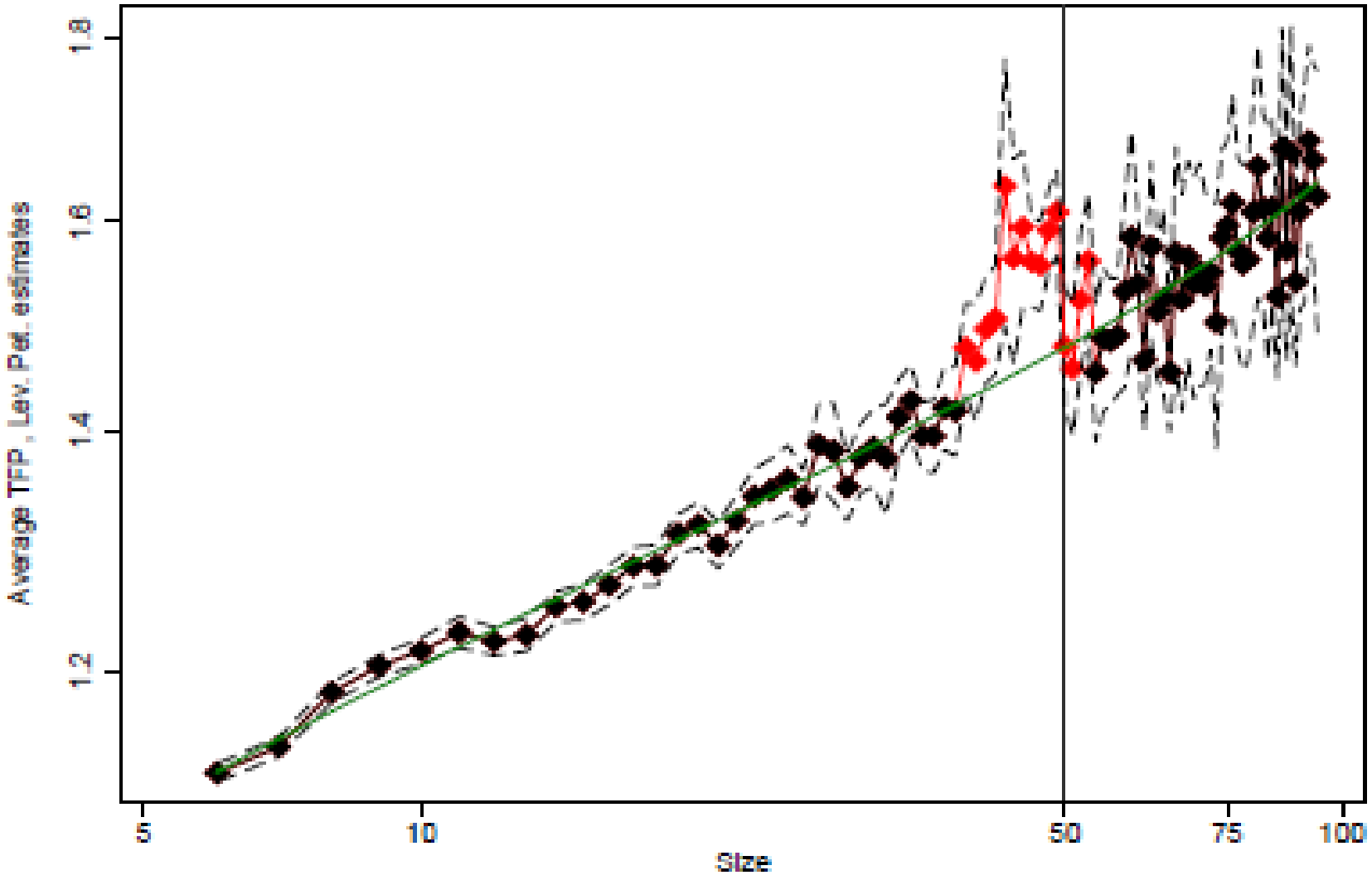
DATA

- Universe of French firms between 2002 - 2007
  - Mandatory fiscal returns of all French firms ("FICUS") and DADS (for some skills and hours info)
  - This is the administrative unit that the main law pertains to.

- FICUS contains balance sheet information on value added, labor, capital, investment, wage bills, materials, SIC4, etc.
  - Use this to calculate TFP via several methods (LP, OP, Solow, etc.)

TFP & SIZE RELATIONSHIP: CONSISTENT WITH THEORY THERE IS A BULGE IN TFP AROUND THE REGULATORY THRESHOLD (FIG 10A)



OUTLINE

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TABLE 1: ML ESTIMATES OF SIZE DISTRIBUTION – THE BROKEN POWER LAW

Parameter	Baseline
β, power law	1.702
	(0.002)
Tax $T = \tau^{\frac{1-\beta}{1-\theta}}$	0.799
	(0.009)
n_u, upper emp.	61.068
Threshold	(0.461)
σ, variance of	0.212
msremnt. error	(0.004)
Observations	690,855
Firms	167,528

Note: Estimates by ML, Manufacturing firms with >1 employee, standard errors clustered by firm

FIRM SIZE DISTRIBUTION: ACTUAL AND FITTED (FIG 11)

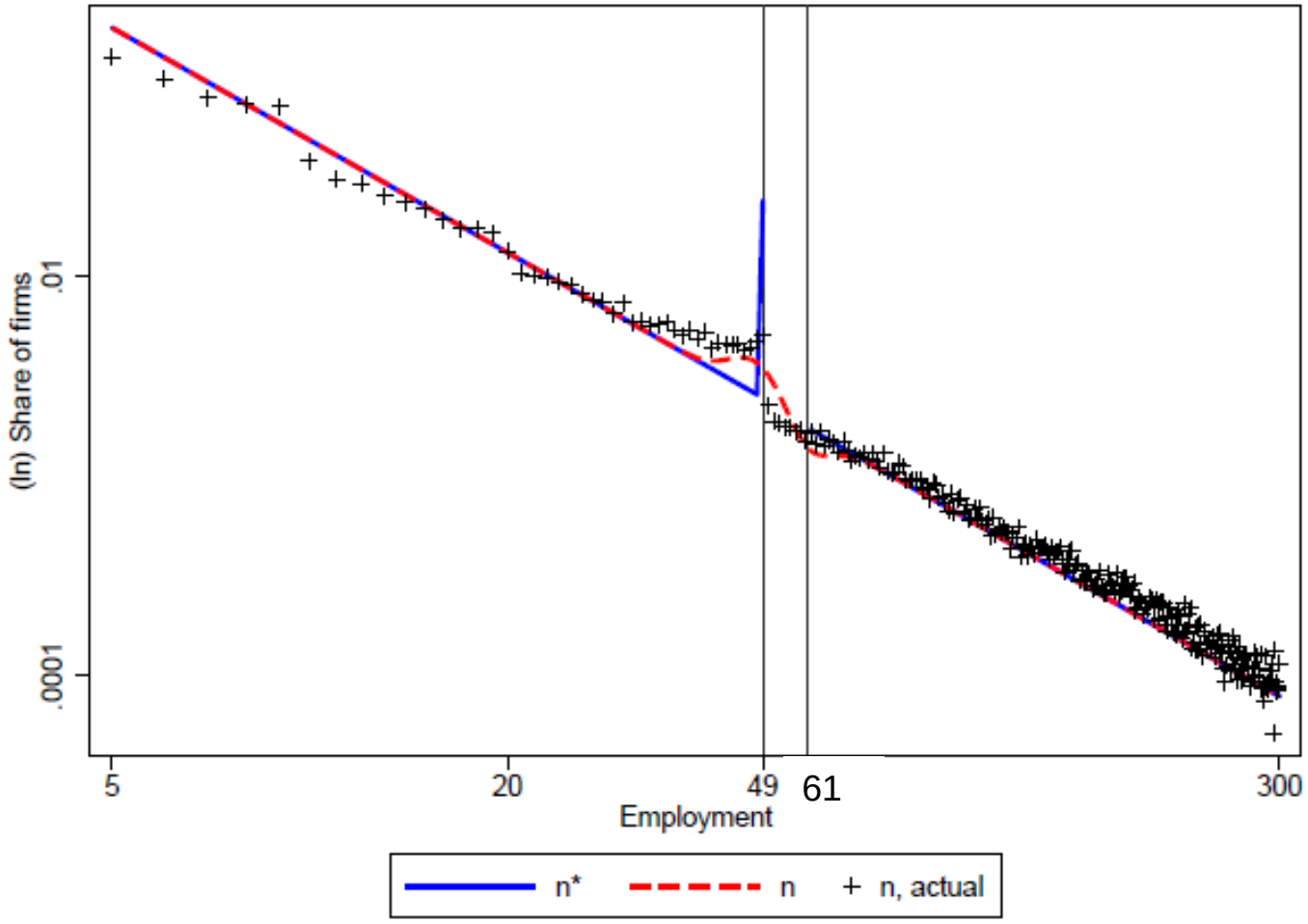


TABLE 2: ESTIMATES OF IMPLICIT TAX/COST OF LABOR REGULATION (~5%)

Experiment	Scale parameter, θ	Implicit Tax, τ
1. Calibrated	0.800	1.066
		(0.003)
2. Using TFP-Size relationship	0.802	1.065
3. Using the production function parameters	0.874 (0.003)	1.041 (0.003)
4. Split sample production function	0.912 (0.003)	1.029 (0.003)
5. High tech industries	0.900 (0.008)	1.013 (0.006)
6. Low Tech industries	0.862 (0.008)	1.054 (0.005)

PRELIMINARY WELFARE COSTS

- Just looking at distortion around threshold of 49-61 employees
  - About 0.5% of GDP (small number of firms, but large falls in output)

- If include the cost of keeping large firms (61+ workers) smaller via the tax, much larger welfare losses

ROBUSTNESS/EXTENSIONS

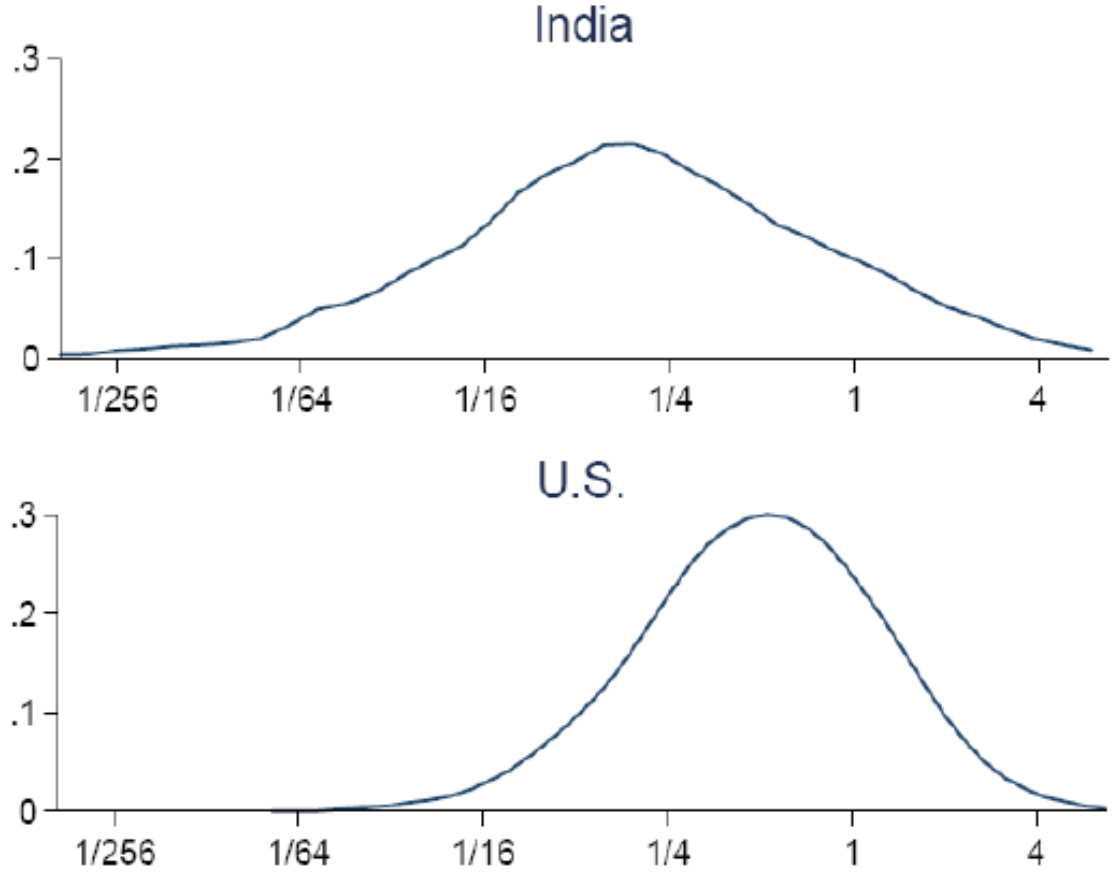
- Big firms pretending to be small?
  - We see effects for standalone firms as well as those part of business groups
- Other margins of adjustment
  - Hours, capital, skills, outsourcing
  - Reduces cost, but still distortion unless perfect substitutes
- Industry heterogeneity
- Workers benefit from “insurance” & take lower wages (Lazear, 1990)?
- Growth around threshold

CONCLUSIONS

- Simple methodology for quantifying effect of size-related regulations
- Theory helps explain qualitative & quantitative features of data
- Loss of output is significant, ~5% implicit tax
- Next Steps:
  - Welfare
  - Productivity estimates
  - More industry heterogeneity
  - Dynamics
  - Build in other size-related regulations
  - Fixed vs. variable cost effects of regulation
  - Other explanations for firms 50-60

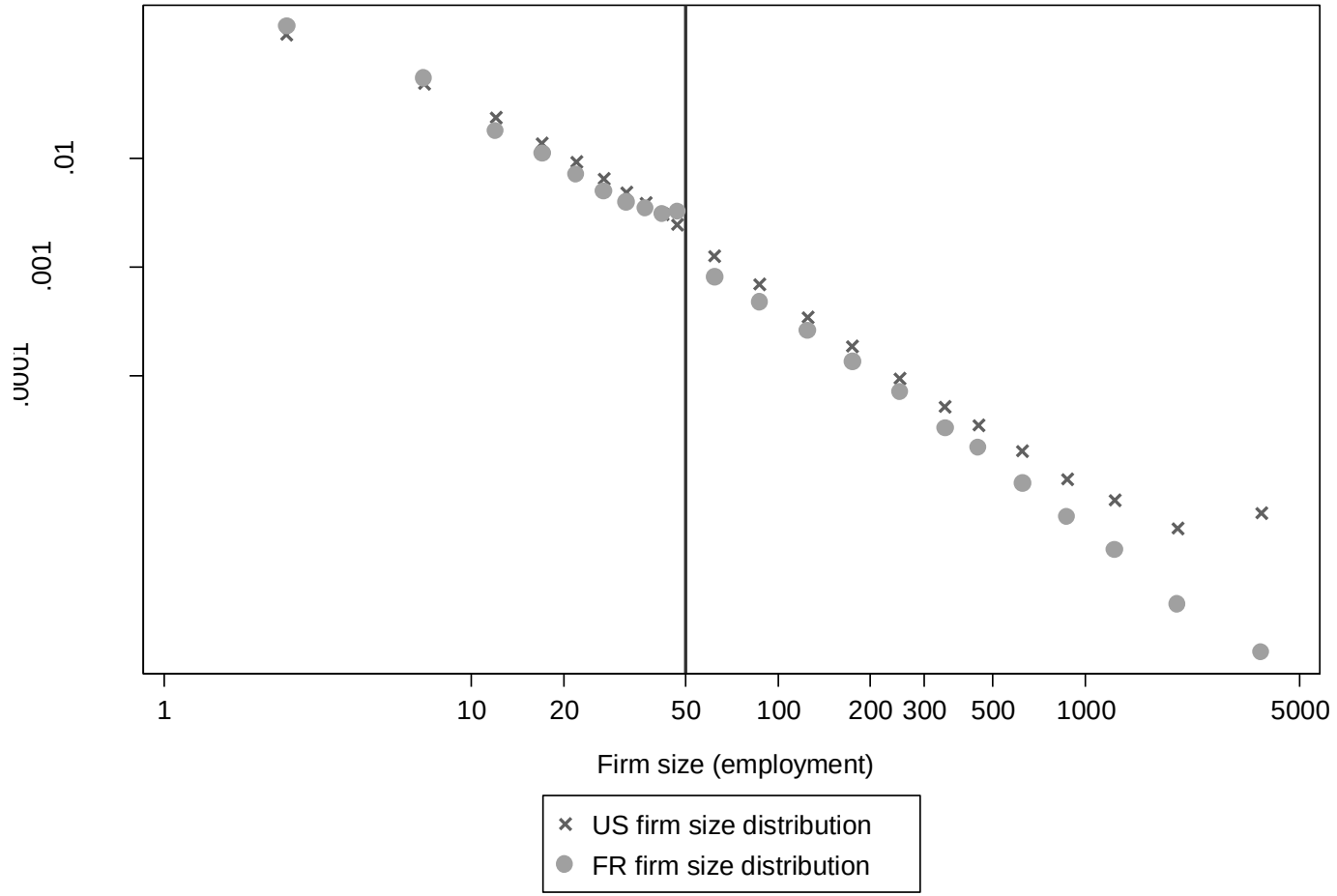
Back Up

DISTRIBUTION OF PLANT TFP DIFFERENCES IN US VS. INDIA HIGHER US TFP DUE TO REALLOCATION - THINNER "TAIL" OF LESS PRODUCTIVE PLANTS



Source: Hsieh and Klenow (2009); US mean=1

Firm size distribution: USA and France



Previous Literature

- Papers using the **same type of variation of the Lucas model**:
  - Murphy, Shleifer & Vishny (1991).
  - Braguinsky, Branstetter & Regateiro (2011)
- On the empirical side:

  FSD: atheoretic «smoothing » strategies
  - Schivardi and Torrini (2008)
  - Ceci-Renaud and Chevallier (2010)

  Separation costs:
  - Kramarz & Michaud (2010): data about actual separation expenditures using tobit

EQUILIBRIUM (3)

- Occupations:

$$\alpha_{\min} f(n) - wn = w$$

- Firm size:

$$\begin{aligned}
n(\alpha) &= 0 \quad \text{if } \alpha < \alpha_{\min} \\
n(\alpha) &= f'^{-1}(\frac{w}{\alpha}) \quad \text{if } \alpha_{\min} < \alpha < \alpha_c \\
n(\alpha) &= N - 1 \quad \text{if } \alpha_c < \alpha < \alpha_u \\
n(\alpha) &= f'^{-1}(\frac{\tau w}{\alpha}) \quad \text{if } \alpha_u < \alpha < \infty
\end{aligned}$$

- Labor supply = labor demand

$$\Phi(\alpha_{\min}) = \int_{\alpha_{\min}}^{\infty} n(\alpha) d\Phi(\alpha)$$

EMPIRICAL IMPLEMENTATION

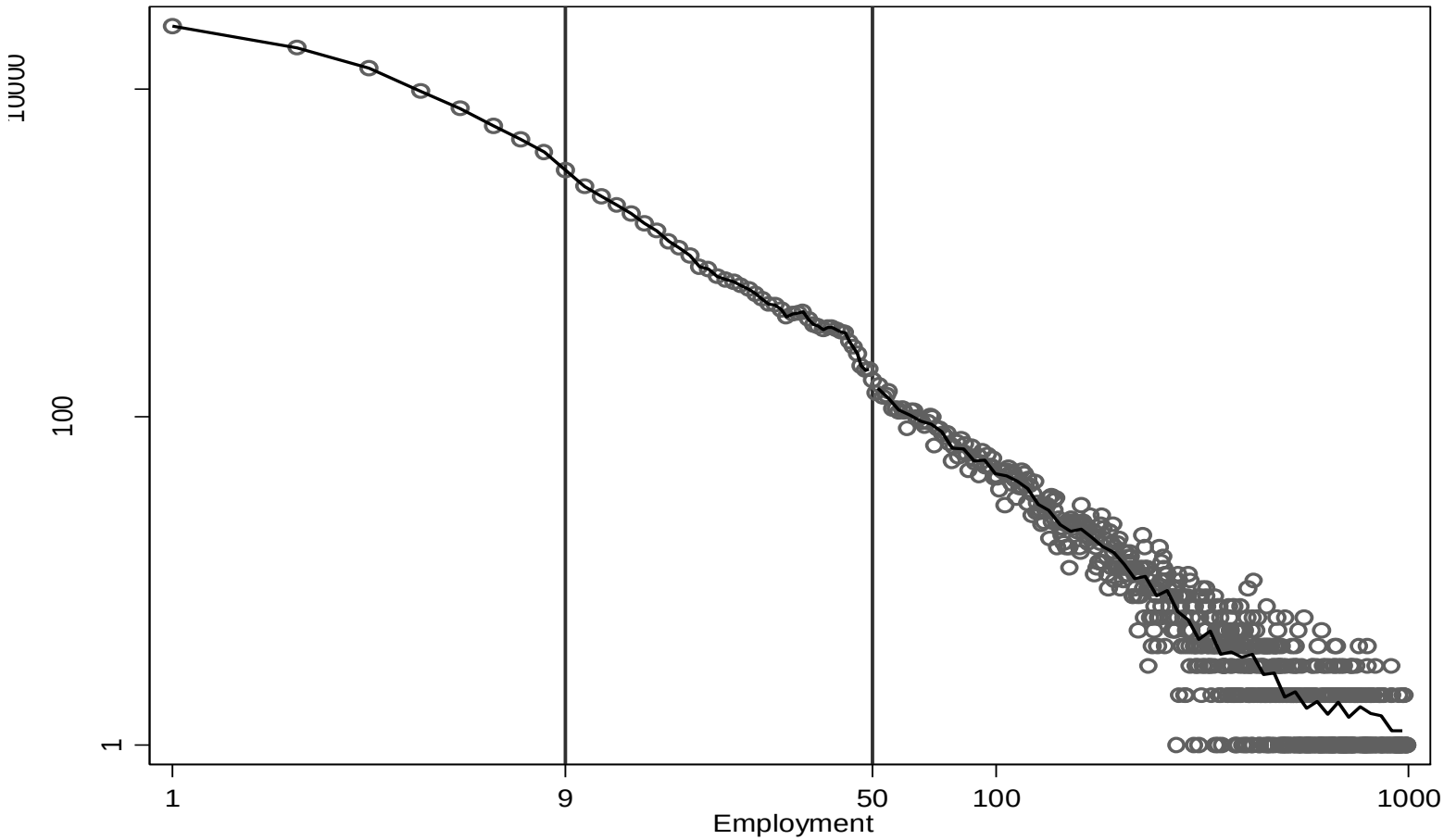
- **TFP/Size relationship:**

$$n^*(\alpha) = \begin{cases} \left(\frac{\alpha\theta}{w}\right)^{1/(1-\theta)} = c_1.\alpha^{1/(1-\theta)} = n_1(\alpha) & \text{if} \quad \alpha < \alpha_c \\ 49 = n_1(\alpha_c) & \text{if} \quad \alpha_c \leq \alpha < \alpha_u \\ \left(\frac{\alpha\theta}{w.\tau}\right)^{1/(1-\theta)} = \underbrace{c_1.\tau^{-1/(1-\theta)}}_{=c_2}.\alpha^{1/(1-\theta)} = \underbrace{n_1(\alpha).\tau^{-1/(1-\theta)}}_{=n_2(\alpha)} < n_1(\alpha) & \text{if} \quad \alpha_u \leq \alpha \end{cases}$$

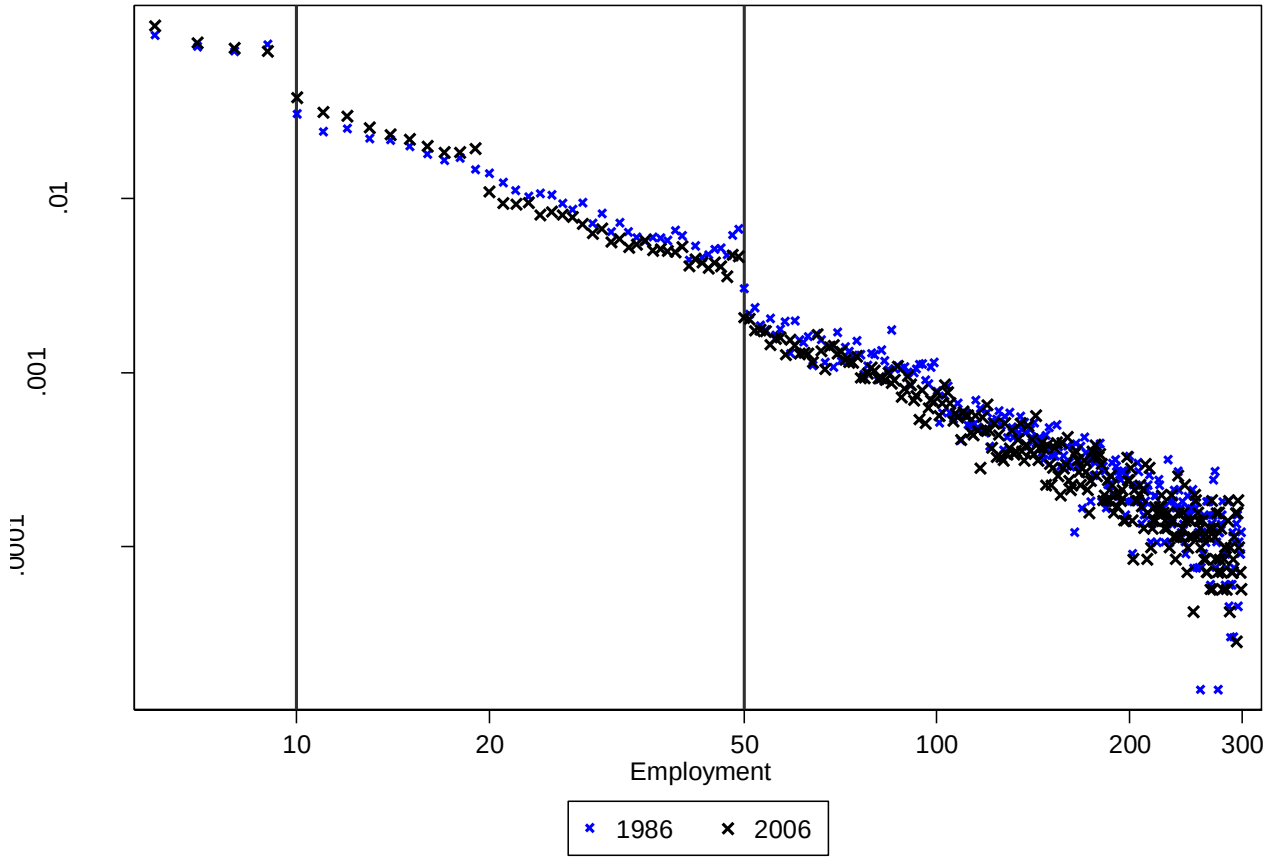
- **Firm size distribution (pdf):**

$$\chi^*(n) = \begin{cases} (\beta-1).n^{-\beta} & \text{if} \quad n < 49 = n_1(\alpha_c) \\ 49^{1-\beta} - T.n_u^{1-\beta} & \text{if} \quad n = 49 = n_1(\alpha_c) \\ 0 & \text{if} \quad 49 < n < n_u = n_2(\alpha_u) \\ (\beta-1).T.n^{-\beta} & \text{if} \quad n_2(\alpha_u) = n_u \leq n \end{cases}$$

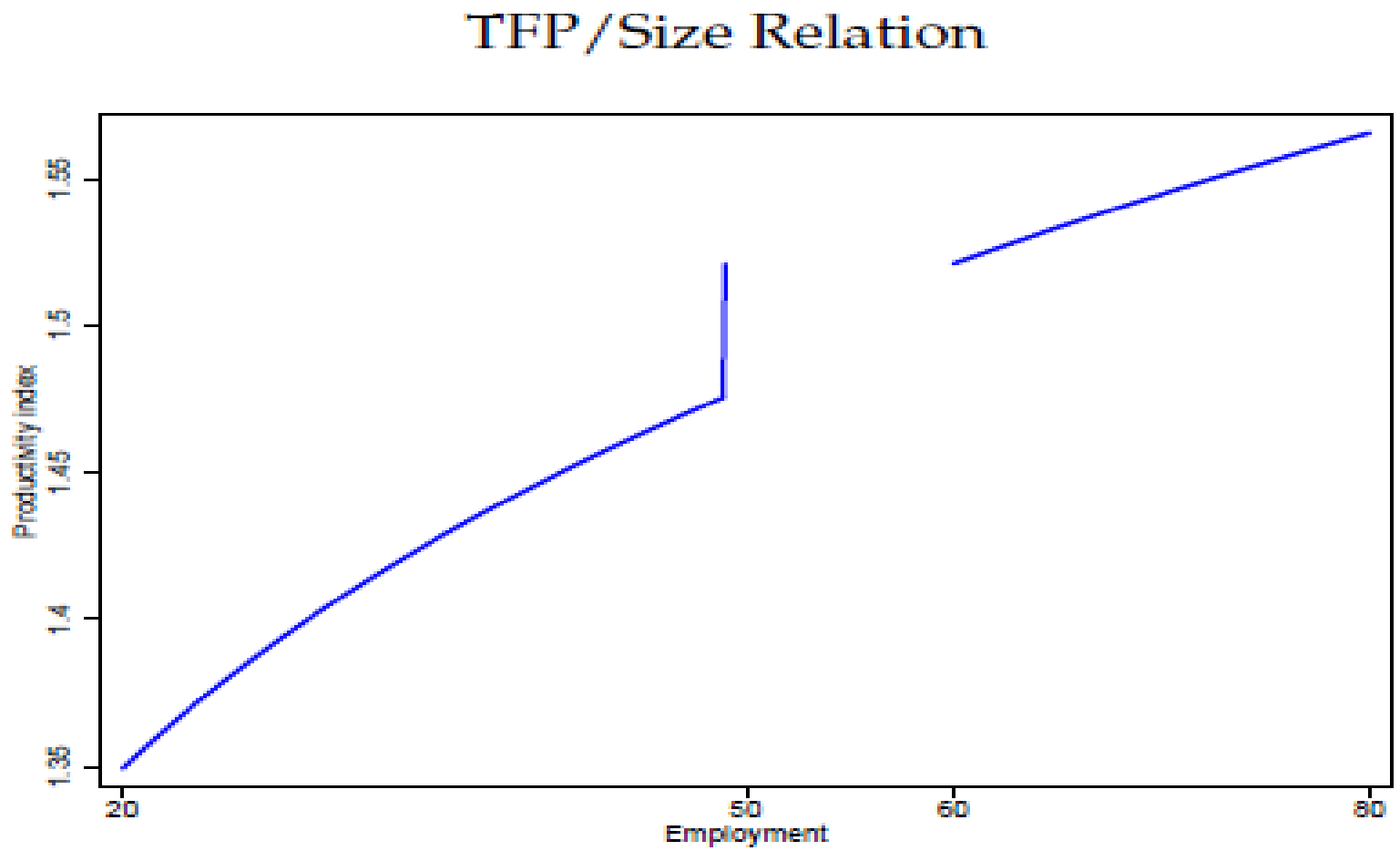
THE IMPORTANCE OF USING THE RIGHT DATA
FULL TIME EQUIVALENTS (ANNUALIZED)



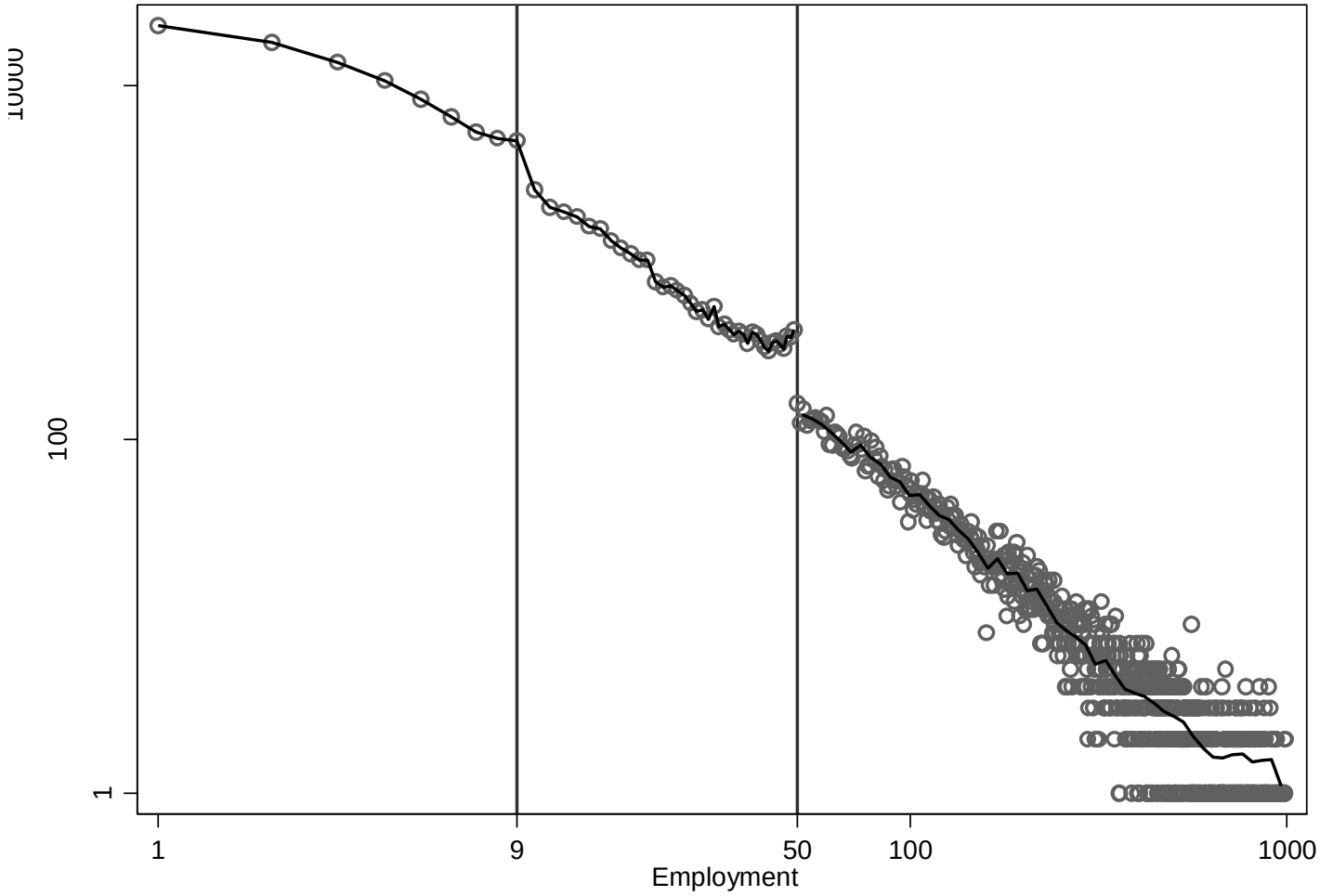
Manufacturing industries, 1986 vs 2006



THEORY: SIZE AND PRODUCTIVITY (FIG. 5)



FIRM SIZE DISTRIBUTION- FICUS DATASET, ALL WORKERS (FIG. 8)



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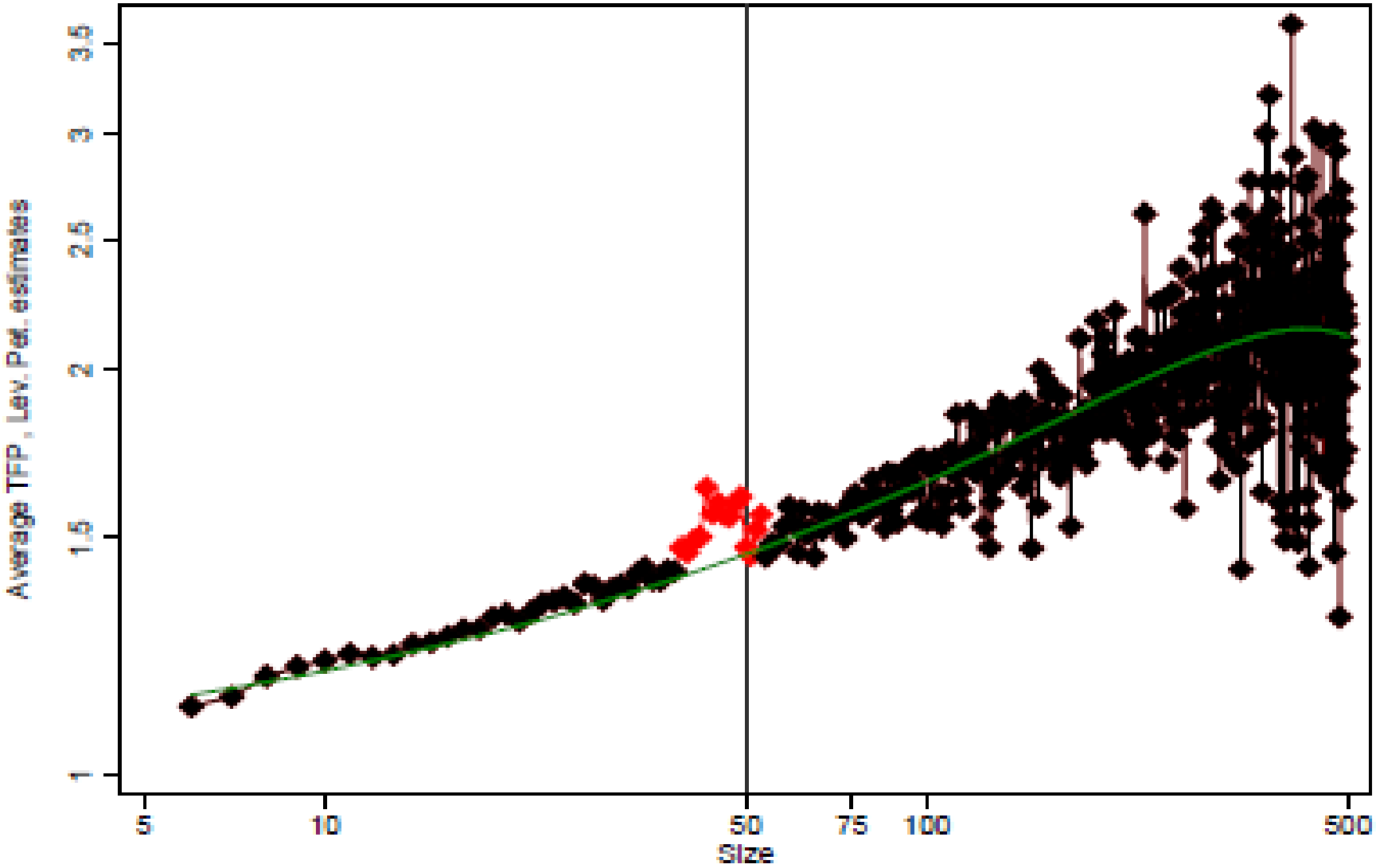
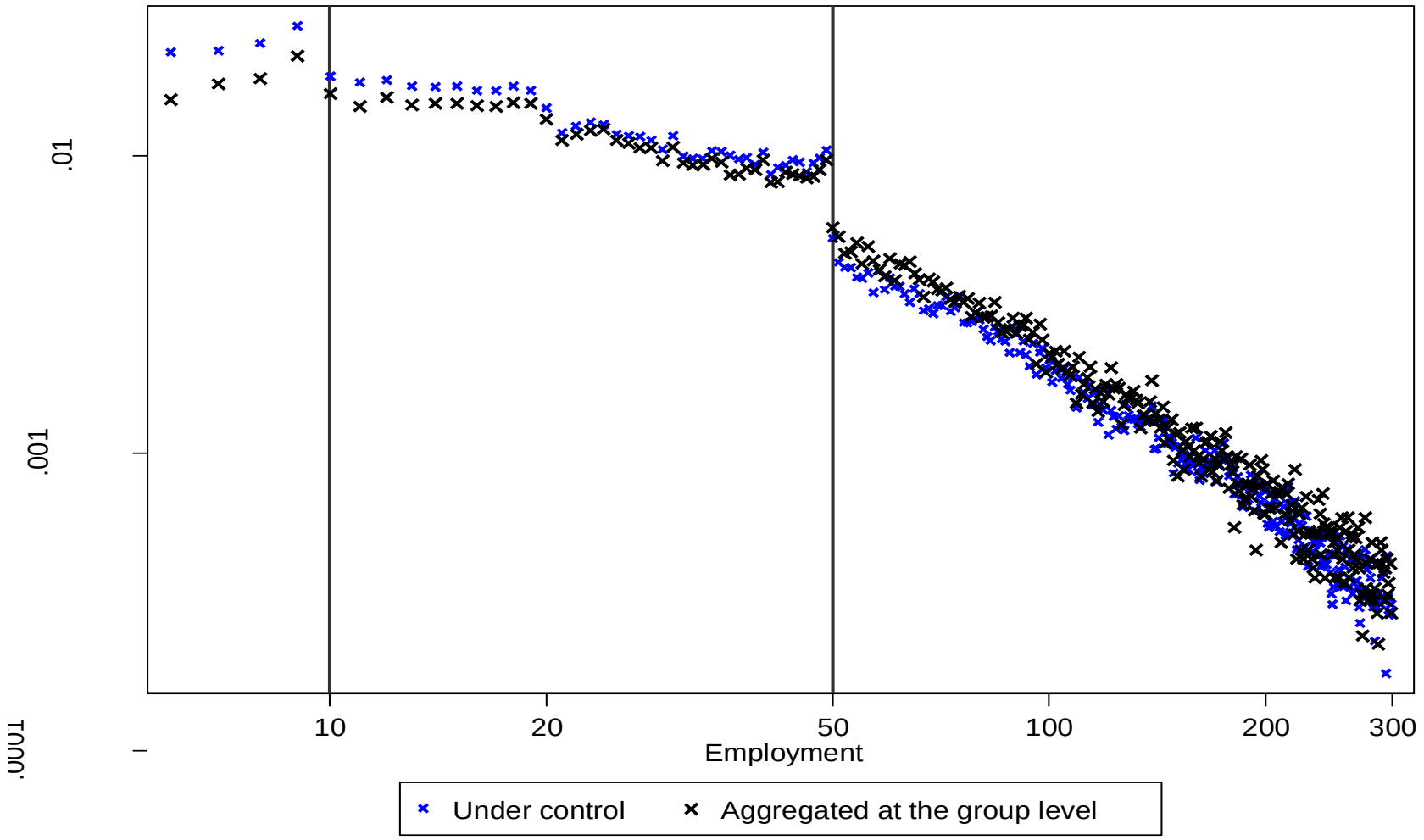


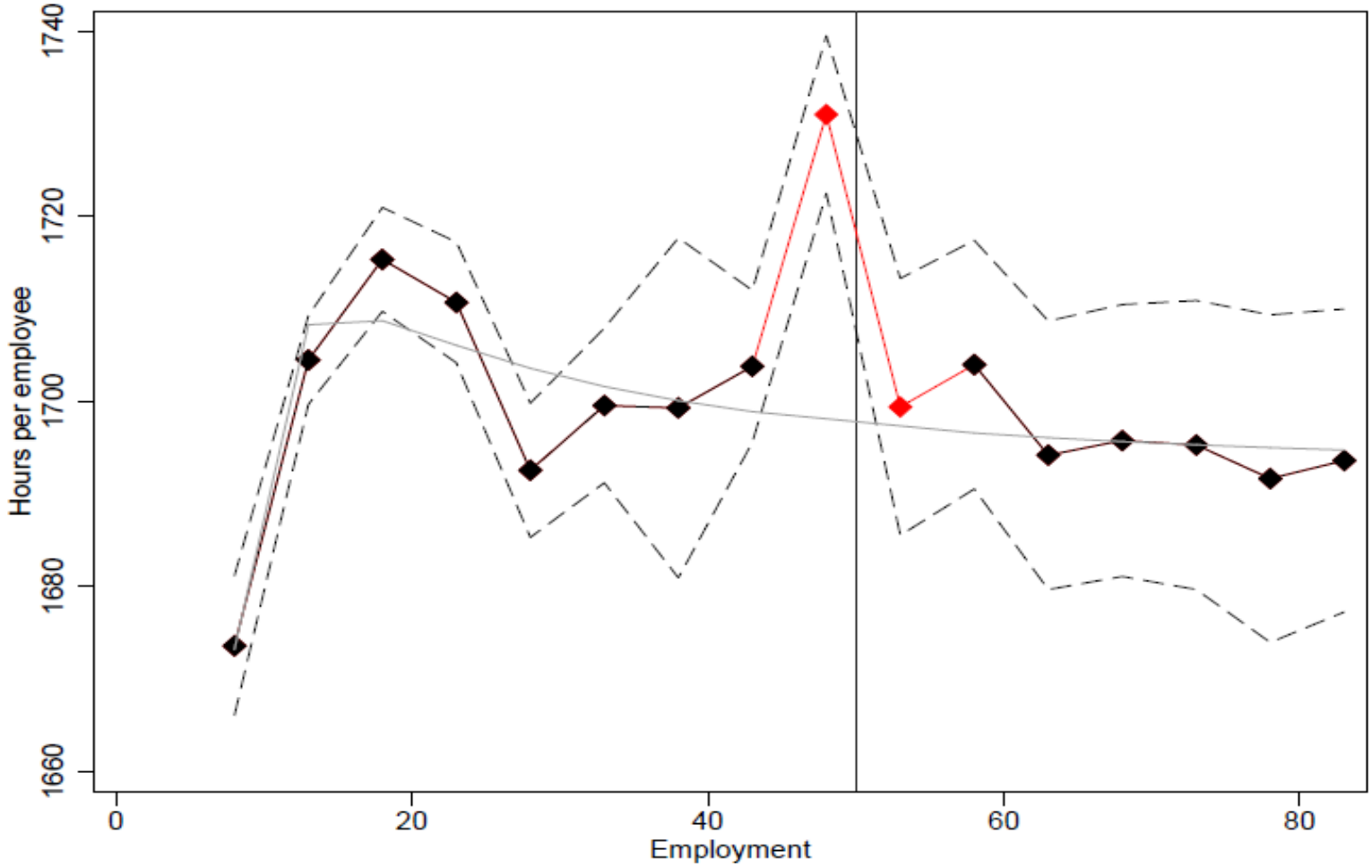
TABLE 1: ML ESTIMATES OF SIZE DISTRIBUTION – THE BROKEN POWER LAW

Parameter	Baseline	High Tech Sectors	Low Tech Sectors
β, power law	1.702	1.586	1.724
	(0.002)	(0.005)	(0.002)
Tax $T = \tau^{\frac{1-\beta}{1-\theta}}$	0.799	0.924	0.758
	(0.009)	(0.028)	(0.010)
n_u, upper emp.	61.068	58.899	61.143
Threshold	(0.461)	(1.559)	(0.537)
σ, variance of	0.212	0.140	0.220
msremnt. error	(0.004)	(0.047)	(0.003)
Observations	690,855	92,260	598,595
Firms	167,528	21,503	146,466

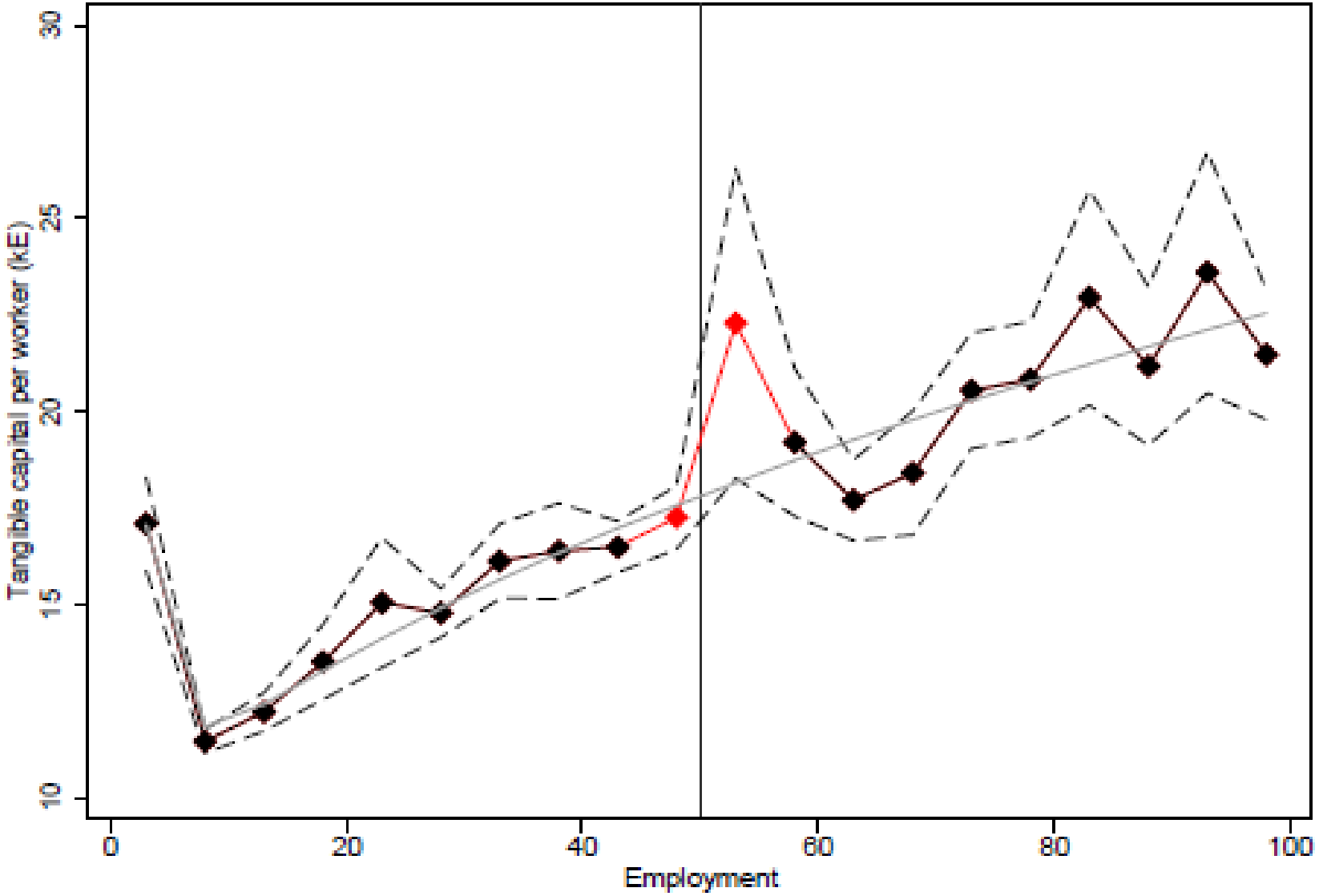
ITS NOT JUST BIG BUSINESS GROUPS PRETENDING TO BE SMALL



OTHER MARGINS OF ADJUSTMENT AROUND THE THRESHOLD: MORE HOURS PER WORKER

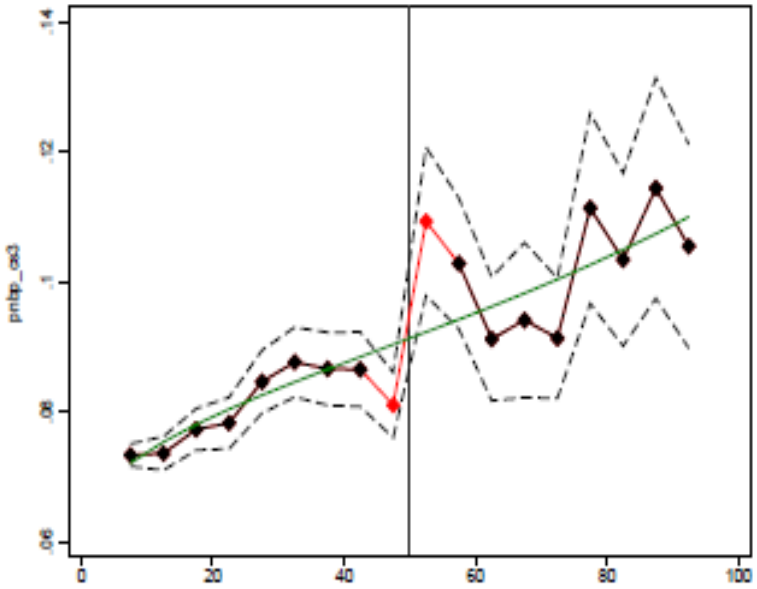


OTHER MARGINS OF ADJUSTMENT AROUND THE THRESHOLD: MORE CAPITAL PER WORKER

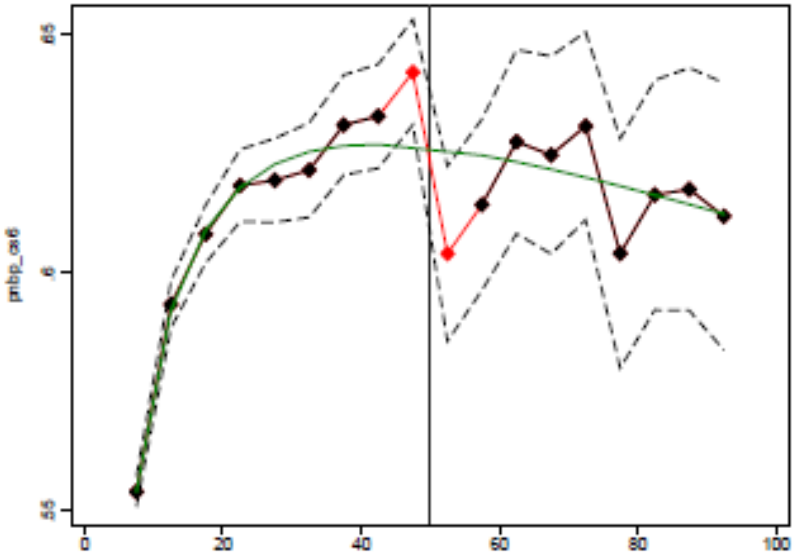


OTHER MARGINS OF ADJUSTMENT AROUND THE THRESHOLD: MORE SKILLS

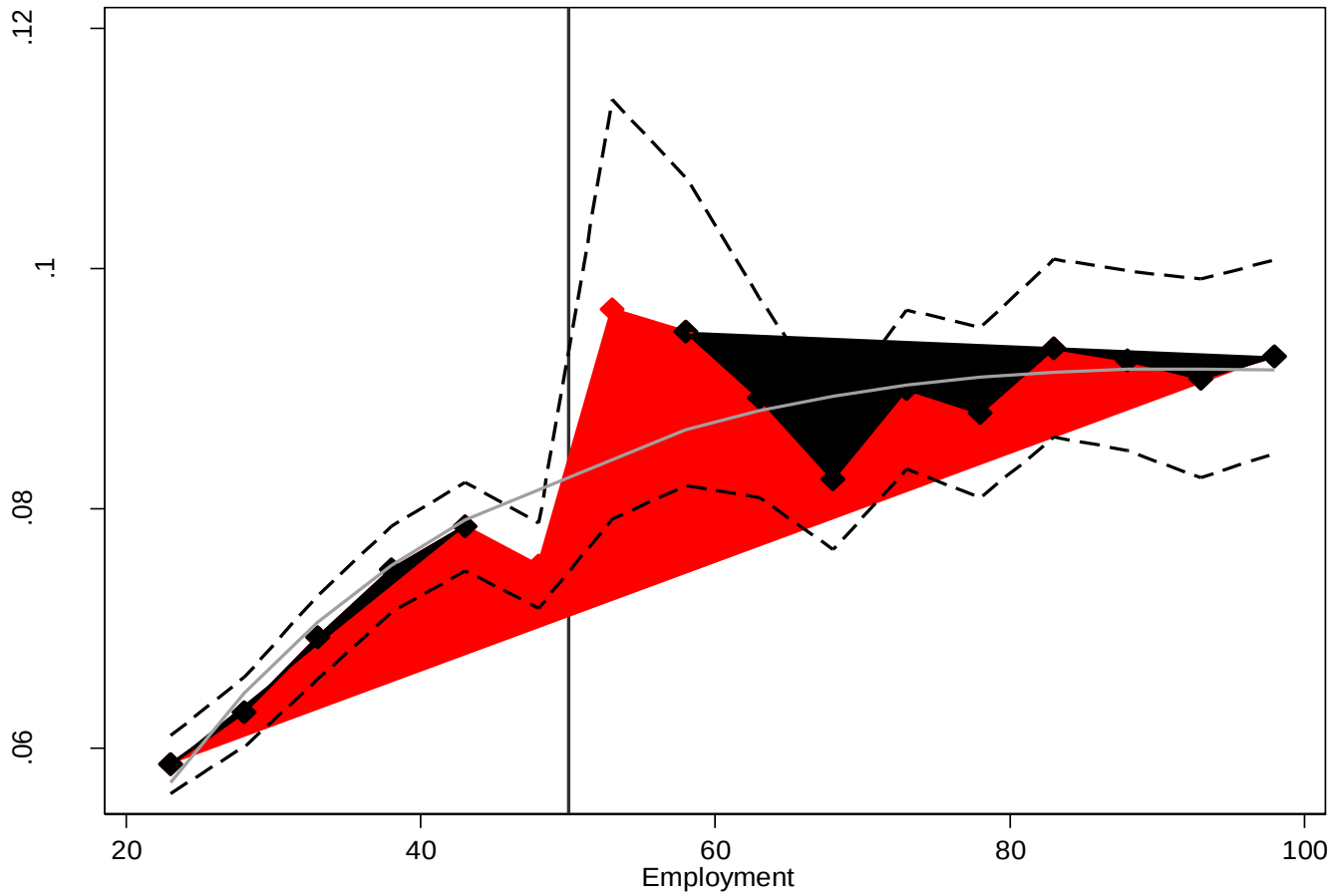
Share of managerial & professional up



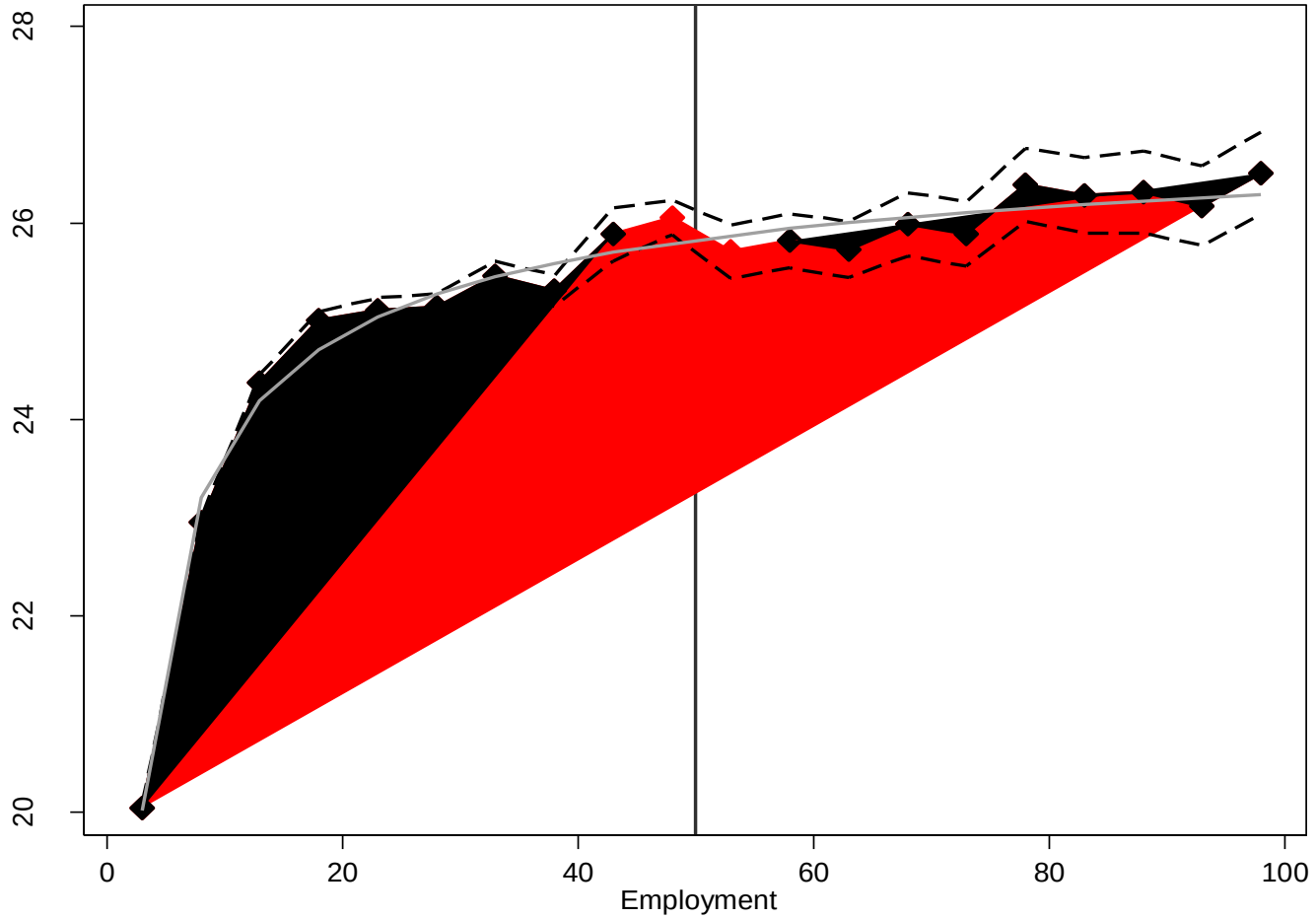
Share of blue collar workers down



OTHER MARGINS OF ADJUSTMENT AROUND THE THRESHOLD: MORE OUTSOURCED WORKERS



NO EVIDENCE THAT WORKERS ARE ACCEPTING LOWER WAGES IN RETURN FOR `INSURANCE' AGAINST FIRING COSTS



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