Product and labor market imperfections and scale economies : Micro-evidence on France, Japan and the Netherlands

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Aim (1)

There is an abundant literature on **production function estimation** studying how firms convert inputs into outputs and the efficiency with which this occurs (see Syverson, 2011, JEL, for a survey)

There is a long tradition in applied IO of **estimating product market power** (see De Loecker-Warzynski, 2012, AER for references)

While most economists believe that **product and labor market imperfections** almost surely exist to one degree or another, only few have explicitly accounted for their **joint influence on production function estimation** at the micro level (see Dobbelaere-Mairesse, 2012, JAE for references)

Aim (2)

This study starts from

(*i*) the **belief** that **product and labor markets** are **intrinsically characterized** by **imperfections** and

(*ii*) the finding that **variable input factors' estimated marginal products** are **often larger than their measured payments**

Aim (3)

We rely on **two extensions of Hall's (1988, JPE) productivity econometric framework** for estimating price-cost margins :

- **Extension 1** presumes that employees possess a degree of market power when negotiating with the firm over wages and employment (**efficient bargaining**; McDonald-Solow,1981, AER)

- **Extension 2** abstains from the assumption that the labor supply curve facing an individual employer is perfectly elastic (**monopsony model**; Manning, 2003, Princeton Univ. Press)

Both extensions identify **product and labor market imperfections** as **two sources of discrepancies between the output contributions of individual production factors and their respective revenue shares**

Aim (4)

Following the productivity measurement literature, we use econometric **production functions** as a tool for testing the competitiveness of product and labor markets

Empirical strategy :

1. Using firm-level data in FR, JP and NL, we **estimate a standard Cobb-Douglas production function** for each selected manufacturing industry $j \in \{1, \ldots, 30\}$

2. From the estimated industry-specific output elasticities for labor and materials and from their average revenue shares, we derive the **industry-specific joint market imperfections parameter ψ_j**

Aim (5)

- Depending on the sign and statistical significance of ψ_j, we **classify industries in 6 distinct regimes** that differ in terms of the type of competition prevailing in both the product and the labor market. We consider:
  - **2 product market settings** :

    PC : perfect competition
    IC : imperfect competition

  - **3 labor market settings** :

    PR : perfect competition or right-to-manage bargaining
    EB : efficient bargaining
    MO : monopsony

  We thus distinguish 6 regimes :

$$R \in \Re = \{PC\text{-}PR, IC\text{-}PR, PC\text{-}EB, IC\text{-}EB, PC\text{-}MO, IC\text{-}MO\}$$

Aim (6)

3. For each of the three predominant regimes in each country, we investigate **industry differences** in the **estimated product and labor market imperfection parameters** and **scale economies**

Theoretical framework (1)

Following Dobbelaere-Mairesse (2012, JAE), we extend Hall's econometric framework for estimating price-cost mark-ups and scale economies by considering three labor market settings (LMS) :

1. perfect competition or right-to-manage bargaining (PR)
2. efficient bargaining (EB)
3. monopsony (MO)

Theoretical framework (2)

Production function :

$$Q_{it} = \Theta_{it} F(N_{it}, M_{it}, K_{it}) \quad \text{where} \quad \Theta_{it} = A e^{\eta_i + u_t + v_{it}} \tag{1}$$

Logarithmic specification :

$$q_{it} = (\varepsilon_N^Q)_{it} n_{it} + (\varepsilon_M^Q)_{it} m_{it} + (\varepsilon_K^Q)_{it} k_{it} + \theta_{it} \tag{2}$$

Each firm operates under **imperfect competition in the product market**

We assume that material input and labor are variable factors. Short run profit maximization implies the following *FOC* with respect to material input:

$$(\varepsilon_M^Q)_{it} = \mu_{it} (\alpha_M)_{it} \tag{3}$$

where $(\alpha_M)_{it} = \frac{j_{it} M_{it}}{P_{it} Q_{it}}$ is the share of material costs in total revenue and $\mu_{it} = \frac{P_{it}}{(C_Q)_{it}}$ is the mark-up of output price P_{it} over marginal cost $(C_Q)_{it}$.

Theoretical framework (2)

Assuming that the elasticity of scale, $\lambda_{it} = (\varepsilon_N^Q)_{it} + (\varepsilon_M^Q)_{it} + (\varepsilon_K^Q)_{it}$, is known, the capital elasticity can be expressed as :

$$(\varepsilon_K^Q)_{it} = \lambda_{it} - (\varepsilon_N^Q)_{it} - (\varepsilon_M^Q)_{it} \tag{4}$$

If each firm operates under **perfect competition in the labor market**, $(\varepsilon_N^Q)_{it} = \mu_{it}\,(\alpha_N)_{it}$. From Eqs. (3), (4) and (2), we have:

$$q_{it} = \mu_{it}\left[(\alpha_N)_{it}\,(n_{it} - k_{it}) + (\alpha_M)_{it}\,(m_{it} - k_{it})\right] + \lambda k_{it} + \theta_{it} \tag{5}$$

Theoretical framework (3)

If each firm operates under **imperfect competition in the labor market**, we have:

$$q_{it} = \mu_{it}\left[(\alpha_N)_{it}\left(n_{it} - k_{it}\right) + (\alpha_M)_{it}\left(m_{it} - k_{it}\right)\right] + \psi_{it}(\alpha_N)_{it}\left(k_{it} - n_{it}\right) + \lambda k_{it} \tag{6}$$

where ψ_{it} indicates the parameter of joint market imperfections (for more detail, see Dobbelaere-Mairesse (2012, JAE)):

$$\begin{aligned}
\psi_{it} &= \frac{(\varepsilon_M^Q)_{it}}{(\alpha_M)_{it}} - \frac{(\varepsilon_N^Q)_{it}}{(\alpha_N)_{it}} && (7)\\
&= 0 \quad \text{if } LMS = PR && (8)\\
&> 0 \quad \text{if } LMS = EB && (9)\\
&< 0 \quad \text{if } LMS = MO && (10)
\end{aligned}$$

Econometric implementation (1)

It follows that the data features that are key to **empirical identification** of the product and labor market imperfection parameters are the **differences between the estimated output elasticities of labor and materials and their revenue shares**

Essential is that the test for the prevalent *LMS* takes the materials market as perfectly competitive and compares it to the labor market.

Given the purpose of our study, we estimate *average* parameters. The empirical specification that acts as the bedrock for the regressions at the industry level is hence given by :

$$q_{it} = \mu \left[\alpha_N \left(n_{it} - k_{it}\right) + \alpha_M \left(m_{it} - k_{it}\right)\right] + \psi\alpha_N \left(k_{it} - n_{it}\right) + \lambda k_{it} + \zeta_{it} \tag{11}$$

Econometric implementation (2)

$\widehat{\psi}$ **determines the regime** characterizing the type of competition prevailing in the product and the labor market

A priori, **6 distinct regimes are possible**, denoted by

$R \in \Re = \{PC\text{-}PR, IC\text{-}PR, PC\text{-}EB, IC\text{-}EB, PC\text{-}MO, IC\text{-}MO\}$

- **Part 1** reflects the **type of competition in the product market** :

  PC : perfect competition

  IC : imperfect competition

- **Part 2** reflects the **type of competition in the labor market** :

  PR : perfect competition or right-to-manage bargaining

  EB : efficient bargaining

  MO : monopsony

Data

FR
Period: 1986-2001
Source: Annual Enterprise survey (EAE).
 # obs. = 174 600 (N = 17 653 manufacturing firms)

JP
Period: 1994-2006
Source: Basic Survey of Japanese Business Structure and Activities
 # obs. = 83 291 (N = 8 725 manufacturing firms)

NL
Period: 1993-2007
Source: Production Survey (PS)
 # obs. = 73 149 (N = 7 828 manufacturing firms)

In each country, we consider 30 comparable manufacturing industries, making up our sample.

Classification of industries (1)

We estimate the production function for each industry $j \in \{1, ..., 30\}$ in *FR*, *JP* and *NL*

Classification procedure :

1. Performing an F-test (**explicit joint test**) of the joint hypothesis

$$H_0 : \left(\boldsymbol{\mu_j} - \mathbf{1} = \frac{\left(\varepsilon_M^Q\right)_j}{(\alpha_M)_j} - 1\right) = \left(\boldsymbol{\psi_j} = \frac{\left(\varepsilon_M^Q\right)_j}{(\alpha_M)_j} - \frac{\left(\varepsilon_N^Q\right)_j}{(\alpha_N)_j}\right) = \mathbf{0}$$

   If H_0 is not rejected, the prevalent regime $R = PC\text{-}PR$

2. Conducting two separate t-tests to classify the remaining industries in one of the 5 other regimes $R \in \Re \backslash \{PC\text{-}PR\}$

   E.g. if the null hypothesis is that the *IC-EB*-regime applies, we perform the following **implicit joint test** :

$$H_{10} : (\mu_j - 1) > 0 \text{ and } H_{20} : \psi_j > 0$$

Classification of industries (2)

We observe **important regime differences across the three countries**

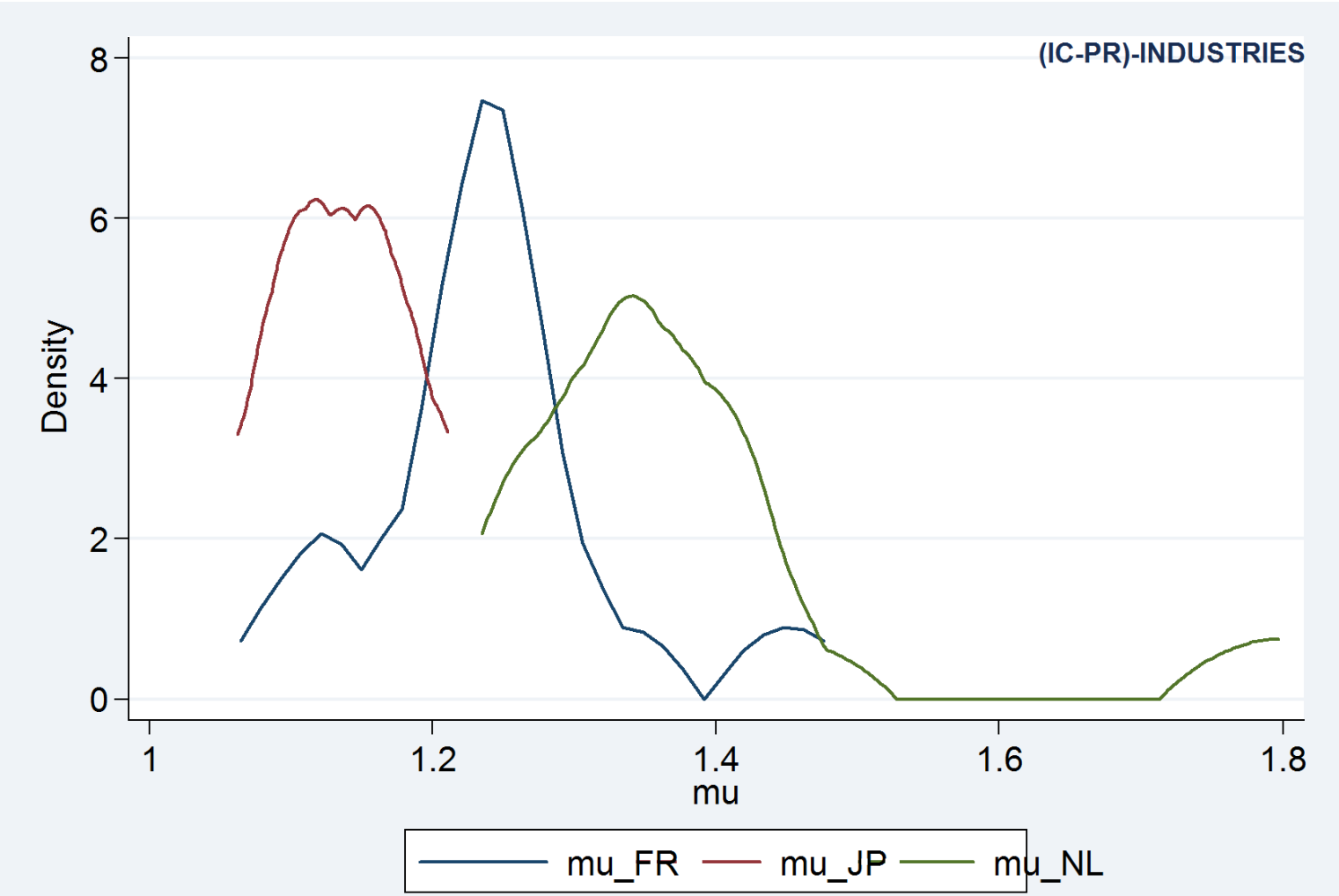
- Focusing on the **product market side** :
  - $>$ 80% of the industries comprising $>$ 90% of the firms are characterized by *IC* in *FR* and *NL*
  - only 50% of the industries comprising 50% of the firms are typified by *IC* in *JP*
- Focusing on the **labor market side** :
  - *EB* and *PR* are by far the most prevalent *LMSs* in *FR*
  - *PR* is the most prevalent *LMS* in *JP*
  - in *NL*, the 3 *LMSs* are more evenly distributed

Classification of industries (3)

- The predominant regimes in **FR** are :
  - *IC-PR* : 50% of the industries comprising 38% of the firms
  - *IC-EB* : 30% of the industries comprising 55% of the firms
  - *PC-PR* : 13% of the industries comprising 5% of the firms
- The predominant regimes in **JP** are :
  - *PC-PR* : 50% of the industries comprising 50% of the firms
  - *IC-PR* : 33% of the industries comprising 33% of the firms
  - *IC-EB* : 17% of the industries comprising 16% of the firms
- The predominant regimes in **NL** are :
  - *IC-PR* : 40% of the industries comprising 44% of the firms
  - *IC-EB* : 30% of the industries comprising 30% of the firms
  - *IC-MO* : 17% of the industries comprising 17% of the firms

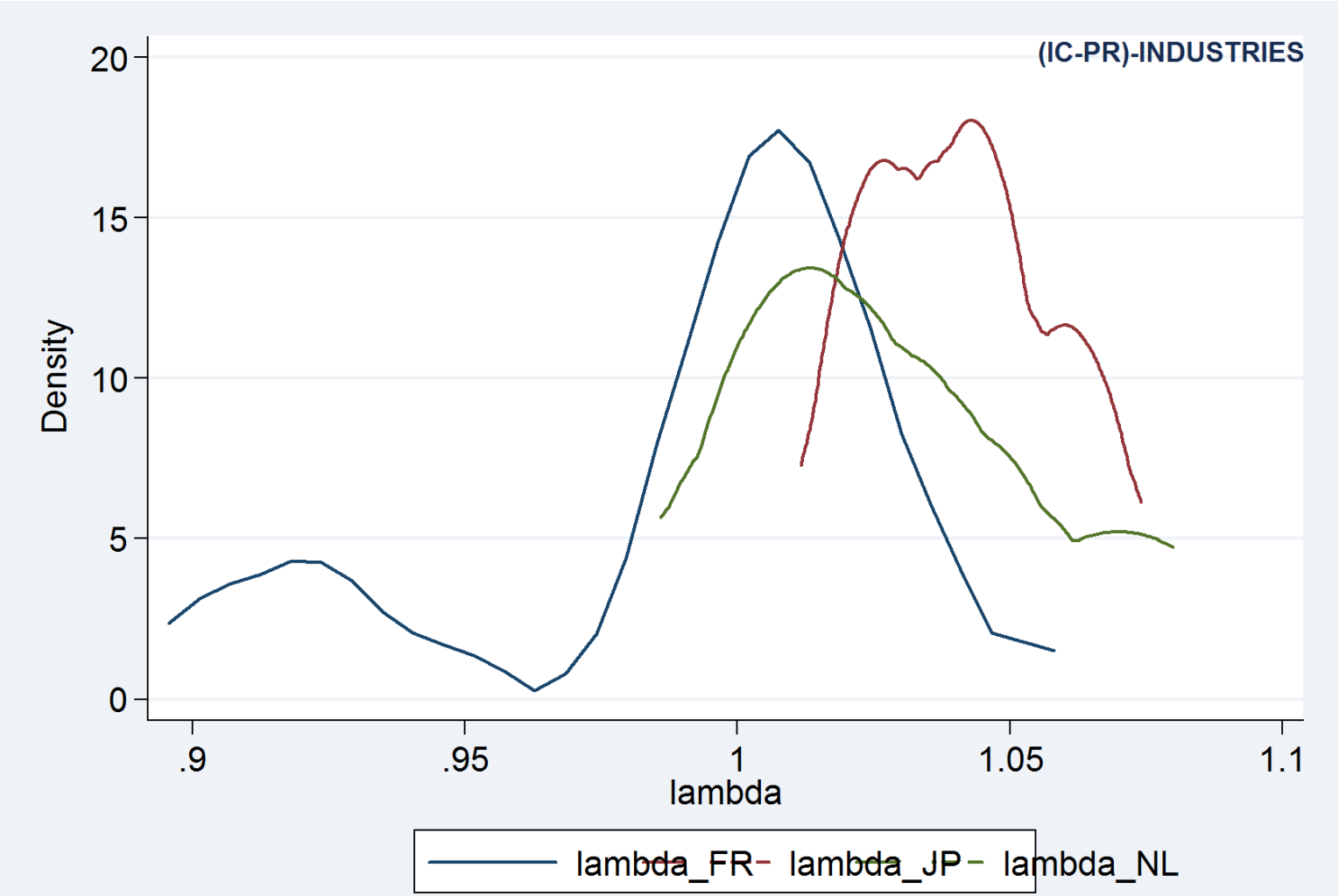
Within-regime industry differences (1)

We observe **cross-country differences in the levels of product and labor market imperfections and scale economies within a particular regime**



Within-regime industry differences (2)

We observe **cross-country differences in the levels of product and labor market imperfections and scale economies within a particular regime** (ctd)



Conclusion (1)

How different are manufacturing industries in their factor shares, in their marginal products, **in their scale economies and in their imperfections in the product and labor markets in which they operate** ?

How does their behavior deviate across countries ?

In order to analyze these questions, we **extend Hall's (1988, JPE) productivity framework** for estimating price-cost mark-ups and scale economies **by nesting three distinct labor market settings** (perfect competition or right-to-manage bargaining, efficient bargaining and monopsony)

Conclusion (2)

Our analysis provides **evidence of pronounced regime differences across FR, JP and NL**

Our study also reveals **cross-country differences in the levels of product and labor market imperfections and scale economies within a particular regime**

Appendix (1)

Depending on the prevalent *LMS*, short-run profit maximization implies the following *FOC* with respect to labor:

$$
\begin{aligned}
(\varepsilon_N^Q)_{it} &= \mu_{it}(\alpha_N)_{it} \quad \text{if } LMS = PR && (12)\\
&= \mu_{it}(\alpha_N)_{it} - \mu_{it}\gamma_{it}\left[1-(\alpha_N)_{it}-(\alpha_M)_{it}\right] \quad \text{if } LMS = EB && (13)\\
&= \mu_{it}(\alpha_N)_{it}\left(1+\frac{1}{(\varepsilon_w^N)_{it}}\right) \quad \text{if } LMS = MO && (14)
\end{aligned}
$$

where $(\alpha_N)_{it} = \frac{w_{it}N_{it}}{P_{it}Q_{it}}$ is the share of labor costs in total revenue,

$\gamma_{it} = \frac{\phi_{it}}{1-\phi_{it}}$ the relative extent of rent sharing,

$\phi_{it} \in [0,1]$ the absolute extent of rent sharing and

$(\varepsilon_w^N)_{it} \in \Re_+$ the wage elasticity of the labor supply.

Appendix (2)

From the first-order conditions with respect to material input and labor, it follows that the parameter of joint market imperfections ψ_{it} :

$$\psi_{it} = \frac{(\varepsilon_M^Q)_{it}}{(\alpha_M)_{it}} - \frac{(\varepsilon_N^Q)_{it}}{(\alpha_N)_{it}} \tag{15}$$

$$= 0 \quad \text{if } LMS = PR \tag{16}$$

$$= \mu_{it}\gamma_{it}\left[\frac{1-(\alpha_N)_{it}-(\alpha_M)_{it}}{(\alpha_N)_{it}}\right] > 0 \quad \text{if } LMS = EB \tag{17}$$

$$= -\mu_{it}\frac{1}{(\varepsilon_w^N)_{it}} < 0 \quad \text{if } LMS = MO \tag{18}$$

Appendix (3)

Depending on the *LMS*, **it follows from ψ_{it} that the differences between the estimated output elasticities of labor and materials and their revenue shares can be mapped into** either

- $\psi_{it} = \frac{(\varepsilon_M^Q)_{it}}{(\alpha_M)_{it}} - \frac{(\varepsilon_N^Q)_{it}}{(\alpha_N)_{it}} = \boldsymbol{\mu_{it}} \frac{\boldsymbol{\phi_{it}}}{\mathbf{1-\phi_{it}}} \left[\frac{1-(\alpha_N)_{it}-(\alpha_M)_{it}}{(\alpha_N)_{it}} \right] > 0$, i.e.

  the price-cost mark-up μ_{it} and absolute the extent of rent sharing ϕ_{it} or

- $\psi_{it} = \frac{(\varepsilon_M^Q)_{it}}{(\alpha_M)_{it}} - \frac{(\varepsilon_N^Q)_{it}}{(\alpha_N)_{it}} = -\boldsymbol{\mu_{it}} \frac{1}{(\boldsymbol{\varepsilon_w^N})_{it}} < 0$, i.e.

  the price-cost mark-up μ_{it} and the labor supply elasticity $\left(\varepsilon_w^N\right)_{it}$

Appendix (4) Classification of industries

We observe :

- **10 strong IC-industries** : e.g. chemicals, pharmaceuticals, special industrial machinery, electronic parts and components, precision instruments
- **6 strong PR-industries** : e.g. pharmaceuticals, household electrical appliances, motor vehicles
- **4 weak EB-industries** : food products, wooden products, chemicals, special industry machinery
- **1 weak MO-industry** : beverages and tobacco