



EUROPEAN CENTRAL BANK

EUROSYSTEM

**WORKING PAPER SERIES**

**NO 847 / DECEMBER 2007**

**DEEPER, WIDER AND  
MORE COMPETITIVE?**

**MONETARY INTEGRATION,  
EASTERN ENLARGEMENT  
AND COMPETITIVENESS IN  
THE EUROPEAN UNION**

by Gianmarco Ottaviano,  
Daria Taglioni  
and Filippo di Mauro



EUROPEAN CENTRAL BANK

EUROSYSTEM



In 2007 all ECB publications feature a motif taken from the €20 banknote.

## WORKING PAPER SERIES

NO 847 / DECEMBER 2007

### DEEPER, WIDER AND MORE COMPETITIVE?

### MONETARY INTEGRATION, EASTERN ENLARGEMENT AND COMPETITIVENESS IN THE EUROPEAN UNION<sup>1</sup>

by Gianmarco Ottaviano<sup>2</sup>,  
Daria Taglioni<sup>3</sup>  
and Filippo di Mauro<sup>4</sup>

This paper can be downloaded without charge from  
<http://www.ecb.europa.eu> or from the Social Science Research Network  
electronic library at [http://ssrn.com/abstract\\_id=1068864](http://ssrn.com/abstract_id=1068864).

<sup>1</sup> We are grateful to Giordano Mion for his precious advices on data collection and processing. The views expressed in this study are those of the authors and do not necessarily reflect those of the European Central Bank.

<sup>2</sup> University of Bologna, Via Zamboni 33, 40126 Bologna, Italy; e-mail: [ottaviano@economia.unibo.it](mailto:ottaviano@economia.unibo.it)

<sup>3</sup> European Central Bank, Kaiserstrasse 29, 60311 Frankfurt am Main, Germany;  
e-mail: [Daria.Taglioni@ecb.int](mailto:Daria.Taglioni@ecb.int)

<sup>4</sup> European Central Bank, Kaiserstrasse 29, 60311 Frankfurt am Main,  
Germany; e-mail: [filippo.di\\_mauro@ecb.int](mailto:filippo.di_mauro@ecb.int)

© European Central Bank, 2007

**Address**

Kaiserstrasse 29  
60311 Frankfurt am Main, Germany

**Postal address**

Postfach 16 03 19  
60066 Frankfurt am Main, Germany

**Telephone**

+49 69 1344 0

**Website**

<http://www.ecb.europa.eu>

**Fax**

+49 69 1344 6000

**Telex**

411 144 ecb d

*All rights reserved.*

*Any reproduction, publication and reprint in the form of a different publication, whether printed or produced electronically, in whole or in part, is permitted only with the explicit written authorisation of the ECB or the author(s).*

*The views expressed in this paper do not necessarily reflect those of the European Central Bank.*

*The statement of purpose for the ECB Working Paper Series is available from the ECB website, <http://www.ecb.europa.eu/pub/scientific/wps/date/html/index.en.html>*

ISSN 1561-0810 (print)

ISSN 1725-2806 (online)

# CONTENTS

|  |    |
|--|----|
| Abstract   | 4  |
| Non-technical summary                                    | 5  |
| 1 Introduction   | 7  |
| 2 Underlying stylised facts<br>and background literature | 8  |
| 3 Theoretical framework                                  | 10 |
| 3.1 Demand   | 10 |
| 3.2 Supply   | 11 |
| 3.3 Equilibrium  | 12 |
| 4 Calibration  | 14 |
| 4.1 Trade frictions                                      | 15 |
| 4.2 Production costs                                     | 17 |
| 4.3 Revealed competitiveness                             | 18 |
| 5 Validation   | 19 |
| 5.1 Share of exporters                                   | 19 |
| 5.2 Productivity advantage of exporters                  | 20 |
| 6 Simulation   | 20 |
| 6.1 EMU  | 20 |
| 6.2 Enlargement  | 22 |
| 7 Conclusion and policy implications                     | 26 |
| References   | 28 |
| Data Appendix  | 29 |
| A Trade flows and production data                        | 29 |
| B Population and geographical data                       | 29 |
| C Firm level data  | 30 |
| European Central Bank Working Paper Series               | 32 |

## Abstract

What determines a country's ability to compete in international markets? What fosters the global competitiveness of its firms? And in the European context, have key elements of the EU strategy such as EMU and enlargement helped or hindered domestic firms' competitiveness in local and global markets? We address these questions by calibrating and simulating a conceptual framework that, based on Melitz and Ottaviano (2005), predicts that tougher and more transparent international competition drives less productive firms out the market, thereby increasing average productivity as well as reducing average prices and mark-ups. The model also predicts a parallel reduction of price dispersion within sectors. Our conceptual framework allows us to disentangle the effects of technology and freeness of entry from those of accessibility (i.e. the ease for local firms to reach local and foreign consumers). On the one hand, by controlling for the impact of trade frictions, we are able to construct an index of 'revealed competitiveness', which would drive the relative performance of countries in an ideal world in which all faced the same barriers to international transactions. On the other hand, by focusing on the role of accessibility while keeping 'revealed competitiveness' as given, we are able to evaluate the impacts of EMU and enlargement on the competitiveness of European firms. We find that EMU positively affects the competitiveness of firms located in participating economies. Enlargement has, instead, two contrasting effects. It improves the accessibility of EU members but it also increases substantially the relative importance of unproductive competitors from Eastern Europe.

**JEL Classification:** F12, R13

**Keywords:** European integration, gains from trade, competitiveness, firm-level data, total factor productivity

# Non-Technical Summary

What determines a country's ability to compete in international markets? What fosters the global competitiveness of its firms? And in the European context, have key elements of the EU strategy such as EMU and enlargement helped or hindered domestic firms' competitiveness in local and global markets?

The present paper addresses these questions moving one step further from existing investigations, which focus on aggregate and sectoral trade flows in assessing the ex-post impact of, and benefits from specific economic policies. As pointed out by the so-called new trade theory, trade flows are an imperfect measure of the potential impacts on prices and productivity. With a growing recognition that such price and productivity effects can be uncovered only by complementing country and sector-level information with the firm level of analysis, the proposed paper takes a fresh look at the data by implementing a quantitative investigation of the microeconomic effects of key elements of the EU strategy that exploits a wide array of new theoretical and empirical developments that have recently entered the toolbox of trade economists.

Specifically, a general equilibrium multi-country multi-sector model with imperfectly competitive heterogeneous firms featuring differentiated goods and variable mark-ups is developed and calibrated. The model, based on Melitz and Ottaviano (2005), highlights the interactions between technological leadership, freeness of entry and market accessibility in determining the competitive environment of a country. Countries exhibiting technological advantage, freer entry and better accessibility to foreign firms develop a tougher competitive environment. Moreover, tougher and more transparent international competition drives less productive firms out of the market while redistributing their market shares to more productive firms, thereby increasing average productivity as well as reducing average prices and mark-ups. The model also predicts a parallel reduction of price dispersion within sectors.

This conceptual framework allows to distinguish the effects of technology and freeness of entry from those of accessibility. In a nutshell, the empirical strategy exploits the fact that the theoretical model allows to disentangle what a country can potentially do and what it ends up doing in equilibrium. This becomes clearer when looking for example at the two extreme situations of autarchy and frictionless trade. In autarchy countries have to produce everything themselves, so their actual aggregate productivity would be solely driven by the underlying competitiveness of their own firms. At the other extreme, with frictionless trade, firms from all countries compete in a single integrated market. In this situation, only the best firms would survive wherever they are based. Hence a

country, whose institutional settings increase the likelihood of domestic firms to be highly productive, can reasonably expect more of its domestic firms to survive in equilibrium than a country with institutional settings less supportive of firm productivity. In the real world of partial trade barriers, the equilibrium outcome will be somewhere in between and both the above stories will matter.

The model presented in this study and its empirical implementation are meant to reflect this fact. On the one hand, by controlling for the impact of international trade frictions, an index of 'revealed competitiveness' can be constructed, which would drive the relative performance of countries in an ideal world in which all faced the same barriers to international transactions. On the other hand, by focusing on the role of accessibility while keeping 'revealed competitiveness' as given, the focus can be shifted on the role of those barriers to evaluate the impacts of specific policies on average firm productivity. In so doing it is possible to evaluate the impacts of EMU and enlargement on the competitiveness of European firms.

The study finds that EMU positively affects the competitiveness of firms located in participating economies. In particular, if in 2002 France had been outside EMU, its firms would have been on average less competitive by up to 7 percentage points while the country as a whole would have been downgraded of two positions in the European competitiveness ranking. Adoption of the euro by Great Britain in the same year would have increased average productivity of British firms by 0.5 to 3 percentage points but its position in the European competitiveness ranking would have remained unaffected.

Enlargement has, instead, two contrasting effects. It improves the accessibility of EU members but it also increases substantially the relative importance of unproductive competitors from Eastern Europe. Overall, while EMU increases the toughness of competition in member countries, and through this channel generates lower average (delivered) costs, markups, prices and quantities, enlargement can be expected to have similar effects only after an increase in the 'revealed competitiveness' of new members that is yet to come.

# 1 Introduction

Globalization has been characterized, *inter alia*, by the entrance of new players into world markets. The growing integration of emerging Asia, as well as central and eastern European countries (CEECs), following the collapse of the Soviet Union, is expected to have led to a sharpening in the competitive environment and to large changes in the structure of global trade. Against this changing background, the global economy has enjoyed an exceptionally rapid pace of growth over the current cycle.<sup>1</sup> However, in spite of these overall results at the world level, globalization has increasingly been associated with concerns, and even fears sometimes. Such concerns might not be completely unjustified since globalization is associated with major changes in the structure of production, employment and trade.

In the face of globalization, some argue that each country left alone could more flexibly respond to globalization challenges. Others instead support the view that being part of a larger set of countries, most notably the EU/EMU area, would create more favourable conditions. Who is right? Why countries - but also regions within countries, workers and firms - are variously affected by globalization, and not all of them are necessarily better off in the more open global environment? How to assess the stakes of different nations as filtered through the network of domestic and foreign firms in local and global markets?

Nesting the new trade theory framework originating in the works of Helpman and Krugman (1985) with the work on firm heterogeneity developed by Melitz (2003) provides helpful insights on what determines a country's ability to compete in international markets, and on what fosters the global competitiveness of its firms. It also allows to evaluate if, in the European context, key elements of the EU strategy such as EMU and enlargement have helped or hindered domestic firms' competitiveness in local and global markets.

By allowing for the joint presence of imperfectly competitive markets, increasing returns and firm heterogeneity, new trade theories predict that trade and FDI liberalisations induce not only trade creation but also, and more importantly, a general reallocation of resources across firms, countries and regions. Four types of reallocations are privileged by the most recent literature. First, the selection effect that reallocates resources from the least to the most productive firms, not only across industries but also, and more importantly, within industries. Second, the market size effect which induces a shift of resources from smaller to larger countries, firms being attracted by the associated higher market potential. Third, the higher sourcing from low cost countries. Finally, the reallocation effects derived from preferential trade agreements, which tend to favour insiders (countries that are part of them) to the detriment of outsiders. To sum up, the theoretical expectation is that - in general - liberalization leads to higher welfare for the participant countries, to degrees variously determined through the channels above. Higher welfare stems from richer product variety, higher productivity, lower average mark-ups and lower average prices, reflecting a more efficient allocation of resources across firms, sectors, and locations.

In order to quantify how these mechanisms concur to determine countries' performance in international markets, we calibrate and simulate a multi-country, multi-sector theoretical framework with monopolistic competition and variable markups in the wake of Melitz and Ottaviano (2005, Appendix B and C) as extended by Del Gatto, Mion and Ottaviano (2006). By merging the insights of traditional trade theory and new trade theory, the framework highlights the interactions between technological leadership, freeness of entry

---

<sup>1</sup>Freeman (2006) reports that after recovering from the ICT bubble, the global economy has expanded significantly above longer-term averages in the past three years, *i.e.* by about 5% in the period 2004-2006, 1.5 percentage points higher than in 1995-2003.

and market accessibility in determining the competitive environment of a country. Countries exhibiting technological advantage, freer entry and better accessibility to foreign firms develop a tougher competitive environment in which firms are more productive, operate at a larger scale and earn larger profits while quoting lower prices and lower markups.

Our conceptual framework allows us to disentangle the effects of technology and freeness of entry from those of accessibility. In a nutshell, the empirical strategy exploits the fact that the theoretical model allows one to disentangle what a country can potentially do and what it ends up doing in equilibrium. To further elaborate on this point, let us look at the two extreme situations of autarchy and frictionless trade. In autarchy countries have to produce everything themselves, so their actual aggregate productivity would be solely driven by the underlying competitiveness of their own firms. At the other extreme, with frictionless trade, firms from all countries compete in a single integrated market. In this situation, only the best firms would survive wherever they are based. Hence a country, whose institutional settings increase the likelihood of domestic firms to be highly productive, can reasonably expect more of its domestic firms to survive in equilibrium than a country with institutional settings less supportive of firm productivity. In the real world of partial trade barriers, the equilibrium outcome will be somewhere in between and both the above stories will matter. Our model and its empirical implementation are meant to reflect this fact.

On the one hand, by controlling for the impact of international trade frictions, we are able to construct an index of ‘revealed competitiveness’, which would drive the relative performance of countries in an ideal world in which all faced the same barriers to international transactions. On the other hand, by focusing on the role of accessibility while keeping ‘revealed competitiveness’ as given, we can focus on the role of those barriers to evaluate the impacts of specific policies on average firm productivity. In so doing we are able to evaluate the impacts of EMU and enlargement on the competitiveness of European firms.

We find that EMU positively affects the competitiveness of firms located in participating economies. In particular, we find that, if in 2002 France had been outside EMU, its firms would have been on average less competitive of up to 7 percentage points while the country as a whole would have been downgraded of two positions in the European competitiveness ranking. Adoption of the euro by Great Britain in the same year would have increased average productivity of British firms by 0.5 to 3 percentage points but its position in the European ranking would have remained unaffected.

Enlargement has, instead, two contrasting effects. It improves the accessibility of EU members but it also increases substantially the relative importance of unproductive competitors from Eastern Europe. Overall, while EMU increases the toughness of competition in member countries, and through this channel generates lower average (delivered) costs, markups, prices and quantities, enlargement can be expected to have similar effects only after an increase in the ‘revealed competitiveness’ of new members that is yet to come.

The rest of the paper is organised as follows. Section 2 discusses underlying stylised facts and background literature to this study. Section 3 presents the theoretical framework and derives its equilibrium properties. Section 4 calibrates the model to the data. Section 5 discusses the model’s fit to the data. Section 6 simulates alternative macroeconomic scenarios while section 7 concludes and draws some policy implications.

## 2 Underlying stylised facts and background literature

Recent analyses of micro-datasets tracking production and international involvement at the firm and the plant levels demonstrate that firms vary tremendously along a number of

dimensions even within industries and this plays an important role in aggregate outcomes. In particular, a hallmark regularity is that firms serving foreign markets are more productive than their purely domestic competitors. Moreover, following trade liberalisations, the reallocation of productive resources take place not so much across sectors but rather within sectors. Through this mechanism, the least productive firms are likely to terminate production and their market share to be reallocated to more productive foreign and domestic firms, thus raising aggregate industry level productivity. Furthermore, a country whose share of exporting firms increases over time will experience an increase in aggregate productivity as well as in aggregate competitiveness on international markets. Hence, as countries open up to trade, the set of firms that trade and invest abroad changes together with the set of goods traded and the range of destinations served. As less productive firms are competed out of the market, sectoral composition changes and aggregate productivity increases. This reveals a new source of gains from trade due to tougher competition and the associated reallocation of resources from less to more efficient firms.

The above stylized facts have been highlighted by a growing empirical literature. For example, self-selection into export activities is reported by Bernard and Jensen (1999) as well as Tybout (2003). The exit of the least productive firms by Clerides, Lach and Tybout (1998), Bernard and Jensen (1999) as well as Aw, Chung and Roberts (2000). Market share reallocation towards the most productive firms by Pavcnik (2003) as well as Bernard, Jensen and Schott (2003). The foregoing stylized facts have been explained by recent developments of new trade theory that show how, in settings allowing for heterogeneous firms, international trade integration has a positive impact on aggregate productivity through the selection of the best firms (see Melitz, 2003; Bernard, Eaton, Jensen and Kortum, 2003; Melitz and Ottaviano, 2005). This outcome is due to a combination of greater import competition and easier market access. While all firms suffer from increased import competition, those that are productive enough to cover the additional costs of accessing foreign markets compensate their losses at home with new profits abroad. Firms that are, instead, not productive enough to serve foreign markets exit or are confined to withering domestic sales. In the process productive resources reallocate from less to more productive firms creating aggregate productivity gains.

In this study, we apply the theoretical framework of Melitz and Ottaviano (2005) to a quantitative analysis inspired by Bernard et al (2003). Specifically, as this latter study, we develop, calibrate and validate a model of many industries and many countries, which we then use to simulate the effects of counterfactual scenarios reflecting key elements of the EU strategy of deeper and wider regional integration. However, while Bernard et al (2003) rely on Bertrand market structure, our use of Melitz and Ottaviano's (2005) model allows for a more realistic characterisation of the economy, including the fact that many firms operate in a market at each point in time, that more efficient firms charge higher mark-ups than less efficient firms and that the average mark-up falls when there is more competition in the market. Moreover, while Bernard *et al.* (2003) use sectoral data as according to the model used in that study only one firm is predicted to be active in each market at any point in time, the fact that many firms operate in our model allows us to fully exploit the information of comparable firm-level data on European countries. A similar methodology has been used by Del Gatto, Mion and Ottaviano (2006), who calibrate the model by Melitz and Ottaviano (2005) to quantify the gains from international trade. We extend their analysis to the investigation of the effects of deeper and wider EU integration. Note, finally, that there are some predecessors to our proposed strategy of using simulations to calculate the productivity gains from trade in the CGE literature. The closest is Smith and Venables (1988) who study the effects of the common market when firms differ in terms of productivity. However, unlike this type of studies, we derive endogenous productivity

distributions through the entry and exit of firms.

### 3 Theoretical framework

Our model is based on Melitz and Ottaviano (2005, Appendix B and C) as extended by Del Gatto, Mion and Ottaviano (2006). The set-up considers  $M$  countries (indexed by  $l = 1, \dots, M$ ). Labor is the only factor of production and is internationally immobile with country  $l$  hosting  $L^l$  units of labor. Each worker supplies one unit of labor inelastically, so  $L^l$  is both the number of workers and the number of consumers residing in country  $l$ . Countries may differ in terms of size, technology and trade barriers.

#### 3.1 Demand

Preferences are defined over  $S + 1$  goods. One of them is homogenous while the other  $S$  goods are horizontally differentiated and we index them by  $s = 1, \dots, S$ . Each differentiated good  $s$  comes in a set of varieties  $\Omega_s$  indexed by  $i \in \Omega_s$ . Utility is linear in the consumption of the homogenous good and additive quadratic in the consumption of the differentiated goods. This assumption neutralizes the effect of income on demand and allows us to focus on the consumer surplus only. Specifically, the preferences of a typical consumer in country  $l$  are represented by the quasi-linear utility function:

$$U^l = d_0^l + \sum_{s=1}^S \left\{ \alpha_s \int_{i \in \Omega_s} d_s^l(i) di - \frac{1}{2} \gamma_s \int_{i \in \Omega_s} [d_s^l(i)]^2 di - \frac{1}{2} \eta_s \left( \int_{i \in \Omega_s} d_s^l(i) di \right)^2 \right\}, \quad (1)$$

where  $d_0^l$  and  $d_s^l(i)$  represent the individual consumption levels of the numeraire good and variety  $i$  of good  $s$ .

Parameters  $\alpha_s$ ,  $\eta_s$ , and  $\gamma_s$  are all positive and have the following interpretations. The parameters  $\alpha_s$  and  $\eta_s$  measure the substitutability between the varieties of good  $s$  and the homogeneous good 0. Larger  $\alpha_s$  and smaller  $\eta_s$  increase the demand for the differentiated varieties relative to the numeraire. The parameter  $\gamma_s$  measure the substitutability between the varieties of good  $s$ . When  $\gamma_s = 0$ , varieties are perfect substitutes and utility depends on the total consumption level over all varieties,  $D_s^l = \int_{i \in \Omega_s} d_s^l(i) di$ , but not on its allocation across varieties. Such allocation becomes increasingly important as  $\gamma_s$  rises, hence  $\gamma_s$  is a measure of product differentiation.

Under the assumption that the typical consumer in country  $l$  has positive demand for the homogeneous good, the maximization of (1) under her budget constraint yields a linear inverse demand for each variety  $i$ :

$$p_s^l(i) = \alpha_s - \gamma_s d_s^l(i) - \eta_s D_s^l, \quad (2)$$

which can be inverted to obtain aggregate demand:

$$q_s^l(i) \equiv L^l d_s^l(i) = \frac{\alpha_s L^l}{\eta_s N_s^l + \gamma_s} - \frac{L^l}{\gamma_s} p_s^l(i) + \frac{\eta_s N_s^l}{\eta_s N_s^l + \gamma_s} \frac{L^l}{\gamma_s} \bar{p}_s^l \quad (3)$$

for each variety featuring positive demand, i.e. such that:

$$p_s^l(i) \leq \frac{1}{\eta_s N_s^l + \gamma_s} \left( \gamma_s \alpha_s + \eta_s N_s^l \bar{p}_s^l \right) \equiv p_s^l. \quad (4)$$

where  $N_s^l$  is the number of varieties with positive demand and  $\bar{p}_s^l = (1/N_s^l) \int_{i \in \tilde{\Omega}_s^l} p_s^l(i) di$  is their average price. Note that a lower average price  $\bar{p}_s^l$  or a larger number of varieties  $N_s^l$  increase the price elasticity of demand and decrease the price bound for positive demand defined by the right hand side of (4). Hence, falling  $\bar{p}_s^l$  or rising  $N_s^l$  lead to a ‘tougher’ competitive environment.

### 3.2 Supply

National labor markets are all perfectly competitive. Perfect competition also characterizes the market of the homogeneous good. This good is assumed to be freely traded, so its price is the same everywhere. It is also assumed to be produced in all countries so that, due to perfect competition, also the wage is the same everywhere. Then, choosing the homogeneous good as numeraire allows us to pin down the wage to one in all countries.

The differentiated goods markets are monopolistic competitive and geographically segmented. Entry requires the payment of a sector specific sunk cost  $f_s^l$  in units of numeraire, which is the same for each entrant in sector  $s$ . Such cost is associated with R&D activities that lead to the invention of new varieties whose marketability is ex ante uncertain. The reason is that an entrant does not know the marginal production cost  $c$  of its variety until its entry cost is sunk. This cost is then determined by a draw from a common and known distribution  $G_s^l(c)$ , with support  $[0, c_{A,s}^l]$ . The fact that the support varies across sectors and countries allows us to introduce (probabilistic) ‘comparative advantage’ due to technological differences that impact the distribution of firm-level productivity draws. For instance, if  $(c_{A,s}^l/c_{A,r}^l) < (c_{A,s}^h/c_{A,r}^h)$ , countries  $l$  and  $h$  are said to have comparative advantages in sectors  $s$  and  $r$  respectively because relative to entrants in  $h$  ( $l$ ), entrants in  $l$  ( $h$ ) have a ‘better chance’ of getting lower cost draws in sector  $s$  than in sector  $r$ .

All entrants draw their marginal costs simultaneously. Hence, after their draw, they can figure out whether they are productive enough to survive competition. In particular, given that the entry cost  $f_s^l$  is sunk, only entrants whose operating profits can cover their marginal costs choose to stay in the market. Other entrants exit immediately. Survivors can serve not only the domestic market but also foreign ones. In so doing, they face however per-unit trade costs. In particular, the overall cost of a delivered unit with cost  $c$  from country  $h$  to country  $l$  is  $\tau_s^{hl}c$  with  $\tau_s^{hl} > 1$ , where  $(\tau_s^{hl} - 1)c$  is the frictional trade cost. Such cost should be interpreted in a wide sense as due to all distance-related barriers. That is why, even within countries, trade may not be costless:  $\tau_s^{ll} \geq 1$ .

Under monopolistic competition, each survivor maximizes profit taking the demand function (3) into account as well as the average price  $\bar{p}_s^l$  and the number of competitors  $N_s^l$  as given. The profit maximizing price and quantity sold for a firm in sector  $s$  producing in country  $l$  with cost  $c$  and selling to country  $h$  equals:

$$p_s^{lh}(c) = \frac{1}{2}(c_s^{hh} + \tau_s^{lh}c), \quad q_s^{lh}(c) = \frac{L^h}{2\gamma_s} (c_s^{hh} - \tau_s^{lh}c) \quad (5)$$

with associated operating profit and mark-up

$$\pi_s^{lh}(c) = \frac{L^h}{4\gamma_s} (c_s^{hh} - \tau_s^{lh}c)^2 \quad (6)$$

$$\mu_s^{lh}(c) = \frac{1}{2} (c_s^{hh} - \tau_s^{lh}c) \quad (7)$$

In these expressions  $c_s^{hh}$  denotes the upper bound (‘cutoff’) cost inclusive of trade costs (‘delivered cost’) for firms selling to country  $h$ . It corresponds to the marginal cost of sellers that just break even:  $\pi_s^{lh}(c_s^{hh}) = 0$ . In particular, given (4),  $c_s^{hh}$  satisfies:

$$c_s^{hh} = \sup \left\{ \tau_s^{lh}c : \pi_s^{lh}(c) > 0 \right\} = p_s^h \quad (8)$$

Sellers with marginal cost  $c$  such that  $\tau_s^{hl}c = c_s^{hh}$  just break even while firms with  $c$  such that  $\tau_s^{hl}c > c_s^{hh}$  choose not to sell as they anticipate operating losses. Since the cutoff (8)



is the same for sellers from any origin, higher trade barriers from  $l$  to  $h$  make it harder for exporters from  $l$  to break even as they need better cost draws to do so.

Before entering, firms are uncertain about their marginal cost. They know, however, the probability distribution of cost draws and can thus calculate their expected operating profits from sales to each country. Free entry then implies that the sum of expected operating profits across all countries exactly match the fixed entry cost:

$$\sum_{h=1}^M \left[ \int_0^{c_s^{hh}/\tau_s^{lh}} \pi_s^{lh}(c) dG_s^l(c) \right] = f_s^l. \quad (9)$$

Substituting (6) into (9) and solving the resulting system of  $M$  equations for  $l = 1, \dots, M$  gives the  $M$  cost cutoffs. These summarize all the effects of market conditions relevant for firm performance. Moreover, substituting (8) into (4) and solving the  $M$  resulting equations individually yields the number of sellers to each country:

$$N_s^h = \frac{2\gamma_s \alpha_s - c_s^{hh}}{\eta_s c_s^{hh} - \bar{c}_s^h}, \quad (10)$$

where  $\bar{c}_s^h = \sum_{l=1}^M \left\{ \left[ \int_0^{c_s^{lh}} \tau_s^{lh} c dG_s^l(c) \right] / G_s^l(c_s^{lh}) \right\}$  is the average delivered cost of sellers.

### 3.3 Equilibrium

Explicit solutions for the equilibrium cutoffs can be derived by specifying the distribution of cost draws  $G_s^l(c)$  as a Pareto distribution with upper bound  $c_{A,s}^l$  and shape parameter  $k_s \geq 1$ :

$$G_s^l(c) = \left( \frac{c}{c_{A,s}^l} \right)^{k_s}, \quad c \in [0, c_{A,s}^l]. \quad (11)$$

As we will show in the empirical sections, the Pareto assumption allows us to capture in a simple way one of the key features of the data, namely the skewness of the distribution of firms across cost levels. This is captured by the shape parameter  $k_s$ , which is assumed to vary across sectors but not across countries. In particular,  $k_s = 1$  corresponds to a uniform cost distribution while increasing  $k_s$  raises the relative number of high cost firms by concentrating more density in the upper part of the support  $[0, c_{A,s}^l]$ . As  $k_s$  approaches infinity, the distribution becomes degenerate at  $c_{A,s}^l$  and firm heterogeneity vanishes.

In the present setting, another useful property of the Pareto distribution is that any truncation from above at  $c_s^{hh}/\tau_s^{lh} < c_{A,s}^l$  is also a Pareto distribution with shape parameter  $k_s$  such that  $G_s^{lh}(c) = [c/(c_s^{hh}/\tau_s^{lh})]^{k_s}$ ,  $c \in [0, c_s^{hh}/\tau_s^{lh}]$ . Therefore expressions (5)-(8) allow us to express the average performance variables for sellers in country  $h$  as functions of the cutoff  $c_s^{hh}$ . In particular, average (delivered) costs, markups, prices, quantities and operating profits are respectively equal to:

$$\bar{c}_s^h = \frac{k_s}{k_s+1} c_s^{hh} \quad \bar{\mu}_s^h = \frac{1}{2(k_s+1)} c_s^{hh} \quad \bar{p}_s^h = \frac{2k_s+1}{2(k_s+1)} c_s^{hh} \quad (12)$$

$$\bar{q}_s^h = (k_s + 2) \frac{\sum_{l=1}^M |C_s^{lh}| / (\psi_s^l / f_s^l)}{|P_s|} (c_s^{hh})^{-(k_s+1)} \quad \bar{\pi}_s^h = \frac{\sum_{l=1}^M |C_s^{lh}| / (\psi_s^l / f_s^l)}{|P_s|} (c_s^{hh})^{-k_s}$$

Smaller cutoffs are associated with smaller average costs, markups and prices as well as larger average quantities and profits. A percentage fall in the cutoff  $c_s^{hh}$  leads to the same percentage fall in the average cost  $\bar{c}_s^h$  ('selection effect'), in the average

markup  $\bar{\mu}_s^h$  ('pro-competitive effect') and thus in the average price. Since (12) implies  $\bar{p}_s^h = (2k_s + 1) \sqrt{\bar{\mu}_s^h \bar{c}_s^h / 2k_s}$ , lower average cost and lower average markup each account for half of the percentage fall in the average price. Moreover, a percentage fall in the cutoff leads to  $-(k_s + 1)$  and  $-k_s$  per cent rise in average quantity and average profit respectively. For this reason, the cutoff  $c_s^{hh}$  can be interpreted as a measure of the equilibrium 'toughness of competition' in country  $h$  and sector  $s$ .

To characterize the equilibrium cutoff, let  $\rho_s^{lh} \equiv (\tau_s^{lh})^{-k_s} \in (0, 1]$  be a measure of the 'freeness' of trade for exports from  $l$  to  $h$  such that

$$P_s \equiv \begin{pmatrix} \rho_s^{11} & \rho_s^{12} & \cdots & \rho_s^{1M} \\ \rho_s^{21} & \rho_s^{22} & \cdots & \rho_s^{2M} \\ \vdots & \vdots & \ddots & \vdots \\ \rho_s^{M1} & \rho_s^{M2} & \cdots & \rho_s^{MM} \end{pmatrix}.$$

is the trade freeness matrix for sector  $s$  with determinant  $|P_s|$  and cofactor  $|C_s^{lh}|$  for its  $\rho_s^{lh}$  element. The free entry condition (9) in country  $l$  can then be rewritten as:

$$\sum_{h=1}^M \rho_s^{lh} L^h (c_s^{hh})^{k_s+2} = \frac{2\gamma_s(k_s+1)(k_s+2)f_s^l}{\psi_s^l} \quad l = 1, \dots, M, \quad (13)$$

where  $\psi_s^l = (c_{A,s}^l)^{-k_s}$  is an index of absolute advantage in sector  $s$ . In each sector  $s$  the cutoffs can thus be obtained by solving the  $M$  conditions (13):

$$c_s^{hh} = \left( \frac{2(k_s+1)(k_s+2)\gamma_s \sum_{l=1}^M |C_s^{lh}| / (\psi_s^l / f_s^l)}{L^h |P_s|} \right)^{\frac{1}{k_s+2}} \quad h = 1, \dots, M, \quad (14)$$

The fact that  $c_s^{hh}$  is an increasing function of  $\gamma_s$  shows that competition is tougher in sectors in which varieties are less differentiated. Cross-country differences in the toughness of competition in country  $h$  are driven instead by two factors: own country 'size'  $L^h$ , as well as a combination of trade freeness, entry barriers and comparative advantage  $\left[ \sum_{l=1}^M |C_s^{lh}| / (\psi_s^l / f_s^l) \right] / |P_s|$ . This sum deserve closer inspection. The ratio  $\psi_s^l / f_s^l$  measures how easily country  $l$  generates firms with high productivity ('good competitors') and, hence, we call it the 'producer competitiveness' of country  $l$  in sector  $s$ . Since competitiveness depends positively on the absolute advantage  $\psi_s^l$  and negatively on the entry cost  $f_s^l$ , a technologically disadvantaged country with low entry barriers can be as 'competitive' as a technologically advantaged one with high entry barriers. When all countries have the same competitiveness,  $\psi_s^l / f_s^l = \psi_s / f_s$  can be factored out of the sum to yield  $(\psi_s / f_s)$  times  $\sum_{l=1}^M |C_s^{lh}| / |P_s|$ . This last term measures how difficult it is for local and foreign firms to reach consumers in country  $h$ . It is, therefore, an inverse index of the 'accessibility' of country  $h$  to firms. Accordingly, in the general case of cross-country differences in competitiveness, the sum  $\left[ \sum_{l=1}^M |C_s^{lh}| / (\psi_s^l / f_s^l) \right] / |P_s|$  represents an inverse index of the distance-weighted average competitiveness of countries whose firms sell to country  $l$ . We will refer to it as the inverse index of (average) 'seller competitiveness' of country  $h$ .

To summarize, expression (14) reveals that competition is tougher in countries benefitting from larger local markets and stronger seller competitiveness. Given (12), on average such countries exhibit lower average (delivered) costs, markups, prices as well as higher quantities and operating profits. Note that seller competitiveness and producer competitiveness coincide only when trade barriers are prohibitive. When international trade is

feasible, the two concepts may diverge: seller competitiveness in a country with weak producer competitiveness can be as high as in a country with strong producer competitiveness if the former is more accessible than the latter.

Apart from average performance variables, the toughness of competition also determines the numbers of producers and sellers across countries. Specifically, substituting  $\bar{c}_s^h$  from (12) into (10) allows us to solve the latter for the numbers of sellers:

$$N_s^h = \frac{2\gamma_s(k_s + 1)}{\eta_s} \frac{\alpha_s - c_s^{hh}}{c_s^{hh}} \quad (15)$$

These include domestic producers, whose number is  $G_s^h(c_s^{hh})N_{E,s}^h$ , and foreign exporters, whose number is  $G_s^l(c_s^{hh}/\tau_s^{lh})N_{E,s}^l$  for each country of origin. We can, therefore, write  $N_s^h = \sum_{l=1}^M G_s^l(c_s^{hh}/\tau_s^{lh})N_{E,s}^l$ . Using (8) and (11) in that equality then gives:

$$\sum_{l=1}^M \rho_s^{lh} \psi_s^l N_{E,s}^l = \frac{N_s^h}{(c_s^{hh})^{k_s}}.$$

For  $h = 1, \dots, M$  the above expression gives a system of  $M$  linear equations is that can be solved for the number of entrants in the  $M$  countries:

$$N_{E,s}^l = \frac{2(k_s + 1)\gamma_s}{\eta_s |P_s| \psi_s^l} \sum_{h=1}^M \frac{(\alpha_s - c_s^{hh}) |C_s^{lh}|}{(c_s^{hh})^{k_s+1}} \quad (16)$$

Among them,  $N_{E,s}^l G_s^l(c_s^{ll}/\tau_s^{ll})$  firms survive and produce for the local market while  $N_{E,s}^l G_s^l(c_s^{hh}/\tau_s^{lh})$  export to country  $h$ . This implies that the number of producers located in country  $l$  equals:

$$N_{P,s}^l = \psi_s^l N_{E,s}^l \rho_s^{ll} (c_s^{ll})^{k_s} \quad (17)$$

Finally, the model generates a simple measure of welfare for each country  $h$ . Since profits are zero both ex-ante (due to free entry) and ex-post (due to the law of large numbers), such measure considers only consumer surplus net of the sunk costs of entry. It is obtained by substituting the quantities that are consumed in equilibrium into utility (1):

$$U^h = 1 + \sum_{s=1}^S \frac{1}{2\eta_s} (\alpha_s - c_s^{hh}) \left( \alpha_s - \frac{k_s + 1}{k_s + 2} c_s^{hh} \right). \quad (18)$$

where 1 is individual income that coincides with the equilibrium wage. According to (18), the welfare of country  $l$  decreases monotonically with its domestic cost cutoff.

## 4 Calibration

The previous section has presented a theoretical model that determines the economic performance of a country as a function of the toughness of competition in its local markets. This is inversely measured by the endogenous cost cutoff  $c_s^{hh}$  and depends on some exogenous parameters capturing both the size and the (seller) competitiveness of the country. The aim is now to calibrate those parameters to real world data and, after validation, to use the calibrated model for policy analysis. In particular, we calibrate the model to 12 manufacturing industries operating in 14 European economies in the year 2002.<sup>2</sup>

<sup>2</sup>An overview of the data used is available in Appendix 7.

All the relevant parameters of the model can be directly observed or estimated except the ‘revealed (producer) competitiveness’ index  $\psi_s^l/f_s^l$ . However, if we assume that the observed behavior of the economy is well captured by the equilibrium of the theoretical model,  $\psi_s^l/f_s^l$  can be calibrated to fit the observed distribution of productivity across industries and countries given all other parameters.<sup>3</sup>

#### 4.1 Trade frictions

We explain the estimation of the parameters of the model starting with the trade freeness matrix  $P$ . This is recovered by exploiting the fact that the theoretical model generates a ‘gravity’ prediction of bilateral exports based on the characteristic of the countries of origin and destination as well as on their reciprocal distance. To see this, note that in sector  $s$  an exporter from  $h$  to  $l$  with cost  $c$  earns f.o.b. export revenues  $r_s^{hl}(c) = p_s^{hl}(c)q_s^{hl}(c)$ . Aggregate bilateral exports  $EXP_s^{hl}$  can then be obtained by aggregating  $r_s^{hl}(c)$  over all exporters from  $h$  to  $l$  (with cost  $c \leq c_s^{ll}/\tau_s^{hl}$ ). Using expressions (5) and (8) yields:

$$EXP_s^{hl} = \frac{1}{2\gamma_s(k_s + 2)} N_{E,s}^h \psi_s^{hl} L^l \left(c_s^{ll}\right)^{k_s+2} \rho_s^{hl} \quad (19)$$

which is a gravity equation in so far as it determines bilateral exports as a function of bilateral trade barriers and country characteristics. Note that tougher competition in the country of destination (lower  $c_s^{ll}$ ) dampens exports by making it harder for potential exporters to break into that market. Differently, given (16), tougher competition in the country of origin (lower  $c_s^{hh}$ ) promotes exports by increasing the number of entrants into that market.

Following standard practice, equation (19) can be estimated in logs as

$$\ln(EXP_s^{hl}) = EX_h + IM_l + \delta_s \ln(d^{hl}) + \beta^l Border^{hl} + \lambda Lang^{hl} Border^{hl} + du^{time} + \epsilon^{hl} \quad (20)$$

where  $EX_h$  and  $IM_l$  are dummies specific to the countries of origin and of destination respectively,  $Lang^{hl}$  is a dummy that equals 1 when the two countries share a common language,  $du^{time}$  is a time dummy, and  $\epsilon^{hl}$  is the error term. Trade barriers are captured by two variables. While bilateral distance  $d^{hl}$  is used to measure all distance related trade frictions, the border effect  $Border^{hl}$  targets international trade frictions due to crossing one or more borders.

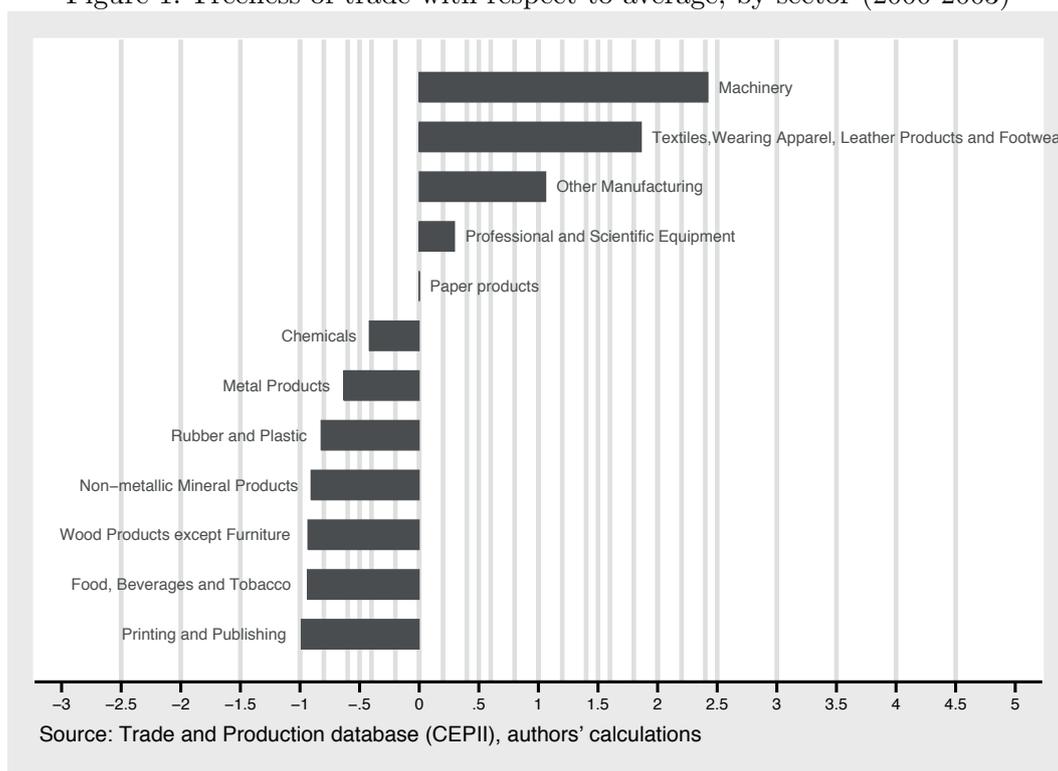
In estimating (20), we use data for the years 2000-2003. Although we are interested in calibrating the model relative to the cross-section of data for the year 2002, extending the estimates to the interval 2000-2003 increases the statistical robustness of the estimated coefficients. These are used to calculate industry-exporter-importer specific trade costs as  $\rho_s^{hl} = \exp(\beta^l - \lambda Lang^{hl})(d^{hl})^{\delta_s}$ . Hence, trade barriers are modeled as a power function of distance that increases frictional costs when a new border is crossed and reduces them if countries share a common language. We allow for non-negligible distances within countries ( $\rho_s^{hh} = (d^{hh})^{\delta_s} < 1$ ) and asymmetric trade barriers between countries ( $\rho_s^{hl} \neq \rho_s^{lh}$ ).

The results of our estimation across sectors are reported in Figure 1, which ranks industries by degree of trade freeness, relative to the overall average value.

Table 1 reports the estimated components  $\rho_s^{hl}$  of the trade freeness matrix. For completeness, distance coefficients  $\delta_s$  are also included. “Printing and Publishing”, “Wood Products except Furniture” and “Non-metallic Mineral Products” are the least tradable

<sup>3</sup>Expression (17) would allow us to disentangle also the absolute advantage parameter  $\psi_s^h$  from the entry cost  $f_s^h$ .

Figure 1: Freeness of trade with respect to average, by sector (2000-2003)



industries while “Professional and Scientific Equipment”, “Textiles, Wearing Apparel, Leather Products and Footwear” and “Electrical and non-electrical Machinery” are the most tradable ones. The table also shows that the  $\rho_s^{hl}$ 's are highly correlated with the coefficients of distance elasticity  $\delta_s$ , which largely explains the variation in tradability across sectors.

Table 1: Coefficients of freeness of trade and elasticity with respect to distance, by sector

| Industry code | Industry   | $\rho_s$ | $\delta_s$ |
|---------------|--|----------|------------|
| 1             | Food, Beverages and Tobacco                              | 6.52E-06 | -1.93      |
| 2             | Textiles, Wearing Apparel, Leather Products and Footwear | 3.03E-04 | -1.19      |
| 3             | Wood Products except Furniture                           | 7.02E-06 | -1.91      |
| 4             | Paper products   | 1.06E-04 | -1.38      |
| 5             | Printing and Publishing                                  | 1.12E-06 | -2.29      |
| 6             | Chemicals  | 6.16E-05 | -1.49      |
| 7             | Rubber and Plastic                                       | 1.87E-05 | -1.72      |
| 8             | Non-metallic Mineral Products                            | 9.78E-06 | -1.85      |
| 9             | Metal Products   | 3.89E-05 | -1.57      |
| 10            | Machinery  | 3.63E-04 | -1.16      |
| 11            | Professional and Scientific Equipment                    | 1.37E-04 | -1.34      |
| 12            | Other Manufacturing                                      | 2.18E-04 | -1.25      |

Source: Trade and Production Dataset (CEPII) and authors calculations

Turning to the country dimension, table 2 reports the average  $\rho_s^{hl}$ 's by countries ranked from worst to best accessibility. The left hand side of the table shows how easy it is to access foreign markets from different countries of origin ( $\rho_s^{out}$ ). The right hand side shows, instead, how easy it is to access different domestic markets from abroad ( $\rho_s^{in}$ ). Unsurprisingly, the ease of accessing foreign market is the highest for the core European countries and the lowest for peripheral ones. More interestingly, the ease of accessing the domes-

tic market from abroad seems to follow a cultural/linguistic divide, with the anglosaxon, germanic and scandinavian countries being more accessible than the latin/mediterranean ones. This confirms that geography is an important determinant of trade costs but other factors also have a strong influence.

Table 2: Freeness of trade, by countries of origin and destination

|    | Exporter       |               | Importer      |               |       |
|----|----------------|---------------|---------------|---------------|-------|
|    | $\rho_s^{out}$ | border effect | $\rho_s^{in}$ | border effect |       |
| PT | 1.56E-05       | -1.29         | NO            | 3.53E-06      | -3.12 |
| ES | 2.10E-05       | -1.23         | ES            | 7.68E-06      | -1.96 |
| FI | 2.18E-05       | -1.28         | IT            | 7.77E-06      | -2.09 |
| IT | 2.53E-05       | -1.22         | FR            | 1.07E-05      | -2.17 |
| IE | 3.50E-05       | -1.31         | PT            | 1.40E-05      | -1.16 |
| AT | 3.53E-05       | -1.28         | FI            | 1.57E-05      | -1.30 |
| NO | 3.65E-05       | -1.14         | AT            | 2.12E-05      | -1.37 |
| SE | 3.65E-05       | -1.29         | SE            | 2.83E-05      | -1.17 |
| DK | 4.31E-05       | -1.35         | IE            | 3.26E-05      | -0.92 |
| FR | 4.68E-05       | -1.22         | GB            | 3.70E-05      | -1.11 |
| GB | 5.81E-05       | -1.30         | DE            | 3.73E-05      | -1.22 |
| DE | 6.94E-05       | -1.29         | DK            | 7.19E-05      | -0.41 |
| BE | 1.08E-04       | -1.38         | NL            | 1.84E-04      | -0.01 |
| NL | 1.09E-04       | -1.38         | BE            | 1.89E-04      | -0.01 |

Source: Trade and Production Dataset (CEPII) and authors calculations

## 4.2 Production costs

The skewness parameters  $k_s$  and the cut-offs  $c_s^{hh}$  can be recovered from estimated firm-level TFPs. As to the former, call  $x = 1/c$  the TFP of a firm with marginal cost  $c$  and  $x_{A,s}^l = 1/c_{A,s}^l$  the lower bound of its support. If  $c$  follows the assumed Pareto distribution (11), also  $x$  is Pareto distributed with cumulative density function

$$F_s^l(x) = 1 - \left( \frac{x}{x_{A,s}^l} \right)^{-k_s}, \quad x \in [c_{A,s}^l, \infty).$$

which can be rewritten as  $\ln[1 - F_s^l(x)] = k_s \ln(x_{A,s}^l) - k_s \ln(x)$ . Accordingly, if  $x$  is Pareto distributed with skewness parameter  $k_s$  and cumulative density function  $F(x)$ , the OLS regression of  $\ln[1 - F(x)]$  on  $\alpha + \beta \ln(x)$  consistently estimates  $k_s$  as  $-\hat{\beta}$  with an  $R^2$  close to 1. The results of this regression are shown in Table 3. The  $R^2$  is on average 0.8, which indicates that the Pareto is a fairly good approximation of the underlying productivity distributions. As for the skewness parameter, larger  $k_s$  implies a larger share of high cost (low productivity) and therefore small firms. Hence, "Metal Products", "Rubber and Plastic" as well as "Machinery" appear to be the sectors with the highest concentration of inefficient and small firms, while "Textiles, Wearing Apparel, Leather Products and Footwear", "Food, Beverages and Tobacco" as well as "Chemicals" exhibit the most even distribution of firms across all levels of productivity and size. Turning to the cutoff cost,  $c_s^{hh}$  corresponds to the highest cost (the lowest productivity) of producers in country  $h$ . In principle, the reverse of the minimum observed productivity approximates well the cutoff cost. However, due to noise and extreme values associated with micro data, a more robust estimate can be obtained through a moment estimator. Specifically, if  $x$  is Pareto distributed with shape parameters  $k_s$  over the support  $[x_s^{hh}, \infty)$ , then its mean is equal to  $x_s^{hh} k_s / (k_s - 1)$ . Using the observed country-sector productivity mean and the estimated  $k_s$ , one can invert this formula to recover  $x_s^{hh}$  as a scaled average sectoral productivity. Raising this to the power of  $-1$ , generates the cost cutoff  $c_s^{hh}$ .

By averaging the cost cutoffs across sectors within countries, we can get the distribution of the toughness of competition and hence observed productivity across our European

Table 3: Sectoral shape parameters of TFP Pareto distributions, by sector

| Industry code | Industry   | $k_s$ | $R^2$ |
|---------------|--|-------|-------|
| 1             | Food, Beverages and Tobacco                              | 1.20  | 0.79  |
| 2             | Textiles, Wearing Apparel, Leather Products and Footwear | 1.19  | 0.81  |
| 3             | Wood Products except Furniture                           | 1.45  | 0.81  |
| 4             | Paper products   | 1.50  | 0.82  |
| 5             | Printing and Publishing                                  | 1.52  | 0.83  |
| 6             | Chemicals  | 1.32  | 0.85  |
| 7             | Rubber and Plastic                                       | 1.59  | 0.78  |
| 8             | Non-metallic Mineral Products                            | 1.49  | 0.80  |
| 9             | Metal Products   | 1.80  | 0.78  |
| 10            | Machinery  | 1.56  | 0.77  |
| 11            | Professional and Scientific Equipment                    | 1.48  | 0.75  |
| 12            | Other Manufacturing                                      | 1.46  | 0.80  |
|               | Average  | 1.46  | 0.80  |

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

countries. This is reported in Table 4. The table shows that the most competitive EU

Table 4: Observed productivity, by country

| Country | $c^{hh}$ |
|---------|----------|
| IE      | 0.05     |
| NO      | 0.14     |
| DK      | 0.14     |
| DE      | 0.17     |
| FR      | 0.17     |
| AT      | 0.18     |
| GB      | 0.18     |
| FI      | 0.19     |
| IT      | 0.23     |
| SE      | 0.25     |
| ES      | 0.28     |
| PT      | 0.33     |

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

country is Ireland followed by Norway and Denmark. Among large countries the toughest competitive environment can be found in Germany followed by France.

### 4.3 Revealed competitiveness

We have now all the information we need to calculate revealed competitiveness  $\psi_s^l/f_s^l$  from (13). In so doing, we proceed in two steps. First, we compute the bundling parameter  $\psi_s^l/(\gamma_s f_s^l)$ . Then, we remove the sectoral scaling term  $\gamma_s$  from  $\psi_s^l/(\gamma_s f_s^l)$  by estimating the residuals of a regression of  $\ln \psi_s^l/(\gamma_s f_s^l)$  on a set of industry dummies. These are reported in the last column of Table 3. By averaging the regression residuals across sectors, we obtain our index of revealed (producer) competitiveness.

Table 5 shows the results. According to this table, the most competitive EU country is Ireland followed by Finland and Denmark. Of the large countries, France is the most competitive followed by Germany. This remarkably squares with assessments of European competitiveness based on completely different methodologies such as the Global Competitiveness Index calculated by the World Economic Forum.

The comparison between Tables 4 and 5 reveals substantial rank correlation. Such correlation is, however, far from perfect. For instance, France and Germany switch positions with Germany ranking higher in terms of toughness of competition, and hence observed

Table 5: Revealed competitiveness, by country

| Country | $\frac{\psi_s^a}{F_{E,s}^a}$ |
|---------|------------------------------|
| IE      | 2.44                         |
| FI      | 2.37                         |
| DK      | 1.81                         |
| AT      | 1.56                         |
| SE      | 1.32                         |
| FR      | 1.20                         |
| DE      | 1.05                         |
| NL      | 0.68                         |
| BE      | 0.57                         |
| IT      | 0.55                         |
| GB      | 0.52                         |
| ES      | 0.52                         |
| PT      | 0.47                         |

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

productivity, but lower in terms of revealed competitiveness. Accordingly, given different sectoral specialization, size and accessibility, the observed performance of French firms with respect to German ones, though worse, can be explained only if France is more likely to generate more productive firms. In other words, if Germany had the same specialization, size and accessibility of France, the observed performance of German firms would be worse than French ones. This can be explained in terms of absolute disadvantage or higher barriers to entry in the case of Germany. Quite remarkable are also the different rankings of Finland and Sweden. These countries face limited accessibility from other European countries. Accordingly, the observed performance of their firms can be explained only through substantial revealed competitiveness. If Finland and Sweden were more accessible, the observed productivity of their firms would be much higher. The opposite is true for Great Britain. Mediterranean countries are, instead, consistently at the bottom of both rankings.

## 5 Validation

In order to test the reliability of our calibration, we validate the model by reproducing other key properties of the distribution of firm sales and exports. We focus on France, this choice being dictated by the extensive and high quality coverage of French firm data as well as by comparability with existing works such as Eaton, Kortum and Kramarz (2004) and Del Gatto, Mion and Ottaviano (2006). French results are also amenable to comparison with Bernard, Eaton, Jensen and Kortum (2003) given the similarity of patterns uncovered in US and French firm-level data. We target two moments: the share of French firms that export and their productivity gap with respect to non-exporters. Data come from the EAE database compiled by the French National Institute of Statistics (INSEE) and covering around 25.000 firms for the year 2000.

### 5.1 Share of exporters

In Section 3.3 we have seen that, given country  $l$  and industry  $s$ ,  $N_{E,s}^l G_s^l (c_s^{ll} / \tau_s^{ll})$  firms survive and produce for the local market while  $N_{E,s}^l G_s^l (c_s^{hh} / \tau_s^{lh})$  export to country  $h$ . Countries that are easier to export to are characterized by larger  $c_s^{hh} / \tau_s^{lh}$ . Firms that are not able to serve the country with the largest  $c_s^{hh} / \tau_s^{lh}$  do not export at all. Accordingly, if we define the least severe export cutoff as:

$$c_{X,s}^l \equiv \max_h \left[ c_s^{hh} / \tau_s^{lh} \right] = \max_h \left[ c_s^{hh} (\rho_s^{lh})^{1/k} \right]$$

the ratio  $G_s^l(c_{X,s}^l)/G_s^l(c_s^l/\tau_s^l)$  gives the percentage of exporters from country  $l$ . In the case of France in 2002, our calibration predicts that 20.8% of French firms export. Del Gatto, Mion and Ottaviano (2006) report that in the EAE dataset the real share is 22.26%. This figure is also very close to the one reported by Eaton, Kortum and Kramarz (2004) in 1986.

## 5.2 Productivity advantage of exporters

From the calibrated model it is also possible to measure the productivity advantage of exporters. Our model predicts a 72% productivity advantage of exporters. For the US, Bernard, Eaton, Jensen and Kortum (2003) report a 33% productivity advantage of exporters over non-exporters. They use this moment to calibrate their productivity variance parameter  $\theta$ , obtaining a value of 3.6. This parameter  $\theta$  is similar to the  $k_s$  used in this paper. By rescaling our parameter  $k_s$  from its current average value of 1.46 to 3.6 we obtain a 31% productivity advantage. In the EAE database, the productivity advantage for the year 2000 is slightly above 27% but it is likely to be underestimated as the database covers only firms with at least 20 employees, 73% of which are exporters.

## 6 Simulation

We now turn to simulating how changes in the freeness of trade implied by different EMU membership hypotheses and EU enlargement change average productivity. We consider two sets of scenarios and quantify the equilibrium  $c_s^{hh}$  in 14 under the different hypotheses.

### 6.1 EMU

Has EMU affected the toughness of competition in the euro area, and through this channel, average (delivered) costs, markups prices and quantities? To answer this question, we simulate the changes in the cost cutoffs in two counterfactual scenarios: non-participation of France to EMU and participation of the UK. In the first scenario, we investigate what would have happened to the productivity of French and other European firms if France had not been part of EMU in the period up to 2002. In the second, we study the implications of Great Britain having joined EMU over the same time frame.

Table 6: EMU effect on trade volumes

|                              | (a)        | (b)       |
|------------------------------|------------|-----------|
| EA11                         | 0.114***   | 0.088***  |
| (EMU trade creation effect)  | (0.025)    | (0.025)   |
| EA10                         | 0.064***   | 0.008     |
| (EMU export boosting effect) | (0.023)    | (0.027)   |
| EA01                         | 0.071***   | 0.071***  |
| (EMU import boosting effect) | (0.024)    | (0.025)   |
| Ln (real GDP exporter)       | 1.214***   | 1.194***  |
|                              | 0.08       | 0.08      |
| Ln (real GDP importer)       | 1.077***   | 0.99***   |
|                              | 0.074      | 0.072     |
| Observations                 | 2912       | 2184      |
| R2                           | 0.99       | 0.99      |
| Data period                  | 1989-2002  | 1989-2002 |
| Country coverage             | EU-15+EF7A | EU-15     |

Notes: Robust standard errors; All standard controls, including year, EU membership, nominal exchange rates, and bilateral fixed effects included in the regression but not reported.

Source: Flam and Nordstrom, 2003. Table 6

Table 7: Changes in cutoffs, by country

|    | effective $c_s^{hh}$ | counterfactual $c_s^{hh}$<br>with France<br>out of EMU    | % change cutoff | counterfactual $c_s^{hh}$ with France<br>out of EMU<br>(conservative estimate)    | % change cutoff |
|----|----------------------|---|-----------------|---|-----------------|
| AT | 0.1783               | 0.1781  | -0.11           | 0.1782  | -0.07           |
| DE | 0.1664               | 0.1663  | -0.04           | 0.1663  | -0.02           |
| DK | 0.1375               | 0.1371  | -0.25           | 0.1373  | -0.15           |
| ES | 0.284                | 0.284   | -0.01           | 0.284   | 0               |
| FI | 0.1946               | 0.1945  | -0.03           | 0.1946  | -0.02           |
| FR | 0.1724               | 0.1844  | 6.97            | 0.1813  | 5.15            |
| GB | 0.1839               | 0.1838  | -0.06           | 0.1839  | -0.04           |
| IE | 0.0457               | 0.043   | -5.85           | 0.0439  | -3.92           |
| IT | 0.2335               | 0.2335  | -0.01           | 0.2335  | -0.01           |
| NO | 0.1369               | 0.1361  | -0.61           | 0.1364  | -0.32           |
| PT | 0.3252               | 0.3252  | -0.01           | 0.3252  | -0.01           |
| SE | 0.2471               | 0.247   | -0.04           | 0.2471  | -0.03           |
|    | effective $c_s^{hh}$ | counterfactual $c_s^{hh}$<br>with Great<br>Britain in EMU | % change cutoff | counterfactual $c_s^{hh}$ with Great<br>Britain in EMU<br>(conservative estimate) | % change cutoff |
| AT | 0.1783               | 0.1783  | 0.02            | 0.1783  | 0.01            |
| DE | 0.1664               | 0.1664  | 0.01            | 0.1664  | 0               |
| DK | 0.1375               | 0.1376  | 0.09            | 0.1375  | 0.04            |
| ES | 0.284                | 0.284   | 0               | 0.284   | 0               |
| FI | 0.1946               | 0.1946  | 0.01            | 0.1946  | 0               |
| FR | 0.1724               | 0.1724  | 0.02            | 0.1724  | 0.01            |
| GB | 0.1839               | 0.1786  | -2.89           | 0.1832  | -0.41           |
| IE | 0.0457               | 0.0505  | 10.48           | 0.0477  | 4.41            |
| IT | 0.2335               | 0.2336  | 0               | 0.2336  | 0               |
| NO | 0.1369               | 0.1372  | 0.22            | 0.137   | 0.09            |
| PT | 0.3252               | 0.3252  | 0               | 0.3252  | 0               |
| SE | 0.2471               | 0.2472  | 0.02            | 0.2471  | 0.01            |

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

The simulation is carried out by recomputing the components  $\rho_s^{lh}$  of the trade freeness matrix in the two cases. We then calculate the new cutoffs  $c_s^{hh}$  corresponding to the new trade freeness matrices. In so doing, we rely on recent assessments of the impact of the EMU on bilateral trade flows between European countries. In this respect, the most careful analysis is arguably presented by Flam and Nordstrom (2003). These authors measure the effects of the EMU on borders effects by introducing three specific dummies in otherwise standard gravity equations. Their findings are shown in Table 6. The dummy EA11 equals 1 when both the country of destination and the country of origin use the euro as national currency. The dummy EA10 takes value 1 when the country of origin uses the euro whereas the country of destination does not, whereas the dummy EA01 equals 1 when the opposite is true.

The table reports the results for two regressions that give us an upper and a lower bounds for the effects of EMU on trade flows. Regression (a) considers all Western European countries whereas regression (b) includes only EU-15 members. The observed period goes from from 1989 to 2002. Comparing the two regressions, the dummy EA11 has an estimated coefficient that ranges from about 9 to 11 per cent and is statistically significant. Also the coefficient of the dummy EA01 is statistically significant and estimated around 7 per cent. Both are statistically significant. The coefficient of the dummy EA10 is instead significant only when all Western European countries are considered with an estimated value of 6 per cent. It is less than 1 per cent and statistically non significant when the sample is restricted to EU countries only.<sup>4</sup>

In our first counterfactual scenario, we reallocate France from the EMU to the non-EMU groups of countries and adjust the border effects accordingly using the coefficients of

<sup>4</sup>A positive EMU effect on trade is a finding common in the literature. See, e.g., Micco, Stein and Ordonez (2003) as well as Berger and Nitsch (2005) and Baldwin (2006) for a review of the literature.

the dummies estimated by Flam and Nordstrom (2003). In the second scenario, we adopt the same procedure to reallocate Great Britain from the non-EMU to the EMU groups. The corresponding results are reported in Table 7.

The upper part of the table refers to the French experiment. It shows that, if France had been excluded from the EMU in 2002, its firms would have exhibited an average productivity of 5 to 6 per cent lower and, in the best case, would have dropped from fifth to seventh in the European ranking. Accordingly, prices would have been from 5 to 6 per cent higher due to higher average production costs and larger mark-ups. The reason is that a less competitive French market would have allowed for less resources to be transferred from less to more efficient firms. Among the other countries, only Ireland would have experienced a relevant change in the average productivity of its firms. This would have risen by 3 to 5 per cent due to the exit of inefficient firms in a competitive environment made tougher by a substantial increase in Ireland's relative accessibility.

The bottom part of the table regards the British experiment. The adoption of the euro would have increased the average productivity of British firms by 0.5 to 3 per cent with comparable drops in prices and mark-ups. While Great Britain's position in the European ranking would have not been affected, the increased exposure to international competition would have triggered the exit of inefficient firms. This would have been of little consequence for the other European countries with the exception of Ireland which would have experienced a substantial fall in average productivity as well as comparable increases in prices and mark-ups.

## 6.2 Enlargement

Let us now turn to the simulation of the changes in average productivity induced by changes in the freeness of trade associated with two additional scenarios: EU enlargement ('wider integration') and a fully integrated enlarged Europe ('deeper and wider integration'). In designing these scenarios, we will play with the border effects as we did in the previous section.

We start with recalibrating the model on an expanded dataset with 25 rather than 14 European countries.

Table 8: Freeness of trade and distance decay by industry (25 countries)

| Industry code | Industry   | $\rho_s$     | $\rho_s$     |
|---------------|--|--------------|--------------|
|               |  | 14 countries | 25 countries |
| 1             | Food, Beverages and Tobacco                              | 6.52E-06     | 1.32E-05     |
| 2             | Textiles, Wearing Apparel, Leather Products and Footwear | 3.03E-04     | 2.03E-04     |
| 3             | Wood Products except Furniture                           | 7.02E-06     | 3.70E-06     |
| 4             | Paper products   | 1.06E-04     | 2.43E-06     |
| 5             | Printing and Publishing                                  | 1.12E-06     | 6.10E-07     |
| 6             | Chemicals  | 6.16E-05     | 1.33E-05     |
| 7             | Rubber and Plastic                                       | 1.87E-05     | 4.30E-06     |
| 8             | Non-metallic Mineral Products                            | 9.78E-06     | 2.52E-06     |
| 9             | Metal Products   | 3.89E-05     | 1.76E-05     |
| 10            | Machinery  | 3.63E-04     | 5.54E-05     |
| 11            | Professional and Scientific Equipment                    | 1.37E-04     | 5.02E-05     |
| 12            | Other Manufacturing                                      | 2.18E-04     | 1.81E-05     |

Source: Trade and Production Dataset (CEPII) and authors calculations

Table 8 reports the estimated components  $\rho_s^{hl}$  of the trade freeness matrix for the enlarged dataset by industry. For the sake of comparison, in the first column we report once more the coefficients  $\rho_s^{hl}$  from Table 1. With the only exception of "Food, Beverages and Tobacco", accessibility is reduced for all sectors, reflecting increases in distance and trade barriers. "Paper products" is the most affected industry while "Textiles, Wearing Apparel, Leather Products and Footwear" is the least affected one.

Table 9: Freeness of trade, by countries of origin and destination

| Exporter |                | Importer |               |
|----------|----------------|----------|---------------|
|          | $\rho_s^{out}$ |          | $\rho_s^{in}$ |
| IS       | 5.73E-06       | UA       | 1.85E-07      |
| UA       | 5.93E-06       | RO       | 6.60E-07      |
| PT       | 6.14E-06       | BG       | 6.78E-07      |
| BG       | 7.14E-06       | NO       | 6.94E-07      |
| FI       | 7.62E-06       | IS       | 9.17E-07      |
| ES       | 8.14E-06       | LV       | 1.35E-06      |
| RO       | 8.39E-06       | ES       | 1.53E-06      |
| LV       | 1.05E-05       | PT       | 1.83E-06      |
| IT       | 1.20E-05       | PL       | 2.06E-06      |
| NO       | 1.34E-05       | IT       | 2.45E-06      |
| SE       | 1.37E-05       | FR       | 2.53E-06      |
| HU       | 1.44E-05       | SV       | 3.27E-06      |
| PL       | 1.54E-05       | FI       | 3.43E-06      |
| IE       | 1.60E-05       | CZ       | 4.46E-06      |
| SK       | 1.76E-05       | SE       | 4.90E-06      |
| SV       | 1.83E-05       | SK       | 6.17E-06      |
| AT       | 1.92E-05       | IE       | 8.05E-06      |
| DK       | 2.15E-05       | GB       | 1.00E-05      |
| CZ       | 2.19E-05       | CH       | 1.09E-05      |
| FR       | 2.51E-05       | HU       | 1.22E-05      |
| CH       | 2.76E-05       | AT       | 1.50E-05      |
| GB       | 3.29E-05       | DE       | 1.77E-05      |
| DE       | 3.98E-05       | DK       | 2.23E-05      |
| BE       | 6.14E-05       | NL       | 1.59E-04      |
| NL       | 8.15E-05       | BE       | 2.18E-04      |

Source: Trade and Production Dataset (CEPII) and authors calculations

Turning to the country dimension, Table 9 reports the average  $\rho_s^{hl}$ 's for the 25 European countries under analysis, ranked from worst to best accessibility. Similarly to Table 2, the left hand side shows how easy it is to access foreign markets from different countries of origin as quantified in the first column by  $\rho_s^{out}$ . The right hand side shows, instead, how easy it is to access different domestic markets from abroad ( $\rho_s^{in}$ ). The ease of accessing foreign markets remains highest for core European countries and lowest for peripheral ones. Nevertheless, the boundaries of the EU core seem to have shifted eastward.

Table 10: Observed productivity, by country

| 14 Countries |          | 25 Countries |          |
|--------------|----------|--------------|----------|
| Country      | $c^{hh}$ | Country      | $c^{hh}$ |
| IE           | 0.05     | IE           | n.a.     |
| NO           | 0.14     | DK           | 0.15     |
| DK           | 0.14     | DE           | 0.17     |
| DE           | 0.17     | AT           | 0.17     |
| FR           | 0.17     | NO           | 0.17     |
| AT           | 0.18     | FR           | 0.18     |
| GB           | 0.18     | GB           | 0.19     |
| FI           | 0.19     | FI           | 0.20     |
| IT           | 0.23     | IT           | 0.23     |
| SE           | 0.25     | SE           | 0.25     |
| ES           | 0.28     | ES           | 0.28     |
| PT           | 0.33     | PT           | 0.33     |

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

Table 10 shows how changing accessibility as well as the presence of new competitors from the East affect the toughness of competition across countries. It reports a new ranking of countries by observed productivity that favors central European countries and leaves the observed productivity in other areas of the continent unchanged. Unsurprisingly, also revealed competitiveness  $\psi_s^l/f_s^l$  changes. The corresponding values are reported in Table 11.

For some countries (Finland, Germany and Sweden) revealed competitiveness falls

Table 11: Revealed competitiveness, by country

| 14 Countries |                              | 25 Countries |                              |
|--------------|------------------------------|--------------|------------------------------|
| Country      | $\frac{\psi_s^o}{F_{E,s}^o}$ | Country      | $\frac{\psi_s^o}{F_{E,s}^o}$ |
| IE           | 2.44                         | NO           | 3.80                         |
| FI           | 2.37                         | FI           | 2.50                         |
| DK           | 1.81                         | DK           | 1.46                         |
| AT           | 1.56                         | AT           | 1.40                         |
| SE           | 1.32                         | SE           | 1.22                         |
| FR           | 1.20                         | FR           | 1.16                         |
| DE           | 1.05                         | DE           | 1.02                         |
| NL           | 0.68                         | IT           | 0.58                         |
| BE           | 0.57                         | ES           | 0.57                         |
| IT           | 0.55                         | NL           | 0.51                         |
| GB           | 0.52                         | GB           | 0.49                         |
| ES           | 0.52                         | BE           | 0.43                         |
| PT           | 0.47                         | PT           | 0.42                         |
| NO           | n.a.                         | IE           | n.a.                         |

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

when we enlarge the dataset from 14 to 25 countries, for others it increases. When the block of eastern European countries is considered in the analysis, observed firm performance and trade flows suggest that the implied ability of countries such as Denmark, Austria, Germany and Sweden to generate good firms is somewhat lower whereas it is higher for the countries in which revealed competitiveness increases. In other words, neglecting Eastern markets overplays the competitiveness of the former group of countries and underplays the competitiveness of the latter.

We now proceed to recompute the trade freeness matrix isolating the impact of EU membership by introducing corresponding dummies in the gravity equation (20): the dummy *EU00* equals 1 when neither the country of destination nor the country of origin are EU members in the period 2000-2003; the dummy *EU01* takes value 1 when the country of destination is a EU member whereas the country of origin is not; the dummy *EU10* takes value 1 in the opposite case when the country of origin is a EU member whereas the country of destination is not. As shown in Table 12, all estimated coefficients are statistically significant and quite large. Interestingly, being part of the EU favors exports to non-EU location reducing the border effect by half.

Table 12: EU membership effect on trade volumes

|  |                       |
|--|-----------------------|
| Dependent variable:ln(X)   |                       |
| Border effect  | -0.80***<br>(0.06)    |
| Border effect * EU00<br>(EU trade diversion effect on bilateral trade between third countries) | -3.25***<br>(0.26)    |
| Border effect * EU01<br>(EU import diverting effect)   | -3.94***<br>(0.06)    |
| Border effect * EU10<br>(EU export enhancing effect)   | 0.43***<br>(0.27)     |
| Observations   | 29416                 |
| R2   | 0.98                  |
| Data period  | 2000-2003             |
| Country coverage   | 25 European countries |

Source: Authors calculations

Notes: Robust standard errors; Specification as in Equation 20, including distance measure, importer, exporter and time dummies.

Coefficients estimated but not reported.

Based on these border effect estimates, we simulate two counterfactual scenarios. In the first scenario, we adjust the border effects to assume that all countries in the dataset were EU member states in the period of analysis. In the second scenario we eliminate all

border effects, imagining an enlarged EU as integrated as if it were a single nation. The results are interesting. While the elimination of the border effect, benefits all European countries, and small countries to a larger degree than big countries, this is not the case for enlargement as all countries experience a loss in productivity.

Table 13: Changes in cutoffs from deeper and wider integration, by country

|    | effective $c_s^{hh}$ | counterfactual $c_s^{hh}$<br>with enlargement | % change | counterfactual $c_s^{hh}$<br>with no border | % change |
|----|----------------------|---|----------|---|----------|
| AT | 0.1707               | 0.1721  | 0.83     | 0.1604                                      | -6.05    |
| DE | 0.1423               | 0.1438  | 1.05     | 0.1121                                      | -21.21   |
| DK | 0.1327               | 0.1470  | 10.75    | 0.1026                                      | -22.68   |
| ES | 0.2829               | 0.2831  | 0.08     | 0.2683                                      | -5.17    |
| FI | 0.1946               | 0.2027  | 4.17     | 0.1618                                      | -16.86   |
| FR | 0.1593               | 0.1602  | 0.55     | 0.1353                                      | -15.07   |
| GB | 0.1786               | 0.1793  | 0.40     | 0.1736                                      | -2.76    |
| IT | 0.2328               | 0.2330  | 0.11     | 0.2272                                      | -2.41    |
| NO | 0.1401               | 0.2339  | 66.99    | 0.2993                                      | 113.71   |
| PT | 0.3250               | 0.3252  | 0.06     | 0.3022                                      | -7.01    |
| SE | 0.2436               | 0.2566  | 5.34     | 0.2554                                      | 4.84     |

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

These results can be explained in terms of equation (14). This shows that enlargement has two effects on the inverse index of (average) ‘seller competitiveness’ of an incumbent member country  $h$ . Recall that such index is an inverse measure of the distance-weighted average competitiveness of countries whose firms sell to country  $h$ . As such it depends on the average producer competitiveness of countries selling to  $h$  and on the accessibility of country  $h$ . Note also that it does not depend on the size of the integrated market as only own size  $L^h$  matters. Enlargement (lower border effects with respect to the East) has thus two effects. On the one hand, it improves the accessibility of incumbent EU members, on the other it increases a lot the relative importance of unproductive competitors from the East. This latter effect dominates, which reduces seller competitiveness and therefore the toughness of competition.

## 7 Conclusion and policy implications

Globalization is triggering major changes around the world as countries attempt to reap the benefits and absorb the costs of associated fast-paced structural changes. Measuring how countries are faring in this process is increasingly difficult using traditional indicators of comparative advantages, as the latter cannot account for the underlying heterogeneity in the competitiveness of domestic firms and the interactions within the network of local and global markets. Those questions can be fruitfully addressed by accounting for the interactions between countries fundamental characteristics, including their market access, institutional settings, technology and factor endowments, and the effective distribution of domestic and foreign firms with different productivity across sectors and markets.

To this end, this paper proposes a new conceptual framework of analysis, which merges the insights of traditional trade theory and new trade theory in a multi-country, multi-sector model with monopolistic competition and variable markups. As a result, an innovative indicator of ‘revealed competitiveness’ is presented. This latter is empirically derived by calibrating the model on firm level data and industry level trade figures from a large panel of European countries. The indicator is then used to provide a ranking of European countries which remarkably squares with assessments of European competitiveness based on completely different methodologies such as the Global Competitiveness Index of the World Economic Forum.

The calibrated model is further exploited to investigate whether key elements of the EU strategy, namely EMU and enlargement are helping or hindering the efforts of Europe to adapt to the challenges of a more competitive global environment. The results indicate that outside EMU, less firms would be able to survive competition on domestic and foreign markets. In particular, in the absence of EMU, a country’s accessibility is lower and its share of unproductive firms higher. The quantification of these effects shows, however, that the effect is uneven across countries.

Enlargement has on the other hand two contrasting effects. On the one hand, it improves the accessibility of EU members, on the other it increases substantially the relative importance of unproductive competitors from the East. Overall, while EMU has increased the toughness of competition in Euro area countries, and through this channel lowered average (delivered) costs, markups, prices and quantities, enlargement can be expected to have similar effects only with an increase in average productivity in the new EU members.

All in all, four critical channels have been explicitly considered in the model - in line with new trade theories - as critical sources of a country’s overall competitiveness. The first is accessibility. Regions with overall better access tend to be associated - *ceteris paribus* - with tougher competition, richer product variety, and higher productivity. These regions are indeed also better export-bases and therefore attract a greater amount of firms from neighbouring countries. The second important channel is market size. In a world embodying economies of scale, larger and more integrated markets are characterized by tougher competition, lower mark-ups and lower prices. EMU and EU enlargement have arguably implied the creation of a larger and more accessible domestic market, hence helping European firms to cope better with the structural changes associated with globalization than firms in the previous collection of smaller and less integrated national markets. The third channel is Ricardian technological advantage. Technologically advanced regions are associated with higher productivity level and tougher competition. Again, this generates higher product variety, lower prices and higher welfare. Finally, the last channel is the institutional and political framework, since the quality and resilience of the domestic institutions are key elements of success amid global competition. These two last channels are synthesised in the proposed indicator of ‘revealed competitiveness’.

Though stylized this analysis bears two main policy implications for the euro area and other EU countries. First, in order to take full advantage of the positive effects of globalization - which are mostly related to increased accessibility to foreign markets and enhanced efficiency of the domestic markets - a continuation of structural reforms in euro area and other EU countries appears beneficial in enhancing their ability to adjust to major changes taking place in the global environment. In particular, implementing structural reforms which are beneficial for growth and innovation seems to be paramount. The success of the implementation of such reforms partly hinges on an important link between innovation, growth and reforms and, for the specific situation in the EU, the interaction between EU and national policies. At the same time, policies should aim at raising flexibility and lower the adjustment costs for domestic firms and workers facing the challenges of a globalisation process that they cannot control.

Second, while the euro has provided participating countries with a strong currency, a credible monetary policy and - together with other EU key strategies such as the Single Market Programme and enlargement - a better export base, it has also increased the need for cooperation and coordination of economic policies among member states leading to Europe-wide structural reforms. In particular, our model suggests that policies able to improve market access are likely to be associated with broad competitive gains.

All in all, as globalisation is triggering major transformations all over the world, the analysis supports the view that the adoption of a common currency and the deepening of EU integration would have contributed to make member countries more competitive but that the strategy of broadening the EU borders needs to be accompanied by further adjustments to boost competitiveness further.

## References

- Aw, Bee Yan, Sukkyun Chung, and Mark J. Roberts**, “Productivity and Turnover in the Export Market: Micro Evidence from Taiwan and South Korea,” *World Bank Economic Review*, 2000, 14, 65–90.
- Baldwin, Richard E.**, *In or Out: Does It Matter? An Evidence-Based Analysis of the Euro’s Trade Effects*, 90-98 Goswell Road, London EC1V 7RR United Kingdom.: CEPR, 2006.
- Berger, Helge and Volker Nitsch**, “Zooming Out: The Trade Effect of the Euro in Historical Perspective,” Working Paper 1435, CES 2005.
- Bernard, Andrew B. and J. Bradford Jensen**, “Exceptional Exporter Performance: Cause, Effect, or Both?,” *Journal-of-International-Economics*, 1999, (47), 1–25.
- , **Jonathan Eaton, J. Bradford Jensen, and Samuel Kortum**, “Plants and Productivity in International Trade,” *American Economic Review*, 2003, 93 (4), 1268–1290.
- Clerides, Sofronis, Saul Lach, and James R. Tybout**, “Is Learning by Exporting Important? Micro-dynamic Evidence from Colombia, Mexico, and Morocco,” *Quarterly Journal of Economics*, 1998, (113), 903–47.
- Eaton, Jonathan, Samuel Kortum, and Francis Kramarz**, “An Anatomy of International Trade: Evidence From French Firms,” 2004.
- Flam, Harry and Hakan Nordstrom**, “Trade Volume Effects of the Euro: Aggregate and Sector Estimates,” 2003. Institute for International Economic Studies, mimeo.
- Freeman, Richard**, “Labour market imbalances: shortages, or surpluses, or fish stories?,” 2006. Boston Federal Reserve Economic Conference, Global imbalances As Giants evolve, Chatham, Massachusetts, June 14-16, 2006.
- Gatto, Massimo Del, Giordano Mion, and Gianmarco I.P. Ottaviano**, “Trade Integration, Firm Selection and the Costs of Non-Europe,” Discussion Paper 5730, CEPR 2006.
- Head, Keith and Thierry Mayer**, “Illusory Border Effects: Distance Mismeasurement Inflates Estimates of Home Bias in Trade,” Working Paper 2002-01, CEPII 2002.
- and – , “Market Potential and the Location of Japanese Firms in the European Union,” *Review of Economics and Statistics*, 2004, (86), 959–972.
- Helpman, Elhanan and Paul R. Krugman**, *Market Structure and Foreign Trade*, Cambridge: MIT Press, 1985.
- Mayer, Thierry and Soledad Zignago**, “Market Access in Global and Regional Trade,” Working Paper 2005-02, CEPII 2005.
- Melitz, Marc J.**, “The Impact of Trade on Aggregate Industry Productivity and Intra-Industry Reallocation,” *Econometrica*, 2003, 71 (6), 1695–1725.
- and **Gianmarco I.P. Ottaviano**, “Market Size, Trade and Productivity,” Working Paper 11393, NBER 2005.
- Smith, Alasdair and J. Venables Anthony**, “Completing the Internal Market in the European Community: Some Industry Simulations,” *European Economic Review*, 1988, 32, 1501–1525.
- Tybout, James**, “Plant- and Firm- Level Evidence on New Trade Theories,” in James Harrigan, ed., *Handbook of International Trade*, Oxford: Basic-Blackwell, 2003.

## Data Appendix

The data we use to compute trade costs are provided by a combination of sources.

### A Trade flows and production data

Data on Trade figures and production are from the combined CEPII(BACI)-World Bank dataset described in Mayer and Zignago (2003) and freely downloadable at [www.cepii.fr](http://www.cepii.fr).

These data together allow us to recover both the intra-national flows ( $EXP_s^{hh}$ ) and the external flows ( $EXP_s^{lh}$ , with  $o \neq h$ ) flows of goods. To recover the bilateral trade costs for the countries under analysis, we consider trade among 32 European countries in the years from 1999 to 2003. We use a larger number of countries and years to obtain more accurate measures.

### B Population and geographical data

Data on population (thousand of inhabitants) are from the World Development Indicators.

Geographical data are from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII). The distance variables are in km and cover both simple and weighted measures. In this analysis we use weighted distance but we also checked the consistency of results for the simple distance. Simple (geodestic) distances are calculated following the great circle formula, which uses latitudes and longitudes of the most important cities/agglomerations (in terms of population) for the "dist" variable and the geographic coordinates of the capital cities for the "distcap" variable. Both variables incorporate internal distances that, as in the theoretical model, are allowed to be non-zero. As in Head and Mayer (2002, 2004), the internal distance  $d^{hh}$  of country  $h$  is calculated from its area as  $d^{hh} = \frac{2}{3} \times \sqrt{area^h/\pi}$ . This formula models the average distance between producer and consumer on a stylised geography where all producers are centrally located and the consumers uniformly distributed across a disk-shaped region.

By contrast, weighted distances use city-level data on distance and the geographic distribution of population inside each nation. The basic idea is to calculate the distance between two countries as the weighted average bilateral distance between their biggest cities with the corresponding weights determined by the shares of those cities in the overall national populations. This procedure can be used in a totally consistent way for national and international distances. Specifically as Head and Mayer (2002) indicate: the distance between country  $l$  and country  $h$  is:

$$d_{lh} = \left[ \sum_{p \in l} \sum_{r \in h} \frac{pop^p}{pop^l} \frac{pop^r}{pop^h} (d^{pr})^\theta \right]^{\frac{1}{\theta}} \quad (21)$$

where  $\frac{pop^p}{pop^l}$  and  $\frac{pop^r}{pop^h}$  designate the populations of agglomerate  $p$  in country  $l$  and of agglomerate  $r$  in country  $h$ , respectively. The parameter  $\theta$  measures the sensitivity of trade flows to bilateral distance  $d^{pr}$ . For the *distw* variable,  $\theta$  is set equal to 1, while for the *distwces* variable,  $\theta$  is set equal to  $-1$ , which corresponds to the standard distance coefficient estimated from gravity equations.

## C Firm Level Data

This paper retrieves data on value added, fixed assets (capital), sales and the cost of materials (intermediate consumption) in thousand of euros as well as the number of employees from a large cross section of manufacturing firms from 25 European countries.

Table 14 shows number of firms and their average, minimum and maximum values for total factor productivity.

Table 14: Firms, by country

| Country | Firms  | TFP (OLS Method) |                    |          |           |
|---------|--------|------------------|--------------------|----------|-----------|
|         |        | Average          | Standard Deviation | Min      | Max       |
| AT      | 105    | 33.32094         | 26.39095           | 2.212487 | 193.4029  |
| BE      | 2567   | 29.07782         | 48.90826           | 1.63548  | 2192.651  |
| BG      | 1075   | 3.478918         | 6.956333           | .0213871 | 129.778   |
| CZ      | 2365   | 8.811675         | 7.5188             | .3352955 | 105.8155  |
| DE      | 278    | 39.31219         | 35.05724           | .4000357 | 329.0522  |
| DK      | 651    | 38.52366         | 34.14457           | 1.298811 | 361.1505  |
| ES      | 57023  | 15.13584         | 10.98763           | .1211805 | 182.9147  |
| FI      | 5171   | 22.9919          | 26.79103           | .4409083 | 1317.939  |
| FR      | 32858  | 27.96352         | 17.82251           | .969883  | 272.4582  |
| GB      | 6615   | 27.24272         | 46.74277           | .075911  | 2017.521  |
| HU      | 94     | 9.751219         | 8.597522           | 1.465112 | 55.74363  |
| IE      | 72     | 34.53856         | 114.58916          | .3239747 | 2110.6823 |
| IT      | 8542   | 20.79159         | 15.36606           | .2417498 | 265.8112  |
| LV      | 34     | 4.933191         | 2.765409           | 1.359142 | 15.1516   |
| NL      | 410    | 44.68786         | 123.4879           | .119943  | 2201.635  |
| NO      | 3652   | 30.18319         | 26.15541           | .5131263 | 299.1277  |
| PL      | 2303   | 7.783876         | 7.787789           | .0400448 | 118.2887  |
| PT      | 355    | 12.88198         | 10.9181            | .2936199 | 122.3479  |
| RO      | 8533   | 2.376443         | 2.393516           | .0511188 | 64.61783  |
| SE      | 14621  | 18.3754          | 11.39272           | .2973468 | 155.7835  |
| SK      | 38     | 11.06216         | 19.38057           | .4526804 | 109.7441  |
| UA      | 1991   | 1.834839         | 1.710435           | .0160045 | 21.85019  |
| Total   | 149353 | 19.03911         | 20.87742           | .0160045 | 2201.635  |

Source: Amadeus

The data are from the Amadeus database (Bureau van Dijk, BvD)<sup>5</sup> We eliminate missing values and extreme observations defined as having either a value added/employee or capital/employee ratio out of the range identified by the 1st and 99th percentile. This leaves us with an initial sample of 149,353 firms. As we can see from the table, data coverage for some countries including Germany is rather poor. This is a shortcoming as Germany is the biggest European economy as well as among the most productive. We use these data to estimate firm-level total factor productivity.

Turning to the industry disaggregation we work with a 12 sectors breakdown of manufacturing activities, which is derived from merging the information contained in AMADEUS, classified in 4-digit NACE sectors with the database needed to compute

<sup>5</sup>Amadeus provides comparable firm-level balance-sheet data for 4 million companies in 34 European countries at the 4-digit NACE sectoral detail and covers all industries with exception of the bank and insurance sectors. Amadeus gathers information on firms that satisfy country specific size-thresholds. By construction, the database is biased towards large companies. A further shortcoming of the data is that statutory reporting and filing requirements differ from country to country, and the amount of balance sheet information required by each country varies correspondingly, so that the data coverage is very unbalanced. Also Amadeus, to date, is less complete in countries where there is a lack of centralisation, with companies registering at offices based in their region rather than at a single registry. This is a problem in particular for Germany where, furthermore, value added data is available only for a small subset of companies.

trade costs, organised by 3-digit ISIC sectors. The resulting disaggregation is detailed in Table 15.

Table 15: Representativeness of the AMADEUS sample

---

| Own industry code | Industry description                        |
|-------------------|---|
| 1                 | Food, beverages and tobacco                 |
| 2                 | Textiles, Wearing apparel and footwear      |
| 3                 | Wood products except furniture              |
| 4                 | Paper products                              |
| 5                 | Printing and publishing                     |
| 6                 | Chemicals                                   |
| 7                 | Rubber and Plastics                         |
| 8                 | Non-metallic mineral products               |
| 9                 | Metal products                              |
| 10                | Machinery except electrical                 |
| 11                | Professional and scientific equipment       |
| 12                | Other manufacturing and transport equipment |

---

## European Central Bank Working Paper Series

For a complete list of Working Papers published by the ECB, please visit the ECB's website (<http://www.ecb.europa.eu>).

- 807 "Cross-border lending contagion in multinational banks" by A. Derviz and J. Podpiera, September 2007.
- 808 "Model misspecification, the equilibrium natural interest rate and the equity premium" by O. Tristani, September 2007.
- 809 "Is the New Keynesian Phillips curve flat?" by K. Kuester, G. J. Müller und S. Stölting, September 2007.
- 810 "Inflation persistence: euro area and new EU Member States" by M. Franta, B. Saxa and K. Šmídková, September 2007.
- 811 "Instability and nonlinearity in the euro area Phillips curve" by A. Musso, L. Stracca and D. van Dijk, September 2007.
- 812 "The uncovered return parity condition" by L. Cappiello and R. A. De Santis, September 2007.
- 813 "The role of the exchange rate for adjustment in boom and bust episodes" by R. Martin, L. Schuknecht and I. Vansteenkiste, September 2007.
- 814 "Choice of currency in bond issuance and the international role of currencies" by N. Siegfried, E. Simeonova and C. Vespro, September 2007.
- 815 "Do international portfolio investors follow firms' foreign investment decisions?" by R. A. De Santis and P. Ehling, September 2007.
- 816 "The role of credit aggregates and asset prices in the transmission mechanism: a comparison between the euro area and the US" by S. Kaufmann and M. T. Valderrama, September 2007.
- 817 "Convergence and anchoring of yield curves in the euro area" by M. Ehrmann, M. Fratzscher, R. S. Gürkaynak and E. T. Swanson, October 2007.
- 818 "Is time ripe for price level path stability?" by V. Gaspar, F. Smets and D. Vestin, October 2007.
- 819 "Proximity and linkages among coalition participants: a new voting power measure applied to the International Monetary Fund" by J. Reynaud, C. Thimann and L. Gatarek, October 2007.
- 820 "What do we really know about fiscal sustainability in the EU? A panel data diagnostic" by A. Afonso and C. Rault, October 2007.
- 821 "Social value of public information: testing the limits to transparency" by M. Ehrmann and M. Fratzscher, October 2007.
- 822 "Exchange rate pass-through to trade prices: the role of non-linearities and asymmetries" by M. Bussière, October 2007.
- 823 "Modelling Ireland's exchange rates: from EMS to EMU" by D. Bond and M. J. Harrison and E. J. O'Brien, October 2007.
- 824 "Evolving U.S. monetary policy and the decline of inflation predictability" by L. Benati and P. Surico, October 2007.

- 825 “What can probability forecasts tell us about inflation risks?” by J. A. García and A. Manzanares, October 2007.
- 826 “Risk sharing, finance and institutions in international portfolios” by M. Fratzscher and J. Imbs, October 2007.
- 827 “How is real convergence driving nominal convergence in the new EU Member States?” by S. M. Lein-Rupprecht, M. A. León-Ledesma, and C. Nerlich, November 2007.
- 828 “Potential output growth in several industrialised countries: a comparison” by C. Cahn and A. Saint-Guilhem, November 2007.
- 829 “Modelling inflation in China: a regional perspective” by A. Mehrotra, T. Peltonen and A. Santos Rivera, November 2007.
- 830 “The term structure of euro area break-even inflation rates: the impact of seasonality” by J. Ejsing, J. A. García and T. Werner, November 2007.
- 831 “Hierarchical Markov normal mixture models with applications to financial asset returns” by J. Geweke and G. Amisano, November 2007.
- 832 “The yield curve and macroeconomic dynamics” by P. Hördahl, O. Tristani and D. Vestin, November 2007.
- 833 “Explaining and forecasting euro area exports: which competitiveness indicator performs best?” by M. Ca’ Zorzi and B. Schnatz, November 2007.
- 834 “International frictions and optimal monetary policy cooperation: analytical solutions” by M. Darracq Pariès, November 2007.
- 835 “US shocks and global exchange rate configurations” by M. Fratzscher, November 2007.
- 836 “Reporting biases and survey results: evidence from European professional forecasters” by J. A. García and A. Manzanares, December 2007.
- 837 “Monetary policy and core inflation” by M. Lenza, December 2007.
- 838 “Securitisation and the bank lending channel” by Y. Altunbas, L. Gambacorta and D. Marqués, December 2007.
- 839 “Are there oil currencies? The real exchange rate of oil exporting countries” by M. M. Habib and M. Manolova Kalamova, December 2007.
- 840 “Downward wage rigidity for different workers and firms: an evaluation for Belgium using the IWFP procedure” by P. Du Caju, C. Fuss and L. Wintr, December 2007.
- 841 “Should we take inside money seriously?” by L. Stracca, December 2007.
- 842 “Saving behaviour and global imbalances: the role of emerging market economies” by G. Ferrucci and C. Miralles, December 2007.
- 843 “Fiscal forecasting: lessons from the literature and challenges” by T. Leal, J. J. Pérez, M. Tujula and J.-P. Vidal, December 2007.
- 844 “Business cycle synchronization and insurance mechanisms in the EU” by A. Afonso and D. Furceri, December 2007.
- 845 “Run-prone banking and asset markets” by M. Hoerova, December 2007.

- 846 “Information combination and forecast (st)ability: evidence from vintages of time-series data” by C. Altavilla and M. Ciccarelli, December 2007.
- 847 “Deeper, wider and more competitive? Monetary integration, Eastern enlargement and competitiveness in the European Union” by G. Ottaviano, D. Taglioni and F. di Mauro, December 2007.

ISSN 1561-0810



9 771561 081005