Much ado about something?

Regulation, resource reallocation and firm-level productivity in OECD countries

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Motivation

- The long-standing process of economic convergence has come to a halt in the past 15 years
  - Because of the acceleration in growth in some of the affluent countries (e.g. the U.S.)...
  - ...and persistent slowdown in many EU and Japan
- At the same time, significant effort at policy reform in most countries
  - With policy convergence in many areas (macro, trade)...
  - ...including in product market regulations
- Focus on pre-crisis period (recent data few and noisy)
Outline

- Heterogeneity and productivity
- Regulation and productivity
  - The channels
  - Trends in regulation
- A first look at the industry and firm-level evidence
- Modelling the regulation-productivity link
  - Regulation-productivity link at the firm level
- Conclusions
Productivity Growth and Heterogeneity

• Recent literature has highlighted the importance of heterogeneity of industries and firms within industries.

• Productivity developments depend on:
  – Shifts in sectoral composition of the economy
  – Average productivity of firms active in each sector at each point in time
    Which in turn depends on:
    • Productivity developments within existing firms
    • Re-allocation of resources across firms: Entry, exit, differential growth of firms with different productivity
Stylised facts: Industry- and Firm-Level

<table>
<thead>
<tr>
<th>Industry-level evidence</th>
<th>Firm-level evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>– Wide heterogeneity of productivity levels and growth across industries</td>
<td>– Wide heterogeneity of productivity levels and growth across firms</td>
</tr>
<tr>
<td>– ICT-intensive industries have played a specific role in sustaining productivity over past decade</td>
<td>– Re-allocation of resources across firms with different productivities adds substantially to aggregate productivity growth (Bartelsman et al., 2009)</td>
</tr>
<tr>
<td>– Productivity in service industries has proved to be particularly dynamic in the recent past</td>
<td></td>
</tr>
</tbody>
</table>

Aggregate productivity growth highest where resources flow most easily to fast growing high productivity firms and industries
**The Role of Regulation**

- **Extensive literature on the links between policies, competition and productivity growth**
  
  (reviews in this paper and by e.g. Griffith and Harrison, 04; Crafts, 06)

- **Inappropriate regulations can:**
  - Raise barriers to market entry and rents
  - Generate market frictions and adjustment costs

- **Hence, appropriate product market reform can:**
  - Reduce slack (e.g. Winston, 93; Vickers, 95)
  - Increase efficiency in resource reallocation (Restuccia and Rogerson, 07; Hsieh and Klenov, 06; Bartelsman et al. 08, 09; Melitz, 2003)
  - Stimulate technology adoption and innovation (Parente and Prescott, 1994, 1999; Aghion and Howitt, 98; Poschke, 07)
Measuring PMR rigidities

• Two basic sets of policy indicators:
  – The indicators of domestic non-manufacturing regulation (NMR)
    • Cover 7 network industries (energy, transport and communication), over 1975-2007
    • Cover retail trade and business services in 1998, 2003, 2007
    • Regulations of financial sector, 2003
  – The indicators of border barriers (BB)
    • FDI restrictions in all sectors (especially non-manufacturing) over 1980-2007

• These cover mostly barriers to market entry and adjustment costs (e.g. red tape, conduct regulation)

• To account more fully for the implied costs of inappropriate regulation in all sectors of the economy, we compute indicators of Regulation Impact (RI)
  • Derived from NMR and/or BB indicators using U.S. I-O table
  • Cover 38 ISIC sectors in 29 OECD countries from 1975 to 2007

• RI indicators are used in our empirical analysis
Recent trends in PM rigidities

• Evidence on OECD measures suggests extensive reforms over past two decades:
  – Border barriers were eased substantially
  – Non-manufacturing sectors were liberalised

• As a result, regulatory impact was reduced in all sectors, easing entry and lowering adjustment costs

• However, several features may have borne on outcomes in different countries:
  – Pace and depth of reform differed widely across countries, dispersion in approaches increasing precisely at the time of the ICT shock
  – While convergence towards liberal markets accelerated over past decade, many laggard countries liberalised only quite recently (e.g. continental Europe)
  – In many of these countries crucial ICT-using sectors remained heavily burdened by behind the border regulation (e.g. retail and business services)

• Specifically, EU services markets are still hampered by explicit barriers and heterogeneous service regulations that prevent full integration, with EU firms enjoying less economies of scale and scope than US ones
1. To what extent can product market policies explain differential cross-country developments in productivity?

2. What is the role of the resource re-allocation channel for the link between PMR and productivity?

3. Do PMR affect different industries or firms in different ways?

4. Do different product market policies (border vs behind the border) have differential effects in different industries or firms?
Anticipating the main findings

1. Limits and delays in PM reform have held up productivity gains in many countries

2. Inappropriate regulations curb productivity growth by making reallocation towards the most efficient firms and industries difficult

3. The effect of regulations is particularly harmful in
   – ICT-intensive industries that have driven productivity acceleration over the past
   – Catching up firms in dynamic sectors

4. Barriers to foreign entry are more harmful for firms that are close to frontier

➢ Firm heterogeneity is important for predicting the effects of PMR
Data used in the Analysis

- **Industry-level data:**
  - EU Klems data base, March 2007 release

- **Firm-level data:**
  - Amadeus data base by commercial provider BvD
  - Used a random sampling technique to match the sample distribution to the population weights with respect to
    - Sector composition
    - Firm size groups
A first look at the data: Industry level

- Look at labour productivity growth distributions by country, industry and year (taking into account differences in means)
  - High dispersion of productivity growth rates

- Compare productivity distributions across country groups
  - Median and density higher in English-speaking

- Compare productivity distributions for low and high regulation impact
  - Median and density higher in lower-regulated
A first look at the data: Firm-level

• Look at labour productivity distributions of firms within industries in different countries and years
  – High heterogeneity of productivity levels
  – Dispersion is rising over time (perhaps linked to increasing openness/ease of entry)
  – Increase in dispersion is driven by top performers

• Hence, increases in average productivity are related to
  – ability to shift resources from low to high productivity firms
  – ability of high-productivity firms to gain market shares
A first look at the data: firm level
How well do economies allocate resources across firms?

1. **Static view:** Is resource allocation correlated with firm productivity?

Olley-Pakes productivity decomposition:

\[ P = \sum_{i} \theta_i P_i = \left(\frac{1}{N}\right) \sum_{i} p_i + \sum_{i} (\theta_i - \bar{\theta})(p_i - \bar{P}) \]

- Simple Average
- Allocative Efficiency

2. **Dynamic view:** Do resources move efficiently across heterogeneous firms? Do better firms grow faster?
Linking allocative efficiency to regulation

- Anti-competitive regulation correlates negatively with allocative efficiency
- Correlation is significant in services industries, and particularly in ICT-using industries

Table 1. Product market regulation and allocative efficiency

<table>
<thead>
<tr>
<th>Dependent variable: Olley-Pakes indicator</th>
<th>Business Sector</th>
<th>Manufacturing only</th>
<th>Services only</th>
<th>ICT using sectors</th>
<th>Non-ICT using sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulation Impact Indicator</td>
<td>-0.33 ***</td>
<td>0.54</td>
<td>-0.37 **</td>
<td>-0.30 **</td>
<td>-0.26</td>
</tr>
<tr>
<td></td>
<td>(0.10)</td>
<td>(1.44)</td>
<td>(0.16)</td>
<td>(0.14)</td>
<td>(0.17)</td>
</tr>
<tr>
<td>Country-year FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Industry FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>N</td>
<td>894</td>
<td>703</td>
<td>191</td>
<td>417</td>
<td>477</td>
</tr>
<tr>
<td>R2</td>
<td>0.20</td>
<td>0.21</td>
<td>0.19</td>
<td>0.21</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Standard Errors in parentheses. *, **, *** indicate statistical significance at the 10, 5 and 1 percent levels, respectively.
Agriculture, forestry, fishing, mining and construction are excluded, as are public administration, education and health sectors. ICT-intensive sectors include both ICT-producing and ICT-using ones (see Annex)
Modeling the regulation-productivity link

- Productivity analysis increasingly based on a neo-Schumpeterian model of productivity growth:

\[
\frac{A_t}{A_{t-1}} = \int_0^1 s_t(\nu) \left[ \gamma_t(\nu) + \eta \left( \frac{A_{t-1}}{A_t} \right) \right] d(\nu)
\]

AAZ (2006)

\[
\frac{A_t}{A_{t-1}} - 1 = \mu_n (\gamma - 1) + \mu_m \left[ \left( \frac{A_{t-1}}{A_t} \right) - 1 \right]
\]

AH (2006)

- Productivity growth depends on growth at the frontier and catch up to the frontier
Modeling the regulation-productivity link

- Empirical implementation of the neo-Schumpeterian model
  - Productivity is an ADL(1,1) process with level co-integrated with productivity at frontier (Griffith et al. 2006)

\[ A_{icst} = \alpha_0 A_{icst-1} + \alpha_1 \bar{A}_{icst} + \alpha_2 \bar{A}_{icst-1} + \varepsilon_{icst} \]

- With LR homogeneity \((\alpha_0 + \alpha_1 + \alpha_2 = 1)\) and regulation:

\[ \Delta \ln A_{icst} = \alpha_0 + \alpha_1 \Delta \ln \bar{A}_{icst} - (1 - \alpha_0) \ln \left( \frac{A}{\bar{A}} \right)_{icst-1} + \\
+ \left[ \alpha_3 PMR_{cst-1} + \alpha_4 PMR_{cst-1} \times \ln \left( \frac{A}{\bar{A}} \right)_{icst-1} \right] + \gamma_s + \gamma_{ct} + \varepsilon_{icst} \]
Modeling the regulation-productivity link

• **Notable features of empirical model:**
  – Innovation is a fraction of innovation at the frontier
  – Innovation at the frontier is not modelled
    • Only productivity levels are explained
  – Regulation is introduced in the same way as R&D in Griffith et al (2006), but modelling is ad hoc
    • PMR inhibits innovation
    • PMR inhibits technological catch-up
  – Model was estimated at industry and firm levels
Regulation-productivity link
Industry-level evidence

• Panel data analysis based on model variants and different data sets (OECD STAN, EU-KLEMS) or measures of regulation (OECD PMR, EU SMP)

• Negative link between inappropriate regulation and productivity generally found

  ❖ *Direct effects*: Nicoletti, Scarpetta 03; Conway et al. 06; Griffith et al. 06; Aghion, Griffith, 06; Tressel, 2008; Inklaar et al. 2008; Barone and Cingano, 2009; Cette et al. 2009)

  ❖ *Indirect effects*: Nicoletti and Scarpetta, 2003; Conway et al, 2006 (regulation curbs catch-up process)

  ❖ *Sectoral effects*: several studies found a stronger effect in ICT-intensive industries

  ➢ *These studies do not distinguish effects of different regulations on different kinds of firms (e.g. different distances to frontier)*
Regulation-productivity link
Firm-level evidence

- Based on
  - Firm-level Amadeus MFP data (with focus on incumbents)
  - New OECD regulation impact indicators

Main findings in this paper are:

- Inappropriate regulations directly reduce MFP growth in all sectors
- Firms catching up are particularly affected
- Negative effects are particularly strong in firms far from frontier and ICT-intensive industries
- Border barriers are more harmful for close to frontier firms

- Robustness checks relative to:
  - Alternative MFP measures (OLS, Levinsohn-Petrin)
  - Broader set of policy & institutional factors (LM, Fin. development)
Concluding Remarks

- Inappropriate regulations hamper productivity growth through a number of channels
- Delays and limits in reforming them can partly explain cross-country differences in performance over the past 15 years
- Heterogeneity crucial to understand effects of regulation on productivity:
  - Effects differ across industries
  - Effects differ across firms
- Regulation curbs within-firm productivity gains but also affects aggregate productivity by hampering growth of catching-up firms and industry dynamism (reallocation channel)
- This could be particularly important as the current crisis unfolds
- But more work is required to shed further light on the process of resource reallocation and firm-level productivity
Thank you
Annex

Figures, tables and details
Liberalisation in energy, transport and communications
Border barriers were eased
(FDI restrictions indicator)
Liberalisation in energy, transport and communications
The OECD indicators of regulation impact (RI)

- Measure the direct and “knock-on” effects of both behind-the-border and border regulations on each sector of the economy
- Derived from NMR and BB sectoral indicators using total I-O coefficients $w$:

$$ RI_{cst} = \sum_k w_{cks} \times NMR_{ckt} + \sum_k w_{cks} \times BB_{ckt} $$

Where $c$=country, $s$=sector, $k$=intermediate input, $t$=period
- Computed for 38 ISIC sectors in 29 countries over 1975-2007
The burden of regulation has declined in all OECD countries

Indicators of regulation impact

**Behind the border regulation**

![Graph showing the burden of regulation behind the border across different years and countries.]

**Border regulation**

![Graph showing the burden of regulation at the border across different years and countries.]

(Data for specific years and countries are available for analysis.)
Impact of regulation on different industries

2007

Behind the border regulation

<table>
<thead>
<tr>
<th>Country</th>
<th>Non-ICT</th>
<th>ICT using/producing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swe</td>
<td></td>
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<tr>
<td>Nld</td>
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<tr>
<td>Dnk</td>
<td></td>
<td></td>
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<tr>
<td>Irl</td>
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<tr>
<td>Usa</td>
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<tr>
<td>Fin</td>
<td></td>
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<tr>
<td>Nzl</td>
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<td>Aus</td>
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<td>Gbr</td>
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<tr>
<td>Ita</td>
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<tr>
<td>Jpn</td>
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<td></td>
</tr>
<tr>
<td>Bel</td>
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</tbody>
</table>

Border regulation

| Country | | |
|---------| | |
| Nld     | | |
| Gbr     | | |
| Deu     | | |
| Usa     | | |
| Jpn     | | |
| Irl     | | |
| Fra     | | |
| Nor     | | |
| Bel     | | |
| Ita     | | |
| Dnk     | | |
| Prt     | | |
| Che     | | |
| Esp     | | |
| Grc     | | |
| Swe     | | |
| Fin     | | |
| Aut     | | |
| Can     | | |
| Nzl     | | |
| Aus     | | |

The graphs show the impact of regulation on different industries in 2007, comparing behind-the-border regulation and border regulation across various countries.
Regulation-productivity: Industry-Level

Median and density is higher in English-speaking countries

Distribution of productivity growth across country groups

4 Continental European Countries

vs.

3 English-speaking countries

Labour productivity growth purged of country, industry and period means, based on EU KLEMS.
Median and density is higher for lower-regulated observations

Distribution of productivity growth by strength of regulatory impact

Labour productivity growth purged of country, industry and period means, based on EU KLEMS.
Wide firm heterogeneity within industries

Productivity dispersion across firms in ICT-producing France

Electrical and optical equipment

Telecommunications

The figures present the distribution of labour productivity in each industry and year between the 5th and 95th percentiles. The upper bound of the grey bar represent the 75th percentile, the lower bound the 25th percentile and the line in the middle of each grey bar being the median. Labour productivity is measured as value added per worker in 100 thousands of 1995 Euros. Source: Authors’ calculations from AMADEUS database.
Wide firm heterogeneity within industries

Productivity dispersion across firms in ICT-producing

United Kingdom

Electrical and optical equipment

Telecommunications
Differences in allocative efficiency, especially in services

Contribution of resource allocation to sectoral MFP levels
(Based on Olley-Pakes productivity decomposition)
Different Abilities of Countries to Channel Resources towards More Productive Firms

Growth of real value added by productivity quartiles (relative to average of country/sector/year group)
## Regulation and MFP at firm level

### Baseline Panel regression results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall regulation</th>
<th>Border vs domestic regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>Standard Error</td>
</tr>
<tr>
<td><strong>Frontier Growth</strong></td>
<td>0.065 **</td>
<td>0.008</td>
</tr>
<tr>
<td><strong>MFP Gap, t-1</strong></td>
<td>-0.113 **</td>
<td>0.009</td>
</tr>
<tr>
<td><strong>Regulation, t-1</strong></td>
<td>-0.093 ***</td>
<td>0.028</td>
</tr>
<tr>
<td><strong>Regulation domestic, t-1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Regulation border, t-1</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Observations: 217797 | 182104
- R square: 0.10 | 0.11
- Country-year fixed effects: Yes | Yes
- Industry fixed effects: Yes | Yes
## Regulation and MFP at firm level

The effects of firm growth heterogeneity

<table>
<thead>
<tr>
<th>Variable</th>
<th>Dynamic vs non-dynamic firms</th>
<th>Overall regulation</th>
<th>Border vs domestic regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontier Growth, MFP Gap, t-1</td>
<td>yes</td>
<td>yes</td>
<td></td>
</tr>
<tr>
<td>Regulation, t-1 * Dynamic</td>
<td>-0.111 (***)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulation, t-1 * Non-dynamic</td>
<td>-0.075 (***)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic firm dummy</td>
<td>0.139 (***)</td>
<td>0.140 (***)</td>
<td></td>
</tr>
<tr>
<td>Regulation dom., t-1 * Dynamic</td>
<td>-0.077 (***)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulation dom., t-1 * Non-dynamic</td>
<td>-0.059 (***)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulation border, t-1 * Dynamic</td>
<td>-0.167 (***)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulation border, t-1 * Non-dynamic</td>
<td>-0.129 (*)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dynamic = Non-dynamic (F-test)</td>
<td>3.84 (***)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Regulation and MFP at firm level

The effects of distance to frontier

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall regulation</th>
<th>Border vs domestic regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All firms</td>
<td>ICT-intensive only</td>
</tr>
<tr>
<td><strong>Frontier Growth, MFP Gap, t-1</strong></td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td><strong>Regulation, t-1</strong></td>
<td>-0.095 ***</td>
<td>-0.109 ***</td>
</tr>
<tr>
<td></td>
<td>(0.029)</td>
<td>(0.036)</td>
</tr>
<tr>
<td><strong>MFP Gap, t-1 * Regulation, t-1</strong></td>
<td>0.130 ***</td>
<td>0.191 ***</td>
</tr>
<tr>
<td></td>
<td>(0.051)</td>
<td>(0.078)</td>
</tr>
<tr>
<td><strong>Regulation domestic, t-1</strong></td>
<td></td>
<td></td>
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<tr>
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<td></td>
<td></td>
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<tr>
<td><strong>Regulation border, t-1</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Regulation dom., t-1 * MFP Gap, t-1</strong></td>
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</tr>
<tr>
<td><strong>Regulation border, t-1 * MFP Gap, t-1</strong></td>
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