Measuring dynamic market selection: the case of EU business services

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joint work with George van Leeuwen
Structure

- **European business services: large industry with a productivity problem**
  - is deficient competition the cause?

- **Quantifying dynamic selection in markets**
  - market as moving firm distribution
  - without and with scale economies

- **Environment factors that affect market selection**
  - Regulation affecting entry/exit costs and firm growth
  - Market contestability (entry, imports)
European business services as case study

- **Large industry**
  - fabulous employment growth between 1990-2005
  - now: employment share close to manufacturing or even larger
  - about 50% of employment is in knowledge-intensive sub-sectors
  - one of the largest providers of intermediary inputs for the rest of the economy

- **But: ... with stagnating productivity growth since 1980**
  - single largest contribution to the 1995-2007 gap in labour productivity growth between EU25 and the USA
  - knowledge-intensive business services did not perform better
  - country pattern is fairly similar in most countries, but some USA and UK performed better (positive productivity growth)
  - several sub-sectors with zero or negative TFP growth: may indicate badly functioning markets
Effectiveness of competitive selection

- **Market process itself is too complex to quantify**
  - constant turbulence: market reallocation, entry, exit
  - many dimensions of firm behaviour
  - actions by individual firms cannot or at best partly be observed
  - causality problems in behaviour: independent actions, reactions, anticipations, inertness
  - external shocks for the market (macroeconomics, regulation, globalisation, technology)

- **Better to focus on outcomes of the market process:** characteristics of changes in firm distribution between $t_0$ and $t_1$

- **Theory:** average efficiency in effective markets should increase over time (perfect competition, monopolistic competition)
Mickey Mouse market model

- Suppose the ONLY observables of firms in a market are:
  - firm identity
  - an efficiency parameter of each firm (e.g. productivity, TFP) at $t_0$ and $t_1$

- This allows:
  1. ranking of performance
     - frontier (frontier group, sub-frontier group)
     - size frontier gap
  2. comparing performance at $t$ and $t+1$
Market = firm distribution moving over time
1st dynamic: shift in frontier group share
frontier gap change: additional dimension

\[ \Delta F \]

\[ F_{t1} \]

F_to : effic. gap

Sub-frontier group

\( q_{to} \)

frontier group

\( t_0 \)

\( t_1 \)

time \( \rightarrow \)
2\textsuperscript{nd} dynamic: change in frontier gap distribution
Both dynamics combined: EMSI (indicator)
Quantifying competitive selection

- Effective competitive selection in a market should increase general efficiency performance through:
  1. Larger groups of firms at the efficiency frontier, and/or
  2. Smaller median frontier gap of non-frontier firms, and/or
  3. Upward shift of frontier itself (possibly effect of competition)

- EMSI is a simple measure for effectiveness of market selection between $t_0$ and $t_1$:

  $$EMSI = q_{t0} \cdot \Delta q + (1 - q_{t0}) \cdot (- \Delta w)$$

  with initial frontier group share $q_{t0}$ as a plausible weight
  □ correction for frontier shift is necessary if $\Delta t$ is large
Data

- Microdata for international comparative research
  - always a problem
  - mostly: no good representation of small firms (often 90-95%)

- Use Eurostat panel data by data cell
  \{country \times industry \times sizeclass \times year\}
  - includes sales, value added, depreciation, employment, number of firms per cell
  - 13 EU countries, 1999-2005
  - 5 size classes, 8 industries (homogenised)
  - (n = 2696)

- allows to calculate representative firms by data cell
  - but also tells something about intra-cell distribution using finding that Zipf distribution characteristics apply (cf. Axtell 2001)
'Zipf'-like size distribution of BS firms in EU, 1999 (size measured by employed persons, log-log scale)

\[ y = 13.98 - 1.055 x \]

\[ R^2 = 0.9496 \]
### EMSI calculated for EU business services
13 countries, 8 sub-sectors (3-digit), 1999-2005

<table>
<thead>
<tr>
<th>Industry</th>
<th>share frontier group in 1999</th>
<th>$\Delta$ share frontier group</th>
<th>$\Delta$ median frontier gap</th>
<th>EMSI for period 1999-2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer/IT services</td>
<td>0.036</td>
<td>+0.018</td>
<td>−0.069</td>
<td>+0.067</td>
</tr>
<tr>
<td>Legal, auditing, accounting, consultancy</td>
<td>0.077</td>
<td>−0.015</td>
<td>+0.134</td>
<td>−0.125</td>
</tr>
<tr>
<td>Architectural, engineering, technical services</td>
<td>0.092</td>
<td>−0.046</td>
<td>+0.200</td>
<td>−0.186</td>
</tr>
<tr>
<td>Marketing services</td>
<td>0.035</td>
<td>+0.035</td>
<td>−0.037</td>
<td>+0.037</td>
</tr>
<tr>
<td>Labour recruitment</td>
<td>0.077</td>
<td>+0.046</td>
<td>−0.072</td>
<td>+0.070</td>
</tr>
<tr>
<td>Industrial cleaning</td>
<td>0.095</td>
<td>−0.016</td>
<td>−0.037</td>
<td>+0.032</td>
</tr>
<tr>
<td>Security services</td>
<td>0.154</td>
<td>−0.031</td>
<td>−0.065</td>
<td>+0.050</td>
</tr>
<tr>
<td>Miscellaneous bus. services</td>
<td>0.031</td>
<td>+0.047</td>
<td>−0.166</td>
<td>+0.162</td>
</tr>
</tbody>
</table>
First results on competition effectiveness

- EMSI indicates largest problems in sub-sectors
  - K741 (legal, administrative, accounting, consulting)
  - K742-2 (architects, engineering services)
  - Both are also sub-sectors with worst productivity growth performance

- Requires further investigation:
  - refined market demarcation (e.g. 5-digit) : no data......!!
  - possible role for scale effects:
    - non-homogeneous technology across size classes?
    - role growth barriers between size classes?

- Focus on scale effects
Scale economies matter in business services

Relative capital intensity (fixed capital per worker)

Size classes (employment per firm)

K72  K741  K742-3  K744  K745  K746  K747  K748
1. **Thought experiment**: consider steady state in a competitive industry with a homogeneous product and scale economies:
   - firms grow or shrink until they reach optimal scale $Q$
   - result of selection: only firms close to the optimal scale $Q$ will survive (this is our benchmark)
Time persistence of scale inefficiencies (II)

2. Now consider the same market if barriers to market selection are operative:
   - not all firms achieve minimal optimal scale: many will remain too small
   - other firms will remain too large despite having diseconomies of bureaucracy / weak internal efficiency
   - result: persistence of scale diseconomies between size classes

3. \textbf{X-inefficiency:} due to shielded sub-markets, some firms always operate below efficiency frontier of own size class
Decomposing the relation between size and productivity in an industry with scale economies: frontier / actual

Entry and growth barriers

X-inefficiencies, sub-frontier productivity

Exit barriers, market power

steady state, imperfect competition
steady state, competitive market
imperfect competition, possible lower threshold of actual distribution
Empirical strategy

1. Assess per industry the persistence of:
   - scale-inefficiency (between size classes)
   - X-inefficiency (efficiency gaps within size classes)

2. Use DEA to construct X-efficiency and scale-efficiency indicators
   - inefficiencies are implied
Average **scale efficiency** scores by size class, across sectors, countries and years (13 EU countries, 1999-2005)

<table>
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<tr>
<th>Size class</th>
<th>Scale efficiency scores (frontier = 1)</th>
</tr>
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<tbody>
<tr>
<td>1. (1-9 employees)</td>
<td>0.49 !!</td>
</tr>
<tr>
<td>2. (10-19 employees)</td>
<td>0.93</td>
</tr>
<tr>
<td>3. (20-49 employees)</td>
<td>0.97</td>
</tr>
<tr>
<td>4. (50-249 employees)</td>
<td>0.99</td>
</tr>
<tr>
<td>5. (≥ 250 employees)</td>
<td>0.98</td>
</tr>
</tbody>
</table>

Note: scale-efficiency gap between size class 4 (frontier) and size class 1 is >50%! Small firms must have a huge cost disadvantage

===> *weak competitive selection or market segmentation?*
Average **X-efficiency scores** by size class, across sectors, countries and years (13 EU countries, 1999-2005)

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<tr>
<td>1. (1-9 employees)</td>
<td>0.93</td>
</tr>
<tr>
<td>2. (10-19 employees)</td>
<td>0.61</td>
</tr>
<tr>
<td>3. (20-49 employees)</td>
<td>0.62</td>
</tr>
<tr>
<td>4. (50-249 employees)</td>
<td>0.66</td>
</tr>
<tr>
<td>5. (≥ 250 employees)</td>
<td>0.81</td>
</tr>
</tbody>
</table>

The high X-efficiency in the smallest size class indicates strong competition **within** this size class (among smallest firms)
Finding: inefficiencies persistant and growing

1. **Scale efficiency** deteriorated in most BS industries, in almost all countries and in almost all size classes

2. Average efficiency gap between best- and worst-performing size classes became wider in most countries
   
   ==> no convergence to an optimal firm size
   
   ==> weak competitive selection **between** size classes

3. **X-efficiency** diminished in half of the BS industries. Similar for the average size of the gap.
   
   ==> weak competitive selection **within** size classes
Role of external shocks

- **Policies may hamper market selection:**
  - creating entry barriers (e.g. start-up costs new firms)
  - creating exit barriers (e.g. bankruptcy laws, labour protection)
  - obstacles for post-entry growth and shrinking of firms (like size-related legal and administrative burdens, size-related tax breaks or subsidies)
  - Policy-related obstacles to import competition (e.g. policies that create sunk entry costs for foreign firms, VAT differences)

- **Non-contestability:** market power incumbents not enough challenged
  - by imports
  - by domestic start-ups and innovating firms
Quantifying role of shocks

- **Indicators regulatory environment (World Bank)**
  - WB Cost of starting a business (entry costs);
  - WB Cost of closing a business (exit costs);
  - WB Costs of changing employment contracts (costs of growth / shrink)

- **Indicators market contestability:**
  - Import share in domestic use of business services (net of exports) : calculated from national IO-tables
  - Firm entry-exit ratios (per industry and country, EUKLEMS)

- **Estimated with RE Tobit panel model**
  - Bootstrapped SE (cope with non-normal distributed SE)
  - Fixed effects by country and industry
## Factors that explain scale-related efficiencies

<table>
<thead>
<tr>
<th>A 10% increase in the following variables</th>
<th>gives a ..% effect on scale-efficiency</th>
<th>gives a ..% effect on X-efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>regulatory start-up costs (entry)</td>
<td>–</td>
<td>−0.8%</td>
</tr>
<tr>
<td>regulation-caused labour inflexibility (growth-shrink costs)</td>
<td>−0.5%</td>
<td>−1.3%</td>
</tr>
<tr>
<td>regulatory exit costs</td>
<td>−1.5%</td>
<td>−3.1%</td>
</tr>
<tr>
<td>import penetration</td>
<td>–</td>
<td>+1.0%</td>
</tr>
<tr>
<td>domestic firm start-up ratio</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

(with controls for industry and size class, bootstrapped SE, n=2063,
Conclusions

- EMSI indicates weak market selection in some large sub-sectors of EU business services.

- Accounting for scale effects shows a persistence of scale-inefficiencies and - to a lesser extent - also a persistence of X-inefficiencies.

- Policy shocks (entry/exit, labour contract inflexibility) and weak market contestability (imports) significantly explains the persistence of inefficiencies over time.
Thanks for your attention

dpaper online in *Economic Dynamics and Structural Change*
Average scale-efficiency scores for Architectural, Engineering and Technical Services (K742-3)
Average X-efficiency scores for Architectural, Engineering and Technical Services (K742-3), 13 EU countries, 1999-2005