Market imperfections, skills and total factor productivity: Firm-level evidence on Belgium and the Netherlands

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Introduction
The Single Market Program and the Lisbon Strategy were based on the premise that costs, prices and mark-ups would fall and that more competition would foster productivity (Cecchini et al., 1988).

Over the past decade, there has been a growing interest in the role of institutions in explaining different patterns of productivity growth across countries and industries (Scarpetta & Tressel, 2004; Storm & Naastepad, 2007; Bas & Causa, 2013).

By affecting the degree of competition in product and labor markets and/or affecting the allocation of resources, policy institutions might greatly influence the productivity of an economic entity.
Aim (1)

This paper examines the joint effect of market power in the output and the labor market on firms’ TFP growth within a modified production function framework.

Part 1: Identifying and quantifying product and labor market imperfections

- Using econometric production functions as a tool for testing the type and the degree of imperfection using firm-level data.
- Focusing on both cross-country (BE vs. NL) and cross-industry (19 ind. in Manufacturing, 11 ind. in Services) differences.
- Distinguish 6 regimes of competitiveness: \( R \in \mathbb{R} = \{ PC-PR, IC-PR, PC-EB, IC-EB, PC-MO, IC-MO \} \):
  - 2 product market settings (\( PC \) and \( IC \)) and
  - 3 labor market settings (\( PR \), \( EB \) and \( MO \)).
This paper examines the joint effect of market power in the output and the labor market on firms’ TFP growth within a modified production function framework (ctd).

Part 2: Revisiting the potential relationship between the type and the degree of product and labor market imperfections and firms’ TFP growth

- Measuring TFP as the residual of a SYS-GMM estimation of industry-specific standard Cobb-Douglas production functions.
- Exploiting variation in the prevalence of regimes characterizing the type of competition prevailing in product and labor markets in each country.
- Evaluating how TFP distributional characteristics vary across countries and regimes, taking into account skill heterogeneity.
Research questions - Part 1

- Do we observe large cross-country variation in the prevalence of regimes characterizing the type of competition prevailing in product and labor markets?

- Are the revealed regimes compatible with institutional differences in terms of product market environment and the industrial relations system in the two countries?

- Do we uncover important cross-country differences in the composition of industries making up the regimes?

- Do we observe heterogeneity in the degree of industry-specific product and labor market imperfections within regimes?
Research questions - Part 2

- Does our analysis reveal any *pattern in the moments of regime-specific TFP distributions*?

- Which role do skill heterogeneity and the compositional variation within regimes play in shaping *TFP* distributions?

- Do we discern a *link between the degree of market imperfections* and *TFP distributional characteristics*?
Policy relevance

From a policy perspective, our study contributes to an understanding of the institutional context of TFP growth

- By consistently analyzing the indirect impact of the Single Market Program and the Lisbon Strategy on TFP growth, we investigate whether increasing flexibility is conducive to TFP growth.

- Examining a novel indirect channel through which human capital might influence firm-level TFP growth.
Introduction

Outline (1)

1. Comparative setting
2. Theoretical framework
3. Data: *Production function variables, Skill heterogeneity*
4. Econometric framework: *Estimation method, Classification procedure*
5. Results
6. Conclusion & Extensions
Comparative setting
Comparative setting - TFP (1)

Total Factor Productivity

Using EUKLEMS data for the period 1995-2008, we observe:

- Cross-country variation in the contribution of TFP growth to real output growth
- Large cross-country cross-industry variation in TFP growth rates
  E.g.: average TFP growth in Finance & Business industry:
  -3.47% in BE while 0.18% in NL
Comparative setting - Product market setting (2)

Product market setting

- Higher level of import competition in Manufacturing and to a lesser extent in Services in BE
- Stronger pro-competitive impact of imports in BE
- Differences in the intra-sectoral composition of exports
  - BE : Semi-finished goods and components oriented towards competitive world markets
  - NL : Finished, high-tech goods flowing through a few MNEs with Dutch origin
- Determinants of price stickiness
  - BE : Labor and other factor costs main driver for price increases while competitive behavior main determinant of price decreases
Labor market setting

Industrial relations in BE and NL share some similar wage bargaining institutional characteristics:

Broadly regulated system characterized by:

- Dominance of industry-level wage bargaining
- Existence and widespread use of extension procedures for industry-level wage agreements
  - Collective bargaining coverage rate: 96% in BE and 83% in NL
- Statutory minimum wages
Comparative setting - Labor market setting (4)

Labor market setting (ctd)

Industrial relations in BE and NL also differ on important aspects:

- Employee representation
  - BE: Trade unions $\implies$ Very high trade union membership (52%)
  - NL: Works councils $\implies$ Low trade union membership (21%)

- State-imposed automatic wage indexation in BE

- Modest wage increases and agreements based on consensus central in wage negotiations in NL
  - Collective bargaining system conducive to social stability

Higher employment protection in terms of stricter regulation on permanent contracts in BE
Theoretical framework
Following Dobbelaere-Mairesse (2013), we extend Hall’s (1988) econometric framework for estimating price-cost margins and scale economies by considering three labor market settings (LMS):

- perfect competition or right-to-manage bargaining (PR)
- efficient bargaining (EB)
- monopsony (MO)
Production function:

\[ Q_{it} = \Theta_{it} F(N_{it}, M_{it}, K_{it}) \quad \text{where} \quad \Theta_{it} = Ae^{n_{it} + u_{it} + v_{it}} \quad (1) \]

Logarithmic specification:

\[ q_{it} = (\varepsilon_{N}^{Q})_{it} n_{it} + (\varepsilon_{M}^{Q})_{it} m_{it} + (\varepsilon_{K}^{Q})_{it} k_{it} + \theta_{it} \quad (2) \]

where \((\varepsilon_{J}^{Q})_{it} \quad (J = N, M, K)\) is the elast. of output w.r.t. input factor \(J\)
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 $FOC$ w.r.t. material input:

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

where $\alpha_M = j_{it} M_{it} / P_{it} Q_{it}$ is the share of material costs in total revenue and

$$ \mu_{it} = P_{it} / (C_Q)_{it} \text{ the mark-up of output price } P_{it} \text{ over marginal cost } (C_Q)_{it} $$
Depending on the prevalent $LMS$, short-run profit maximization implies the following $FOC$ with respect to labor:

\[
\begin{align*}
(\varepsilon^Q_N)_{it} &= \mu_{it} (\alpha_N)_{it} \quad \text{if } LMS = PR \\
&= \mu_{it} (\alpha_N)_{it} - \mu_{it} \gamma_{it} \left[ 1 - (\alpha_N)_{it} - (\alpha_M)_{it} \right] \quad \text{if } LMS = EB \\
&= \frac{\mu_{it} (\alpha_N)_{it}}{\beta_{it}} \quad \text{if } LMS = MO
\end{align*}
\]

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,

$\beta_{it} = \frac{(\varepsilon^N_w)_{it}}{1 + (\varepsilon^N_w)_{it}}$ and

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

\[
\psi_{it} = \frac{(\varepsilon^Q_M)_{it}}{(\alpha_M)_{it}} - \frac{(\varepsilon^Q_N)_{it}}{(\alpha_N)_{it}}
\]

(7)

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

(8)

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

(9)

\[
= -\mu_{it} \frac{1}{(\varepsilon^N_W)_{it}} < 0 \quad \text{if } LMS = MO
\]

(10)
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:

\[
(\varepsilon^Q_K)_{it} = \lambda_{it} - (\varepsilon^Q_N)_{it} - (\varepsilon^Q_M)_{it}
\]  

(11)

Inserting Eqs. (3), (7) and (11) in Eq. (2) and rearranging terms gives:

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

(12)
Data
Data - Production function variables (1)

**BE**
- Source: Belfirst (Bureau van Dijck)
- \# obs. = 37,876
- \( N = 5,285 \text{ firms} \) (41\% Manufacturing, 59\% Services)
- Median \# participations = 8

**NL**
- Source: Production Surveys (Statistics Netherlands)
- Period: 1999-2008
- \# obs. = 60,499
- \( N = 9,653 \text{ firms} \) (67\% Manufacturing, 33\% Services)
- Median \# participations = 6

We only select firms having at least 3 consecutive observations and consider **30 comparable industries** (19 in Manuf. and 11 in Services)
Our approach of defining skill heterogeneity is based on the concept of knowledge workers (Horwitz et al., 2003)

- Classify employees as having
  - a high-paid-job if wage is $\geq p(81)$
  - a high-medium-paid job if $p(56) \leq \text{wage} < p(80)$
  - a low-medium-paid job if $p(31) \leq \text{wage} < p(56)$ and
  - a low-paid job if wage $< p(31)$
A firm is defined to be $HS (LS)$ if its employment share of $HS$ employees $\geq (<)$ median value of the share of $HS$ labor in firm size class $s$ of industry $j$ (NACE 2-digit classification) in year $t$.

- We observe strong firm-level persistence in skill types:
  - $>80\%$ of both skill types remain in their initial state.

Two validation exercises using Dutch employer-employee data:

- Confirming a positive correlation between individual wages and the level of education, controlling for age groups and industry dummies.
- Comparing our measure of the share of $HS$ employees with the measure of the share of $HS$ employees that is derived from the education type of employees as used in Bartelsman-Dobbelraere-Peters (2014).
Econometric framework:

Estimation method
We use **econometric production functions** as a **tool for testing the competitiveness** of product and labor markets and for assessing their degree of imperfection.

Since our study aims at (i) comparing regime differences across BE and NL and (ii) evaluating whether TFP distributional characteristics differ across regimes and firms’ skill types, we estimate average parameters:

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

Main estimator: **SYS-GMM**
Robustness check: **OLS, FE, Wooldridge-Levinsohn-Petrin** estimators
Differences in regimes and market imperfections:

Prevalent regimes
## Prevalent regimes

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<thead>
<tr>
<th>% ind.</th>
<th>LABOR MARKET</th>
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<tbody>
<tr>
<td>PRODUCT MARKET</td>
<td>BE</td>
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<tr>
<td>PR</td>
<td>EB</td>
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<td>PC</td>
<td>3</td>
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<td>IC</td>
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<th>% firms</th>
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<td>PRODUCT MARKET</td>
<td>BE</td>
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<td>PC</td>
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<td>IC</td>
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- Predominant regimes:
  - **BE**: IC-EB, IC-MO and IC-PR
  - **NL**: IC-EB, IC-PR and IC-MO
Differences in regimes and market imperfections:

Within-regime industry differences
Within-regime industry differences (1)

Minor cross-country regime differences mask important cross-country differences in the composition of industries making up the regimes

- 68% of the industries (13 out of 19) in Manufacturing are characterized by a different regime
  - in most of the 6 common IC-EB-industries, $\hat{\mu}_j$ is estimated to be larger in NL while $\hat{\phi}_j$ is estimated to be larger in BE
- 55% of the industries (6 out of the 11) in Services are characterized by a different regime
  - in the common IC-PR-industry, $\hat{\mu}_j$ is not sign. different in BE and NL
  - in the common IC-MO-industry, both $\hat{\mu}_j$ and $\left(\hat{\varepsilon}_w^K\right)_j$ are estimated to be larger in BE
  - in the 3 common IC-EB-industries, $\hat{\mu}_j$ is estimated to be larger in NL while $\hat{\phi}_j$ is estimated to be larger in BE
### Within-regime industry differences: $R = IC - EB$

**BE**: 53% of industries, 51% of firms

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<thead>
<tr>
<th></th>
<th>$\widehat{\mu}_j$</th>
<th>$\widehat{\phi}_j$</th>
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<tbody>
<tr>
<td>Industry mean</td>
<td>1.183 (0.106)</td>
<td>0.463 (0.167)</td>
</tr>
<tr>
<td>Industry $Q_1$</td>
<td>1.090 (0.041)</td>
<td>0.323 (0.072)</td>
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<tr>
<td>Industry $Q_2$</td>
<td>1.153 (0.062)</td>
<td>0.428 (0.105)</td>
</tr>
<tr>
<td>Industry $Q_3$</td>
<td>1.190 (0.094)</td>
<td>0.577 (0.274)</td>
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**NL**: 57% of industries, 64% of firms

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<th>$\widehat{\mu}_j$</th>
<th>$\widehat{\phi}_j$</th>
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<tbody>
<tr>
<td>Industry mean</td>
<td>1.360 (0.123)</td>
<td>0.249 (0.125)</td>
</tr>
<tr>
<td>Industry $Q_1$</td>
<td>1.242 (0.069)</td>
<td>0.196 (0.084)</td>
</tr>
<tr>
<td>Industry $Q_2$</td>
<td>1.305 (0.101)</td>
<td>0.262 (0.113)</td>
</tr>
<tr>
<td>Industry $Q_3$</td>
<td>1.453 (0.190)</td>
<td>0.318 (0.175)</td>
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Differences in regimes and market imperfections

Within-regime industry differences (3)

\[ R = IC-EB \]

\[ BE : \rho_{\hat{\mu}_j,\hat{\gamma}_j} = 0.66^{***} \]

\[ NL : \rho_{\hat{\mu}_j,\hat{\gamma}_j} = 0.22 \]

DOBBELAERE - VANCAUTEREN Market imperfections, skills & TFP (1) VU University Amsterdam, Tinbergen Institute, IZA (2) Hasselt University, Statistics Netherlands
Differences in TFP distributions:
Related literature
Related literature (1)

- Well-established result: Important role of misallocation of resources across productive units in explaining aggregate outcomes

- Existing studies examine e.g. the extent to which specific policies, institutional factors and market imperfections impact aggregate TFP via generating misallocation (Restuccia and Rogerson, 2013)

- We assess the importance of product and labor market competition in explaining TFP growth differences in a descriptive way (Amoroso et al., 2015)
There is a vast theoretical and empirical literature on the impact of product market competition on productivity

- Theoretically, increased product market competition might *positively* affect productivity through increasing:
  - allocative efficiency $\rightarrow$ confirmed empirically
  - technical efficiency $\rightarrow$ confirmed empirically
  - dynamic efficiency $\rightarrow$ empirical evidence remains inconclusive
Related literature (3)

There is a large literature on the impact of unionization on productivity:

- **Unions might have a positive impact on productivity through improving allocative and technical efficiency via:**
  - reduction of staff turnover
  - improved worker motivation
  - better communication between workers and management

- **Unions might have a negative impact on productivity through decreasing allocative and technical efficiency via:**
  - strike activity and non-cooperative behavior
  - adoption of inefficient work practices

- Different channels through which unions might affect dynamic efficiency

  ➔ Micro evidence remains inconclusive
Labor market institutions might also influence productivity in different directions:

- On the one hand, rigid labor market institutions might hinder productivity growth through raising labor adjustment costs thereby impeding labor reallocation.
- On the other hand, cooperative labor relations might lead to higher productivity growth.
Differences in TFP distributions:
Descriptive evidence
We measure $TFP$ as the residual of a $SYS-GMM$ estimation of the standard Cobb-Douglas production function at the industry level:

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

(14)
Differences in TFP distributions

Descriptive evidence (2)

**TFP distribution, by country and regime**

Cross-country comparison

* **Mean**: [0.3-2.2] in BE, [1.4-2.4] in NL
  lower in IC-PR & IC-EB in BE, higher in IC-MO in BE

* **Dispersion**: higher in all regimes in NL, except for IC-MO
Descriptive evidence (3)

TFP distribution, by country and regime

Cross-regime comparison

* **IC-PR**: Rel. high mean, high dispersion which is caused by extreme outliers
* **IC-EB**: Relatively low mean, low dispersion
Which factors could further explain these differences in *TFP* distributions across countries and regimes?

- Skills
- Compositional variation within regimes
Differences in TFP distributions

**Descriptive evidence (5)**

* **Mean** : higher in *HS* enterprises in all regimes in *BE & NL*, except for *PC-PR*
  highest skill premium in *PC-MO* in *BE* (1.6 pp.) and *IC-PR* in *NL* (2.0 pp.)

* **Dispersion** : higher in *HS* enterprises in all regimes in *NL*,
  only in *PC-MO & IC-EB* in *BE*
Differences in TFP distributions

Descriptive evidence (6)

TFP distribution, by country, regime and manufacturing/services

* Mean: higher in services in all regimes in BE & NL

  highest service premium in IC-PR in BE (1.8 pp.) & NL (1.0 pp.)

* Dispersion: higher in services in all regimes in BE & NL, except for IC-PR in BE
Examining the potential link between the degree of market imperfections and different moments of TFP distributions

- **IC-EB**: 
  - **BE**: Negative correlation between TFP dispersion and $\hat{\mu}_j$
  - **NL**: Negative correlation between average TFP growth rates and $\hat{\gamma}_j$
Differences in TFP distributions

Descriptive evidence (8)

\[ R = IC-EB \]

**BE**: \( \rho_{TFPGR_{Sd,j}, \hat{\mu}_j} = -0.22^{**} \)

**NL**: \( \rho_{TFPGR_{Mean,j}, \hat{\gamma}_j} = -0.21^{**} \)
Conclusion & Extensions
Conclusion (1)

This paper examines – in a descriptive way – the joint impact of product and labor market imperfections on TFP.

The prevalent product and labor market settings and hence the prevalent regimes are to some extent comparable in BE and NL.

- dominant regime in both countries: *IC-EB*
- most pronounced difference: higher prevalence of *MO* and lower prevalence of *PR* in *BE*.

Important cross-country differences in:

- the composition of industries making up the regimes
- the levels of product and labor market imperfections within *IC-EB*.
Conclusion (2)

- Cross-country cross-regime differences in TFP distributions

  - descriptive evidence of resource misallocation across heterogeneous production units being an important source of cross-country differences in measured TFP

  - the prevalent LMS appears to be more decisive than the PMS in shaping regime-specific TFP distributions in BE & NL:
    
    average TFP growth rates are among the largest but TFP is more unequally distributed in IC-PR, the opposite holds in IC-EB

  - TFP distributional characteristics vary to some extent by the degree of imperfections in product and labor markets

- Average TFP growth rates are higher in high-skilled enterprises in all regimes, except for PC-PR, and in services in all predominant regimes
Our gap methodology identifies regimes by comparing differences between the estimated average output elasticities of labor and materials and their average revenue shares.

A more rigorous identification strategy could be based on estimating a more flexible functional form of the production function (translog) and on bootstrap hypothesis testing.

A natural extension of our production function framework is to take into account worker heterogeneity by building on the method of Hellerstein et al. (1999).
Extensions (2)

- Extending our analysis from a static to a dynamic framework might enable us to investigate the impact of country- and industry-level adjustment costs which are structural/permanent in nature on the prevalence of different product and labor market settings and on TFP performance.

- Not estimating *sensu stricto* a production function for lack of firm output price information can be a cause of bias in our estimates.

  - Extending our production function framework by disentangling efficiency and demand-enhancing effects.