Firm Size Distortions and the Productivity Distribution: Evidence from France

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NBER Entrepreneurship Group,
December 2\textsuperscript{nd} 2011
Or…… “Lucas in France”

Firms in the manufacturing in

1. Ficus
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

The graph shows the distribution of firm size in terms of employment. The x-axis represents firm size in terms of employment, ranging from 10 to 5000. The y-axis represents the share of total employment, ranging from 0.0001 to 0.01.

The graph includes two types of data points:
- Crosses (×): Representing the US allocation of workers across firms.
- Circles (○): Representing the FR (France) allocation of workers across firms.

The graph illustrates a significant concentration of employment in firms with just under 50 workers, which is referred to as a “bulge.”
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 $\alpha$ and $n$ workers produces
  – $y = \alpha f(n)$,
  – $f'(n) > 0$, $f''(n) < 0$ from managerial span of control problem (e.g. $f(n) = n^\Theta$, $\Theta < 1$)
INDIVIDUAL OPTIMIZATION

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

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

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

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

1. An economy-wide 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)

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

2. The choice of $n(\alpha)$ for each manager is optimal given their skills $\alpha$, taxes $\tau$ and wages $w$.

3. Labor supply = labor demand.
EQUILIBRIUM (3)

• Firm size & productivity:

\[ n(\alpha) = \begin{cases} 
0 & \text{if } \alpha < \alpha_{\text{min}} \\
 f'^{-1}\left(\frac{w}{\alpha}\right) & \text{if } \alpha_{\text{min}} < \alpha < \alpha_{c} \\
 N - 1 & \text{if } \alpha_{c} < \alpha < \alpha_{u} \\
 f'^{-1}\left(\frac{\tau w}{\alpha}\right) & \text{if } \alpha_{u} < \alpha < \infty 
\end{cases} \]

Workers
`Small Firms’
`Constrained’
`Unconstrained’
THEORY: FIRM SIZE DISTRIBUTION (FIG 4)
THEORY: SIZE AND PRODUCTIVITY

Some productive firms choose to remain small to avoid "tax".
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)
OUTLINE

1. Theory: Lucas in France

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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*):

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

• \( \beta \) = “slope” of power law in firm size = \( \beta \alpha(1- \theta) + \theta \)

• Tax affects change in intercept & size of the ‘bulge’ and ‘dip’

\[
T = T^{-\frac{\beta - 1}{1-\theta}}
\]
EMPIRICAL IMPLEMENTATION (FIG. 6)
EMPIRICAL IMPLEMENTATION (FIG. 6)

Tax identified from
i) shift in the intercept
EMPIRICAL IMPLEMENTATION (FIG. 6)

Tax identified from
i) shift in the intercept
ii) “spike” & “hole”
FIRM SIZE MEASURED WITH ERROR

• Observed size (allow for measurement error)

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

• Conditional cdf

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

• Obtain pdf of \( n \) & estimate parameters by ML to obtain \( \beta, T(t, \beta, \theta), n_u \).
• \( \theta \) from production function estimation to recover implicit \( t \).
THEORETICAL FIRM SIZE DISTRIBUTION (WITH MEASUREMENT ERROR)
OUTLINE

1. Theory: Lucas in France

2. Empirical Implementation

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4. Results
   • Main findings
   • Robustness/Extensions
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

1. Theory: Lucas in France
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**TABLE 1: ML ESTIMATES OF SIZE DISTRIBUTION – THE BROKEN POWER LAW**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$, power law</td>
<td>1.702</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
</tr>
<tr>
<td>Tax</td>
<td>0.799</td>
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<td>$T = \tau^{1-\theta}$</td>
<td>$\frac{1-\beta}{\sigma}$</td>
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**Note:** Estimates by ML, Manufacturing firms with >1 employee, standard errors clustered by firm
FIRM SIZE DISTRIBUTION: ACTUAL AND FITTED (FIG 11)
<table>
<thead>
<tr>
<th>Experiment</th>
<th>Scale parameter, $\theta$</th>
<th>Implicit Tax, $\tau$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Calibrated</td>
<td>0.800</td>
<td>1.066</td>
</tr>
<tr>
<td>2. Using TFP-Size relationship</td>
<td>0.802</td>
<td>1.065</td>
</tr>
<tr>
<td>3. Using the production function parameters</td>
<td>0.874 (0.003)</td>
<td>1.041 (0.003)</td>
</tr>
<tr>
<td>4. Split sample production function</td>
<td>0.912 (0.003)</td>
<td>1.029 (0.003)</td>
</tr>
<tr>
<td>5. High tech industries</td>
<td>0.900 (0.008)</td>
<td>1.013 (0.006)</td>
</tr>
<tr>
<td>6. Low Tech industries</td>
<td>0.862 (0.008)</td>
<td>1.054 (0.005)</td>
</tr>
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TABLE 2: ESTIMATES OF IMPLICIT TAX/COST OF LABOR REGULATION (~5%)
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

![Graph showing firm size distribution for USA and France](image-url)
Previous Literature

• Papers using the same type of variation of the Lucas model:
  – 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:

\[ \alpha_{\text{min}} f(n) - wn = w \]

• Firm size:

\[ n(\alpha) = 0 \quad \text{if} \quad \alpha < \alpha_{\text{min}} \]
\[ n(\alpha) = f^{-1}\left(\frac{w}{\alpha}\right) \quad \text{if} \quad \alpha_{\text{min}} < \alpha < \alpha_c \]
\[ n(\alpha) = N - 1 \quad \text{if} \quad \alpha_c < \alpha < \alpha_u \]
\[ n(\alpha) = f^{-1}\left(\frac{\tau w}{\alpha}\right) \quad \text{if} \quad \alpha_u < \alpha < \infty \]

• Labor supply = labor demand

\[ \Phi(\alpha_{\text{min}}) = \int_{\alpha_{\text{min}}}^{\infty} n(\alpha) \, d\Phi(\alpha) \]
EMPIRICAL IMPLEMENTATION

• TFP/Size relationship:

\[ n^*(\alpha) = \begin{cases} 
(\frac{\alpha_0}{w})^{1/(1-\theta)} = c_1.\alpha^{1/(1-\theta)} = n_1(\alpha) \\
49 = n_1(\alpha_c) \\
(\frac{\alpha_0}{w.\tau})^{1/(1-\theta)} = c_1.\tau^{1/(1-\theta)}.\alpha^{1/(1-\theta)} = n_1(\alpha).\tau^{1/(1-\theta)} < n_1(\alpha) \\
= c_2 \\
= n_2(\alpha) \\
\end{cases} \]

if \( \alpha < \alpha_c \)
if \( \alpha_c \leq \alpha < \alpha_u \)
if \( \alpha_u \leq \alpha \)

• Firm size distribution (pdf):

\[ \chi^*(n) = \begin{cases} 
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THE IMPORTANCE OF USING THE RIGHT DATA
FULL TIME EQUIVALENTS (ANNUALIZED)
Manufacturing industries, 1986 vs 2006

![Graph showing the share of firms and employment in manufacturing industries, comparing 1986 and 2006. The x-axis represents employment, and the y-axis represents the logarithm of the share of firms. The graph indicates a decrease in the number of large firms and an increase in the number of small firms from 1986 to 2006.](image-url)
THEORY: SIZE AND PRODUCTIVITY (FIG. 5)
FIRM SIZE DISTRIBUTION - FICUS DATASET, ALL WORKERS (FIG. 8)
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ITS NOT JUST BIG BUSINESS GROUPS PRETENDING TO BE SMALL
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
NO EVIDENCE THAT WORKERS ARE ACCEPTING LOWER WAGES IN RETURN FOR `INSURANCE’ AGAINST FIRING COSTS