Firm Size Distortions and the Productivity Distribution: Evidence from France

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Or…… “Lucas in France”
MOTIVATION

1. **Reallocation**: bigger share of economic activity to more productive/efficient firms. Important in understanding:
   - Aggregate productivity changes over time **within countries** (e.g. Bailey et al, 1992) & **within industries**
   - Trade with heterogeneous firms (e.g. Melitz, 2003)
   - Aggregate productivity **across countries** (Hsieh & Klenow, 2009; Bartelsman, Haltiwanger & Scarpetta, 2013)

2. **Labor market regulation**.
   - How do we estimate the cost of labor regulations? Most Employment Protection Indices are crude & legally based
   - **Our alternative**: back out implicit regulatory “tax” using theory & data
     - Labor Reform is hot political issue in EU due to crisis
     - In France regulation increases for firms >50 workers
     - Affordable Care Act penalties for firms >50 workers who don’t offer health insurance, but not smaller firms
MANAGEMENT QUALITY DISTRIBUTION ACROSS FIRMS WITHIN COUNTRIES BLOOM & VAN REENEN DATA. TAIL OF VERY BADLY MANAGED FIRMS SMALLEST IN US

Firm-Level Management Scores (1 = worst, 5 = Best)
SUMMARY

• Focus on major labor regulations in GE setting:
• Method for estimating effects of size-related regulation
  – Extension of Lucas (1978) firm size paper
  – Exploit discontinuity in size-distribution (“Broken power law”) & theory for structural estimation

• Findings:
  – Big distributional effects: workers & large firms lose; small firms gain
  – Welfare costs potentially large: ~1% GDP if real wages fully adjust to regulation; ~5% if real wages don’t adjust down (US/France contrast?)
RAW DATA ON NUMBER OF FIRMS BY EACH SIZE CLASS (INTEGER NUMBER OF EMPLOYEES)

Exactly 49 employees
FIG 1: FIRM SIZE DISTRIBUTION: US DOESN’T HAVE A BREAK AT 49 WORKERS LIKE FRANCE

US firm size distribution
FR firm size distribution
WHY THE BREAK AT 49 WORKERS?

• Sharp increase in regulation at 50 workers
  – Creation of “work council” (“comité d’entreprise”) with minimum budget 0.3% of total payroll.
  – Firm has to offer union representation
  – Health & safety committee
  – Profit sharing scheme
  – Collective dismissal requires “social plan” to facilitate re-employment through training, job search, etc.
    Negotiated/monitored by unions & Labor Ministry

• These costs make firms reluctant to grow: an implicit tax on firm size (e.g. Bentolila & Bertola, 1990)
EXAMPLES OF RELATED PREVIOUS LITERATURE

• Lucas model applications

• Firm Size Distribution
  – Gibrat (1931); Axtell (2001); Ramsden & Kiss-Hapal (2000); Giovanni et al (2010); Hernandez-Perez et al (2006)

• Labor Market Regulation

• Productivity and Firm Size distribution

• Discontinuities related to tax kinks & notches
  – Saez (2010); Chetty et al (2011); Kleven et al (2011); Kleven & Wassoum (2012)
1. Theory: “Lucas in France”

2. Empirical Implementation

3. Data

4. Results
   • Main findings
   • Robustness/Extensions
THEORY

• One input, one sector a la Lucas (1978)

• Distribution of managerial ability ($\alpha$)

• Ability: how much an agent can raise a team’s output:
  – Manager with ability $\alpha$ and $n$ workers produces
    $$y = \alpha f(n)$$
  – $f'(n) > 0$, $f''(n) < 0$ from managerial span of control problem (e.g. $f(n) = n^\Theta$, $\Theta < 1$)
  – More able managers run bigger firms
INDIVIDUAL OPTIMIZATION

- Economy-wide wage, $w$

- Profits:

$$\pi(\alpha) = \max_n \alpha f(n) - w\bar{\tau}n - \bar{k}, \quad \text{with} \quad \begin{cases} 
\bar{\tau} = 1, \bar{k} = 0 \text{ if } n \leq N \\
\bar{\tau} = \tau, \bar{k} = k \text{ if } n > N
\end{cases}$$

- Once employment exceeds $N=49$ regulation implies implicit tax, $\tau$ & possibly a fixed cost, $k$

- First order condition at each side of threshold:

$$\alpha f'(n^*) - \bar{\tau}w = 0,$$
EQUILIBRIUM (1/3)

1. Wage level $w$
2. An allocation $n(\alpha)$: firm size ($n$) function of ability ($\alpha$)
3. A triple of cutoffs
   - $\{\alpha_{\text{MIN}}, \alpha_{\text{C}}, \alpha_{\text{U}}\}$
EQUILIBRIUM (2/3)

1. Labor supply = labor demand

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

3. The choice of \( n(\alpha) \) for each manager is optimal given their skills \( \alpha \), taxes \( \tau \), \( k \) and wage \( w \)

   “Marginal Manager” at \( \alpha_u \)

Profits at threshold  
Profits above threshold

\[
\alpha_u f(N) - wN = \alpha_u f(n^*(\alpha_u)) - w n^*(\alpha_u) - k
\]
EQUILIBRIUM (3/3)

- Firm size & productivity:

\[
\begin{align*}
n^*_N(a) &= 0 \quad \text{if } a < a_{\text{min}}^{N,\tau,k} \\
n^*_N(a) &= f^{I-1} \left( \frac{w^*_N(a)}{a} \right) \quad \text{if } a_{\text{min}}^{N,\tau,k} \leq a \leq a_c^{N,\tau,k} \\
n^*_N(a) &= N \quad \text{if } a_c^{N,\tau,k} \leq a < a_u^{N,\tau,k} \\
n^*_N(a) &= f^{I-1} \left( \frac{\tau w^*_N(a)}{a} \right) \quad \text{if } a_u^{N,\tau,k} \leq a < \infty
\end{align*}
\]
• Following Lucas (1978) assume:
  – The managerial returns to scale function has 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:

\[
\phi(\alpha) = c_\alpha \alpha^{-\beta_\alpha}
\]
Notes: parameter values are $\beta_\alpha=1.6$, $\tau=1.01$, $n_u=60$, $\beta=1.06$, $k=0$
THEORY: SIZE AND PRODUCTIVITY (FIG. 4)

Notes: parameter values are $\beta_\alpha=1.6$, $\tau=1.01$, $n_u=60$, $\beta=1.06$, $k=0$
Some productive firms Choose to remain small To avoid “tax”
LABOR REGULATION GENERATES `TOO MANY’ SMALL FIRMS FOR TWO 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 managerial ability individuals to form firms instead of remaining workers
  – And smaller firms enjoy lower labor costs

• `Too many’ small firms in Europe?
  – Braguinsky, Branstetter & Regateiro (2011) on Portugal
1. Theory: Lucas in France

2. Empirical Implementation

3. Data

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   • Main findings
   • Robustness/Extensions
EMPIRICAL IMPLEMENTATION

- Equilibrium Firm Size Distribution (pdf of $n^*$):

$$
\chi^*(n) = \begin{cases} 
\frac{(1-\theta)^{1-\beta}}{\theta} (\beta - 1)n^{-\beta} & \text{if } \frac{\theta}{1-\theta} \leq n \leq N \\
\frac{(1-\theta)^{1-\beta}}{\theta} (N^{1-\beta} - Tn_{u}^{1-\beta}) & \text{if } n = N \\
0 & \text{if } N < n < n_{u}^{N,\tau,k} \\
\frac{(1-\theta)^{1-\beta}}{\theta} (\beta - 1)Tn^{-\beta} & \text{if } n_{u}^{N,\tau,k} \leq n
\end{cases}
$$

- $\beta = \text{“slope” of power law in firm size} = \beta_\alpha (1- \theta) + \theta$

- Tax $\tau$, affects shift in ‘intercept’ of power law & size of ‘bulge’ & ‘valley’

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

Small Firms
“Bulge”
“Valley”
Large Firms
Since we have fully characterized firm size distribution we estimate parameters by straightforward ML to obtain $\beta$, $T(\tau, \beta, \theta)$, $n_U$, $\sigma$ and $k$

ML estimation of broken power law follows physics literature (e.g. Howell, 2002), but we also compare with OLS + structural breaks (e.g. Bai and Perron, 1998)

Also need estimate of $\theta$, returns to scale to identify the implicit tax:

$$T = \tau^{-\frac{\beta - 1}{1-\theta}}.$$
HOW TO ESTIMATE RETURNS TO SCALE ($\theta$)?

- In principle can estimate from the size distribution (but hard in practice as relies on marginal worker)
- Alternative more robust methods:
  - Calibrate from existing estimates (e.g. Basu and Fernald, 1997; Atkeson-Kehoe, 2005; Hsieh-Klenow, 2009)
  - Use firm-level production function estimates (Olley & Pakes, 1996); Levinsohn & Petrin, 2003; Blundell & Bond, 2000; Solow residual, etc.)
  - Use the TFP-size relationship
- We look at all these methods to show robustness of the estimates of the regulation
IDENTIFICATION OF THE TAX (FIRM SIZE POWER LAW IN LOG-LOG SPACE)
IDENTIFICATION OF THE TAX

Slope is $\beta$
IDENTIFICATION OF THE TAX

Tax identified from
i) shift in the intercept
IDENTIFICATION OF THE REGULATORY TAX

Tax identified from
i) shift in the intercept
ii) “bulge” & “valley”

Note: Fixed cost of regulation, k, does not affect intercept
FIG 5: THEORETICAL FIRM SIZE DISTRIBUTION (WITH MEASUREMENT ERROR, $\sigma$)
EMPirical IMPLEMENTATION

- \( \beta \) = "slope" of power law in firm size
- Tax = change in intercept
  - Tax partly identified from "bulge" at 49 & "valley"
OUTLINE

1. Theory: Lucas in France

2. Empirical Implementation

3. Data

4. Results
   • Main findings
   • Robustness/Extensions
DATA

• Universe of French firms between 2002 - 2007
  – Mandatory fiscal returns of all French firms ("FICUS")
  – DADS (for some extra info on workers, e.g. hours, skills)
  – This is the administrative unit that the main law pertains to.

• FICUS has balance sheet information on value added, labor, capital, investment, wage bills, materials, 4 digit industry, etc.
  – Use this to calculate TFP via several methods (Levinsohn-Petrin, Olley Pakes, Solow residual, etc.)
FIG 7: EMPIRICAL FIRM SIZE DISTRIBUTION – SLOPE, BULGE, VALLEY & INTERCEPT SHIFT

Note: Another regulatory break at 10 so focus econometrics on firms between 10 and 1000 (& check robustness)
FIG 8: TFP & SIZE RELATIONSHIP: CONSISTENT WITH THEORY THERE IS A BULGE IN TFP AROUND THE REGULATORY THRESHOLD
OUTLINE

1. Theory: Lucas in France

2. Empirical Implementation

3. Data

4. Results
   - Main findings
   - Robustness/Extensions
<table>
<thead>
<tr>
<th>Parameter</th>
<th>0.8 (Basu-Fernald)</th>
<th>0.85 (Atkeson-Kehoe)</th>
<th>(\theta=0.5)</th>
<th>(\theta=0.9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\theta), Ret Scale</td>
<td>0.8</td>
<td>0.85</td>
<td>(\theta=0.5)</td>
<td>(\theta=0.9)</td>
</tr>
<tr>
<td>(calibrated)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\tau), Implicit variable tax</td>
<td>1.013 (0.005)</td>
<td>1.010 (0.004)</td>
<td>1.033 (0.013)</td>
<td>1.004 (0.002)</td>
</tr>
<tr>
<td>(\beta), power law</td>
<td>1.822 (0.059)</td>
<td>1.822 (0.059)</td>
<td>1.822 (0.059)</td>
<td>1.829 (0.057)</td>
</tr>
<tr>
<td>(1-\beta)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(T = \tau^{1-\theta})</td>
<td>0.948 (0.018)</td>
<td>0.948 (0.018)</td>
<td>0.948 (0.018)</td>
<td>0.965 (0.015)</td>
</tr>
<tr>
<td>(n_u), upper emp. cutoff</td>
<td>57.898 (0.024)</td>
<td>57.898 (0.024)</td>
<td>57.898 (0.024)</td>
<td>52.562 (0.002)</td>
</tr>
<tr>
<td>(\sigma), msremnt. error</td>
<td>0.104 (0.025)</td>
<td>0.104 (0.025)</td>
<td>0.104 (0.025)</td>
<td>0.036 (0.008)</td>
</tr>
<tr>
<td>(k/w), Fixed cost of tax</td>
<td>0.141 (0.257)</td>
<td>0.265 (0.192)</td>
<td>-0.606 (0.653)</td>
<td>0.436 (0.990)</td>
</tr>
</tbody>
</table>

**Notes:** 57,008 firms and 238,701 obs (manufacturing size 10-1000); estimates by ML with standard errors clustered at the 4 digit level.
FIG 9 FIRM SIZE DISTRIBUTION: ACTUAL AND FITTED

Notes: Baseline specification Table 1 column (1).
<table>
<thead>
<tr>
<th></th>
<th>Firms having 10 to 48 workers</th>
<th>Firms having 49 to 57 workers</th>
<th>Firms having 58 to 10,000 workers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(Actual data)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distribution of firms</td>
<td>0.762</td>
<td>0.035</td>
<td>0.204</td>
<td>1</td>
</tr>
<tr>
<td>(predicted)</td>
<td>0.760</td>
<td>0.039</td>
<td>0.201</td>
<td>1</td>
</tr>
<tr>
<td>Distribution of employment (actual)</td>
<td>0.295</td>
<td>0.032</td>
<td>0.672</td>
<td>1</td>
</tr>
<tr>
<td>(predicted)</td>
<td>0.277</td>
<td>0.035</td>
<td>0.688</td>
<td>1</td>
</tr>
<tr>
<td>n = n^* [\alpha] \cdot e^{\epsilon \cdot \epsilon} ; \sigma_{\epsilon} = 0.104</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distribution of output (actual)</td>
<td>0.242</td>
<td>0.029</td>
<td>0.728</td>
<td>1</td>
</tr>
<tr>
<td>(predicted)</td>
<td>0.275</td>
<td>[0.219;0.331]</td>
<td>[0.635;0.747]</td>
<td>1</td>
</tr>
</tbody>
</table>

\[ y = \alpha \cdot n^\theta = \alpha \cdot (n^* [\alpha])^\theta \cdot e^{\theta \epsilon}, \sigma_{\epsilon} = 0.104 \]
### TABLE 3 WELFARE & DISTRIBUTION

(Regulated Economy – Unregulated Economy)

<table>
<thead>
<tr>
<th></th>
<th>FULL WAGE ADJUST</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unemployment rate</strong></td>
<td>0%</td>
</tr>
<tr>
<td>Percentage of firms avoiding</td>
<td>3.593%</td>
</tr>
<tr>
<td>the regulation</td>
<td></td>
</tr>
<tr>
<td>Percentage of firms paying</td>
<td>9.036%</td>
</tr>
<tr>
<td>tax (compliers)</td>
<td></td>
</tr>
<tr>
<td><strong>Change in labor costs</strong></td>
<td>-1.074%</td>
</tr>
<tr>
<td>(wage reduction), Small firms</td>
<td></td>
</tr>
<tr>
<td>(below 49)</td>
<td></td>
</tr>
<tr>
<td><strong>Change in labor costs</strong></td>
<td>0.232%</td>
</tr>
<tr>
<td>(wage reduction but tax increase), Large firms (above 49)</td>
<td></td>
</tr>
<tr>
<td><strong>Excess entry by small firms</strong></td>
<td>4.419%</td>
</tr>
<tr>
<td>(percent increase in number of firms)</td>
<td></td>
</tr>
<tr>
<td><strong>Increase in size of small firms</strong></td>
<td>5.370%</td>
</tr>
<tr>
<td><strong>Increase in size of large firms</strong></td>
<td>-1.160%</td>
</tr>
<tr>
<td><strong>Annual welfare loss (as % of GDP):</strong></td>
<td></td>
</tr>
<tr>
<td>Implicit Tax</td>
<td>0.804%</td>
</tr>
<tr>
<td>Output loss</td>
<td>0.016%</td>
</tr>
<tr>
<td><strong>Total (implicit tax + output loss)</strong></td>
<td><strong>0.820%</strong></td>
</tr>
<tr>
<td><strong>Winners and losers:</strong></td>
<td></td>
</tr>
<tr>
<td>Change in expected wage for</td>
<td>-1.074%</td>
</tr>
<tr>
<td>those in labor force</td>
<td></td>
</tr>
<tr>
<td>Average gain by entering</td>
<td>1.603%</td>
</tr>
<tr>
<td>entrepreneurs of small firms</td>
<td></td>
</tr>
<tr>
<td>Average profit gain by small</td>
<td>4.296%</td>
</tr>
<tr>
<td>unconstrained firms</td>
<td></td>
</tr>
<tr>
<td>Average profit gain by firms</td>
<td>2.447%</td>
</tr>
<tr>
<td>constrained at 49</td>
<td></td>
</tr>
<tr>
<td>Change in profit for large</td>
<td>-0.928%</td>
</tr>
<tr>
<td>firms</td>
<td></td>
</tr>
</tbody>
</table>
FIGURE 12: DISTRIBUTIONAL EFFECTS OF REGULATION ACROSS AGENTS

Losers

Winners

Losers

Diff. in ln(income) (with tax - w/o tax)

With tax reallocated to workers

Winners

Losers
<table>
<thead>
<tr>
<th>(Regulated Economy – Unregulated Economy)</th>
<th>FULL WAGE ADJUST</th>
<th>NO WAGE ADJUST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment rate</td>
<td>0%</td>
<td>5.217%</td>
</tr>
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<td>3.593%</td>
<td>3.438%</td>
</tr>
<tr>
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<td>9.036%</td>
<td>8.646%</td>
</tr>
<tr>
<td>Change in labor costs (wage reduction), Small firms (below 49)</td>
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<td>0</td>
</tr>
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<td>Change in labor costs (wage reduction but tax increase), Large firms (above 49)</td>
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<td>1.306%</td>
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<td>4.409%</td>
</tr>
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<td>0</td>
</tr>
<tr>
<td>Increase in size of large firms</td>
<td>-1.160%</td>
<td>-6.530%</td>
</tr>
<tr>
<td>Annual welfare loss (as % of GDP):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implicit Tax</td>
<td>0.804%</td>
<td>0.801%</td>
</tr>
<tr>
<td>Output loss</td>
<td>0.016%</td>
<td>4.302%</td>
</tr>
<tr>
<td>Total (implicit tax + output loss)</td>
<td><strong>0.820%</strong></td>
<td><strong>5.103%</strong></td>
</tr>
</tbody>
</table>

Winners and losers:
- Change in expected wage for those in labor force: -1.074% to -5.358%
- Average gain by entering entrepreneurs of small firms: 1.603% to -2.687%
- Average profit gain by small unconstrained firms: 4.296% to 0
- Average profit gain by firms constrained at 49: 2.447% to -1.849%
- Change in profit for large firms: -0.928% to -5.224%
COST OF REGULATION IS AN INCREASING FUNCTION OF THE DEGREE TO WHICH EQUILIBRIUM REAL WAGES DON’T ADJUST DOWNWARDS AFTER REGULATION

Notes: This estimates the welfare (and unemployment) loss as a function of how much equilibrium real wage Falls as a result of the regulation. Our baseline is fully flexible case (“Wage adjustment = 100%” on the far right), but alternative upper bound is where there is no adjustment (“Wage adjustment = 0%”) on the far left
WELFARE COSTS: SUMMARY

• With flexible wages welfare costs small (under 1% of GDP) as ranking of firm size stays the same (Hopenhayn, 2012)
• But big distributional change
  – Workers lose as they bear cost of regulation through lower wages
  – Large firms lose as lower wages do not fully offset regulation costs
  – Small Firms gain from lower costs & more entrepreneurs
• With inflexible wages (unions, minimum wages, etc.) much bigger welfare costs due to unemployment
  – Similar pattern of redistribution
• And further losses from other size-related regulations
1. Theory: Lucas in France

2. Empirical Implementation

3. Data

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   • Main findings
   • Robustness/Extensions
EXTENSIONS & ROBUSTNESS

• Big firms pretending to be small?
  – We see effects for standalone firms as well as those part of business groups
  – Misreporting

• Other margins of adjustment (e.g. hours)

• Workers benefit from “insurance” & take lower wages (Lazear, 1990)?

• Other Explanations for the “Valley”: dynamic model

• Industry Heterogeneity

• Alternative calculations based on MRPL a la Hsieh-Klenow (2009)

• Allow for discontinuity at size=10
RESULTS NOT DRIVEN BY BIG BUSINESS GROUPS PRETENDING TO BE SMALL (FIG 14A)
EXTENSIONS

• Other margins of adjustment
  – Hours, capital, skills, outsourcing, etc.
  – $y = \alpha [h(n, x)]^\Theta$ instead of $y = \alpha n^\Theta$
  – Substitution reduces costs to firms, but still distortion unless perfect substitutes
  – Our good predictions on output suggest these other margins of substitution are not first order
FIG 15 - OTHER ADJUSTMENTS AROUND THE THRESHOLD: MORE HOURS PER WORKER
EXTENSIONS

• Workers benefit from the “mandated benefit” & take lower wages (Lazear, 1990; Summers, 1989)?
FIG 13: NO EVIDENCE THAT WORKERS ARE ACCEPTING LOWER WAGES IN RETURN FOR TOUGHER REGULATION
EXTENSIONS: Dynamics

- Positive mass in valley to right of threshold could be due to adjustment costs (not just measurement error)
- Consider much more general model:
  - Initial draw of TFP & then random shocks each period (AR(1) with 0.95 persistence)
  - Labor & Capital with quadratic adjustment costs
  - Numerically simulate model
- Use value function iteration to calculate policy correspondences
- Draw 20,000 firms & run for 100 years. Distribution settles down after ~75 years so just use last 25 years to characterize long-run employment distribution
Baseline calibration of steady state firm employment size distribution generates similar picture as static model

Positive mass in valley are firms moving in & out
As adjustment costs increase valley is “smoothed out”
FIG 16A PROPORTION OF FIRMS GROWING BY MORE THAN 10%
FIG 16B PROPORTION OF FIRMS SHRINKING BY MORE THAN 10%
EXTENSIONS

• Industry heterogeneity
  – Some heterogeneity (e.g. high/low tech in Table 2; Table 3 over)
  – Estimate separately for each 3 digit industry
  – Sensible heterogeneity, e.g. higher implicit tax when labor a larger share of total value added
<table>
<thead>
<tr>
<th>Experiment</th>
<th>Manufacturing</th>
<th>Transport</th>
<th>Construction</th>
<th>Wholesale &amp; Dist.</th>
<th>Business Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>θ, Ret Scale</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
</tr>
<tr>
<td>τ, Implicit variable tax</td>
<td>1.013 (0.005)</td>
<td>1.025 (0.010)</td>
<td>1.020 (0.004)</td>
<td>1.022 (0.006)</td>
<td>1.003 (0.004)</td>
</tr>
<tr>
<td>β, power law</td>
<td>1.822 (0.059)</td>
<td>1.878 (0.098)</td>
<td>2.372 (0.147)</td>
<td>2.128 (0.100)</td>
<td>2.001 (0.087)</td>
</tr>
<tr>
<td>T</td>
<td>0.948 (0.018)</td>
<td>0.898 (0.029)</td>
<td>0.871 (0.016)</td>
<td>0.885 (0.022)</td>
<td>0.984 (0.020)</td>
</tr>
<tr>
<td>n_u, upper emp. cutoff</td>
<td>57.898 (0.024)</td>
<td>55.312 (0.016)</td>
<td>57.874 (0.013)</td>
<td>57.151 (0.015)</td>
<td>58.254 (0.018)</td>
</tr>
<tr>
<td>σ, msremnt. error</td>
<td>0.104 (0.025)</td>
<td>0.060 (0.023)</td>
<td>0.089 (0.037)</td>
<td>0.084 (0.050)</td>
<td>0.106 (0.024)</td>
</tr>
<tr>
<td>Obs</td>
<td>238,701</td>
<td>70,479</td>
<td>159,440</td>
<td>255,812</td>
<td>205,835</td>
</tr>
</tbody>
</table>

Notes: size 10-1000 employees; estimates by ML with standard errors clustered at the 4 digit level.
FIG A1 HETEROGENEITY OF THE ESTIMATES ACROSS DIFFERENT THREE DIGIT INDUSTRIES
EXTENSIONS

• Hsieh-Klenow (2009) approach
  – Calculate marginal revenue productivity near threshold
  – How much does this change between “constrained” firms and “unconstrained” firms?

• Issues with approach
  – Those on immediate sides of threshold not comparable
  – Measuring MRP non-trivial (e.g. overhead labor)
COMPARISON WITH HSIEH-KLENOOW APPROACH: MARGINAL REVENUE PRODUCTIVITY OF LABOR
FIG A3: MRPL SUGGESTS A TAX OF 3-4% (SAME AS MAIN RESULTS WHEN WE USE H-K $\theta=.5$)

~3-4% implicit tax

Note: This is data on value added per worker relative to the four digit industry average
EXTENSION: GENERALIZE MODEL TO ALSO ALLOW FOR REGULATION AT SIZE=10

- Extend method to allow for an additional variable and fixed cost after 10 employees (recall smaller discontinuity here)
- Small, but fixed cost bigger than variable cost
- Welfare loss from 10 is 0.06% of GDP (compared to 1% of GDP) under the flexible wage case (0.3% vs. 5% under the rigid wage case.)
CONCLUSIONS

• Simple method for quantifying effect of size-related regulations & explains qualitative features of data
• Big changes in distribution: workers & large firms lose but smaller firms win
• Loss of GDP up to 4-5% with inflexible wages
• **Next Steps:**
  – Re-calculate regulatory tax based on dynamic model
  – Let TFP be influenced by endogenous innovation decisions (e.g. increased penalty of growing may reduce investment incentives)
  – Build in other size-related regulations
  – Other settings for methodology: ACA?
Back Up
FIRM SIZE DISTRIBUTION IN US AND FRANCE – A “BULGE” OF EMPLOYMENT IN FRENCH FIRMS WITH JUST UNDER 50 WORKERS
FIG 6: THE IMPORTANCE OF USING GOOD DATA: FULL TIME EQUIVALENTS DADS
LARGER FIRMS ARE MORE PRODUCTIVE
Manufacturing industries, 1986 vs 2006
FIRM SIZE MEASURED WITH ERROR

- Observed size (allow for measurement error)

\[ n(\alpha, \varepsilon) = n^*(\alpha) \cdot e^\varepsilon \]

- Measurement error log-normal with mean 0, SD \( \sigma \)

- Conditional cdf

\[
P(x < n | \varepsilon) = \begin{cases} 
0 & \text{if } \ln(n) - \ln\left(\frac{\theta}{1-\theta}\right) < \varepsilon \\
1 - \left(1 - \frac{\theta}{\bar{\theta}}\right)^{1-\beta} (ne^{-\varepsilon})^{1-\beta} & \text{if } \ln(n) - \ln(N) \leq \varepsilon \leq \ln(n) - \ln\left(\frac{\theta}{1-\theta}\right) \\
1 - \left(1 - \frac{\theta}{\bar{\theta}}\right)^{1-\beta} T(n_{u}^{N,\tau,k})^{1-\beta} & \text{if } \ln(n) - \ln(n_{u}^{N,\tau,k}) < \varepsilon \leq \ln(n) - \ln(N) \\
1 - \left(1 - \frac{\theta}{\bar{\theta}}\right)^{1-\beta} T(ne^{-\varepsilon})^{1-\beta} & \text{if } \varepsilon \leq \ln(n) - \ln(n_{u}^{N,\tau,k})
\end{cases}
\]
TFP & SIZE RELATIONSHIP: CONSISTENT WITH THEORY THERE IS A BULGE IN TFP AROUND THE REGULATORY THRESHOLD
OTHER MARGINS OF ADJUSTMENT AROUND THE THRESHOLD: MORE OUTSOURCED WORKERS
TABLE 10: SIZE DISTRIBUTION WITH AND WITHOUT REGULATION

<table>
<thead>
<tr>
<th>Number of firms (ln)</th>
<th>Employment with regulation</th>
<th>Employment without regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>200</td>
<td>162</td>
</tr>
<tr>
<td>49</td>
<td>200</td>
<td>149</td>
</tr>
<tr>
<td>58</td>
<td>200</td>
<td>138</td>
</tr>
<tr>
<td>70</td>
<td>200</td>
<td>127</td>
</tr>
</tbody>
</table>
TABLE 11: OUTPUT DISTRIBUTION BY ABILITY LEVEL
FIGURE 12A: DISTRIBUTIONAL EFFECTS OF REGULATION ACROSS AGENTS (RIGID WAGES)
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
WELFARE COSTS OF REGULATION

\[ \Delta Y = Y(N, \tau, k) - Y(N, 1, 0) \]

\[ = \int_{\alpha_{\min}}^{\alpha_{c1,1,0}} \alpha \left[ f(n_{N,\tau,k}^*(\alpha)) - f(n_{N,1,0}^*(\alpha)) \right] \phi(\alpha) d\alpha + \int_{\alpha_{\min}}^{\alpha_{c2,1,0}} \alpha \left[ f(n_{N,\tau,k}^*(\alpha)) - f(n_{N,1,0}^*(\alpha)) \right] \phi(\alpha) d\alpha \]

\[ + \int_{\alpha_{c1,\tau,k}}^{\alpha_{u}} \alpha \left[ f(N) - f(n_{N,1,0}^*(\alpha)) \right] \phi(\alpha) d\alpha \]

\[ + \int_{\alpha_{c2,\tau,k}}^{\infty} \alpha \left\{ f(n_{N,\tau,k}^*(\alpha)) - f(n_{N,1,0}^*(\alpha)) \right\} \phi(\alpha) d\alpha \]

**Losses**

Productive firms choose to be at the “bulge” (second row)
Very large firms are smaller because of tax (last row)

**Gains (first row)**

Some marginal workers become firms
Small firms bigger because lower equilibrium wage
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
<table>
<thead>
<tr>
<th>Experiment</th>
<th>Baseline</th>
<th>Production Function</th>
<th>TFP/Size</th>
<th>High Tech (with PF)</th>
<th>Low Tech (with PF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \theta ), Ret Scale</td>
<td>0.8</td>
<td>0.855</td>
<td>0.799</td>
<td>0.882</td>
<td>0.848</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.025)</td>
<td>(0.012)</td>
<td>(0.016)</td>
<td></td>
</tr>
<tr>
<td>( \tau ), Implicit variable tax</td>
<td>1.013</td>
<td>1.010</td>
<td>1.013</td>
<td>1.001</td>
<td>1.013</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.004)</td>
<td>(0.005)</td>
<td>(0.003)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>( \beta ), power law</td>
<td>1.822</td>
<td>1.822</td>
<td>1.822</td>
<td>1.625</td>
<td>1.864</td>
</tr>
<tr>
<td></td>
<td>(0.059)</td>
<td>(0.052)</td>
<td>(0.055)</td>
<td>(0.063)</td>
<td>(0.063)</td>
</tr>
<tr>
<td>( T )</td>
<td>0.948</td>
<td>0.948</td>
<td>0.948</td>
<td>0.997</td>
<td>0.929</td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td>(0.020)</td>
<td>(0.012)</td>
<td>(0.032)</td>
<td></td>
</tr>
<tr>
<td>( n_u ), upper empl. cutoff</td>
<td>57.898</td>
<td>57.899</td>
<td>57.898</td>
<td>50.000</td>
<td>58.328</td>
</tr>
<tr>
<td></td>
<td>(0.024)</td>
<td>(1.133)</td>
<td>(1.342)</td>
<td>(2.474)</td>
<td>(1.603)</td>
</tr>
<tr>
<td>( \sigma ), ms. rem. error</td>
<td>0.104</td>
<td>0.104</td>
<td>0.104</td>
<td>0.000</td>
<td>0.114</td>
</tr>
<tr>
<td></td>
<td>(0.025)</td>
<td>(0.020)</td>
<td>(0.024)</td>
<td>(0.029)</td>
<td>(0.034)</td>
</tr>
<tr>
<td>Obs</td>
<td>238,701</td>
<td>238,701</td>
<td>238,701</td>
<td>38,713</td>
<td>199,988</td>
</tr>
</tbody>
</table>

**Notes:** 57,008 firms (manufacturing size 10-1000); estimates by ML with standard errors clustered at the 4 digit level.
EXTENSIONS

• Other explanations for the Valley to right of 50 than measurement error
  – Adjustment costs
    • Growth around threshold
  – Shocks to quits
    • but would expect spike prior to 49
  – Leontief production
    • Wouldn’t see the pattern of growth dynamics
  – Bounded rationality
    • Could rationalize findings if completely behavioral
    • But no evidence of lower profits in valley
FIG 17 PROFITABILITY NOT UNUSUALLY LOW IN VALLEY – SO NOT LIKELY TO BE BEHAVIORAL EXPLANATION
INACTION AT 49 IS THERE FOR FIRMS WHO CROSSED THE THRESHOLD IN PREVIOUS YEARS – HENCE SPIKE CANNOT PRIMARILY BE A SUNK COST (AS IN GOURIO & ROYS, 2014)
NO SPIKE AT 49 FOR THE ENTRANTS – SO PROBABLY NOT RESTRUCTURING OF FIRM TO MAKE IT LOOKS LIKE LESS THAN 50
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Basu-Fernald (θ=0.8)</th>
<th>Atkeson-Kehoe (θ=0.85)</th>
<th>Hsieh-K (θ=0.5)</th>
<th>Hsieh-K (θ=0.9)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tau$, Implicit variable tax</td>
<td>1.013 (0.005)</td>
<td>1.010 (0.004)</td>
<td>1.033 (0.013)</td>
<td>1.004 (0.002)</td>
</tr>
<tr>
<td>$\beta$, power law</td>
<td>1.822 (0.059)</td>
<td>1.822 (0.059)</td>
<td>1.822 (0.059)</td>
<td>1.829 (0.057)</td>
</tr>
<tr>
<td>$\frac{1-\beta}{1-\theta}$</td>
<td>0.948 (0.018)</td>
<td>0.948 (0.018)</td>
<td>0.948 (0.018)</td>
<td>0.965 (0.015)</td>
</tr>
<tr>
<td>$n_u$, upper emp. cutoff</td>
<td>57.898 (0.024)</td>
<td>57.898 (0.024)</td>
<td>57.898 (0.024)</td>
<td>52.562 (0.002)</td>
</tr>
<tr>
<td>$\sigma$, msremnt. error</td>
<td>0.104 (0.025)</td>
<td>0.104 (0.025)</td>
<td>0.104 (0.025)</td>
<td>0.036 (0.008)</td>
</tr>
<tr>
<td>$k/w$, Fixed cost of tax</td>
<td>-0.496 (0.257)</td>
<td>-0.372 (0.192)</td>
<td>-1.243 (0.653)</td>
<td>-0.201 (0.099)</td>
</tr>
</tbody>
</table>

**Notes:** 57,008 firms and 238,701 obs (manufacturing size 10-1000); estimates by ML with standard errors clustered at the 4 digit level.
COST OF REGULATION IS AN INCREASING FUNCTION OF THE DEGREE TO WHICH EQUILIBRIUM REAL WAGES DON’T ADJUST DOWNWARDS AFTER REGULATION
RESULTS NOT DRIVEN BY BIG BUSINESS GROUPS PRETENDING TO BE SMALL (FIG 14B)