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).
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 $\psi_j$
Aim (5)

- Depending on the sign and statistical significance of $\psi_j$, 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:

$$R \in \mathbb{R} = \{PC-PR, IC-PR, PC-EB, IC-EB, PC-MO, IC-MO\}$$
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 Dobbelraere-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:

\[ Q_{it} = \Theta_{it} F(N_{it}, M_{it}, K_{it}) \quad \text{where} \quad \Theta_{it} = Ae^{\eta_i + u_t + v_{it}} \]  

(1)

Logarithmic specification:

\[ q_{it} = (\varepsilon^Q_N)_{it} n_{it} + (\varepsilon^Q_M)_{it} m_{it} + (\varepsilon^Q_K)_{it} k_{it} + \theta_{it} \]  

(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:

\[ (\varepsilon^Q_M)_{it} = \mu_{it} (\alpha_M)_{it} \]  

(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

Assuming that the elasticity of scale, \( \lambda_{it} = (\varepsilon_Q^N)_{it} + (\varepsilon_Q^M)_{it} + (\varepsilon_Q^K)_{it} \), is known, the capital elasticity can be expressed as:

\[
(\varepsilon_Q^K)_{it} = \lambda_{it} - (\varepsilon_Q^N)_{it} - (\varepsilon_Q^M)_{it}
\] (4)

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

\[
q_{it} = \mu_{it} [(\alpha_N)_{it} (n_{it} - k_{it}) + (\alpha_M)_{it} (m_{it} - k_{it})] + \lambda k_{it} + \theta_{it}
\] (5)
If each firm operates under **imperfect competition in the labor market**, we have:

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

(6)

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

\[
\psi_{it} = \frac{\varepsilon^Q_{it}}{\alpha_M}_{it} - \frac{\varepsilon^Q_{it}}{\alpha_N}_{it}
\]  

(7)

\[
= 0 \quad \text{if } LMS = PR
\]  

(8)

\[
> 0 \quad \text{if } LMS = EB
\]  

(9)

\[
< 0 \quad \text{if } LMS = MO
\]  

(10)
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:

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

(11)
Econometric implementation (2)

\( \hat{\psi} \) 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

\[ R \in \mathcal{R} = \{ PC-PR, IC-PR, PC-EB, IC-EB, PC-MO, IC-MO \} \]

- **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 $j \in \{1, \ldots, 30\}$ in FR, JP and NL.

Classification procedure:

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

$$H_0 : \left( \mu_j - 1 = \frac{(\varepsilon^Q_M)_j}{(\alpha_M)_j} - 1 \right) = \left( \psi_j = \frac{(\varepsilon^Q_M)_j}{(\alpha_M)_j} - \frac{(\varepsilon^Q_N)_j}{(\alpha_N)_j} \right) = 0$$

If $H_0$ is not rejected, the prevalent regime $R = PC-PR$

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

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

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

$$
(\varepsilon^Q_N)_{it} = \mu_{it} (\alpha_N)_{it} \quad \text{if } LMS = PR
$$

$$
= \mu_{it} (\alpha_N)_{it} - \mu_{it} \gamma_{it} \left[1 - (\alpha_N)_{it} - (\alpha_M)_{it}\right] \quad \text{if } LMS = EB \tag{13}
$$

$$
= \mu_{it} (\alpha_N)_{it} \left(1 + \frac{1}{\varepsilon^N_w}_{it}\right) \quad \text{if } LMS = MO \tag{14}
$$

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

$(\varepsilon^N_w)_{it} \in \mathbb{R}_+$ the wage elasticity of the labor supply.
From the first-order conditions with respect to material input and labor, it follows that the parameter of joint market imperfections $\psi_{it}$:

\[
\psi_{it} = \frac{(\varepsilon_Q)_m^{it}}{(\alpha_M)_m^{it}} - \frac{(\varepsilon_Q)_n^{it}}{(\alpha_N)_n^{it}}
\]

\[
= 0 \quad \text{if } LMS = PR 
\]

\[
= \mu_{it} \gamma_{it} \left[ \frac{1 - (\alpha_N)_N^{it} - (\alpha_M)_m^{it}}{(\alpha_N)_n^{it}} \right] > 0 \quad \text{if } LMS = EB
\]

\[
= -\mu_{it} \frac{1}{(\varepsilon_W)_w^{it}} < 0 \quad \text{if } LMS = MO
\]
Appendix (3)

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

$$\psi_{it} = \frac{(\varepsilon^Q_M)_{it}}{(\alpha_M)_{it}} - \frac{(\varepsilon^Q_N)_{it}}{(\alpha_N)_{it}} = \mu_{it} \frac{\phi_{it}}{1-\phi_{it}} \left[ \frac{1-(\alpha_N)_{it}-(\alpha_M)_{it}}{(\alpha_N)_{it}} \right] > 0,$$

i.e. the price-cost mark-up $\mu_{it}$ and absolute the extent of rent sharing $\phi_{it}$ or

$$\psi_{it} = \frac{(\varepsilon^Q_M)_{it}}{(\alpha_M)_{it}} - \frac{(\varepsilon^Q_N)_{it}}{(\alpha_N)_{it}} = -\mu_{it} \frac{1}{(\varepsilon^N_w)_{it}} < 0,$$

i.e. the price-cost mark-up $\mu_{it}$ and the labor supply elasticity $(\varepsilon^N_w)_{it}$.
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