The euro and the competitiveness of European firms*

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SUMMARY

Standard analyses examining the impact of the euro via the trade channel, tends to focus on its impact on trade flows. However, as pointed out by the so-called "new trade theory", trade flows are an imperfect measure of the potential gains that the euro may have generated by fostering lower prices and higher productivity. The objective of this paper is to quantify these gains. Given the important data constraints which exist, we develop a general equilibrium multi-country multi-sector model with imperfectly competitive and heterogeneous firms and calibrate it using country, sector and firm-specific data. Simulations show that the reduction in trade frictions associated with the adoption of the euro have had a positive impact on the overall competitiveness of firms located in participating countries. The analysis also shows important differences across countries and sectors. In particular, the impact tends to be stronger for countries which are smaller or with better access to foreign markets, and for firms which specialise in sectors where international competition is fiercer and barriers to entry lower.

JEL classifications: F12, R13.

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1. INTRODUCTION

A decade after the creation of the European Economic and Monetary Union, Denmark, Sweden and the United Kingdom still show reluctance towards adopting the euro. How much, if anything, are they losing in terms of the economic gains generated by the reductions in trade costs that a monetary union appears to imply? More generally, has the introduction of the single currency affected – via the trade channel – the intensity of competition across countries while forcing the least efficient firms out of the market? If so, to what extent has this selection process affected unit delivery costs, markups, prices, quantities, revenues and profits in participating and non-participating countries?

While these continue to be very relevant policy questions, there is currently no straightforward approach to deriving a quantitative assessment of the wider benefits of monetary union. Existing studies, which take an international trade perspective on the single currency, are very much focused on its impact on trade flows.[1] Trade flows, however, are only an imperfect measure of the gains that the euro may have created through the trade channel as they fail to capture potential welfare improvements accruing to economic agents through a more efficient and productive economic environment. Such benefits stem from fostering countries' specialisation in sectors in which they are more efficient, enabling a richer product variety, weakening the market power of firms, enhancing the exploitation of economies of scale and improving the efficiency of production through the exit of the least efficient firms. Properly accounting for these channels, is deemed to be very important by recent empirical research. Therefore, the main objective of this paper is to assess the impact of the adoption of the euro on the productivity and international competitiveness of firms belonging to different European countries and industries.

In principle, one potential way to empirically estimate this would be to directly evaluate how firms' productivity and competitiveness are influenced by the reduction in trade barriers as a result of the introduction of the euro. The impact on firms could then be aggregated by sectors and countries in order to perform cross-sector and cross-country comparisons. Unfortunately, this is not feasible, as firm level data are not detailed and homogenous enough across countries to allow for a consistent estimation (Mayer and Ottaviano, 2007), unless the analysis is restricted only to individual countries (see, for example, work by Berthou and Fontagné, 2008, on France).

[1] Between 1998 and 2007, the value of exports and imports of goods within the euro area has increased from 26% to 33% of GDP, and of services from 5% to 7% of GDP. Controlling for exogenous effects, the early literature on the trade impacts of monetary unions has come up with an extremely large range of estimates, comprised between nil (Berger and Nitsch, 2005) and almost 1,400% (Alesina, Barro and Tenreyro, 2002). The current consensus on the trade impact of the euro is that the single currency had a small, but positive effect on trade flows.

This paper opts for an alternative solution. It bypasses the problems related to the lack of data by simulating counterfactual scenarios of euro membership on a general equilibrium multi-country multi-sector model of international trade which we calibrate using macro and micro data. Following the approach of Melitz and Ottaviano (2008), our model accounts for a number of real world features linking trade liberalisation and firm productivity. These features include: richer availability of product varieties; tougher competition and weaker market power of firms; better exploitation of economies of scale; and efficiency gains via the selection of the best firms.

The model is calibrated on 12 manufacturing sectors across 12 EU countries for the years 2001-2003 and is used to evaluate the competitiveness of European manufacturing firms in terms of an efficient use of available inputs, given the institutional and market set-up in which they operate. In so doing, we derive a ranking of European countries in terms of the cost effectiveness of the firms located therein – which we use as a measure of the "overall competitiveness" of the corresponding countries. This indicator is then adopted as a benchmark for a set of experiments, where we simulate three counterfactual scenarios designed to evaluate how alternative (and hypothetical) euro membership setups would have affected the baseline overall competitiveness of the European countries considered.

Overall, this paper contributes to the debate on the trade-related impacts of the euro by establishing a link between trade barriers and industry performance indicators. This link represents the key contribution of the paper to policy analysis given the current – but hopefully temporary –statistical data constraints. Furthermore, the micro-founded measures of countries competitiveness which it produces are policy relevant per se, as they are more comprehensive of the traditional tools used by policymakers to assess international competitiveness, such as measures of international price competitiveness, of countries' total factor or labour productivity, and of trade shares, among others. Finally and equally important from a policy perspective, the methodology developed in the paper makes it possible to disentangle the various determinants of competitiveness and to assess their relative importance for each country and sector. [2]

The structure of the paper is as follows. Section 2 provides some stylised facts and a brief account on how the trade literature has evolved in line with actual changes in the structure of markets and production patterns. This is useful to put in perspective the main characteristics of the model we use. The model itself is described in some detail in Section 3. Its empirical implementation – which consists in circumventing data limitations through the calibration of the model relationships – is

[2] The methodology the paper uses to study the effects of the euro lends itself to application in a wider context. For instance, it could be used to investigate the impact of changes in other institutional determinants of industry performance.

presented in Section 4. Section 5 examines how firm competitiveness is affected within three different scenarios of euro membership. Section 6 concludes. Sections 3.2, 3.3, 3.4 are necessarily rather technical. They can be skipped without losing the flow of thought and the main message of the paper.

2. GAINS FROM TRADE: STYLISED FACTS AND EVOLUTION OF THEORETICAL APPROACHES

In the last few decades, developments in trade theory have been characterised by constant attempts to include "real life" complexities in the basic trade models of Ricardo and of Heckscher and Ohlin. This includes a re-definition of (i) what gains have to be expected from trade and (ii) what channels are likely to be most relevant for generating such gains. In what follows, we underline some of the most important stylised facts in recent economic history, which have been incorporated in theory, and most notably in the model we use in this paper.

During the "first wave of globalisation" - i.e. from the industrial revolution to WWI – the pattern of international trade was mainly characterised by the exchange of manufactured goods from industrialised countries for imports of raw materials from less-developed countries. World trade was mostly "inter-sectoral", and was explained by international differences in relative factor endowments, and technologies. Countries' specialisation in production and in exports was in accordance with their relative costs of production (i.e. having a "comparative advantage" in relatively "cheap" sectors): the so-called "specialisation effect" of trade liberalisation. The theories of Ricardo and of Heckscher and Ohlin were developed to explain such patterns of international trade.

With the "second wave" of globalisation after WWII, the previous paradigm became partly obsolete as a dominant share of international trade was taking place within industries among countries having relatively similar endowments and technological development (Linder, 1961; Grubel and Lloyd, 1975). This led to the appearance of new trade theories, the principal characteristic of which is the attention to the details of market structure. Two distinct strands of literature – both relevant to the model proposed in this paper – underline the different mechanisms at play.

The first strand of literature underlines that horizontal product differentiation within sectors assigns market power to firms even in sectors characterised by a large number of competitors that are free to enter and exit the market (Krugman, 1980). In this setup of "monopolistic competition" with increasing returns to scale, the following results apply. First, firms operate at a given minimum scale if they want to break even. Second, within a sector, firms specialize in the production of distinct varieties of their differentiated goods. Third and last, intra-industry trade arises because consumers love variety, but countries can produce only a limited number of varieties, depending on their "size", i.e. their resource endowment. Hence, trade liberalisation has a "variety effect" insofar as it broadens the range of varieties available for consumption.

A second strand of new trade theory is built on an "oligopolistic competition" set-up where a few large firms sell homogeneous products and, due to trade barriers, achieve larger market shares at home than abroad (Brander and Krugman, 1983). Whenever they are able to discriminate in terms of prices between domestic and foreign customers, they are willing to accept smaller profit margins abroad than at home, therefore selling additional units of their output abroad. This gives rise to bilateral trade within industries even between identical countries. As firms charge lower margins on foreign than on domestic sales, the resulting exchange is sometimes called "reciprocal dumping". In this set-up, trade liberalisation reduces the market share of domestic firms with respect to their foreign rivals, thus increasing their perceived elasticity of demand. The result is an average compression of profit margins as prices fall towards marginal costs. This efficiency-enhancing consequence of freer trade is called the "pro-competitive effect".

If production faces increasing returns to scale at the firm level, tougher competition due to freer trade has an additional efficiency-enhancing effect. The reason is that, to restore profitability, firms compensate for the decrease in prices resulting from the pro-competitive effect by raising their output. Then, in the presence of increasing returns, rising output leads to a decline in the average cost of production. This efficiency gain is called the "scale effect" of trade liberalisation.

Recent analyses of micro-datasets tracking production and international involvement at the firm and at 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 an hallmark regularity is that firms serving foreign markets are more productive than their purely domestic competitors. In this setting allowing for heterogeneous firms, tougher competition and scale economies imply also that freer trade causes the most performing firms to expand and grow – both domestically and internationally – and the least performing firms to exit the market altogether. In the ensuing selection process, the scale of surviving firms increases – as this improves their profitability - while their number drops. As a result, technologies are used more efficiently – the so called "rationalisation effect" of trade liberalisation. Average firm productivity also rises, as less productive firms exit – the so called "selection effect" of trade liberalisation.[3]

[3] The above stylized facts have been highlighted by a growing empirical literature. For example, the exit of the least productive firms is reported 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 (2002) as well as Bernard, Jensen and Schott (2003).

3. THEORETICAL FRAMEWORK

Building on the stylised facts and theoretical insights described in Section 2, our model provides an account of the determinants of trade and mechanisms of adjustment to trade liberalisation as realistic as possible, as this comprises the existence of intra-industry trade, firms' market power and heterogeneity, existence of scale economies and consumers' love of variety. The main purpose of the model is to provide a solid theoretical underpinning for the construction of broad-based indicators of competitiveness in Europe and to use this framework to study the gains from the introduction of the euro, considering the latter as an "instrument" of trade liberalisation among the countries participating to in Stage Three of Economic and Monetary Union (EMU), i.e. the adoption of the euro.

The basic logic of the model is rather intuitive. Consider a sector in which firms differ in terms of efficiency in the use of available inputs. With trade liberalisation, lower trade costs allow foreign producers to target the domestic markets, therefore lowering the markups and the operating profits of domestic firms. At the same time, however, some domestic firms gain access to foreign markets and generate additional profits from their foreign ventures: these are the firms that are efficient enough to cope with the additional costs of reaching foreign customers (such as those due to transportation, administrative duties, institutional and cultural barriers). In the process, a number of firms – the least productive and those unable to afford access to foreign markets – will be forced to exit. The selection process will eventually increase the average efficiency of surviving firms, and lower average prices and markups.

3.1. Main features

Our model is to be seen in the tradition of the new trade theories briefly surveyed in Section 2. Most notably, it exhibits the following five main features. First, the market structure is one of monopolistic competition. Each firm in a sector produces only one variety of a differentiated good. Consumers have inelastic demand and love to have as many varieties to choose from as possible. Second, in order to enter in a sector and start producing, firms must pay ex-ante fixed entry costs, which include for example the research and development (R&D) costs needed to create and market a new variety. With respect to their nature these costs are therefore "sunk", i.e. cannot be recovered, should firms exit the market later on. Bringing entry (and exit) to the forefront, our analysis focuses on the medium to long-run effects of trade liberalisation. Third, in addition to the entry costs, firms incur production costs and delivery costs, which include not only transportation fees – both within a country and for shipping abroad – but also all tariff and non-tariff costs needed to reach the final consumers. We collapse these costs – which vary by sector and by country – into a single indicator, which we will the "freeness of trade". Fourth, trade flows are driven by technology and demand, and there is no role for international cost differentials arising from different relative resource endowments, which are instead critical in the Heckscher-Ohlin trade theory mentioned in Section 2.[4] Fifth and last, in our model the size of the markets matters. The larger are the markets, the tougher the competition in terms of the increased elasticity of demand faced by firms and thus the lower are the markups. In this tougher competitive environment, firms have to achieve a larger scale of operations in order to break even, and this is possible only for the most efficient firms, i.e. those with the lowest marginal costs. Accordingly, the key indicator of industry performance in the model will be the "cut-off" marginal cost. This is the maximum marginal cost that can be profitably sustained by firms in the market. The inverse of the cut-off cost is the minimum productivity or efficiency of firms that are able to at least break even. Knowing how the cut-off varies following trade liberalisation will be enough to evaluate all the ensuing changes in terms of productivity, prices, markups, output and overall welfare.

3.2. A stylized EU economy

With our empirical application and our data constraints in mind, we focus on an economy consisting of 12 countries and 12 manufacturing sectors (more on this in Section 4). Each manufacturing sector (henceforth indexed by the subscript "s") supplies a differentiated good. This good is available in a certain range of varieties which are traded in monopolistic competitive markets. The model assumes that each firm produces one variety only.[5] The rest of the economy is represented by a single residual homogeneous good, which serves as the *numeraire* (i.e. unit of value). The homogeneous good is freely traded in perfectly competitive markets and it is sold at the same price by all firms across the economy. The market for this good will also absorb all labour imbalances in the economy so that nominal wages – but not real ones – will be constant in the model.

3.3. Industry equilibrium

Our model is formally described in Appendix 1. It accommodates several countries and several sectors that differ from each other along several dimensions. While this is important for the empirical application, the intuitive logic of the model can be usefully grasped by concentrating on the simplest case of a single manufacturing sector, labeled "*s*", that operates in two identical countries, labeled "*h*" (mnemonic for "here") and "*t*" (mnemonic for "there"). In the following

[4] We consider this as a reasonable assumption for the EU countries object of the empirical analysis in Section 4, given that their relative resource endowments are very similar and bilateral trade flows mostly intra-industry.

[5] Monopolistic competition can be considered as a reasonable macroeconomic representation of the market structure in our manufacturing sectors as long as sectors are fairly aggregated and our model allows for the pro-competitive effect of richer variety presented in Section 2.

description we focus on country h with the understanding that everything applies symmetrically to country t.

As already mentioned, to introduce a new variety of a good produced in sector s and country h, a firm incurs a (sector-and-country) specific R&D sunk cost, which we call f_s^h. Typically, due to the uncertain R&D outcome, the entrant does not know in advance what will be the marginal cost connected to the production of the new variety that he wants to launch on the market, i.e. it does not know how efficient it will be in producing its variety relative to the production of all other varieties in the market (and actually whether it will be able to produce it at all, given market conditions). To capture such uncertainty, we assume that the marginal cost of production c is determined randomly upon entry as a draw from a sector and country-specific probability distribution.

The production cost distribution is portrayed in the middle panel of Figure 1 where, for any firm, possible cost draws range from a lower external bound equal to 0 (i.e. where c can approximate 0, but always remaining strictly positive) to a country and sector-specific upper bound equal to $c_{A,s}^h$. The panel shows a realistic situation (see Box 1 for details) in which high cost draws for firms (large c) are much more likely than low cost draws (low c). Two are the key parameters in this panel. The first is $c_{A,s}^h$, which identifies the maximum possible cost of producing a variety (i.e. the worst possible return from the investment in R&D) in sector s and country h. The inverse of $c_{A,s}^h$, which we call o_s^h, is an index of "absolute advantage": the higher it is, the more cost effective country h is in producing good s and the more likely it is for a firm willing to introduce a new variety in sector s of country h to succeed. The second key parameter is represented by the curvature, or "shape" k_s, of the cost distribution curve. The parameter k_s, is a direct measure of the bias of the distribution of sector s towards high cost outcomes (i.e. inefficient firms). Hence, the larger k_s is, the more likely it is for a new variety in sector s to have high marginal costs of production. Given these parameters – technological in nature - country h has a "comparative advantage" in sector s with respect to country t and another sector S if $(c_{A,s}^h / c_{A,S}^h) < (c_{A,s}^t / c_{A,S}^t)$. In this case and other things equal, firms entering sector s are more likely to produce at lower cost (i.e. to be more productive) in country h than in country t.

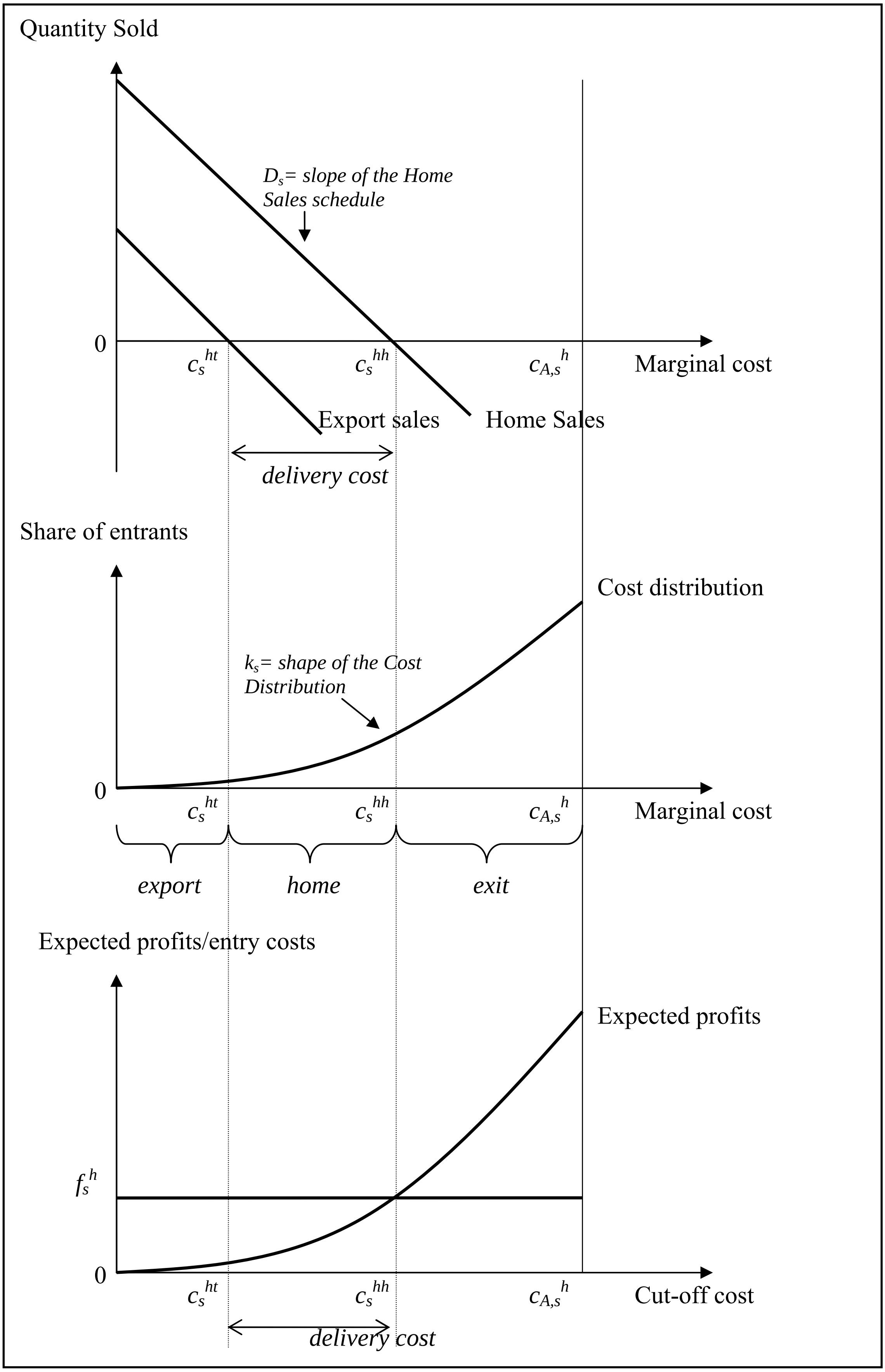


Figure 1. Theoretical framework

Box 1: Pareto Distribution

Our model is based on the assumption that marginal costs draws c in sector s and country h follow a Pareto distribution with possible outcomes ranging from 0 to $c_{A,s}{}^h$ and shape parameter k_s. Formally, the *ex ante* cumulative density function (i.e. the share of draws below a certain cost level c) and probability density function (i.e. the probability of drawing a certain cost level c) are given by:

$$G(c) = \left(\frac{c}{c_{A,s}{}^{h}} \right)^{k_s}, \; 0 \leq c \leq c_{A,s}{}^{h} \text{ and } g(c) = \frac{k_s (c)^{k_s - 1}}{\left(c_{A,s}{}^{h}\right)^{k_s}}, \; 0 \leq c \leq c_{A,s}{}^{h}, \text{ respectively.}$$

On account of the law of large numbers, these are also the *ex post* cumulative density function and probability density function of entrants across marginal cost levels. The cumulative density function is represented in the middle panel of Figure 1. A useful property of this Pareto distribution is that any truncation thereof also belongs to the Pareto family with the same shape parameter k_s. This is due to the fact that, for any value of c, $d\ln G(c)/d\ln(c)= k_s$, i.e. a 1% increase in c leads to a k_s% increase in $G(c)$. In particular, since firms produce for the domestic market as long as their cost draws fall below c_s^{hh}, the distribution of producers across marginal cost levels is characterised by the following cumulative and probability density functions:

$$G_s^h(c) = \left(\frac{c}{c_s^{hh}} \right)^{k_s}, \; 0 \leq c \leq c_s^{hh} \text{ and } g_s^h(c) = \frac{k_s (c)^{k_s - 1}}{\left(c_s^{hh}\right)^{k_s}}, \; 0 \leq c \leq c_s^{hh}.$$

Is this anywhere close to what we observe in the data? This is easily testable, as stated above, under the Pareto assumption $d\ln G(c)/d\ln(c)= k_s$ for any value of c. Then, if the marginal cost c were indeed distributed as Pareto, a simple regression of $\ln G(c)$ on $\ln(c)$ plus a constant would fit the data perfectly (R^2=100%) and, by definition, the estimated coefficient of $\ln(c)$ would provide a consistent estimate of k_s as the constant elasticity of $\ln G(c)$ to $\ln(c)$. The results of such regression, run by sector, are reported in the table below. They clearly show that the Pareto distribution provides a very good description of the data. This has the additional useful practical implication that the average marginal cost in sector s and country h is equal to $c_s^{hh} k_s /(k_s + 1)$, which can be used to obtain a consistent estimate of the cut-off cost from sector-and-country specific averages.

	Industry	k_s	Std. Error	Adj.R^2
1	Food, Beverages and Tobacco	1.91	0.0027	0.96
2	Textiles , Leather products and footwear	1.67	0.0028	0.96
3	Wood Products except Furniture	1.95	0.0044	0.95
4	Paper products, Printing and Publishing	1.91	0.0015	0.99
5	Rubber and Plastic	2.42	0.0035	0.98
6	Chemicals, including Pharmaceuticals	1.68	0.0028	0.98
7	Non-metallic Mineral Prod., incl. Pottery and Glass	2.11	0.0033	0.98
8	Basic Metals and Fabricated Metal Products	2.55	0.0019	0.98
9	Non-electric Machinery	2.48	0.0021	0.99
10	Electric Machinery, incl. Prof. and Scient. Equip.	2.22	0.0029	0.98
11	Transport Equipment	2.32	0.0042	0.98
12	Other Manufacturing, incl. Furniture	2.02	0.0037	0.96
	Average	2.10	0.0030	0.97

Source: AMADEUS, authors calculations

While all firms have identical expectations on their future fortunes, when they enter, some may subsequently end up being luckier than others, giving rise to an ex-post distribution of firm efficiency that mirrors the ex-ante distribution of cost draws (provided that, as in our industries, there is a number of entrants large enough). Accordingly, after entering, firms observe their own costs, as well as those of their competitors, and realise whether they can produce profitably. Firms that do not manage to make profits, will have to exit the market. This is shown by the Home sales schedule in the top panel of Figure 1, in which downward sloping demand implies that the quantity that firms are able to sell domestically decreases proportionally to the increase in marginal cost of their draw, as a higher marginal cost maps into a higher price. The extent to which a higher price reduces demand depends on product differentiation: the more differentiated products are, the fewer sales are lost on account of a given increase in price. Thus, a flatter slope of the Home sales schedule would portray stronger product differentiation. Henceforth, we will call D_s the index of product differentiation in sector s.

The Export sales schedule is lower than the Home sales schedule because exporters face additional delivery costs than domestic producers and this increases the price they need to charge to final consumers, therefore lowering the latters' demand for their products. The higher these delivery costs are, the further apart are the two lines. Accordingly, decisions to produce and export follow simple cut-off rules: firms with costs (and sales price) above c_s^{hh} realise that they are too inefficient to sell in the domestic market, and thus quit; firms with costs below c_s^{hh} but above c_s^{ht} realise that they are too inefficient to export, and thus serve only the domestic market; firms with costs below c_s^{ht} realise that they are efficient enough to sell both at home and abroad, and thus do both.

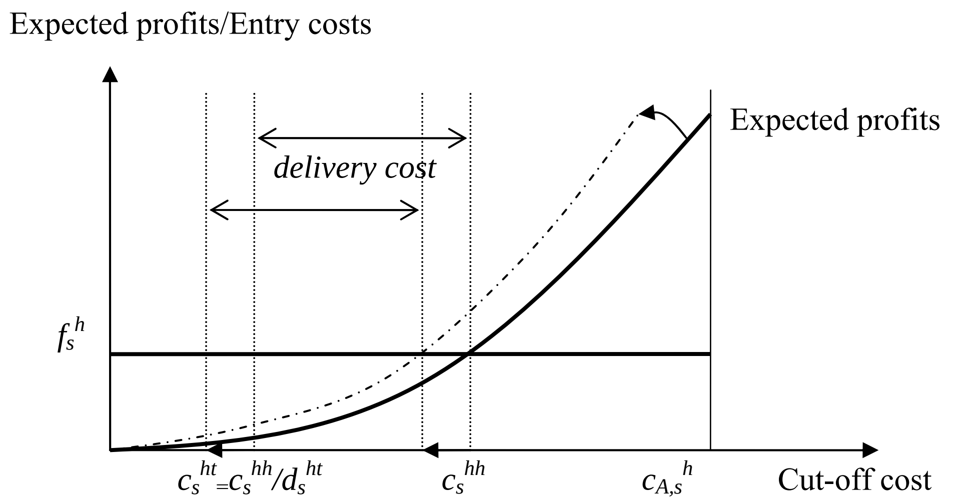
The outcome portrayed in the top panel of Figure 1 is anticipated by firms at the entry stage when they have to decide whether to incur the sunk R&D cost f_s^h or not. In addition, the information contained in the middle panel of the same figure allows them to calculate the probability of drawing marginal costs above or below c_s^{hh} and c_s^{ht}. They can, therefore, figure out their overall expected profits and check whether these cover the sunk entry cost. The bottom panel of Figure 1 provides a graphical representation of the problem set faced by the firm. The upward sloping curve indicates that expected profits are a function of the domestic cut-off cost (threshold beyond which firms are forced to exit the market). As all firms are identical before investing in R&D, they all share the same expected profits. On their part, expected profits are an increasing function of the domestic cut-off cost since a higher cut-off implies that the average efficiency within the sector is lower and, therefore, that incumbents face weaker competition. The horizontal line identifies the sunk entry cost f_s^h. It crosses the curve of expected profits only once. The resulting intersection of those two lines identifies the equilibrium domestic cut-off level c_s^{hh}. This is the only equilibrium cut-off compatible with a stable number of firms active in the market: If the domestic cut-off were above c_s^{hh}, expected profits would be higher than the entry cost, thus inducing additional entry. Conversely, if the domestic cut-off were below c_s^{hh}, expected profits would be lower than the entry cost implying that some incumbent firms would shut down as they would be making losses.

Once c_s^{hh} is determined, the equilibrium export cut-off level can be derived by applying the additional delivery costs. In particular, if we call $d_s^{ht}>1$ the factor measuring these additional costs of delivering goods from country *h* to country *t* (and vice versa), the equilibrium export cut-off level is simply c_s^{hh}/d_s^{ht}, implying that an exporter has to be d_s^{ht} times more efficient than a domestic producer in order to make the same amount of sales in the same country.

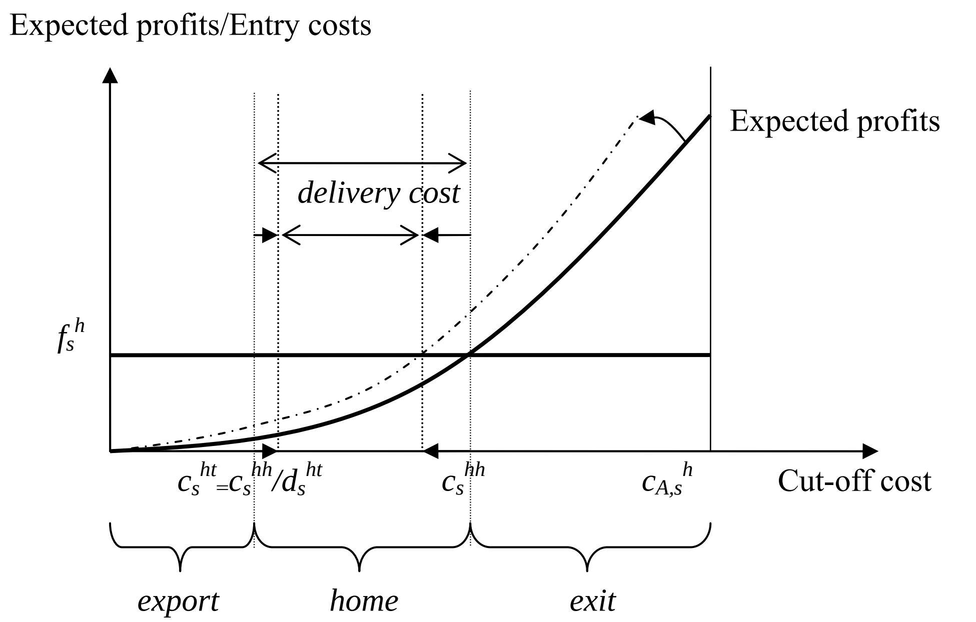
3.4. Key parameters

For a given domestic cut-off level, firms expect higher profits under the following conditions: (i) in larger countries as these would support larger firms (ii) in sectors in which products are less differentiated as these would also support larger firms (iii) in sectors and countries offering better chances of good cost draws as this would foster firms' expected efficiency and (iv) when trade is freer as this would allow firms to grow thanks to easier access to the foreign market.

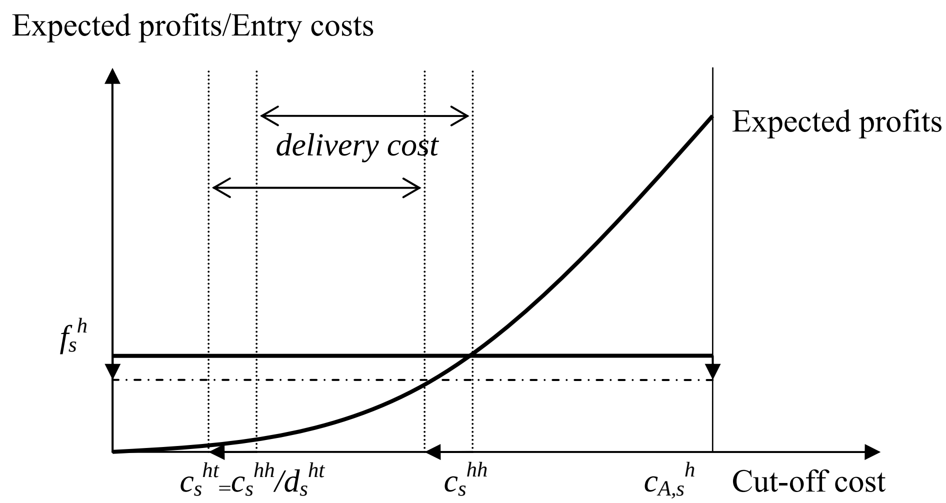
In all these cases the curve of expected profits in the bottom panel of Figure 1 would shift upwards. A detailed gallery of the corresponding outcomes is portrayed in Figure 2, where cases (i), (ii) and (iii) are presented in the top panel (a) while case (iv) is presented in the middle panel (b). For a given level of the domestic cut-off, a larger country size, weaker product differentiation, better technological opportunities and freer trade all imply higher expected profits. The effects of shocks leading to such structural changes are shown graphically by the upward shift of the Expected profits curve in panels (a) and (b) and the corresponding shift to the left of the intersection point between the curves representing respectively Expected profits and Entry costs. As shown graphically, the new equilibrium domestic cut-off c_s^{hh} will have a lower level. This outcome is due to the following sequence of events: the higher expected profits result in the entry of new firms, which increases competition in the market, thereby causing firms' markups to shrink and making survival harder for the weakest among the incumbents. Tougher competition hits all firms but sinks only some of the least efficient ones, i.e. those firms that had marginal costs just below the cut-off before the shock, and that, as a result of the shock, see their sales disappear thereby failing to break even. As only relatively more efficient firms survive, the average efficiency of the industry rises, thereby leading to a lower level for the domestic cut-off c_s^{hh}, as previously mentioned. This selection effect is accompanied by an increase in average scale of firms as well as by a decrease in the average price and markup, revealing that scale and pro-competitive effects are also at work. For a given reduction of the domestic cut-off, the intensity of the selection effects depends on the number of firms that exit the market. What percentage of firms exits when the cut-off falls by a percentage point? Given the discussion in the previous section (see Box 1 for details), the answer is clearly k_s per cent. Hence, we refer to k_s as the "sensitivity to firm selection", or more technically to the "elasticity of the extensive margin" of industry adjustment, which is high in sectors characterised by large fractions of high cost firms.



(a) larger market size / weaker differentiation / better technology



(b) trade liberalization



(c) lower entry costs

Figure 2. Industry reallocations

The difference between panels (a) and (b) in Figure 2 stems from the fact that in the former delivery costs are unaffected while they, of course, fall in the latter. This explains why in panel (a) a lower domestic cut-off leads to a lower export cut-off forcing the least efficient exporters in the initial equilibrium to discontinue their foreign operations. In panel (b), by contrast, as delivery costs fall due to trade liberalisation, the export cut-off rises since some firms that were not exporting under the initial conditions are now able to serve the foreign market.

Finally, a fifth case is presented in panel (c) of Figure 2. This shows that countries and sectors in which entry costs are lower support lower equilibrium cost cut-offs for both domestic and foreign sales. The reason is that, for given cut-offs, lower entry costs foster the entry of additional firms. This increases competition forcing the least efficient domestic producers to shut down and the least efficient exporters to abandon their foreign operations. Hence, as in the other panels, selection leads to larger average scale of firms as well as to lower average price and markup.[6]

Summarising what we have learned from Figure 1 and Figure 2, the domestic cut-off c_s^{hh} determines the average efficiency, the average scale, the average price and the average markup of firms selling the products of sector *s* to consumers in country *h*. Therefore, it determines the overall welfare generated by that sector for that country. In turn, the domestic cut-off is determined by six key parameters:

- the country-specific market size L^h;
- the sector-specific product differentiation D_s;
- the sector-and-country specific absolute advantage o_s^h;
- the sector-specific elasticity of the extensive margin k_s;
- the sector-and-country specific entry cost f_s^h;
- the delivery cost d_s^{ht}, which is specific to the sector, the country of origin and the country of destination.

In particular, we have argued that larger L^h and o_s^h as well as smaller D_s, k_s, f_s^h and d_s^{ht} reduce the equilibrium domestic cut-off (see Box 4 for the formal expression of c_s^{hh} as a function of the various parameters and Appendix 1 for its derivation). The delivery cost parameter deserves further attention. First, d_s^{ht} determines the ratio between the number of exporters and the number of firms that sell only to domestic consumers. This ratio is inversely related to d_s^{ht} and can be interpreted as an index of the "freeness of trade" as it equals zero in autarky and one when trade is perfectly free and exporters face no additional delivery cost with respect to domestic sellers. Second, in the more

[6] In general, the gains in terms of efficiency, scale and prices are associated with ambiguous effects in terms of product variety. Appendix 1 shows that in our model the former always dominate, implying that a lower domestic cut-off is always associated with higher national welfare and that, conversely, a higher domestic cut-off necessarily delivers lower national welfare.

realistic setup with several countries we will use for our empirical analysis, there are several export destinations and a reduction in any of the delivery costs to those destinations causes an upward shift of the Expected profit schedule as in the middle panel (b) of Figure 2. Then, if country h is characterised on average by lower delivery costs than country t to all other countries, it will attract the entry of more firms, thereby leading to a higher average efficiency and average scale, a lower average price and markup, as well as to higher welfare.

4. EMPIRICAL IMPLEMENTATION

As mentioned in the introduction, a direct estimation of the gains to be attributed to the euro is at present not feasible because of the unavailability of sufficiently detailed and harmonised cross-country firm-level data. In particular, as shown by Mayer and Ottaviano (2007), existing data face five types of limitations. First, general information on firms is not always available. Second, the available data do not display the same information across countries. Third, important differences in coverage and methodology reduce the comparability of the available data. Fourth, when available, firm-level data collected homogeneously across Europe are not oriented towards international trade. Finally, confidentiality requirements typically prevent a single research team from directly accessing the source data in different countries. Hence, the econometric analysis of the competitiveness effects of the trade changes triggered by the euro is necessarily restricted to investigating individually the outcome for the very few countries for which all relevant data are available (such as Belgium and France).

To circumvent current data limitations, we use the theoretical structure of the model described in Section 3. In this respect, our approach should be seen as a practical second-best solution to overcome concrete – but hopefully temporary – data availability constraints. Specifically, in order to investigate the gains in competitiveness induced by the euro via the trade channel we test how the actual performance of European economies (as measured by our broadly defined indicators of competitiveness) compares with their simulated performances in counterfactual model scenarios in which some of them changes its official currency (i.e. to or from the euro). Adapting the methodology developed by Del Gatto, Mion and Ottaviano (2006), the analysis is developed in three steps. First, the model is fitted to reality. This is achieved by estimating as many of its parameters as possible and "calibrating" the values of the remaining ones so that the model is able to reproduce selected patterns of the data. In particular, the calibration of the model allows generating the indicators of competitiveness needed to assess the impacts from the euro. Second, the model is "validated" by checking its consistency with additional patterns of the data, different from the ones used in its calibration. Finally, the model is used to "simulate" the counterfactual scenarios relative to the adoption of the euro and provide an assessment on the competitiveness effects of the euro.

Specifically, as we discuss in some technical detail in Appendix 1, in view of producing the above mentioned indicators of competitiveness, the key objective of the empirical strategy is to compute the cut-offs from the from model's prediction (equation 12 of Appendix 1) by ensuring that these latter fit the actual values observed – or calibrated – from the data (see Box 4 for details). As discussed in Section 3.4 and in Appendix 1, the cut-off cost in sector s and country h is determined by the following six key parameters: the country-specific market size L^h; the sector-specific product differentiation D_s; the sector-and-country specific absolute advantage o_s^h; the sector-specific elasticity of the extensive margin k_s; the sector-and-country specific entry cost f_s^h; and the delivery costs to and from all other countries, with each bilateral delivery cost d_s^{ht} being specific to a sector, a country of origin and a country of destination. Some of these parameters are directly measurable, such as the population, which proxies market size.[7] Other parameters can be estimated. This is the case for the delivery costs and the sensitivity to firm selection (i.e. the elasticity of the extensive margin). The remaining parameters (i.e. product differentiation, entry costs and absolute advantage) are neither directly measurable nor estimable with the available data. This is the case for product differentiation, fixed entry costs and the absolute advantage. However, since we can estimate the cost cut-offs c_s^{hh} , the above unobservable parameters can be attributed values (i.e. "calibrated") to ensure that the model exactly matches the cost cut-offs, with these latter estimated on the basis of the directly measured or estimated values of all other parameters.

4.1. Estimation

We consider data relative to 12 manufacturing sectors over the period from 2001 to 2003. We focus on 12 European countries. Nine of them belong to the euro area (Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Portugal and Spain). The remaining three are outsiders (Denmark, Sweden and the United Kingdom).

Notwithstanding the focus on 12 European countries, trade frictions across and within countries are estimated using a far larger panel of bilateral exports and domestic production data (212 countries worldwide), to ensure that our estimated coefficients of trade freeness for the 15 countries in the sample are as accurate as possible. Industry-level trade data and country-level geographical information come from the *Centre d'Etudes Prospectives et d'Informations Internationales*.[8] Delivery costs within a country are calculated, by subtracting the country's overall exports in a given sector from domestic production in the same sector, a standard procedure in international

[7] The robustness of our results when using alternative measures is discussed in the on-line Appendix available at www. economic-policy.org.

[8] Freely downloadable from www.cepii.fr.

trade studies. This latter is measured by gross output at current basic prices, taken from the *Industrial Statistics Database* of the *United Nations Industrial Development Organisation*.

Marginal costs are calculated from sector- and country-specific productivity, measured as value added per hour worked, with data on value added and hour worked at the sectoral level from *EU KLEMS*.[9] The sensitivity to firm selection is calculated using estimates of firm-level total factor productivity based on balance sheet data from the *Amadeus database* of the *Bureau Van Dijk*. Finally, population data come from the *World Development Indicators* by the *World Bank*.

4.1.1. Measuring trade frictions

Trade frictions d_s^{ht} comprise the total costs of delivering a product from factory to consumers, irrespective of whether located at home or abroad. They include not only transportation fees, but also tariffs and non-tariff costs, and can be estimated through their negative impact on trade flows embedded in the "gravity regression" detailed in Box 2.

Box 2: Trade freeness estimation

As shown in Appendix 1, our theoretical framework generates a "gravity relation" between bilateral trade flows, country characteristics and trade impediments (Anderson and Van Wincoop, 2004). We exploit this relation to estimate bilateral trade freeness compatible with the observed flows between European countries. For trade flows from country *h* to country *t* in sector *s* we have:

$$\ln\left(EXP_s^{ht}\right) = EX_h + IM_t + \delta_s \ln(Distance^{ht}) + \beta(Border^{ht}) + \lambda(Language^{ht} Border^{ht}) + \ldots$$
$$\ldots + \ln\{\exp[\mu(Firmshare^{ht} + Selection^{ht})] - 1\} + \xi(Selection)^{ht} + Dummy^{time} + e^{ht}$$

where EXP_s^{ht} are the exports of sector *s* from country *h* to country *t*, while EX_h and IM_t are dummies specific to the countries of origin and destination. Trade barriers are captured by two variables: the bilateral distance ($distance^{ht}$) and the border effect ($Border^{ht}$). The former measures all distance-related trade frictions, the latter additional frictions due to crossing a border. These differ across importing countries and include a language dummy ($Language^{ht}$) that equals 1 when the two countries share a common language. The variables $Firmshare^{ht}$ and $Selection^{ht}$ control for the unobserved underlying firm-level heterogeneity, which is likely to be correlated with trade flows (Helpman, Melitz and Rubinstein, 2008). $Selection^{ht}$ also corrects for biases arising from a possible non-random sample selection of the observations (Heckman, 1979). Finally, $Dummy^{time}$ is a time dummy and e^{ht} is a residual term. We use data for the years from 1999 to 2004 to increase the statistical robustness of the estimated coefficients. Details and robustness checks are provided in Appendix 2 and in the online appendix on trade frictions available at www.economic-policy.org . The interested reader will also find online an excel-spreadsheet providing the country-pair and sector specific values for trade freeness.

[9] Freely downloadable from www.euklems.net.

Following standard practice in the literature (see Head and Mayer, 2004a), trade freeness from country *h* to country *t* is defined as:

$$T_s^{ht} = \left[\exp\left(\beta^2 - \lambda\, Language^{ht}\right)\right]\left(dist\,ance^{ht}\right)^{\delta_s}$$

where crossing a border and speaking different languages induce a drop in bilateral trade beyond that implied by the distance effect. Within country *h* the above expression reduces to $T_s^{hh} = \left(dist\,ance^{hh}\right)^{\delta_s}$, where the internal distance of *h* is the weighted average bilateral distance between its biggest cities, with weights reflecting their relative sizes.

Figure 3 shows the "freeness of trade" T_s^{ht}, associated with delivery cost d_s^{ht}, as simple sectoral averages plotted relative to the median sector. *Paper products, printing and publishing* is the manufacturing sector with the highest trade frictions and lowest trade freeness, followed by *non-metallic mineral products*, *metals* and *wood products*. On the other hand, *electrical machinery, including professional and scientific equipment* is the sector with the highest trade freeness along with the residual sector of *other manufacturing*.

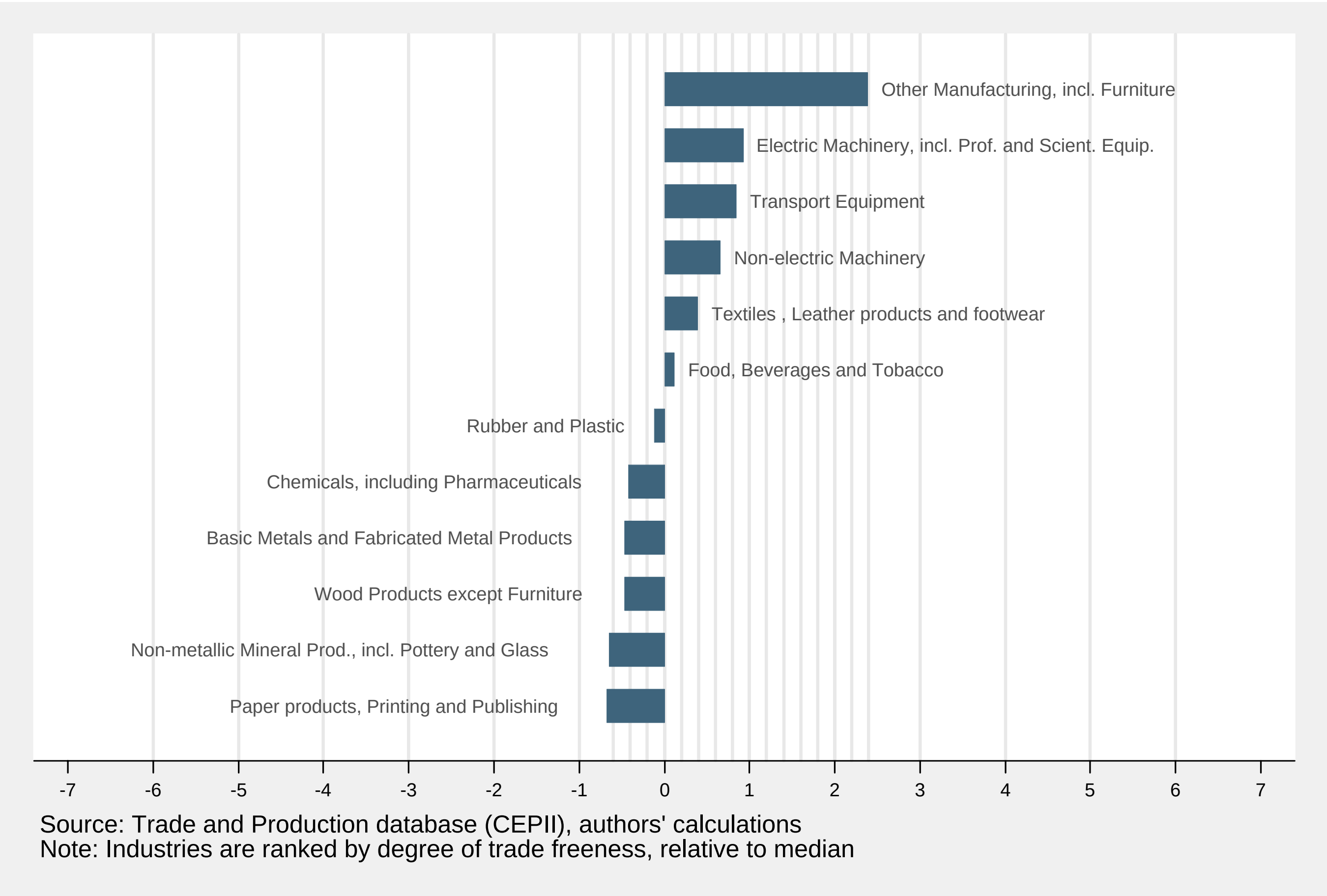
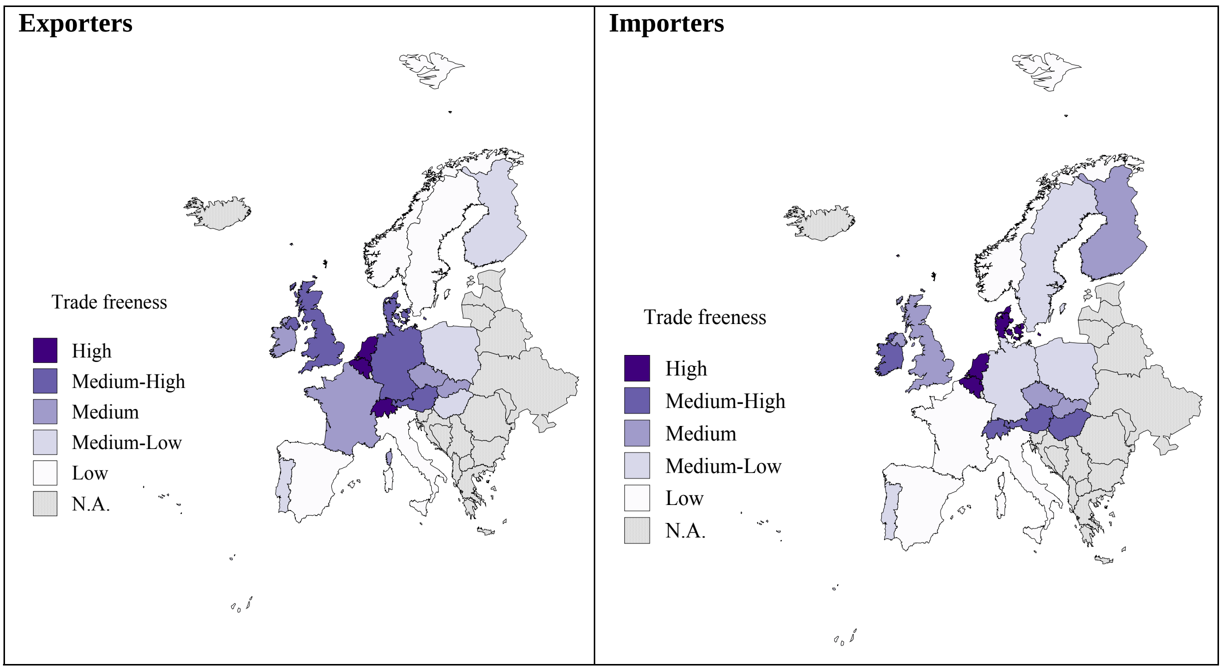


Figure 3. Freeness of trade by sector (difference from the median, 2001-2003)

The results in Figure 3 are broadly in line with previous estimates of trade barriers and border effects in Europe. For instance, in a sample of 12 countries and 113 NACE industries, Head and Mayer (2000) find that, up to 1995, most industries producing machinery (electric and non-electric), leather goods and textiles were relatively open sectors, while carpentry, wooden containers and wood-sawing recorded the highest estimated trade frictions along with oil refining and forging. Similarly, using a dataset of 7 European countries and 78 industries, Chen (2004) finds that in 1996 the home bias was highest for ready-mix concrete, carpentry, mortars, printing and publishing and metal structures. With respect to existing literature our results are different only for *food, beverages and tobacco*, a sector which – according to our estimates – enjoys good freeness of trade.

Turning to a geographic perspective, the left panel of Figure 4 shows that, unsurprisingly, accessing foreign markets is easier from core European countries than from peripheral ones. On the other hand, the accessibility of a country's markets from abroad is related to its size, as well as to cultural and linguistic factors, though to a smaller extent. In particular, the markets of small countries and of Anglo-Saxon, Germanic and Nordic countries are, on average, more accessible from abroad than those of large and southern countries. These results are in line with Chen (2004), who finds that, in 1996, the reduction in trade flows due to crossing borders (i.e. the "border effect") was the highest for exports from Finland, Spain and Portugal, followed by Italy and France. By contrast, the preference for domestic goods over imports (i.e. the "home bias") was the lowest for the United Kingdom and Germany. Overall, the geographical mapping of trade frictions confirms that, while geography is an important determinant of delivery costs, other factors also have a strong influence.



Source: CEPII trade data and author's calculations

Figure 4. Freeness of trade by country (2001-2003)

4.1.2. Calculating the sensitivity to firm selection

As mentioned in section 3.4, the degree at which sectors adjust to the process of firm selection (or the sector-specific elasticity of the extensive margin k_s) is determined by the percentage of firms that exit a sector when the cut-off cost falls by a percentage point. Hence, the larger the elasticity is, the stronger the selection effect of trade liberalisation.

We derive such parameter from the distribution of firms across marginal cost levels, as detailed in Box 3. It exploits the fact that, given the same conditions in factor markets, different marginal costs of production across firms stem from their different efficiencies in using capital and labour (i.e. from "total factor productivity" or simply "TFP"). In other words, more efficient firms produce more output with the same amounts of inputs, and thus have lower marginal costs. Indeed, the distribution of the inverse of TFP represents the distribution of the marginal costs.

Box 3: Estimation of firms' marginal costs

We recover the marginal cost of firm *i* as the inverse of its "total factor productivity" (TFP), which measures its efficiency in the use of available inputs. Our baseline results come from a simple least-square (LS) log-linear regression of value added over measures of capital and labour employment. The details of the TFP estimation are reported in Appendix 2. Specifically, we rely on the following log-linear estimation of a Cobb-Douglas production function on firm level data for the years 2001-2003:

$$\ln Y_{it,s} = \ln A_{it,s} + a \ln K_{it,s} + b \ln N_{it,s} + timedummy + u_{it,s}$$

where $Y_{it,s}$ is output (value added) of firm *i* in sector *s* at time *t*, $K_{it,s}$ is capital input (proxied by fixed tangible assets), $N_{it,s}$ is labour input (total employment), $A_{it,s}$ is firm efficiency in the usage of capital and labour (TFP), and $u_{it,s}$ is a white noise. Inputs $K_{it,s}$ and $N_{it,s}$ are recovered from the firm's balance sheet whereas $A_{it,s}$ is estimated from the residual of the regression. LS estimations of productivity are carried out separately for each of the 12 manufacturing sectors. Given the likely presence of extreme outliers bound to bias the estimations, firm-level data for value added, employment and tangible assets are trimmed by eliminating the 1% lowest and 1% highest observations. Moreover, the usual LS estimates are replaced by iteratively reweighed least squares, a procedure designed to reduce the influence of outliers. We do not run separate estimations by country assuming *de facto* that in any given sector countries have the same technology up to a scale factor. While this hypothesis overlooks the possibility of some heterogeneity of technology across countries, it has the important advantage of yielding a more robust estimation of productivity, given that some countries have very few observations in some sectors.

As discussed in Box 1, our data strongly support the idea that, within sectors, marginal costs follow a distribution with a constant elasticity of the extensive margin k_s. Its estimates by sector are reported in Figure 5.[10]

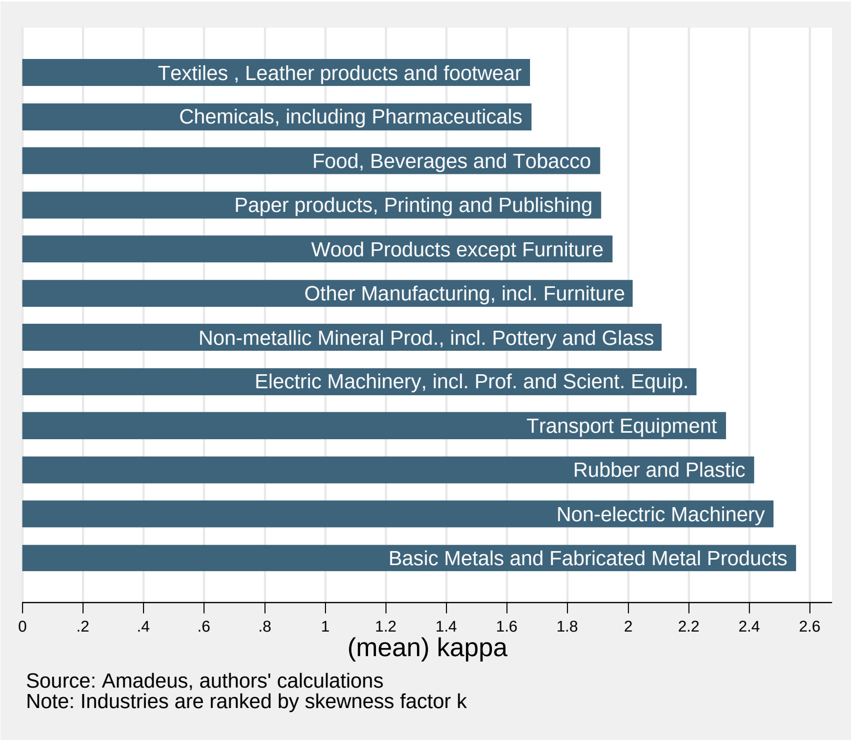


Figure 5. Sensitivity to firm selection

Accordingly, the selection effect is estimated to be the largest in *basic metals and fabricated metal products, non-electric machinery*, as well as *rubber and plastic*. They are estimated to be the smallest in *textiles, leather products and footwear*, *chemicals*, as well as *food, beverages and tobacco*.

4.1.3. Computing sector-and-country specific cost cut-offs

In principle, we could have used the cost distribution estimated from firm-level data also to calculate the cut-off cost c_s^{hh}. In practice, however, our firm-level data exhibit poor coverage for some countries, and especially for Germany. This is not much of a problem for the estimation of k_s as firms in sector *s* are pooled across countries to obtain good estimates of such a sector but not

[10] The robustness of our results when using alternative estimates of k_s is discussed in the on-line Appendix available at www. economic-policy.org.

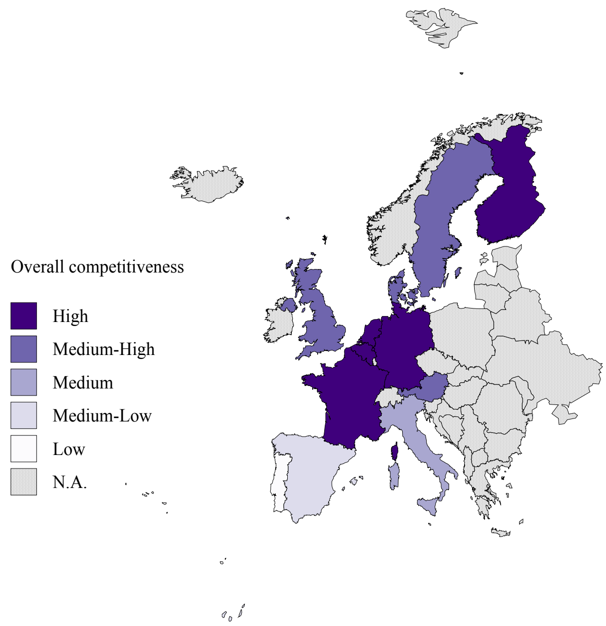
country specific parameter. It is, instead, more of a problem for the estimation of the cut-off c_s^{hh}, which is sector-and-country specific. While the cut-off estimates based on firm-level data are reported in the on-line Appendix available at www.economic-policy.org, we prefer to rely on the sectoral productivity statistics publicly available on the EUKLEMS website. For each country and sector, such statistics provide yearly levels of labour productivity (value added per hour worked). This is a productivity measure that differs from TFP in that it measures the efficient use of labour without controlling for non-labour inputs. Its advantage is that it is directly measurable. We use it as our measure of sector- and country-specific productivity after averaging across the years from 2001 to 2003, to smooth out business cycle fluctuations. The inverse of such productivity measure gives us an estimate of average marginal costs. These can be used to recover the cut-off cost c_s^{hh}. Indeed, when the elasticity of the extensive margin is constant, as in our case, the cut-off in sector s and country h is obtained simply by multiplying the average cost by a discount factor accounting for the above mentioned elasticity of the extensive margin (see Box 1 for an explanation of the methodology and Appendix 2 for the country and sector specific coefficients).

After calculating the weighted average of c_s^{hh} across sectors (with weights determined by sectors' shares in manufacturing output), the resulting country-level average cost cut-off represents a proxy for the country's "overall competitiveness" in the broad sense identified in our conceptual framework, which includes trade frictions, technology, institutional set-up and demand characteristics, among others. The lower the cut-off cost in a country, the higher its overall competitiveness in the sense of a lower average cost and a higher average productivity of its firms. The geographical pattern of overall competitiveness is portrayed in Figure 6, where competitiveness is higher in countries that are at the heart of Europe – such as Belgium, the Netherlands and Germany – and in Finland. This is consistent with the prediction of the theoretical framework that countries that are large or easily accessible to firms from trading partners should exhibit a tougher competitive environment and stronger selection. Italy, Spain and Portugal are at the bottom of the table because of a less central location and a possible technology disadvantage, which is associated with high entry costs in new sectors.

	Country Ranking	Overall competitiveness
BE	Belgium	0.364
FI	Finland	0.374
NL	Netherlands	0.396
DE	Germany	0.413
FR	France	0.417
AT	Austria	0.437
DK	Denmark	0.447
SE	Sweden	0.456
GB	United Kingdom	0.503
IT	Italy	0.613
ES	Spain	0.720
PT	Portugal	1.577

Source: Authors' Calculations

Note: the lower the cut-off, the higher the competitiveness of the country



Note: the darker the colour, the more competitive the country

Figure 6. Overall competitiveness

4.2. Calibrating the remaining parameters of the model and deriving the indicator of producer competitiveness

We are now ready to select values for the unobservable parameters (product differentiation D_s, the absolute advantage o_s^h and the entry cost f_s^h) that make the model exactly match the estimated cost cut-offs c_s^{hh}, given the values of all other directly measured or estimated parameters. See Box 4 for details.

<u>Box 4</u>: Calibration

In Appendix 1 we show that the equilibrium domestic cut-off in country h is determined by the following expression:

$$c_s^{hh} = \left[\frac{2D_s(k_s+1)(k_s+2)}{L^h} \frac{\sum_{t=1}^{12} \left|C_s^{th}\right| / \left[f_s^t / \left(o_s^t\right)^{k_s} \right]}{\left|T_s\right|} \right]^{\frac{1}{k_s+2}}$$

where $o_s^t = 1/c_{A,s}^t$ is the index of absolute advantage, $|T_s|$ is the determinant of the matrix whose element T_s^{ht} indexes the freeness of trade from country *h* to country *t*, and $\left|C_s^{th}\right|$ is the co-factor of that element.

In the above expression market size L^h is directly measurable. The bilateral freeness of trade T_s^{ht} and the elasticity of the extensive margin k_s can be estimated. The remaining parameters - namely the product differentiation D_s, the absolute advantage o_s^h and the entry cost f_s^h - are neither directly measurable nor estimable with the available data. For each sector, however, we can estimate the cost cut-off c_s^{hh} for our 12 countries. This allows us to select values for (i.e. to "calibrate") the unobservable parameters D_s, o_s^h and f_s^h so that the model exactly matches the estimated cut-offs. In particular, after writing an expression like the one above for each of our 12 countries, we can solve the resulting system of 12 equations for the 12 unknown parameter bundles $D_s / \left[f_s^t / \left(o_s^t\right)^{k_s} \right]$ that make the model predict the 12 estimated values of the cut-offs. We can then separate the sector specific component D_s from the sector- and country-specific one $\left[f_s^t / \left(o_s^t\right)^{k_s} \right]$. Details are provided in Appendix 2.

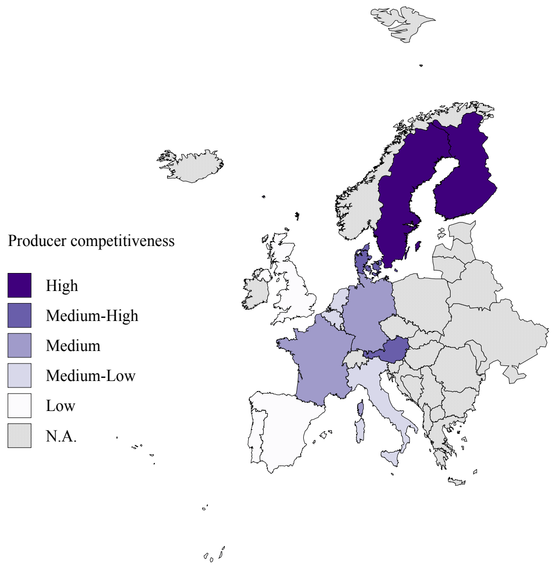
In the simulations presented in Section 5, the above expression is used, in the opposite direction, to predict the impact of changing trade freeness T_s^{ht} on the cost cut-off c_s^{hh}, holding $D_s / \left[f_s^t / \left(o_s^t\right)^{k_s} \right]$ constant at its calibrated value.

The results of the calibration allow us to obtain separate values for sector specific product differentiation D_s from a sector- and country-specific bundle of technological parameters $\left[f_s^t / \left(o_s^t\right)^{k_s} \right]$. This value measures the difficulty of country *h* to generate low-cost firms in sector *s* due to high entry costs and low absolute advantage in production. Hence, calculating its weighted average across sectors (with weights determined by sectors' manufacturing output shares) yields an index of the ability of country *t* to generate low cost firms abstracting from its market size and accessibility. We call this index "producer competitiveness" to distinguish this concept from "overall competitiveness". It is a measure of competitiveness that depends solely on technology (i.e. the ability to produce at low cost) and institutional factors (i.e. cost of entry in a sector). As such, the index "producer competitiveness" can be interpreted as the relative performance of countries in an ideal world in which all firms face the same barriers to international transactions in all countries. The index of "overall competitiveness", by contrast, quantifies the actual performance of countries in the real world.

Accordingly, Figure 7 reports the calibrated producer competitiveness of our countries whereas Table 1 compares the rankings of countries in terms of overall competitiveness and producer competitiveness.

	Country Ranking	Producer competitiveness
FI	Finland	42.2
SE	Sweden	26.2
AT	Austria	19.1
DK	Denmark	18.5
FR	France	11.2
DE	Germany	8.3
NL	Netherlands	7.5
BE	Belgium	6.8
IT	Italy	6.3
GB	United Kingdom	4.6
ES	Spain	4.3
PT	Portugal	1

Source: Authors' Calculations



Note: the darker the colour, the more competitive the country

Figure 7. Producer competitiveness

Table 1: Overall versus producer competitiveness (country rankings)

	Country Ranking	Overall Competitiveness	Producer Competitiveness
AT	Austria	6	3
BE	Belgium	1	8
DE	Germany	4	6
DK	Denmark	7	4
ES	Spain	11	11
FI	Finland	2	1
FR	France	5	5
GB	United Kingdom	9	10
IT	Italy	10	9
NL	Netherlands	3	7
PT	Portugal	12	12
SE	Sweden	8	2

Source: Authors' Calculations

According to this second ranking (see Figure 6 for a comparison), the following interesting results emerge. First, Sweden becomes the second most competitive country in terms of producer competitiveness. This implies that the country shows a strong technology advantage (large o_s^t) and/or a good institutional environment (low f_s^t), but has a disadvantage in terms of location (since it ranks only eighth in terms of overall competitiveness). Hence, being at the periphery does not per se represent a problem for a country, unless it is compounded by clear relative technological and institutional disadvantages that hampers firm productivity. In this context, it is worth noticing a rather substantial improvement in the ranking of Denmark, in terms of producer competitiveness compared to its ranking in terms of overall competitiveness. The opposite is true for Belgium, Germany and the Netherlands, whose rankings in terms of producer competitiveness are substantially lower than those in terms of overall competitiveness. This signals weak technology advantages and/or a worse institutional environment, only partially offset by their central location. Finally, Portugal and Spain – and, to a lesser extent, Italy and UK – are consistently at the bottom of the competitiveness ranking, no matter how this is measured, suggesting the presence of parallel negative impacts of all the determinants of competitiveness identified in the model, namely geographical location, market access, technological and institutional (dis)advantage.

4.3. Validation

After fitting the model to reality and before using it to simulate counterfactual scenarios, we need to check its consistency with additional features of the data, different from those used in its calibration, i.e. different from the cut-off costs. Obvious targets are some key features at both firm and sector levels.

At the firm level, Table 2 reports several quantitative predictions of the model that could be compared with cross-country data. The second column shows the prediction that exporters are a small subset of the total number of producers. Moreover, the third, fourth and fifth columns respectively show that the model also predicts that exporters are a selected elite, being larger, more productive and more price competitive than non-exporters. The reported numbers are so-called exporters' "premia" defined as ratios of exporters' values to non exporters' values.

Table 2: Predicted shares and premia of exporters

Country	Share of exporting firms	Size advantage exporters	Productivity advantage of exporters	Price advantage of exporters	Perceived productivity advantage of exporters
Austria	26%	3.58	2.40	0.80	1.84
Belgium	27%	2.18	2.27	0.80	1.76
Germany	36%	6.14	2.14	0.83	1.69
Denmark	21%	3.45	2.81	0.78	2.09
Spain	22%	3.17	2.27	0.79	1.76
Finland	25%	2.55	2.56	0.79	1.94
France	45%	7.56	1.67	0.86	1.4
United Kingdom	20%	2.96	2.49	0.78	1.9
Italy	21%	3.01	2.42	0.78	1.85
Netherlands	18%	3.13	2.91	0.76	2.15
Portugal	1%	2.09	8.53	0.65	5.51
Sweden	21%	3.05	2.31	0.78	1.79
Total/Average	24%	3.57	2.90	0.78	2.14

Unfortunately, the limited availability of firm-level data constrains the number of predictions that can actually be compared with adequate observations. Mayer and Ottaviano (2007) report some information on a subset of countries. According to Table 2 of this study , the actual percentages of exporters in France and Germany are 67% and 59% respectively. These percentages are higher than those predicted in our Table 2 (45% and 36% respectively). Likewise, the predictions of the model for Italy and the United Kingdom (both at 20%) are smaller than the percentages reported in Mayer and Ottaviano (2007), namely 64% for Italy and 28% for the United Kingdom.

Table 4 in Mayer and Ottaviano (2007) also reports exporters premia. Their size premia for France, Germany, Italy and the United Kingdom are 2.24, 2.99, 2.42 and 1.01 to be compared with 3.08, 2.53, 2.31 and 2.11 in our Table 2. In the case of Belgium, the size premium reported by Mayer and Ottaviano (2007) is 9.16, which is far larger than the predicted 2.18. This can be explained by the fact that their Belgian sample is exhaustive and, therefore, includes a large number of small firms that are excluded from the Amadeus dataset. Overall, while better – but currently unavailable – firm-level data would be needed to refine both calibration and validation, there seems to exist some remarkable conformity between the actual patterns and those predicted by our stylised theoretical framework.

Turning to the sectoral level, we compare the pattern of competitiveness predicted by the model to check its consistency with aggregate export performance. In particular, our model predicts that, in some industries more than in others, countries generate highly productive and thus internationally competitive firms. As a result, they should be net exporters of the goods supplied by the former sectors and net importers of the goods supplied by the latter sectors. A way to see whether this prediction is consistent with reality is to check the sign of the correlation between an index of relative productivity and an index of export specialisation across sectors (see Box 5 for details). If the predictions of the model are consistent with the observation, such a correlation should be positive. Table 3 confirms that this is indeed the case for 11 out of 12 sectors.

Table 3: Relative productivity and export specialization

Industry	Correlation (RCA, ECA)
Food, Beverages and Tobacco	0.45
Textiles , Leather products and footwear	0.77
Wood Products except Furniture	0.41
Paper products, Printing and Publishing	0.36
Rubber and Plastic	0.22
Chemicals, including Pharmaceuticals	-0.32
Non-metallic Mineral Prod., incl. Pottery and Glass	0.70
Basic Metals and Fabricated Metal Products	0.46
Non-electric Machinery	0.50
Electric Machinery, incl. Prof. and Scient. Equip.	0.64
Transport Equipment	0.67
Other Manufacturing, incl. Furniture	0.15

Box 5: Relative productivity and export specialization

Following Mayer and Ottaviano (2007), we measure the relative productivity for country *h* in sector *s* as the "estimated comparative advantage" (ECA), which is defined as:

$$ECA_{h,s} = \frac{P_{h,s} / \overline{P}_h}{P_{w,s} / \overline{P}_{w,s}}$$

where $P_{h,s}$ is productivity (the inverse of the cost cut-off c^s_{hh}) of country *h* in sector *s* while *w* is the label for the group of the other countries in our sample. The averages $\overline{P}$'s are defined as:

$$\overline{P}_h = \frac{\sum_{s=1}^{n} P_{h,s}}{n}, \quad \overline{P}_w = \frac{\sum_{h=1}^{m}\sum_{s=1}^{n} P_{h,s}}{m \cdot n}$$

where *n* is the number of sectors (12) and *m* is the number of countries (also 12). The index is larger (or smaller) than one if country *h* is relatively more (or less) productive in industry *s* than the other countries. In this case, country *h* is said to exhibits an estimated comparative advantage (or disadvantage) in industry *s*.

We quantify export specialisation of country *h* in sector *s* by a standard measure, the "index of revealed comparative advantage" (RCA) which is defined as:

$$RCA_{hs} = \frac{X_{hs}/X_s}{X_{ws}/X_w}$$

where X designates exports. This index is larger (or smaller) than one if the exports of country h are more (or less) specialized in industry s than the exports of the other countries. In this case, country h is said to exhibits a revealed comparative advantage (or disadvantage) in industry s.

The correlations between the two indices in our sample are reported in Table 3.

5. GAINS FROM THE EURO

Has the introduction of the single currency affected the intensity of competition in the euro area and forced least efficient firms out of the market? If so, to what extent has this selection process affected unit delivery costs, markups, prices, quantities, revenues and profits? Are countries that are eligible to adopt the euro losing anything in terms of economic gains?

To answer these questions, we simulate on our calibrated model three counterfactual scenarios of alternative euro area membership setups. The baseline is the actual cross-country pattern of overall competitiveness in 2003, as estimated through the cut-off costs in the previous section: countries with lower cut-off costs are generally more competitive. In the counterfactual scenarios, we let some countries change status with respect to their participation in Stage Three of the European Economic and Monetary Union. Since changes in euro area membership affect trade frictions among our countries, the alternative scenarios are generated by altering the trade freeness parameters T_s^{ht} in the appropriate way. Then, holding all other parameters constant, we use our model to simulate the resulting cut-off costs for each scenario (see Box 4), and compare them with the baseline.[11]

5.1. Trade freeness and the euro

In the logic of our framework, abandoning the euro results in trade frictions. Accordingly, we generate our counterfactual scenarios by changing the bilateral trade frictions as follows. When two countries use the euro in the baseline scenario, while they do not do so in the counterfactual scenario, we increase their bilateral trade frictions. When two trading partners do not share the same currency in the baseline scenario, while they do so in the counterfactual scenario, we decrease their bilateral trade frictions.

[11] We present here our baseline results. Their robustness to alternative measures of trade freeness and productivity is checked in the on-line Appendix available at www. economic-policy.org.

In order to proxy the impact of the euro on trade frictions, we rely on the findings from the substantial body of empirical research that in the past decade has investigated the trade-enhancing effects of the euro and, in general, of monetary unions. Results are very heterogeneous due to the adoption of different econometric specifications. Nonetheless, economists seem recently to be reaching the consensus view that the euro has had a positive effect on trade, though smaller than previously thought. The single currency appears to have boosted the growth of euro area countries' trade on average by a figure below 5 percentage points of the country's total trade growth.[12]

To generate our counterfactuals, we select two studies, by Flam and Nordstrom (2003) and by Baldwin and Taglioni (2008), as respectively providing the upper and the lower bounds of the estimated impacts of the euro on trade frictions. These are reported in Table 4 where column "FN" refers to the former and column "BT" to the latter. We use them to increase/decrease our bilateral measures of the freeness of trade in the various scenarios.

Table 4. Trade effects of the euro in the literature

(estimated impacts on trade frictions; percentages)

	BT (lower bound)	FN (upper bound)
Intra-euro area	2%***	8.8%***
Exports by non-euro users to the euro area	-1%**	0.8%
Euro area exports to the non-euro area	3%***	7.1%***
Period of analysis	1996-2006	1980-2002

(◊) Estimates based on EU-15 sample;
** Statistically significant at 5%;
*** Statistically significant at 1%

5.2. Three counterfactual scenarios

Three scenarios are particularly revealing when it comes to highlighting the effects of the euro on countries' overall competitiveness. In the first, we see what happens when all euro area countries drop the single currency. In the second, we study the implications of Denmark, Sweden and the United Kingdom adopting the euro. In the third, we assess the impact of France abandoning the euro and reverting to the French franc as its national currency.

Scenario 1

[12] For details on the comparative evaluation of methodologies used to capture the trade impact of the euro, see e.g. Baldwin and Taglioni (2007). On the need to disentangle appropriately the effects of the euro from those of other EU integration measures, see e.g. Baldwin (2006).

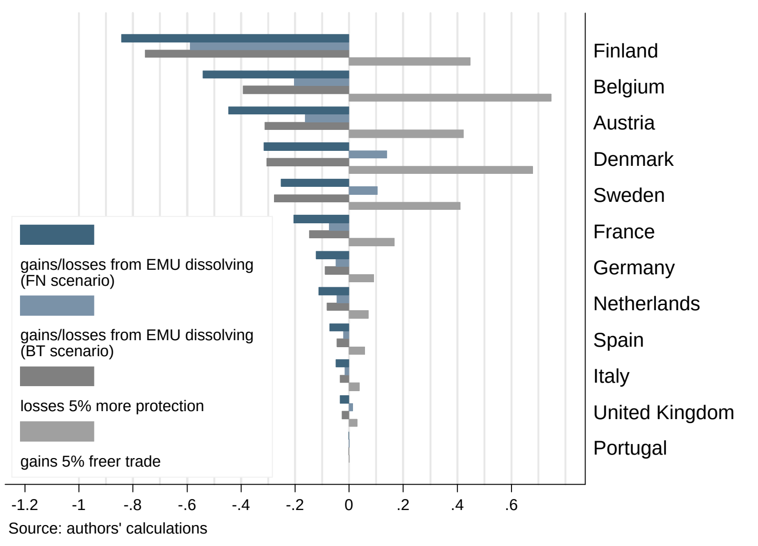
For the first scenario, we increase trade frictions within the euro area by either 2% or 8.8% (see first row of Table 4) and those from the euro area to the non-euro area (Denmark, Sweden and the United Kingdom) by either 3% or 7.1% (see third row of Table 4).

The results, reported in Figure 8, are shown both in terms of new implied cut-off costs for individual countries and – in the chart on the right – as a difference with respect to the previously computed domestic cut-off, used as a baseline. Had all euro area countries reverted to their national currencies in 2003, the average loss in overall competitiveness for Europe as a whole – as measured by higher cut-off costs – would have been substantial. As expected, all euro area countries would have lost, in particular the relatively small euro area countries (most notably Finland, followed by Belgium and Austria). In comparison, gains accrued to non-euro area countries would have been rather minor and limited only to Denmark and Sweden, with the United Kingdom basically remaining unaffected.

In order to provide a benchmark for the gains/losses resulting from dropping the euro, Figure 8 also shows ranges resulting from a comparison of the effects of increasing or reducing trade protection by 5% in all countries in the sample. Two comments are in order. First, the extent of the losses in overall competitiveness resulting from a dissolution of the European currency union (Stage Three of the Economic and Monetary Union) are about the same size – or actually slightly larger – than the losses caused by a 5% increase in trade protection. Second, increasing trade protection by 5% has an asymmetric effect with respect to decreasing it by 5% from the same initial situation. For example, Finland appears to be clearly more disadvantaged by an increase in protection than it is favoured by a reduction. The opposite is true for other countries. This is due to the fact that the effects of trade liberalisation are non-linear.

	Country Ranking	Overall competitiveness (estimated)	Overall competitiveness under hypothesis that all euro area countries revert to the euro	
			FN	BT
AT	Austria	0.437	0.463	0.446
BE	Belgium	0.364	0.395	0.374
DE	Germany	0.413	0.419	0.415
DK	Denmark	0.447	0.466	0.439
ES	Spain	0.720	0.727	0.722
FI	Finland	0.374	0.413	0.398
FR	France	0.417	0.427	0.421
GB	United Kingdom	0.503	0.506	0.503
IT	Italy	0.613	0.618	0.615
NL	Netherlands	0.396	0.401	0.398
PT	Portugal	1.577	1.578	1.578
SE	Sweden	0.456	0.470	0.450

Source: Authors' Calculations



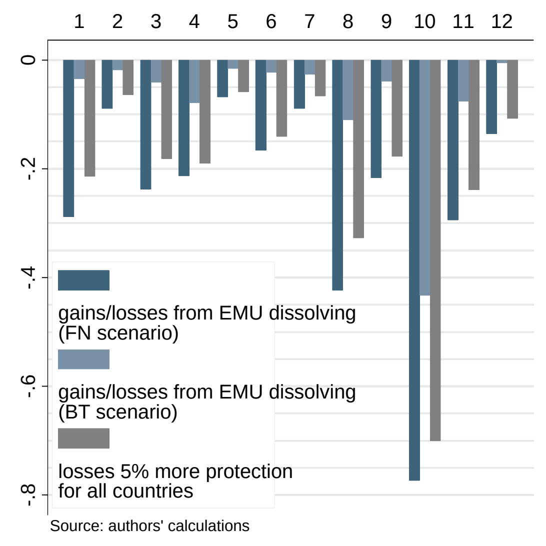
Note: Higher values than the baseline cut-off costs indicate losses in competitiveness.	Note: Changes from baseline productivity (inverse of cut-off costs); A negative sign indicates losses in competitiveness (higher cut-off); The term "5% more protection" indicates the losses arising from a uniform 5% increase in all trade frictions relative to their real value. Conversely the term "gains 5% freer trade" indicates the gains from a 5% reduction of all bilateral trade frictions.

Figure 8. All countries in the euro area revert to national currencies in 2003 (Scenario 1)

Taking a sectoral perspective, Figure 9 reveals that the industry in which firm productivity falls the most is *electric machinery*, followed by *basic metals and fabricated metal products* and *transport equipment*. This is due to a combination of trade freeness and the sensitivity to firm selection. In particular, according to the evidence reported in Figure 3 and Figure 5, *electric machinery* and *transport equipment* are both characterised by a relative dominance of small unproductive firms and a relatively high openness to international competition. For both reasons, selection effects are strong in these sectors, making them more sensitive to frictions related to the existence of different currencies and other trade barriers. While trade freeness is below the median in *basic metals and fabricated metal products*, this sector ranks first in terms of the sensitivity to firm selection (or elasticity of the extensive margin), which explains why it also exhibits a strong selection effect.

	Overall competitiveness (estimated)	Overall competitiveness under hypothesis that all euro area countries revert to the euro	
		FN	BT
1 Food, Beverages and Tobacco	1.138	1.156	1.140
2 Textiles , Leather products and footwear	0.992	1.001	0.994
3 Wood Products except Furniture	0.336	0.357	0.340
4 Paper products, Printing and Publishing	0.505	0.515	0.508
5 Rubber and Plastic	0.215	0.219	0.216
6 Chemicals, including Pharmaceuticals	0.426	0.432	0.427
7 Non-metallic Mineral Prod., incl. Pottery and Glass	0.272	0.277	0.274
8 Basic Metals and Fabricated Metal Products	0.718	0.741	0.724
9 Non-electric Machinery	0.496	0.507	0.498
10 Electric Machinery, incl. Prof. and Scient. Equip.	0.625	0.658	0.640
11 Transport Equipment	0.579	0.591	0.582
12 Other Manufacturing, incl. Furniture	0.415	0.426	0.416

Source: Authors' Calculations



Note: Higher values than the baseline cut-off costs indicate losses in competitiveness.	Note: Changes from baseline productivity (inverse of cut-off costs); A negative sign indicates losses in competitiveness (higher cut-off); The term "5% more protection" indicates the losses arising from a uniform 5% increase in all trade frictions relative to their real value. Conversely the term "gains 5% freer trade" indicates the gains from a 5% reduction of all bilateral trade frictions.

Figure 9. Impact on specific industries when all countries reverting to national currencies in 2003 (Scenario 1)

To summarise, reverting to national currencies reduces the overall competitiveness of all euro area countries while generating small productivity gains for non-euro area countries. These effects are stronger for smaller countries with better access to European markets and specialized in sectors with higher trade freeness and higher sensitivity to firm selection. The same logic will explain what we find in the following scenarios.

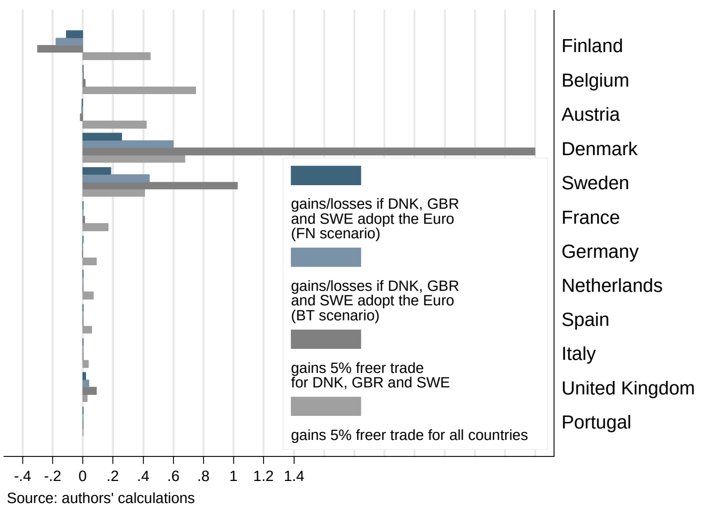
Scenario 2

For the second scenario, we reduce trade frictions between the euro area and Denmark, Sweden, the United Kingdom by either 3% or 7.1% (see third row of Table 4) while obviously leaving unchanged trade frictions within the euro area. The results of the corresponding simulation are reported in Figure 10. The benchmark range is now generated by the effects of increasing/decreasing trade protection between euro area and non-euro area countries by 5%.

Overall, the average impact for Europe as a whole is positive, although rather small. Only two of the three non-euro area countries (namely Denmark and Sweden) would gain in terms of overall competitiveness to an extent similar to an across-the-board reduction of trade frictions by 5%, while the United Kingdom would record an only minor gain.[13] As for the euro area countries, the changes in overall competitiveness are very modest, except in the case of Finland, which sees its competitive position worsening because of proximity to Denmark and Sweden.

	Countries	Overall competitiveness (estimated)	Overall competitiveness if Denmark, Sweden and U.Kingdom adopt the euro	
			FN	BT
AT	Austria	0.437	0.438	0.438
BE	Belgium	0.364	0.364	0.363
DE	Germany	0.413	0.413	0.413
DK	Denmark	0.447	0.433	0.442
ES	Spain	0.720	0.720	0.720
FI	Finland	0.374	0.378	0.381
FR	France	0.417	0.417	0.417
GB	United Kingdom	0.503	0.502	0.501
IT	Italy	0.613	0.613	0.613
NL	Netherlands	0.396	0.396	0.396
PT	Portugal	1.577	1.577	1.577
SE	Sweden	0.456	0.446	0.433

Note: Lower values than the baseline cut-off costs indicate gains in competitiveness



Note: Changes from baseline productivity (inverse of cut-off costs); A negative sign indicates losses in competitiveness (higher cut-off); The term "5% more protection" indicates the losses arising from a 5% increase in trade frictions for trade involving Denmark, Sweden

[13] Figure 10 also shows the rather remarkable gains for Denmark from a 5% decrease in trade frictions. The reason is the critical importance of Sweden as a trading partner for a rather small and nearby country like Denmark.

	or the United Kingdom. Conversely the term “gains 5% freer trade” indicates the gains from a 5% reduction of trade frictions affecting bilateral trade where one of the trade partners is Denmark, Sweden or the United Kingdom.

Figure 10. Denmark, Sweden and the United Kingdom adopt the euro in 2003 (Scenario 2)

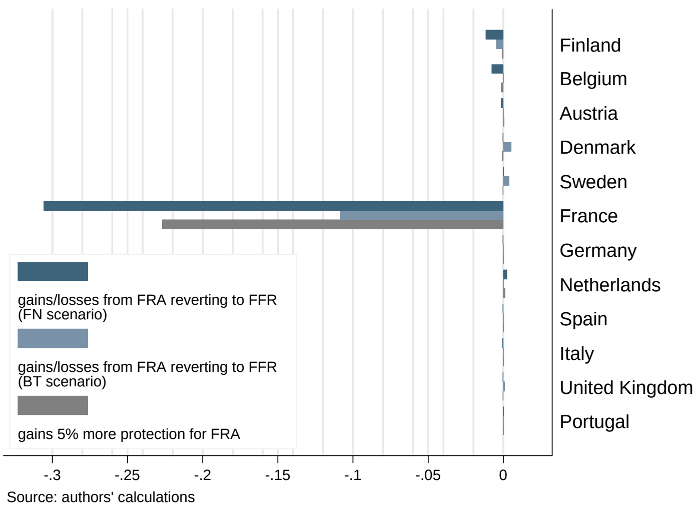
<u>Scenario 3</u>

Finally, for the third scenario, we change only the trade frictions for French exports to the euro area, increasing them either by 2% or 8.8% (see first row of Table 4). The benchmark range is generated by the effects of increasing/decreasing trade protection between France and the other euro area countries by 5 %.

Figure 11 shows that the loss in overall competitiveness for France is rather notable, ranging from 1.4% to 5.8%. The fact that all other countries are hardly affected is in line with the logic of the model. When market size matters, a departing partner faces a sharp reduction in market access across the board, while remaining members compensate for the negative impact of such departure by strengthening trade among themselves.

		Overall competitiveness (estimated)	Overall competitiveness if France reverts to FFR	
			FN	BT
AT	Austria	0.437	0.438	0.437
BE	Belgium	0.364	0.364	0.364
DE	Germany	0.413	0.413	0.413
DK	Denmark	0.447	0.447	0.446
ES	Spain	0.720	0.720	0.720
FI	Finland	0.374	0.375	0.375
FR	France	0.417	0.433	0.423
GB	United King	0.503	0.503	0.503
IT	Italy	0.613	0.613	0.613
NL	Netherlands	0.396	0.396	0.396
PT	Portugal	1.577	1.577	1.577
SE	Sweden	0.456	0.456	0.456

Note: Higher values than the baseline cut-off costs indicate losses in competitiveness.



Note: Changes from baseline productivity (inverse of cut-off costs); A negative sign indicates losses in competitiveness (higher cut-off); The term “5% more protection” indicates the losses arising from a 5% increase in trade frictions for trade involving France.

Figure 11. France reverts to the French Franc in 2003 (Scenario 3)

To summarise, the introduction of the euro appears to have benefited the overall competitiveness of member countries as defined in our “holistic” framework that combines the effects on delivery costs, markups, prices, quantities, revenues and profits. The impact appears to be relatively stronger for small central countries specialised in sectors that: (i) are relatively tradable, so that euro-related frictions are more relevant for them; (ii) have large fractions of small inefficient firms, so that selection effects via firm entry and exit are stronger for them.

6. CONCLUSION AND POLICY IMPLICATIONS

In this paper, we have exploited available data to calibrate a state-of-the-art trade model that we have used to quantify the microeconomic benefits of the euro. These benefits, which are due to an enhanced price transparency and lower transaction costs, arise from a further specialisation of countries in sectors in which they are more efficient, from richer product variety, from weakened market power on the part of firms, from a better exploitation of economies of scale and from improved production efficiency through the exit of the least efficient firms.

The model has been calibrated on 12 manufacturing sectors across 12 EU countries for the years from 2001 to 2003 and has been used to evaluate the competitiveness of European manufacturing firms in terms of an efficient usage of available inputs. In so doing, we have derived a ranking of European countries in terms of the cost effectiveness of the firms located therein – which we have taken as an indicator of the “overall competitiveness” of the corresponding countries. This indicator has then been used as a benchmark for two sets of experiments. First, in order to distinguish the extent to which the ability of a country to generate low-cost firms stems from aspects related to technology, versus market size and accessibility, we have derived another indicator, which we have called “producer competitiveness”. This indicator gives us the extent to which a country would be competitive in an ideal word in which trade frictions did not matter.

In the second set of experiments, we have simulated three counterfactual scenarios designed to evaluate how alternative (and hypothetical) euro membership setups would have affected the baseline overall competitiveness of the European countries considered. In the first scenario, in which all members of the euro area are assumed to have dropped the single currency in 2003, the average loss in their overall competitiveness ranges from 1.4% to 3.3%. In the second scenario, in which Denmark, Sweden and the United Kingdom adopt the euro in 2003, the average gain in overall competitiveness for those countries ranges from 1.5% to 3.4%. In the third and last scenario, in which France reverts to the French franc in 2003, the average loss in French overall competitiveness ranges from 1.4% to 5.8%.

Our findings have several policy implications. First, the impact on trade flows is at best only a first approximation of the possible gains arising from the euro. The reason is that trade creation is not a welfare gain in itself, but rather a channel through which different types of microeconomic gains can materialise. This casts a shadow on the customary obsession with the effects of the euro on trade flows.

Second, market size and accessibility are not the only key drivers of competitiveness. In particular, Mediterranean countries remain at the bottom of the competitiveness league even after controlling for their peripheral location, as shown by the rather insignificant difference between their indicators of overall and producer competitiveness. This suggests that being peripheral does not per se represent the problem with these countries. High entry barriers and poor technological opportunities seem to be more important.

Third, small central countries specialised in tradable sectors – especially if characterised by a relative dominance of small and medium-sized enterprises (SMEs) – experience the strongest reactions to our counterfactual experiments, which suggest that these countries gain most from the euro.

Finally, our methodological approach should be thought of as a practical second-best solution to concrete, but hopefully temporary, constraints on firm-level data availability that prevent a full-fledged econometric investigation. Its main shortcoming is its forced reliance on a complex theoretical structure. In this respect, our results should be interpreted as the "partial effects" of the euro, holding constant all the features of the economy that the theoretical model keeps constant in the first place, such as nominal wages and aggregate employment in the selected European countries, as well as competitiveness elsewhere in the world.

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Appendix 1 – The Calibrating Model

This appendix presents the main equations of the model we calibrate. Its is aimed at making the paper self-contained, so that only necessary information is provided. Interested readers should refer to Melitz and Ottaviano (2006) as well as to Del Gatto, Mion and Ottaviano (2006).

The inverse demand of a consumer in country *h* for the variety of firm *i*, when a set Ω of alternative varieties are on offer in sector *s*, is given by:

$$(1) \qquad p_s^h(i) = A_s - D_s e_s^h(i) - B_s \int_{i\in\Omega} e_s^h(i)di$$

which shows that, if the firm wants to increase the quantity sold $e_s^h(i)$, it has to lower its price $p_s^h(i)$. For an envisaged increase in quantity, the price drop is the larger, the smaller is D_s, which is thus a measure of product differentiation. The firm is unable to sell any quantity at all if it prices above the "choke price" $p_{s,\max}^h = A_s - B_s \int_{i\in\Omega} e_s^h(i)di$ at which $e_s^h(i)$ nullifies. This threshold price falls as the total quantity $\int_{i\in\Omega} e_s^h(i)di$ brought to the market by all firms increases. Equivalently, it falls as the average price $\overline{p}_s^h$ falls and the total number of firms N_s^l increases given that (1) allows us to write

$$(2) \qquad p_{s,\max}^h = \frac{D_s A_s - B_s N_s^h}{D_s + B_s N_s^h}$$

Pricing closer to this choke price implies an increase in the elasticity of demand as this evaluates to

$$(3) \qquad \varepsilon_s^h(i) = \left(\frac{p_{s,\max}^h}{p_s^h(i)} - 1 \right)^{-1}$$

The firm producing variety *i* for L^h consumers in country *h* faces a total demand equal to $q_s^h(i) = L^h e_s^h(i)$. If it draws a marginal cost *c*, the profit-maximising quantity sold to domestic consumers is

$$(4) \qquad q_s^{hh}(c) = \frac{L^h}{2D_s}\left(c_s^{hh} - c\right)$$

where $c_s^{hh} = p_{s,\max}^h$ is the maximum cost at which the quantity sold is (marginally) positive. Analogously, the profit maximising quantity sold to foreign consumers in country *t* is:

$$(5) \qquad q_s^{ht}(c) = \frac{L^h}{2D_s}\left(c_s^{ht} - c\right) = \frac{d_s^{ht} L^h}{2D_s}\left(c_s^{tt} - d_s^{ht} c\right)$$

where $d_s^{ht}>1$ is the factor measuring the cost increase per unit sold that is linked to international deliveries. Hence, the marginal exporter from country *h* to country *t* is necessarily d_s^{ht} times more efficient than the marginal local producer in country in country *t*, i.e. $c_s^{ht}=c_s^{tt}/d_s^{ht}$. Quantities (4) and (5) are both decreasing in *c*, meaning that less efficient firms are able to sell lower quantities and therefore achieve a smaller market share. The case of two identical countries (such that $L^h=L^t$, $d_s^{ht}=d_s^{th}$ and $c_s^{hh}=c_s^{tt}$) is represented in the top panel of Figure 1 in the main text.

If entrants draw their marginal costs from a Pareto distribution with cumulative density function $G_s^h(c)=\left(c/c_{A,s}^h\right)^{k_s}$ and probability density function $g_s^h(c)=k_s c^{k_s-1}/\left(c_{A,s}^h\right)^{k_s}$ (the latter is portrayed in the middle panel of Figure 1; see Box 1 for details), all average performance measures of the industry in country *h* are directly determined by the domestic cut-off. In particular, the average marginal cost, the average price and the average markup are respectively:

$$(6)\qquad \overline{c}_s^h=\frac{k_s}{k_s+1}c_s^{hh},\qquad \overline{p}_s^h=\frac{2k_s+1}{2(k_s+1)}c_s^{hh},\quad\text{and}\quad \overline{m}_s^h=\frac{c_s^{hh}}{2(k_s+1)}.$$

The average quantity, the average revenue and the average profit are:

$$(7)\qquad \overline{q}_s^h=\frac{L^h}{2D_s}\frac{c_s^{hh}}{k_s+1},\qquad \overline{r}_s^h=\frac{L^h}{2D_s}\frac{\left(c_s^{hh}\right)^2}{k_s+2},\quad\text{and}\quad \overline{P}_s^h=\frac{L^h}{2D_s}\frac{\left(c_s^{hh}\right)^2}{(k_s+1)(k_s+2)}.$$

The (indirect) utility associated with demand (1), as achieved by a local resident, is:

$$(8)\qquad U^h=I^h+\frac{1}{2B_s}\left(A_s-c_s^{hh}\right)\left(A_s-\frac{k_s+1}{k_s+2}c_s^{hh}\right)$$

which shows that any decrease in the domestic cut-off c_s^{hh} generates higher welfare.

At the entry stage firms incur the sunk entry cost f_s^h in country *h* until this is exactly matched by expected profits. Since all firms are identical before drawing their marginal costs, they share the same expected profits. For each possible country of destination *t*, these consist of two ingredients: the profit of the average seller in the market

$$(9)\qquad \overline{P}_s^{tt}=\frac{L^t}{2D_s}\frac{\left(c_s^{tt}\right)^2}{(k_s+1)(k_s+2)},$$

and the probability of being efficient enough to sell in that market:

$$(10)\qquad prob_s^{ht}=\left(\frac{c_s^{ht}}{c_{s,A}^h}\right)^{k_s}=\left(\frac{c_s^{tt}}{c_{s,A}^h}\right)^{k_s}T_s^{ht}$$

where the second equality is granted by $c_s^{ht} = c_s^{tt} / d_s^{ht}$ and by the definition of the bilateral trade freeness index $T_s^{ht} = \left(d_s^{ht}\right)^{-k_s}$. Summing up across all 13 countries of destination, expected profits match the sunk entry cost as long as

$$(11) \qquad \sum_{t=1}^{12} prob_s^{ht} \cdot \overline{P}_s^{tt} = \frac{\left(c_{s,A}^{h}\right)^{-k_s}}{2D_s\left(k_s+1\right)\left(k_s+2\right)} \sum_{t=1}^{12}\left[T_s^{ht}\left(c_s^{tt}\right)^{k_s+2} L^t\right] = f_s^h \, ,$$

which is portrayed in the bottom panel of Figure 1 in the case of two identical countries.

Since a free entry condition like (11) holds for each of our 12 EU countries, we have a system of 12 equations in 12 unknown domestic cut-off costs. Its solution gives an equilibrium domestic cut-off cost for each country:

$$(12) \qquad c_s^{hh} = \left[\frac{2D_s(k_s+1)(k_s+2)}{L^h} \frac{\sum_{t=1}^{13}\left|C_s^{th}\right| / \left[f_s^t / \left(o_s^t\right)^{k_s}\right]}{\left|T_s\right|} \right]^{\frac{1}{k_s+2}} ,$$

where $o_s^t = 1/c_{A,s}^t$ is the index of absolute advantage, $\left|T_s\right|$ is the determinant of the trade freeness matrix, whose element T_s^{ht} indexes the freeness of trade from country *h* to country *t*, and $\left|C_s^{th}\right|$ is the co-factor of its T_s^{th} element. In the case of two identical countries the cut-off cost corresponds to the intersection between the entry cost and the expected profit curves in Figure 1.

Finally, the model also yields a "gravity equation" for aggregate bilateral trade flows. A firm operating in sector *s* with cost *c* and exporting from country *h* to country *t* generates export sales $r_s^{ht}(c) = p_s^{ht}(c) q_s^{ht}(c)$ where the quantity exported $q_s^{ht}(c)$ is given by (5) with the associated price:

$$(13) \qquad p_s^{ht}(c) = \frac{1}{2_s}\left(c_s^{tt} + d_s^{ht} c\right).$$

Aggregating these export sales $r_s^{ht}(c)$ over all exporters from country *h* to country *t* (with cost *c* below $c_s^{ht} = c_s^{tt} / d_s^{ht}$) yields the aggregate bilateral exports from country *h* to country *t*:

$$(14) \qquad EXP_s^{ht} = \frac{1}{2D_s(k_s+2)} N_E^h \left(o_s^h\right)^{k_s} L^t \left(c_s^{tt}\right)^{k_s+2} \left(d_s^{ht}\right)^{-k_s}$$

where N_E^h is the number of entrants in sector *s* and country *h*. This is a "gravity equation" insofar as it determines bilateral exports as a log-linear function of bilateral trade barriers and country characteristics. As in Helpman, Melitz, and Rubinstein (2008), (14) reflects the joint effects of country size, technology (absolute advantage), and distance on both the extensive (number of traded goods) and intensive (amount traded per good) margins of trade flows. Similarly, (14) highlights how, holding the importing country size L^t fixed, tougher competition in that country, reflected by a lower c_s^{tt}, dampens exports by making it harder for potential exporters to break into that market. The gravity equation (14) is used in Section 4.1.1 to estimate bilateral trade freeness.

Appendix 2 – Empirical implementation and robustness checks

Trade freeness

On the basis of Helpman, Melitz and Rubinstein (2008) and in line with our theoretical model, the gravity estimation discussed in Box 2 consists of two stages. In the first stage, a probit regression is run on a dataset of world trade at the sectoral level. The dataset covers bilateral trade among 212 countries in 27 three-digit NACE manufacturing industries.[14] It also accounts for domestic flows, constructed as the difference between a country's domestic production and its exports. The probit equation specifies the probability that country *h* exports to country *t* as a function of observable variables:

$$\text{(A.1)} \quad \begin{aligned} pr_{ht} &= \Pr(EXP_s^{ht} = 1 | observed\_variables) \\ &= \phi\left[\ln(distance^{ht}) + EX_h + IM_h + col + comcol + col45 + smctry\right] \end{aligned}$$

where Φ(.) is the cumulative density function of the unit-normal distribution, EXP_s^{ht} are the exports of sector *s* from country *h* to country *t*, EX_h and IM_t are dummies specific to the countries of origin and destination. Trade barriers are captured by bilateral distance ($distance^{ht}$) and a range of other accessory geographical controls: *col*, indicating if two countries were ever in a colony-coloniser relationship; *col45*, indicating if the colony-coloniser relationship extended beyond 1945; *smctry* indicating if two countries were ever part of the same nation. The probit estimation allows us to generate additional variables ($Firmshare^{ht}$ and $Selection^{ht}$) that can be used to control for the unobserved underlying firm-level heterogeneity, which is likely to be correlated with trade flows (Helpman, Melitz and Rubinstein, 2008). $Selection^{ht}$ also corrects for biases arising from a possible non-random sample selection of the observations (Heckman, 1979). Predicted components of this equation are then used in the second stage to estimate the gravity equation expressed in log-linear form and reported in Box 2. This second estimation is free from biases arising from the non-random selection of observations as well as from potentially heterogeneous groups of firms selling to different export markets.

TFP and elasticity of the extensive margin

We have estimated the elasticity of the extensive margin in sector *s* (k_s) from the sectoral distribution of total factor productivity (TFP). Such distribution is generated by estimating TFP at the level of the individual firm by exploiting the balance sheet information (unconsolidated

[14] While we are interested in bilateral trade between the EU-15, these include a very large number of observations (97%) whose characteristics are such that their estimated probability of trade is indistinguishable from 1. This jeopardizes the first step of the approach of Helpman, Melitz and Rubinstein (2008). For this reason, we have expanded our sample to include as many trade partners as possible grouping the 27 NACE sectors in our 12 aggregated industries.

accounts) information provided by the Amadeus database of the Bureau van Dijk. This covers the value added, fixed assets (capital), sales and the cost of materials (intermediate consumption) in thousands of euros, as well as the number of employees from a large cross section of European manufacturing firms. We have used data from a sample covering our 12 countries and eliminated firms with missing values and extreme observations. These are defined as having either value-added-to-employee or capital-to-employee ratios out of the range identified by the 1st and 99th percentiles. The resulting sample consists of 427,242 firms.

The simplest way to estimate TFP is by means of a log-linear OLS regression of value added over measures of capital and labour employment (see Box 3). This method, however, might lead to biased estimates due to the underlying assumption that TFP is constant over time. To correct for these biases, more sophisticated methods have been proposed by Olley and Pakes (1996) as well as by Levinshon and Petrin (2003). These approaches are, nonetheless, more data demanding than OLS, as they require information on firms' investment behaviour and intermediate inputs. Since such information is only available for a subset of firms and countries in our sample, we have opted for a standard log-linear OLS regression for our baseline.[15] Summary statistics for the corresponding results are reported in Table A. 1. Moreover, Table A. 2 reports the average TFP, by country and sector.

Table A. 1 Summary statistics on TFP (sectoral averages), 2001-2003

Sector	Firms	Average TFP	Std. Dev.	Min.	Max	Adj. R^2
1 Food, Beverages and Tobacco	51001	22.11	42.87	2.29	1476.7	0.90
2 Textiles , Leather products and footwear	40510	25.04	21.93	3.51	562.02	0.85
3 Wood Products except Furniture	25930	20	17.75	3.39	444.33	0.89
4 Paper products, Printing and Publishing	49196	33.67	78.45	2.98	3272.43	0.91
5 Rubber and Plastic	19416	32.94	58.51	5.18	943.63	0.92
6 Chemicals, including Pharmaceuticals	15551	42.92	172.99	2.62	3016.16	0.92
7 Non-metallic Mineral Prod., incl. Pottery and Glass	22772	23.06	30.17	3.68	791.1	0.90
8 Basic Metals and Fabricated Metal Products	92139	29.45	90.56	2.67	4738.54	0.91
9 Non-electric Machinery	38314	36.52	46.3	3.54	1216.43	0.93
10 Electric Machinery, incl. Prof. and Scient. Equip.	30095	59.48	249.88	2.33	4187.55	0.92
11 Transport Equipment	12727	29.43	62.81	3.8	1480.83	0.95
12 Other Manufacturing, incl. Furniture	29591	27.85	76.91	2.71	2883.22	0.89

Source: AMADEUS and authors' calculations

Table A. 2 TFP (firm-level based estimates), 2001-2003

[15] A comparison (not reported here) of results using the baseline TFP estimation and the one proposed by Levinshon and Petrin (2003) for the subset of countries that allow such computation however shows that differences are minor.

Sector:	_AT	_BE	_DE	_DK	_ES	_FI	_FR	_GB	_IT	_NL	_PT	_SE
1	22.06	29.64	21.72	30.07	13.31	21.17	20.56	19.66	20.54	40.28	11.36	14.96
2	24.10	30.33	28.93	32.50	15.54	24.27	30.67	24.64	24.71	36.24	8.91	19.61
3	17.33	31.48	21.39	26.93	14.71	19.81	22.03	18.05	20.77	18.90	10.26	18.32
4	34.37	43.98	33.15	52.42	21.92	39.12	42.98	32.19	26.30	32.10	16.60	28.96
5	23.83	33.97	83.35	38.44	20.77	40.68	26.59	21.07	24.50	46.79	12.41	22.89
6	25.57	44.02	102.49	44.79	21.11	38.71	33.76	29.44	36.47	102.71	14.04	21.88
7	23.28	26.48	24.50	34.33	16.05	24.64	25.80	22.19	19.84	28.71	13.29	17.61
8	27.49	51.61	42.02	34.95	20.03	27.27	30.43	26.69	24.01	30.98	16.15	21.77
9	43.03	41.52	43.23	45.41	26.60	47.20	36.87	34.69	30.97	46.05	14.22	28.42
10	39.37	44.34	41.79	54.61	25.24	34.58	37.66	34.58	30.32	320.84	22.11	28.26
11	27.95	45.01	32.02	33.94	22.72	30.98	28.89	27.30	36.50	34.00	12.15	21.72
12	24.69	36.90	29.96	42.84	16.03	28.14	36.01	24.04	30.56	36.50	8.37	20.21

Source: AMADEUS and authors' calculations

Cost cut-offs

As discussed in Box 1, the cost cut-off in sector *s* and country *h* is computed by multiplying the corresponding average cost by the factor $k_s/(k_s+1)$. Results by sector and country are reported in Table A. 3. In turn, the baseline average cost in sector *s* and country *h* is computed as the inverse of the corresponding average labour productivity (value added per hour worked). This is reported in Table A. 4.

Table A. 3: Country and sector specific cost cut-offs, average 2001-2003

Country / Sector	_AT	_BE	_DE	_DK	_ES	_FI	_FR	_GB	_IT	_NL	_PT	_SE
1	0.078	0.052	0.085	0.059	0.100	0.061	0.071	0.060	0.079	0.044	0.161	0.063
2	0.092	0.081	0.095	0.088	0.193	0.134	0.096	0.121	0.121	0.086	0.377	0.101
3	0.071	0.063	0.086	0.071	0.158	0.071	0.078	0.102	0.114	0.166	0.303	0.080
4	0.043	0.048	0.061	0.064	0.078	0.035	0.059	0.061	0.070	0.054	0.110	0.046
5	0.049	0.043	0.050	0.049	0.071	0.049	0.050	0.067	0.064	0.052	0.132	0.056
6	0.046	0.035	0.042	0.040	0.064	0.045	0.028	0.046	0.052	0.030	0.104	0.028
7	0.051	0.042	0.057	0.054	0.077	0.056	0.050	0.063	0.065	0.069	0.140	0.063
8	0.045	0.045	0.048	0.054	0.074	0.049	0.053	0.069	0.069	0.054	0.171	0.053
9	0.049	0.042	0.041	0.052	0.071	0.052	0.049	0.059	0.061	0.051	0.135	0.051
10	0.046	0.046	0.047	0.046	0.080	0.027	0.050	0.061	0.066	0.068	0.129	0.071
11	0.039	0.045	0.034	0.059	0.070	0.059	0.038	0.054	0.064	0.049	0.112	0.048
12	0.078	0.069	0.074	0.067	0.149	0.092	0.079	0.092	0.102	0.070	0.288	0.122

Table A. 4: Labour productivity, average 2001-2003

Country: / Sector:	_AUT	_BEL	_DEU	_DNK	_ESP	_FIN	_FRA	_GBR	_IRL	_ITA	_NLD	_PRT	_SWE
1	26.81	40.69	24.74	35.57	21.09	34.31	29.60	35.32	43.94	26.70	47.79	13.06	33.17
2	26.88	30.73	26.09	28.35	12.86	18.53	25.82	20.51	18.69	20.48	28.73	6.58	24.58
3	28.89	32.44	23.97	29.15	12.98	28.88	26.23	20.08	18.69	17.96	12.36	6.78	25.78
4	48.64	43.58	34.17	32.91	27.02	59.95	35.62	34.65	81.42	30.16	39.05	19.14	45.23
5	34.55	39.79	33.92	35.15	24.16	34.72	34.41	25.66	22.94	26.72	32.69	12.97	30.71
6	54.00	70.41	59.40	62.48	38.41	54.77	87.15	53.62	252.24	47.88	81.44	23.67	87.03
7	37.59	44.79	33.27	35.14	24.72	34.11	38.07	30.33	31.23	29.35	27.38	13.54	29.96
8	36.40	36.54	34.17	30.67	22.15	33.27	31.05	23.85	23.29	23.97	30.42	9.59	30.94
9	34.47	39.94	40.47	32.01	23.74	32.04	34.41	28.57	25.67	27.53	32.83	12.45	32.98
10	39.57	39.83	38.43	39.49	22.84	67.50	36.60	30.02	53.07	27.64	26.56	14.12	25.53
11	45.51	38.74	51.37	30.00	25.19	29.94	46.69	32.82	25.72	27.53	35.64	15.69	36.92
12	25.44	28.81	26.94	29.48	13.34	21.64	25.28	21.52	13.88	19.40	28.35	6.89	16.33

Source: EUKLEMS

Producer competitiveness

Table A. 5 reports the values of producer competitiveness by sector and country. These are obtained from the calibrated bundle $D_s / \left\lfloor f_s^t / \left(o_s^t\right)^{k_s} \right\rfloor$ reported in Table A. 6. In particular, since the parameter of product differentiation D_s is sector but not country specific, we have separated it from $\left\lfloor f_s^t / \left(o_s^t\right)^{k_s} \right\rfloor$ by regressing the logarithm of $D_s / \left\lfloor f_s^t / \left(o_s^t\right)^{k_s} \right\rfloor$ on a complete set of sectoral dummies (*sdum*). Table A. 7 presents the estimated coefficients of such regression, which provide an indication of product differentiation across sectors.

Table A. 5: Producer competitiveness: sector and country specific coefficients

Sector \ Country	_AT	_BE	_DE	_DK	_ES	_FI	_FR	_GB	_IT	_NL	_PT	_SE
1	1.226	1.104	0.298	2.549	0.470	4.569	0.901	0.962	0.738	1.475	0.142	3.374
2	2.390	1.196	1.029	2.764	0.308	2.623	1.293	0.547	0.961	1.246	0.057	3.168
3	2.922	0.321	1.007	2.332	0.621	6.048	1.794	0.766	1.267	0.191	0.095	3.843
4	2.640	0.592	0.455	1.394	0.660	8.440	0.953	0.457	0.641	0.556	0.272	4.285
5	2.336	0.863	0.867	2.507	0.678	4.642	1.339	0.324	0.750	0.778	0.096	2.984
6	1.466	0.872	0.607	2.261	0.439	3.422	2.074	0.435	0.625	1.051	0.130	4.921
7	2.621	0.534	0.716	2.262	0.796	4.763	1.713	0.519	1.043	0.354	0.122	2.900
8	2.799	0.933	1.250	2.389	0.625	4.969	1.297	0.373	0.773	0.836	0.037	3.529
9	2.225	0.938	1.297	2.125	0.556	3.621	1.216	0.481	0.757	0.862	0.077	2.956
10	2.525	0.608	1.040	2.408	0.560	5.052	1.382	0.572	0.797	0.484	0.163	1.844
11	2.683	0.794	1.525	1.525	0.513	2.584	1.731	0.537	0.515	0.760	0.145	2.873
12	2.195	1.339	1.223	2.584	0.331	2.918	1.269	0.738	0.864	1.433	0.059	1.619

Table A. 6: Calibrated parameter bundles $D_s(f_s^t/(o_s^t)^k{}_s)$

Sector \ Country	_AT	_BE	_DE	_DK	_ES	_FI	_FR	_GB	_IT	_NL	_PT	_SE
1	7.707	6.936	1.872	16.021	2.953	28.713	5.662	6.045	4.635	9.272	0.895	21.202
2	0.761	0.381	0.328	0.880	0.098	0.836	0.412	0.174	0.306	0.397	0.018	1.009
3	5.306	0.582	1.829	4.233	1.128	10.981	3.256	1.391	2.300	0.347	0.172	6.978
4	137.001	30.714	23.634	72.336	34.238	437.932	49.475	23.711	33.249	28.828	14.125	222.345
5	228.821	84.554	84.934	245.578	66.405	454.651	131.145	31.686	73.484	76.187	9.403	292.222
6	55.161	32.817	22.838	85.043	16.497	128.741	78.006	16.373	23.501	39.537	4.894	185.133
7	175.343	35.731	47.886	151.349	53.253	318.686	114.605	34.694	69.792	23.666	8.189	194.053
8	498.106	166.091	222.494	425.078	111.301	884.176	230.786	66.397	137.525	148.777	6.649	627.893
9	154.884	65.303	90.250	147.877	38.689	251.987	84.632	33.444	52.703	60.017	5.328	205.739
10	44.567	10.723	18.356	42.502	9.889	89.164	24.396	10.099	14.065	8.548	2.886	32.540
11	130.730	38.680	74.328	74.297	25.019	125.902	84.372	26.192	25.106	37.047	7.084	140.005
12	1.423	0.868	0.793	1.675	0.214	1.892	0.822	0.478	0.560	0.929	0.039	1.050

Table A. 7 : Regression results of OLS estimation of $D_s(f_s^t/(o_s^t)^k{}_s)$ over a full set of sectoral dummies

Variable	Coefficient	
sdum1	-1.84	***
sdum2	1.140	***
sdum3	-0.6	*
sdum4	-3.950	***
sdum5	-4.580	***
sdum6	-3.630	***
sdum7	-4.200	***
sdum8	-5.180	***
sdum9	-4.240	***
sdum10	-2.870	***
sdum11	-3.890	***
sdum12	0.430	*
N	144	
r2_a	0.91	