Measuring Competitiveness: results of traditional & new indicators

Filippo di Mauro (ECB)

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Setting the scene

- Asymmetries within the euro area
- Need to measure competitiveness
- Simple measures of competitiveness may be misleading

⇒ Main message: there is an overemphasis on price-cost measures
⇒ Need a broader and more accurate assessment, firm and product based
⇒ Will present an overview out of three papers and first results of ongoing work
Papers to be reviewed


Outline

- Macro/institutional indicators (price-cost)
- Firm level analysis
- Product level
- Conclusions
1. MACRO INDICATORS
1.1 – Price-cost indicators

The EA has been losing market shares in the last decade...more than competitors

Export market shares
(Index, 1999=100; annual data; in volume terms)

Source: ECB calculations.
Note: Latest observation refers to 2009.
Deteriorating price competitiveness had a role in making exports less competitive. Relative export prices (Index, 1999Q1=100; quarterly data) and nominal effective exchange rates (Index, 1999Q1=100; quarterly data) show how international prices of goods and services changed over time.

Source: ECB calculations. Note: Relative prices equal competitors’ export prices divided by export prices (both for the respective country). An increase indicates a gain in price competitiveness. Last observation refers to 2009Q4.

... hiding important differences at the country level

Export market shares of selected euro area countries (Index, 1999Q1=100; SA; quarterly) and price competitiveness & export market shares (average annual percentage changes, 1999-2008Q3) show variations in market share and how price competitiveness has changed.

Source: Eurostat and ECB calculations. Note: Last observation refers to 2009 Q4.

Note: Price competitiveness is proxied by relative export prices (country export prices divided by competitors’ export prices). An increase in relative export prices implies a fall in competitiveness.
...note also that starting point matters...

Real effective exchange rate of selected euro area countries (EER-27)
(Index: 1999Q1=100; quarterly data; CPI deflated)

Source: BIS.
Note: Last observation refers to 2010 Q2.
1.2 Sector specialization

The Euro area has a rather even degree of specialization, unlike US/JAP.

**Revealed comparative advantage by factor intensity**
(annual data, average for the period 1993-2008)

<table>
<thead>
<tr>
<th>Exports are predominantly:</th>
<th>Euro area</th>
<th>USA</th>
<th>Japan</th>
<th>China</th>
<th>CEEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw materials intensive</td>
<td>0.5</td>
<td>0.7</td>
<td>0.1</td>
<td>0.4</td>
<td>1.7</td>
</tr>
<tr>
<td>Labour intensive</td>
<td>1.1</td>
<td>0.8</td>
<td>0.5</td>
<td>2.3</td>
<td>1.0</td>
</tr>
<tr>
<td>Capital intensive</td>
<td>1.2</td>
<td>0.9</td>
<td>1.6</td>
<td>0.3</td>
<td>1.2</td>
</tr>
<tr>
<td>Research intensive</td>
<td>1.1</td>
<td>1.4</td>
<td>1.4</td>
<td>1.0</td>
<td>0.5</td>
</tr>
</tbody>
</table>

... with nuances at the country level

Export specialisation by euro area country¹)

<table>
<thead>
<tr>
<th></th>
<th>Aircraft and Spacecraft</th>
<th>Pharmaceuticals</th>
<th>Medical, precision and optical instruments</th>
<th>Low-technology industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA</td>
<td>1.2</td>
<td>1.6</td>
<td>1.1</td>
<td>0.9</td>
</tr>
<tr>
<td>DE</td>
<td>0.6</td>
<td>1.3</td>
<td>1.2</td>
<td>0.7</td>
</tr>
<tr>
<td>FR</td>
<td>2.9</td>
<td>1.7</td>
<td>0.8</td>
<td>0.9</td>
</tr>
<tr>
<td>IT</td>
<td>0.4</td>
<td>1.1</td>
<td>0.7</td>
<td>1.1</td>
</tr>
<tr>
<td>NL</td>
<td>0.3</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>ES</td>
<td>0.5</td>
<td>1.0</td>
<td>0.4</td>
<td>1.0</td>
</tr>
<tr>
<td>IR</td>
<td>0.2</td>
<td>4.9</td>
<td>1.1</td>
<td>0.8</td>
</tr>
<tr>
<td>B/LUX</td>
<td>0.2</td>
<td>2.1</td>
<td>0.4</td>
<td>1.1</td>
</tr>
<tr>
<td>FI</td>
<td>0.1</td>
<td>0.4</td>
<td>0.8</td>
<td>1.2</td>
</tr>
<tr>
<td>AU</td>
<td>0.2</td>
<td>1.3</td>
<td>0.7</td>
<td>1.0</td>
</tr>
<tr>
<td>PT</td>
<td>0.2</td>
<td>0.4</td>
<td>0.3</td>
<td>1.6</td>
</tr>
<tr>
<td>GR</td>
<td>0.4</td>
<td>1.1</td>
<td>0.2</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Source: Chelem, ECB calculations

Macro indicators: Conclusions

Price indicators
- **Pros** -- Easy to communicate
- **Cons**
  - Not always able to explain export performance
  - Overemphasis on export as ultimate objective

Revealed comparative advantage
- **Pros** – useful info
- **Cons** – classification is rather arbitrary
  - also hard to relate to export performance
2. FIRM LEVEL ANALYSIS

In the macro analysis there is an over-concentration on export results and “country” view

- First, internationalisation of production has blurred national boundaries

- Higher export also are not a welfare gain per se, but rather a channel through which welfare gains materialise

- Ultimately, what matters is firm productivity and what are the factors enhancing it

- There is extensive literature (Melitz, 2003) that firm heterogeneity and firm performance matters

- Also supported by increasing empirical evidence that firm characteristics (size, structure, organization, ...) matter at least paramount than macro factors
Modelling firm heterogeneity

• In a Economic Policy paper (Ottaviano, G., D. Taglioni and F. di Mauro (2009): The euro and the competitiveness of European firms. Economic Policy, January), we identify firms productivity enhancing factors, regardless of sectors

Objective is to:
- develop a broader concept of competitiveness
- measure it at the firm level
- use it for policy simulations

The model: key features

• Novel model in the tradition of new trade theory (Melitz, 2003; Bernard, Eaton, Jensen, Kortum, 2003)

• Features:
  – Monopolistic competition & product differentiation (variety counts for consumers- Krugman, 1980)
  – There are fixed “sunk” costs (R&D) to enter/produce in a sector
  – ….and delivery costs (including transportation inland and abroad, tariffs, ….) within the “freeness of trade” matrix

• Larger market size increases competition (higher elasticity of demand, and lower markups ➔ pro-competitive effect)
Consumption

- Utility derives from the total consumption of the two types of goods (differentiated manufacturing and homogenous).
- ... as well as from the availability of varieties (i) of the good s (D), with consumer liking variety.
- Demand for variety i of the good s is given by:

\[ p^h_s(i) = A_s - D_s e^h_s(i) - B_s \int_{i \in \Omega} e^h_s(i) di \] (1)

Substitutability across varieties
Total consumption of all varieties

....which corresponds to a standard inverse demand equation for \( D = 0 \)

Production: Firm selection

- Producer does not know in advance his mg. cost of producing (i.e. if he will be competitive and be able to produce in the market).
- Cost is drawn from distribution \( G_s^h(c) \) – assumed to be Pareto - with expected cost \( c \) comprised between 0 and \( c_{A,s}^h \) (i.e. cost varies by sector and countries).
- \( k_s \) (the distribution’s shape) indicates the number of firms exiting/entering when costs change.
- In addition, to enter a sector, producer pays a sunk costs \( f_s^h \) (R&D).
- There are sector-specific cut-off costs (i.e. upperbound costs) above which firms cannot survive:
  - when cost \( \geq c_{s,ht}^h \) \( \Rightarrow \) cannot stay/enter in the market (exit) \( \rightarrow \) point A
  - when cost \( \geq c_{s,ht}^h \) \( \Rightarrow \) only domestic sales, no exports, unless \( f \) drops or \( k \) changes.
Equilibrium cut-off cost (domestic): more formally

- The model is solved for the equilibrium cut-off
- It is that maximum cost which firms can sustain to stay in the market, given
  - Firm level characteristics (technology, demand, …)
  - Institutional factors (sector entry costs, …) and Trade barriers
- The lower it is, the higher is the overall competitiveness of firms.

\[
C^h_s = \left( \frac{2(\kappa^h_s + 1)(\kappa^h_s + 2)}{L^h} \right) \sum_{t=1}^{M} C^{th}_s \left[ \left[ \frac{f^t_s}{o^t_s} \right] \left( \kappa^h_s \right) \right] \frac{1}{\kappa^t_s + 2} 
\]

Calibration of components of Equilibrium Domestic cut-off: Overview

- Some parameters can be directly measured: market sizes \( L \) (population) [in green]
- Others can be estimated: cut-off cost \( c^h_s \), shape of cost distribution (elasticity of extensive margin) \( k \) and trade freeness \( \rho \) [in blue]
- Others are unobserved: \( D \), \( o \) and \( f \), and need to be calibrated from model. [in red]

Calculated on the basis of estimated empirical distribution of firms' TFP

\[
c^h_s = \left( \frac{2(\kappa^h_s + 1)(\kappa^h_s + 2)}{L^h} \right) \sum_{t=1}^{M} C^{th}_s \left[ \left[ \frac{f^t_s}{o^t_s} \right] \left( \kappa^h_s \right) \right] \frac{1}{\kappa^t_s + 2} 
\]
Overall competitiveness is defined as the inverse of cut-off cost

<table>
<thead>
<tr>
<th>Country</th>
<th>Overall Competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finland</td>
<td>3.9</td>
</tr>
<tr>
<td>Belgium</td>
<td>3.6</td>
</tr>
<tr>
<td>Netherlands</td>
<td>3.5</td>
</tr>
<tr>
<td>Sweden</td>
<td>3.4</td>
</tr>
<tr>
<td>Germany</td>
<td>3.3</td>
</tr>
<tr>
<td>France</td>
<td>3.0</td>
</tr>
<tr>
<td>Denmark</td>
<td>3.0</td>
</tr>
<tr>
<td>Austria</td>
<td>3.0</td>
</tr>
<tr>
<td>UK</td>
<td>2.6</td>
</tr>
<tr>
<td>Italy</td>
<td>2.1</td>
</tr>
<tr>
<td>Spain</td>
<td>1.9</td>
</tr>
<tr>
<td>Portugal</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Source: Ottaviano et al. (2009)

Derivation of producer competitiveness (technological & institutional component)

**Producer competitiveness**
- Competitiveness filtered from trade frictions and market characteristics (size, consumer preferences, firm selection)
- Solely depends on technology (i.e. ability to produce at low cost) and institutional factors (i.e. cost of access to a sector)

\[
C_{ss}^{hh} = \left( \frac{2(\kappa_s + 1)\kappa_s + 2}{L^h} \right) \cdot \sum_{t=1}^{M} \frac{C_{ss}^{th}}{\kappa_s} \cdot \frac{f_s^{t}}{T_s^{t}} \cdot \frac{o_s^{t}}{\kappa_s} \cdot \frac{1}{\kappa_s + 2} \quad t = 1, \ldots, M \tag{4}
\]
Producer competitiveness: country ranking

<table>
<thead>
<tr>
<th>Country</th>
<th>Producer Competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Netherlands</td>
<td>14.9</td>
</tr>
<tr>
<td>Sweden</td>
<td>14.5</td>
</tr>
<tr>
<td>Finland</td>
<td>8.5</td>
</tr>
<tr>
<td>Denmark</td>
<td>8.1</td>
</tr>
<tr>
<td>Germany</td>
<td>7.5</td>
</tr>
<tr>
<td>Belgium</td>
<td>6.5</td>
</tr>
<tr>
<td>UK</td>
<td>5.8</td>
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<tr>
<td>Austria</td>
<td>5.7</td>
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<tr>
<td>France</td>
<td>3.5</td>
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<td>Spain</td>
<td>2.9</td>
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<tr>
<td>Italy</td>
<td>1.6</td>
</tr>
<tr>
<td>Portugal</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Source: Ottaviano et al. (2009)

Country ranking comparison: the importance of technology

<table>
<thead>
<tr>
<th>Country</th>
<th>Competitiveness Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Overall</td>
</tr>
<tr>
<td>Finland</td>
<td>1</td>
</tr>
<tr>
<td>Belgium</td>
<td>2</td>
</tr>
<tr>
<td>Netherlands</td>
<td>3</td>
</tr>
<tr>
<td>Sweden</td>
<td>4</td>
</tr>
<tr>
<td>Germany</td>
<td>5</td>
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<tr>
<td>France</td>
<td>6</td>
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<tr>
<td>Denmark</td>
<td>7</td>
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<tr>
<td>Austria</td>
<td>8</td>
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<tr>
<td>UK</td>
<td>9</td>
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<tr>
<td>Italy</td>
<td>10</td>
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<tr>
<td>Spain</td>
<td>11</td>
</tr>
<tr>
<td>Portugal</td>
<td>12</td>
</tr>
</tbody>
</table>

Source: Ottaviano et al. (2009)
Firm level: Conclusions

- **Pros**
  - Firm level productivity is a more appropriate proxy for competitiveness
  - The model framework allows to disentangle the various determinants and allows policy analysis

- **Cons**
  - Data at the firm level are still limited and not available for satisfactory international comparisons
  - More suitable for structural analysis

Firm level: ongoing research

**Firm level**
- (with Altomonte and Ottaviano) project on examining impact of **firm complexity** on their overall performance (French data)
- (with Del Gatto and B. Mandel, FRB) extension of the framework Ottaviano et. al.,2009) across time.
- …possibly getting more involved in the update of the project EFIGE, survey of EU firms
3. PRODUCT LEVEL

Ongoing research

Product level
- Using Comext (Eurostat) export/imports (volume and value) disaggregated at CN-8 digits, monthly data, bilateral trade, 27 EU countries, vis a vis 270 partners (1993-2009) (with Vesna Corbo and C Osbat, EXT)

1. Computing price level-based indicators
2. Establishing country specialisation
3. Computing trade elasticities (e.g. to be used in models such as EAGLE)
4. Conduct product specific assessment (e.g. car industry)
3.1 – Computing price level-based indicators

- We compute **unit values at the most disaggregated level**, comparing as homogeneous goods as possible
- Each observation is then assigned a value between 0 and 100, according to its ranking (low UV → low value)
- Stacking the separate rankings for each CN8 good within a 4-digit sector, we obtain a distribution of UV rankings for each EU country (presented for year 2007)
  ➔ We look at the export price distribution:
    - No clear patterns overall
    - Interesting differences when separating sectors into high price elasticity (price setting dominates) and low-elasticity (quality matters more).
Examples of applications..

2919: Other general-purpose machinery  (Exports; year=2007)

Examples of applications..

3410: Motor vehicles  (Exports; year=2007)
3.2 – Establishing country specialization

Based on statistics for the above discussed sectors:

- Germany trades with a large number of partners (105 in Sugar; 224 in Machinery; 220 in Motor vehicles)
- Greece and Portugal generally with fewer (13/49 in Sugar; 96/103 in Machinery; 54/95 in Motor vehicles)

- While German exports cover most of the world, Greek and Portuguese are less dispersed
- Composition of partners important, since demand is rising much faster in emerging economies

3.3 – Computing trade elasticities

- Calibration tradition in international macroeconomics – elasticity of substitution a key parameter
- Often based on outdated macro-data estimates
- Little consensus in the literature (see table next slide)

- Different model specifications/countries studied/trade partners/time horizons require different calibration values
- Severe aggregation biases in macro-data estimates
- More recent research steers toward use of sector-level data for estimation, with subsequent, properly weighted aggregation
Exampl of applications..

**Summary of estimation results for elasticities of substitution for the euro area and the US:**

---|---|---|---|---|---|---|---|---|---|---
Austria | 4.0 | -0.41 / 0.01 | 0.37 / 1.11 | - | - | -1.30 | - | - | - | -
Belgium | - | -0.16 / 1.73 | 0.46 / 1.11 | - | - | -1.02 | 0.42 | - | - | -
Cyprus | 2.8 | - | - | - | - | - | - | - | - | -
Finland | 3.1 | 0.06 / 0.60 | 0.37 / 1.11 | - | - | - | - | - | - | -
France | 3.7 | 0.06 / 0.24 | 0.15 / 1.11 | -0.711 | 1.056 | 0.17 | -2.27 | -0.1 / -0.4 | -0.1 / -0.2 | -
Germany | 3.9 | -0.42 / -0.11 | 0.42 / 1.11 | -0.782 | 1.021 | -0.24 | 1.70 | -0.2 / -0.06 | -0.1 / -0.3 | -
Greece | 2.6 | 0.04 / 0.34 | 0.92 / 1.11 | - | - | - | - | - | - | -
Ireland | 3.8 | 0.17 / 0.51 | 0.27 / 1.11 | - | - | - | - | - | - | -
Italy | 3.7 | 1.24 / 3.1 | -0.005 / 1.11 | -1.001 | 1.22 | -0.13 | 0.42 | -0.0 / -0.4 | -0.3 / -0.9 | -
Luxemb. | - | - | - | - | - | -1.03 | - | - | - | -
Malta | - | - | - | - | - | - | - | - | - | -
Netherl. | 3.3 | -0.07 / 0.18 | 0.13 / 1.11 | -0.576 | 1.314 | 0.23 | -0.82 | - | - | -
Portugal | 3.4 | -0.10 / 0.76 | 0.09 / 1.11 | - | - | -0.53 | -0.07 | - | - | -
Slovakia | 4.0 | - | - | - | - | - | - | - | - | -
Slovenia | 3.7 | - | - | - | - | - | - | - | - | -
Spain | 2.8 | 0.08 / 0.51 | 0.65 / 1.11 | -0.979 | 1.345 | - | -0.65 | - | - | -
USA | 2.3 | 0.05 / 0.40 | 0.48 / 1.11 | - | - | -0.54 | -1.51 | -0.6 / -0.3 | -0.5 / -1.5 | -

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**3.4 Product specific assessment: the case of car industry**

- Long run export elasticity and long run PTM coefficients are heterogeneous both across countries and across industries.
- Relative to Germany, France exhibits lower PTM coefficients, but lower export elasticities

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di Mauro et al (2011)

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Concluding remarks

• Globalisation has hampered macro/institutional (mostly price-based) indicators

• The firm-level model based framework has several advantages
  → It looks explicitly at productivity at the firm level as the real measure of competitiveness
  → It allows to disentangle its various determining factors

• The product level allows to look at broad country characteristics while still taking structural aspects into account; but it is still unfit for quality-adjusted data analysis

→ Firm level productivity analysis is therefore clearly the way to go, but deeper product level is also useful until we have sufficient firm level data

Thank you for your attention
Reserve slides

4. MACRO MODEL SIMULATIONS
4.1 - EAGLE simulation

Would changes in intra-euro area competitiveness help?

Strategy:
- DSGE framework (4 areas model – EA surplus, RO EA, US, ROW) allows to replicate ULC developments from productivity and wage shock
- ...we check impacts on (relative) export performance in Surplus country (Germany) and deficit one (Spain)

Results:
- Other factors then price/cost competitiveness matter for Deficit country as actual relative export performance is only partially replicated
- ...opposite is true for Surplus country (in line with stylized facts seen before)

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Surplus country has experienced modest wage increases compared with productivity....

**Real compensation per employee** (annual percentage changes, 1999-2007)

- Surplus country has experienced modest wage increases compared with productivity.

**Labor Productivity** (annual percentage changes, 1999-2007)

- Source: Eurostat and ECB calculations.
  - Note: Compensation of employees (total economy) divided by number of employees (domestic industries); deflator GDP.
.... Real unit labor costs have declined in Surplus country

Real unit labor costs
(annual percentage changes, 1999-2007)

![Graph showing real unit labor costs for Surplus and Euro Area from 1999 to 2007. The Surplus country shows a decline, while the Euro Area shows a slight increase.]

Source: Eurostat and ECB calculations.
Note: Ratio of compensation per employee (total economy) to labour productivity.

.... By contrast, unit labor costs increased in Deficit country

Real unit labor costs
(annual percentage changes, 1999-2007)

![Graph showing real unit labor costs for Deficit, Surplus, and Euro Area from 1999 to 2007. The Deficit country shows an increase, while the Surplus country shows a decline.]

Could different trends in price competitiveness explain divergences in export growth?

Source: Eurostat and ECB calculations.
Note: Ratio of compensation per employee (total economy) to labour productivity.
What do DSGE models tell us?

A shock to productivity and wages to match the fall in unit labor costs in Surplus country can replicate several stylized facts...

Note: Quarters in the horizontal axis; vertical axis: percentage deviations from the baseline, expect for inflation, reported as percentage-points deviations.

What do DSGE models tell us? (contd.)

Divergences in unit labor cost growth only partially explain the export growth differential between the Deficit country and the rest of the Euro Area...

Note: Quarters in the horizontal axis; vertical axis: percentage deviations from the baseline, expect for inflation, reported as percentage-points deviations.
Are the EAGLE results robust?

- Quantitative findings depend on the particular choice of calibrated parameter values, therefore it is important to empirically validate the model results:
  - Analysing the sensitivity of the results to changes in some key parameters (price and wage setting behaviour, share of labour in the production function, degree of home bias);
  - Cross-validation through a structural VAR whose shocks are identified using robust sign restrictions derived from the DSGE model.

4.2 - Nigem Simulation:

Would changes in intra-euro area competitiveness help?

- Differentiated Nominal Wage changes across Euro area countries
- Germany ...5% up
- GIPS...5% down
- We use Nigem – a traditional keynesian global model
- RESULTS: .....limited help – taken alone - to improve economic performance and
- .....unable to correct external imbalances
**Simulation 1 - GIPS nominal wages down 5%**

- positive impact on GDP
- worse current account

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**Simulation 1 (…continued)- GIPS nominal wages down 5%**

- Exports
- Imports

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Simulation 2 - GIPS Wages down 5%, Germany wages up 5%

- lower GDP for the whole area
- widening intra euro area current account imbalances

Exports

Imports
The economy

⇒ There are two kinds of goods:

• **S** manufacturing goods, differentiated, and available in different varieties \( S(i) \) with \( d \) = index of product differentiation ⇒ the higher, the more the consumer appreciates a rich availability of varieties.
  → Traded in monopolistic competitive market

• The rest of the economy (services, other…) is collapsed into one single residual homogenous good (numeraire).
  → Traded in perfect competition (across the world at the price \( p \))

⇒ It also absorbs all labour imbalances in the whole economy so
  that nominal wages are constant
Production: Sector Accessibility

- Producer does not know in advance his mg. cost of producing (i.e. if he will be competitive and be able to produce in the market)
- Cost is drawn from distribution $G^h_s(c)$ – assumed to be Pareto - with expected cost $c$ comprised between 0 and $c_{A,s}^h$ (i.e. cost varies by sector and countries)
- The distribution’s shape indicates the number of firms exiting/entering when costs change
- In addition, to enter a sector, producer pays a sunk costs $f^h_s$ (R&D)
- There are sector-specific cut-off costs (i.e. upperbound costs) above which firms cannot survive

\[ \text{cannot stay/enter in the market (exit) } \rightarrow \text{ point A} \]

- when cost $\geq c_{s}^{hh}$or $k$ changes
- when cost $> c_{s}^{ht}$

Production: Sector Accessibility (continued)

- Given $k$, the lower $c_{A,s}^h$, the more technologically efficient the firm is in delivering the variety of the good
- We can therefore define the inverse of $c_{A,s}^h$ as the firm-based absolute advantage $\Rightarrow (1/ c_{A,s}^h) \alpha_s^h$ of country $h$ in sector $s$
- The above implies that, for two goods $(r,s)$ and two countries $(h,t)$, technology considerations only will suggest trade takes place in accordance to (probabilistic) comparative advantage, e.g.

\[
\left(\frac{c^h_{A,s}}{c^h_{A,r}}\right) < \left(\frac{c^t_{A,s}}{c^t_{A,r}}\right) \Rightarrow \text{Country } h \text{ has a technology comparative advantage in producing and exporting } s, \text{ while country } t \text{ in producing exporting } z. 
\]

\[ \Rightarrow \text{in the model, however, additional variables play a role….most notably Market size (L), delivery costs (T}_s \text{ matrix), …} \]
Production: Delivery costs

• To deliver production – both inland and abroad – firms pay a cost per unit of production \( d_{st}^{ht} \), which also depends from the sector \( s \), country of origin \( h \) and country of destination \( t \).

• Delivery costs are also higher (and trade volumes lower) the higher the elasticity of the extensive margin \( k \).

we define \( \rho_s = (1/d_s)^k \)

from which we derive the freeness matrix \( T_s \).

\[
T_s = \begin{pmatrix}
\rho_s^{11} & \rho_s^{12} & \cdots & \rho_s^{1M} \\
\rho_s^{21} & \rho_s^{22} & \cdots & \rho_s^{2M} \\
\vdots & \vdots & \ddots & \vdots \\
\rho_s^{M1} & \rho_s^{M2} & \cdots & \rho_s^{MM}
\end{pmatrix}
\]

Delivery at home

Delivery abroad

Profit maximization: intuition

• Firms decide their exports activities in accordance to the distance to delivery markets and to an assessment – which is partly just subjective at first - of their efficiency as suppliers versus the efficiency of competitors.

• More specifically efficiency in – in the model – depends on the following variables, which we have previously defined, related to:

  • Technology:
    • Technological absolute advantage \( O_s^h \)
    \( \Rightarrow \quad = (1/c_{A,s,h}) \)

  • Costs:
    • Fix cost to entry in a sector \( f_s^h \)
    • Delivery costs \( \Rightarrow \) as defined in the “trade freeness” matrix \( T_s \)
    • Elasticity of the extensive margin \( k_s \)

  • Demand:
    • Size of the market \( N_s^h \)
    • Number of varieties \( \Rightarrow \)
    • Average prices \( \Rightarrow \)
    • Product differentiation \( \Rightarrow \)
From theory to data

We apply our framework to 12 manufacturing sectors in 12 European countries. We focus on the year 2003.

**STEP 1**: estimate trade frictions running a gravity regression using sectoral trade and geographical data.

**STEP 2**: estimate productivity distributions using firm-level data and compute their shape $k$, the elasticity of the extensive margin, and the cut-off costs $c_s^{hh}$.

**STEP 3**: calibrate the unobserved “producer competitiveness” $o^1/f^1$ by netting out the parameter.

**STEP 4**: Validation: Check whether the model also replicates other patterns of the data.
Data requirements and sources

“Trade freeness” matrix.

CEPII, 1999-2004, for:
- international trade data at the 3-digits ISIC rev 2, manufacturing
- common language indicator

Head and Mayer (2002) for:
- formulas to compute distances

Shape parameters and cut-off cost

Amadeus (Bureau Van Dijk)
Firm-level data (161,975 firms) for the year 2003 related to 12 European countries and 13 manufacturing sectors

Population.

WDI, World Bank

STEP 1: “Trade freeness” matrix (T)

- The elements of $T$ represent the total costs of delivering a product from factory to consumers – whether located inland or abroad
- Costs comprise transportation fees as well as tariff and not tariff costs
- Using standard practice in the literature (see Head&Mayer, 2004a) trade barriers are captured by two variables:
  - 1) bilateral distance and
  - 2) all other costs related to crossing international borders
“Trade freeness” matrix (T) - continued

- Formally the elements of the $T$ matrix are as follows

$$\rho_{s}^{12} = \exp(\beta^2 - \lambda \text{Language}^{12}) \exp(distance^{12})^{\delta_s}$$  \hspace{1cm} (4)

which – within a country – reduces to

$$\rho_{s}^{11} = \exp(distance^{11})^{\delta_s}$$  \hspace{1cm} (4a)

- The three needed parameters ($\beta, \delta, \lambda$) are derived from the following gravity regression

$$\ln(\text{EXP}_{s}^{12}) = E_{X_1} + I_{M_2} + \delta_{s} \ln(distance^{12}) + ...$$

$$... + \beta^2 \text{Border}^{12} + \lambda \text{Language}^{12} \text{Border}^{12} + \text{Dummy}^{\text{time}} + e^{12}$$  \hspace{1cm} (5)

---

**Estimated Trade Freeness**

(difference from manufacturing average (1999-2004))

Source: Trade and Production database (CEPII), authors' calculations

Note: Industries are ranked by degree of trade freeness, relative to median
STEP 2: Cost distribution

- In order to compute cut-off costs \( c_{hh} \) and elasticity of the extensive margin \( k \) we need to estimate sectoral cost distributions.
- To do so we estimate firm-level TFPs as the Solow residuals of a production function regression:
  \[
  \ln Y = \ln A + a \ln K + b \ln N
  \]
- assuming that - within sectors - TFP has a constant distributional shape \( k \): (i.e. ‘Pareto’)
- Cost distributions are the inverse of the TFP
- TFP aggregation can be done at the sector or country level

Step 3: Calibration of “Producer competitiveness”

Having computed all measurable parameters, we are now able to calibrate as residual the unobservable parameters of equation (5):

\( D_s = \text{variety substitutability} \)

Most notably, we can derive

\[
\left( \frac{o_s}{f_s} \right) = \text{producer competitiveness}, \text{ which is a combination of firms technological capacity to produce efficiently (i.e.) and the country institutional environment as in a sector proxied by } c_{A,s} = \frac{1}{C_{A,s}}
\]

The computation of requires to estimate separately the parameter (see next slide for details)
Calibration of “Producer competitiveness” (continued)

- Computationally, we first derive $D_s(f_s/o_s)$ for all countries and sectors.
- Since $D_s$ is sector but not country specific, we can estimate from the residuals of a regression of $D_s(f_s/o_s)$ on a set of industry dummies.
- $(o_s/f_s)$ is therefore obtained by averaging out country by country the regression residuals across sectors, and inverting the result.
- The computation yields also on estimation of $D$ by sector (see table): chemically and pharmaceutical are the most differentiated sectors.

Simulation 1: Impact of lower trade barriers

- With trade liberalization (lower trade barriers):
  - competition is harder and profits curve shifts down
  - domestic cut-off $c_{s, hh}$ declines (because of higher import competition)
  - export cut-off $c_{s, ht}$ increases (as domestic firms can better access foreign markets)

- domestic-only sector shrinks
Simulation 1: Higher trade barriers – Impact on countries

![Graph showing lower competitiveness for various countries.](source: Ottaviano, Tagliani and di Mauro 2009)

- Finland
- Belgium
- Austria
- Denmark
- Sweden
- France
- Germany
- Netherlands
- Spain
- Italy
- United Kingdom
- Portugal

Simulation 1: Higher trade barriers – Impact on sectors

![Graph showing lower competitiveness for various sectors.](source: Ottaviano, Tagliani and di Mauro 2009)

- Electric Machinery, incl. Prof. and Scient. Equip.
- Basic Metals and Fabricated Metal Products
- Transport Equipment
- Food, Beverages and Tobacco
- Paper products, Printing and Publishing
- Wood Products except Furniture
- Non-electric Machinery
- Chemicals, including Pharmaceuticals
- Other Manufacturing, incl. Furniture
- Non-metallic Mineral Prod., incl. Pottery and Glass
- Textiles, Leather products and footwear
- Rubber and Plastic
## Preliminary extension outside EU

### Country ranking

<table>
<thead>
<tr>
<th>Country</th>
<th>Overall Competitiveness</th>
<th>Producer Competitiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweden</td>
<td>1.5</td>
<td>Sweden</td>
</tr>
<tr>
<td>Japan</td>
<td>1.3</td>
<td>Denmark</td>
</tr>
<tr>
<td>Denmark</td>
<td>1.3</td>
<td>USA</td>
</tr>
<tr>
<td>USA</td>
<td>1.3</td>
<td>UK</td>
</tr>
<tr>
<td>Euro Area</td>
<td>1.2</td>
<td>Australia</td>
</tr>
<tr>
<td>UK</td>
<td>1.1</td>
<td>Euro Area</td>
</tr>
<tr>
<td>Australia</td>
<td>1.0</td>
<td>Japan</td>
</tr>
</tbody>
</table>

---

### 6 – MISCELLANEOUS, INCLUDING INTRA EURO AREA
Table 1: Exports of Peripheral Countries: Intra- versus Extra-Euro Area (2009)

<table>
<thead>
<tr>
<th></th>
<th>Greece</th>
<th>Portugal</th>
<th>Spain</th>
<th>Ireland</th>
<th>Italy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intra Euro-Area</td>
<td>43.5</td>
<td>63.2</td>
<td>57.1</td>
<td>42.1</td>
<td>43.7</td>
</tr>
<tr>
<td>o/w Germany</td>
<td>11.1</td>
<td>13.0</td>
<td>11.1</td>
<td>5.7</td>
<td>12.6</td>
</tr>
<tr>
<td>Extra Euro-Area</td>
<td>56.5</td>
<td>36.8</td>
<td>42.9</td>
<td>57.9</td>
<td>56.3</td>
</tr>
</tbody>
</table>

Source: IMF Direction of Trade Statistics (2010)

Intra and extra EA competitiveness are strongly correlated

Price Competitiveness
(Change between 1999:Q1 and 2008:Q2)
Chart 1: Extra- versus Intra-Euro Area Trade (average 1999 – 2009, % of GDP)

Euro area has actually reduced its specialisation in some of the fastest growing manufacturing high-tech sectors ...

World import demand and euro area export specialisation (extra-euro area exports, goods)

World trade growth, %, p.a., average 1999-2008

Change in export specialisation

Source: Chelem, ECB calculations.
Note: Balassa index of revealed comparative advantage.
The size of the bubbles is determined by the share of exports in total exports.
... a trend that also shows up for insurance and financial services.

**World import demand and euro area export specialisation**

*extra-euro area exports, goods & services*

**World trade growth, percentages p.a. 1994-2005**

- Fuel: 14.0%
- Computer, information and other business services: 12.0%
- Manufactures: 10.0%
- Ores and metals: 8.0%
- Transport services: 6.0%
- Travel services: 4.0%
- Food: 2.0%
- Agricultural raw materials: 0.0%

**Change in specialization**

**Merchandise**

- Merchandise
- Services

Source: Chelem, ECB calculations.

Note: Balassa index of revealed comparative advantage. The size of the bubbles is determined by the share of exports in total exports.

---

**Bubbles for the USA**

**World trade growth, %, p.a., average 1999-2008**

- Missed opportunities
  - Basic metals and fabricated metal products (including mining and quarrying)
  - Building and repairing of ships and boats
  - Manufacturing of furniture
  - Chemicals, rubber products, printing and publishing
  - Textiles, textile products, leather and footwear
- Rising stars
  - Pharmaceuticals
  - Aircraft and spacecraft
- Declining stars
  - Office, accounting and computing machinery
  - Paper and printing
  - Textiles, textile products, leather and footwear

Source: Chelem, ECB calculations.

Note: Balassa index of revealed comparative advantage. The size of the bubbles is determined by the share of exports in total exports.
The crisis confirmed and aggravated previous trends. Germany however was particularly hit.

Changes in export market shares and price competitiveness (annual average growth; percentage)

<table>
<thead>
<tr>
<th>Type of approach</th>
<th>Objective</th>
<th>Indicators/tools/models</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macro/institutional</td>
<td>Price-cost based</td>
<td>- REER</td>
<td>Easy to communicate</td>
<td>- not always able to explain export</td>
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<tr>
<td></td>
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<td>- ULC</td>
<td></td>
<td>performance</td>
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<td></td>
<td></td>
<td>- ...</td>
<td></td>
<td>- overemphasis on trade</td>
</tr>
<tr>
<td></td>
<td>Sectoral specialization</td>
<td>Revealed comparative advantage</td>
<td>provides useful info on overall export structure characteristics</td>
<td>- Unable to explain one to one export performance</td>
</tr>
<tr>
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<td>- allocation of sectors by technological content (or factor use) is arbitrary</td>
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<tr>
<td></td>
<td>Non-price competitiveness</td>
<td>- R&amp;D</td>
<td>relatively easy to measure using national and OECD/WB indicators</td>
<td>- difficult to establish relation with trade performance</td>
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<td></td>
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<td>- Education</td>
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<td>- useful for long, not short-term analysis</td>
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<td></td>
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<td>- Institutional environment</td>
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<tr>
<td>Firm Level</td>
<td>Firm level empirical analysis</td>
<td>e.g. EFGE survey 14000 EU firms</td>
<td>direct info on firms characteristics (size, sectoral, geographical specialization, production organization)</td>
<td>- data intensive and difficult to update frequently</td>
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<td></td>
<td>Work using French and Polish data (Taglioni)</td>
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<td>- more suitable for structural policy analysis</td>
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<td>Assessing impact of firm organizational complexity on competitiveness (with Atkinson, Otsuka, ...)</td>
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<td>Model based indicators</td>
<td>Overall competitiveness (provided by firm TFP)</td>
<td>It allows explicit representation of explanatory factors</td>
<td>- data intensive and difficult to update frequently</td>
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<td>- It allows policy analysis (e.g. lower tariff)</td>
<td>- more suitable for structural policy analysis</td>
</tr>
</tbody>
</table>

Source: ECB calculations.
### Specialisation in China shifts from low-tech to high-tech industries

#### China: Balassa indices of revealed comparative advantage

(annual data)

<table>
<thead>
<tr>
<th>Year</th>
<th>0.2</th>
<th>0.4</th>
<th>0.6</th>
<th>0.8</th>
<th>1.0</th>
<th>1.2</th>
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</tbody>
</table>

**Source:** Chelem and ECB calculations.
EA specialises in medium-high-tech sectors...

<table>
<thead>
<tr>
<th>Revealed comparative advantage by sector¹</th>
<th>EA</th>
<th>US</th>
<th>China</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High-technology industries</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aircraft and spacecraft</td>
<td>1.2</td>
<td>3.6</td>
<td>0.1</td>
</tr>
<tr>
<td>Pharmaceuticals</td>
<td>1.6</td>
<td>0.9</td>
<td>0.3</td>
</tr>
<tr>
<td>Office, accounting and computing machinery</td>
<td>0.7</td>
<td>0.9</td>
<td>1.8</td>
</tr>
<tr>
<td>Radio, TV and communications equipment</td>
<td>0.6</td>
<td>1.0</td>
<td>1.3</td>
</tr>
<tr>
<td><strong>Medium-high-technology industries</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical machinery and apparatus, n.e.s.</td>
<td>1.0</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>Motor vehicles, railroad and transport equipment</td>
<td>1.1</td>
<td>0.9</td>
<td>0.1</td>
</tr>
<tr>
<td>Chemicals excluding pharmaceuticals</td>
<td>1.2</td>
<td>1.2</td>
<td>0.5</td>
</tr>
<tr>
<td>Machinery and equipment, n.e.s.</td>
<td>1.4</td>
<td>1.2</td>
<td>0.7</td>
</tr>
<tr>
<td><strong>Low-technology industries</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wood, pulp, paper and paper products</td>
<td>1.0</td>
<td>1.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Agriculture, food products, beverages and tobacco</td>
<td>0.8</td>
<td>1.1</td>
<td>0.6</td>
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<tr>
<td>Textiles, textile products, leather and footwear</td>
<td>0.8</td>
<td>0.3</td>
<td>3.4</td>
</tr>
</tbody>
</table>

Source: Chelem, ECB calculations

Empirical evidence

Based on the newly released EFIGE EU data base (16000 firms, 150 characteristics each).

Main finding (Barba Navaretti et al., 2010):
1) Firm performance, both for extensive and intensive margin, largely explained by firm-characteristics
2) Larger, more productive firms are more likely to export, and to export larger share of production
3) Simulation show the importance of firm structure for results

Percentage change in the value of export (using German size-sector employment distribution with constant total employment)