Productivity and Firm Selection: Quantifying the "New" Gains from Trade.*

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Abstract

We discuss how standard computable equilibrium models of trade policy can be enriched with selection effects without missing other important channels of adjustment. This is achieved by estimating and simulating a partial equilibrium model that accounts for a number of real world effects of trade liberalisation: richer availability of product varieties; tougher competition and weaker market power of firms; better exploitation of economies of scale; and, of course, efficiency gains via the selection of the most efficient firms. The model is estimated on E.U. data and simulated in counterfactual scenarios that capture several dimensions of European integration. Simulations suggest that the gains from trade are much larger in the presence of selection effects. Even in a relatively integrated economy as the E.U., dismantling residual trade barriers would deliver relevant welfare gains stemming from lower production costs, smaller markups, lower prices, larger firm scale and richer product variety. We believe our analysis provides enough ground to support the inclusion of firm heterogeneity and selection effects in the standard toolkit of trade policy evaluation.

Keywords: European integration, firm-level data, firm selection, gains from trade, total factor productivity
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1 Introduction

In the aftermath of the financial crisis and the ensuing collapse of manufacturing, the temptation of protectionism looms on the path to recovery. The welfare losses from protectionism are well understood and some have been known for a couple of centuries: protectionism breeds inefficiency. By doping the price mechanism, protectionism distorts the allocation of resources forcing consumers to buy from cost ineffective producers and countries to be active in industries in which they have no cost advantage. By focusing firms on their domestic markets, protectionism also prevents the exploitation of scale economies and reduces the variety of both final and intermediate products available to consumers and producers. Finally, by promoting the market power of local firms, protectionism fosters their rents and wasteful rent-shifting activities.

Though the principles are well understood, as protectionist pressure mounts it is becoming increasingly crucial to give a sense of the order of magnitude of the costs of protectionism and, symmetrically, of the benefits of free trade. Along the years, this has been the objective of a vast literature that has tried to put numbers on the predictions of theoretical models of trade policy (see, e.g., Piermartini and Teh, 2005, for a recent survey). Its main tools are computable partial and general equilibrium models based on two methodological pillars. On the one hand, the idea is that policy analysis cannot but benefit from the logical rigour and consistency of theoretical models. On the other hand, it is acknowledged that the issues analyzed, often involving a multiplicity of linkages among a plethora of economic players, are so complex that they cannot be solved by relying only on a model in the analyst's head or a simple diagram. Computer-based models are then used to track such complex interactions and, through simulation, answer 'what if' type of questions concerning the effects of trade policies.

Compared with the state of the art in international trade theory, the main limitation of that literature is its current neglect of firm heterogeneity, which implies that only scale economies drive endogenous changes in aggregate productivity.[1] In recent models with heterogeneous firms trade liberalization has, instead, an additional positive impact on aggregate productivity through the selection of the most efficient firms (Bernard et al., 2003; Melitz, 2003). The reason is a combination of import competition and export market access. On the one hand, as lower trade costs allow foreign producers to target the domestic markets, the operating profits of domestic firms in those markets shrink whatever their productivities. On the other hand, some domestic firms gain access to foreign markets and get additional profits from their foreign ventures. These are the firms that are productive enough to cope with the additional costs of foreign activity (such as those due to transportation and remaining administrative duties or institutional and cultural barriers). The result is the partition of the initially active domestic firms in three groups. As they start making losses in their home markets without gaining access to foreign markets, the least productive firms are forced to exit. On the contrary, as they are able to compensate lost profits on home sales with new profits on foreign sales, the most productive firms survive and expand their market shares. Finally, firms with intermediate levels of productivity also survive but, not being productive enough to access foreign markets, are relegated to home sales only and their market shares fall. Since international trade integration eliminates the least productive firms, average productivity grows through the reallocation of productive resources from less to more efficient producers.

This mechanism found empirical support in early firm-level analyses that tried to identify the direction of causation hidden in the positive correlation between the export status of a firm and its productivity (called 'exceptional exporter performance' by Bernard and Jensen, 1999). This is a crucial issue for trade policy. Causation going from export status to firm performance would reveal the existence of 'learning by exporting' and, therefore, call for export promotion. However, apart from peculiar cases concerning developing countries, most of the evidence supports reverse

[1] See, e.g., Haaland and Norman (1992).

causation in the form of 'selection into export status': firms that already perform better have a stronger propensity to export than other firms (Tybout, 2003). Selection comes with two additional effects that are consistent with the theoretical argument discussed above. First, exposure to trade forces the least productive firms to shut down (Clerides, Lach and Tybout, 1998; Bernard and Jensen, 1999; Aw, Chung and Roberts, 2000). Second, trade liberalization leads to market share reallocations towards the most productive firms (Pavcnik, 2002; Bernard, Jensen and Schott 2006). On both counts, aggregate average productivity improves. In the last few years a burgeoning empirical literature has confirmed those early results.[2]

The empirical relevance of the selection effect motivates additional efforts towards quantifying the corresponding gains from trade as a preliminary step towards their integration in the large-scale computable general equilibrium models used for policy analysis. This line of research has been heralded by Tybout (2003) and pursued by Bernard et al. (2003). These authors calibrate and simulate an oligopolistic model with heterogenous firms obtained by introducing Bertrand competition in the probabilistic Ricardian framework developed by Eaton and Kortum (2002).[3] Aggregate U.S. production data and trade data on the 47 leading U.S. export destinations (including the U.S. itself) are used to calibrate the model's parameters governing geographic barriers, aggregate technology differences, and differences in input costs. U.S. plant level data are used, instead, to calibrate the parameters that relate to the heterogeneity of goods in production and consumption. The calibrated model is then used to assess the impacts of various counterfactual scenarios.

The counterfactual analysis by Bernard et al. (2003) has the merit of showing for the first time how to provide a quantitative assessment of the selection effect of trade liberalization in the spirit of computable equilibrium models. It neglects, however, a few important dimensions of the effects of trade policy highlighted by both theoretical and empirical research. First, in the model of Bernard et al. (2003) the equilibrium distribution of firm markups is invariant to country characteristics and to geographic barriers. This removes an important source of cross-country variation in the selection effects and is not consistent with empirical evidence showing that markups do vary across firms and markets (Tybout, 2003). Second, Bernard et al. (2003) assume that firms' entry does not respond to market profitability. This removes an important channel through which industry equilibrium is eventually restored and gives the model a strong short-run flavor.[4]

The aim of the present paper is to supplement the analysis by Bernard et al. (2003) suggesting how standard computable equilibrium models of trade policy can be enriched with selection effects without missing other important channels of adjustment. This is achieved by estimating and simulating a partial equilibrium model derived from Melitz and Ottaviano (2008). This model accounts for a number of real world effects of trade liberalisation: richer availability of product varieties; tougher competition and weaker market power of firms; better exploitation of economies of scale; and, of course, efficiency gains via the selection of the most efficient firms.[5] The model is estimated on E.U. data and simulated in counterfactual scenarios that capture several dimensions of European integration. Simulations show that the gains from trade are much larger in the pres-

[2] Recent evidence on the existence of causation from trade to aggregate income and productivity is provided by Frankel and Rose (2002), who find per capita income to be positively affected by the formation of currency unions, thanks to their positive impact on trade, and by Alcalà and Ciccone (2004), who report strong support for a positive causal effect of trade on labor productivity. With respect to our analysis, Alcalà and Ciccone (2004) provide the interesting insight that, at the aggregate level, such a positive causation mainly acts through total factor productivity.

[3] See also Finicelli et al. (2008) for a calibration and simulation of the perfectly competitive model by Eaton and Kortum (2002) as well as Waugh (2008) for a variant of the same model with traded intermediates and non-traded final goods.

[4] Markups are constant also in the CES models by Melitz (2003) and Chaney (2008).

[5] Chen, Imbs and Scott (2009) test the implications of the model by Melitz and Ottaviano (2008) for the dynamics of prices, productivity and markups as functions of openness to trade at a sectoral level. Using disaggregated data for EU manufacturing over the period 1989-1999, they find evidence that trade openness exerts a competitive effect, with prices and markups falling and productivity rising.

ence of selection effects. Even in a relatively integrated economy as the E.U., dismantling residual trade barriers would deliver relevant welfare gains stemming from lower production costs, smaller markups, lower prices, larger firm scale and richer product variety.[6] These effects of international trade liberalization are, however, unevenly distributed between and within countries. Small, competitive and centrally located countries are those who benefit the most. Within countries, the main beneficiaries are the border regions located closer to the core of the European market. Given the current map of regional disparities, the fact that geography plays a key role in determining the distribution of gains across European regions implies that deeper integration may actually foster regional divergence.

How should our results be read? First of all, simulations of computable equilibrium models are not forecasts. As pointed out by Piermartini and Teh (2005), a forecast involves predicting the future values of the endogenous variables in the model making assumptions on the likely evolution of all its exogenous variables. Simulations concern, instead, hypothetical counterfactual scenarios whose investigation is not necessarily wedded to a particular view about the likelihood of the exogenous variables changing in a certain way. However, their usefulness in understanding complex and sometimes unexpected interactions in an economy should not be underestimated. As shown by Ottaviano et al (2009) in their investigation of the selection effects of the euro based on the methodology developed in the present paper, the simulation of computable equilibrium models is often the only way to give a sense of the order of magnitude of policies when data unavailability prevents econometric investigation.

Second, we use a computable *partial* equilibrium model. As such it focuses only on a part of the economy (manufacturing) abstracting from the impact of that part on the rest of the economy and vice versa. Because it does not take into account the link between factor incomes and expenditures, our partial equilibrium model cannot be used to determine income, whereas general equilibrium models can. In our case, however, we think that the benefits of a general equilibrium model are offset by the too high level of aggregation it requires to be able to use comparable and consistent data.

Third, in our simulations we adopt a comparative statics approach that examines how a change in policy changes the endogenous variables. Accordingly, we are concerned with discerning the difference between the initial and final equilibrium of the economy and not with the transition required to move from the former to the latter. An obvious limitation of this approach is that it may fail to capture some of the costs and benefits associated with the transition and so misstate the costs and benefits of a policy change. Dynamic models of international trade are, however, a exception both in theoretical and applied research.[7]

Fourth and last, we estimate our model on the European Union. This is mainly due to the fact that comparable firm-level panel data across a large set of countries is available only for Europe. While computable equilibrium models are not forecasts, they are clearly more valuable the more accurate their calibration and simulation are. An important methodological contribution of the present paper is to shows how to structurally estimate several parameters of the model combining macro and micro data. In addition, the focus on a set of sufficiently integrated countries, which are relatively homogeneous in terms of economic development and institutions, allows us to control for several confounding factors that may blur the working of selection effects in more heterogenous data sets.

The rest of the paper is organized in five additional sections. Section 2 presents the model. Section 3 describes its estimation. Section 4 simulates alternative scenarios. Section 5 discusses the robustness of the simulated results. Section 6 concludes. Additional details on data are provided

[6] As we will discuss, there is no obvious way to estimate the preference parameters. Hence, we are not able to assess the quantitative impact of counterfactual scenarios on the number of firms and, therefore, on overall welfare. Nevertheless, in the theoretical model indirect utility turns out to be positively correlated with average productivity irrespective of the number of firms.

[7] See Costantini and Melitz (2008) and Arkolakis (2008) for two recent exceptions.

in the Appendix.

2 Theoretical framework

The model is based on the one proposed by Melitz and Ottaviano (2008) that we apply to a partial equilibrium framework and extend to allow for international differences in factor prices and entry costs.

2.1 An industry model

Consider an industry that is active in M countries, indexed $l = 1, ..., M$. Country l is endowed with given amounts of labor L^l and capital K^l. Both labor and capital are geographically immobile. The output of the industry is horizontally differentiated in a large set of varieties and we call N^l the measure ('number') of varieties sold in country l. Following Ottaviano et al. (2002), the inverse demand of a generic variety i in country l is linear and given by:

$$p^l(i) = \alpha - \frac{\upsilon q^l(i) + \eta Q^l}{L^l} \tag{1}$$

where $p^l(i)$ and $q^l(i)$ are the price and the quantity of variety i while $Q^l \equiv \int_0^{N^l} q^l(i)di$ is the total quantity of the differentiated good. Parameters α and η are positive and measure the intensity of the preference for the differentiated good: the larger α and the smaller η, the higher the vertical intercept of the linear demand. The parameter υ is also positive and measures the degree of product differentiation among the varieties of the differentiated good: the larger υ, the flatter the linear demand.

We define average price and average quantity of varieties sold in country l as $\overline{q}^l \equiv Q^l/N^l$ and $\overline{p}^l \equiv \left(1/N^l\right) \int_0^{N^l} p^l(i)di$ respectively. Then (1) implies the simple average relation $\overline{q}^l = (\alpha - \overline{p}^l)/(\upsilon + \eta N^l)$. This can be used to substitute for $Q^l = N^l \overline{q}^l$ in (1) to show that variety i is demanded (i.e. $q^l(i) > 0$) provided that its price is low enough

$$p^l(i) \leq \frac{1}{\eta N^l + \upsilon} \left(\upsilon\alpha + \eta N^l \overline{p}^l\right) \equiv p^l. \tag{2}$$

This condition holds if consumers like the differentiated good a lot (large α and small η), varieties are very differentiated (large υ), the average price $\overline{p}^l$ is high, and the number of competing varieties N^l is small. In all these circumstances the price elasticity of demand $\varepsilon^l(i) \equiv \left\{\left[p^l/p^l(i)\right] - 1\right\}^{-1}$ is low.

Market structure is monopolistically competitive and each variety is supplied by one and only one firm. In particular, the demand function (1) implies that firms do not interact directly. However, they do interact indirectly through an aggregate demand effect as shown by the presence of Q^l. Thus, though each firm is negligible to the market, when choosing its output level it must figure out what the total output of the industry will be. In other words, a firm accurately neglects its impact on the market but must explicitly account for the impact of the market on its profit.

All firms use the same technology employing labor and capital as their inputs but are heterogeneous in terms of efficiency in their usage. Different efficiency stems from different 'total factor productivity' (TFP). Specifically, the technology of a generic firm based in country l is described by the following Cobb-Douglas production function with constant returns to scale:

$$q^l(c) = c^{-1} x^l(c) \tag{3}$$

where c is the firm's inverse TFP, which we call 'unit input requirement' (UIR), while $x^l(c) = k^l(c)^{\beta_K} l^l(c)^{\beta_L}$ is the Cobb-Douglas composite input of capital $k^l(c)$ and labor employment $l^l(c)$

with factor shares $\beta_K + \beta_L = 1$ respectively. As in traditional Heckscher-Ohlin models, we assume that factor shares are the same across countries.

It will turn out to be convenient to index each firm by its UIR. Accordingly, technology (3) implies that firm c producing in country l faces marginal cost

$$m^l(c) = B\omega^l c \tag{4}$$

where $B \equiv (\beta_L)^{-\beta_L}(\beta_K)^{-\beta_K}$ is a positive constant and $\omega^l \equiv \left(r^l\right)^{\beta_K}\left(w^l\right)^{\beta_L}$ is the exact price index of the composite input $x^l(c)$ with w and r denoting the wage and the rental price of capital respectively.

Firm heterogeneity is modelled as the outcome of a research and development process with uncertain outcome. In particular, in order to enter the market, each firm has to make an irreversible ('sunk') investment in terms of labor and capital to invent its own variety. The investment is equal to $F^l = \omega^l f^l$ as we assume that it entails the same factor proportions as subsequent production. A prospective entrant knows for certain that it will invent a new variety and use a Cobb-Douglas technology like (3). It does not know, however, its efficiency, as this is randomly assigned only after the sunk cost has been payed. In particular, upon entry each firm draws its c from a common and known distribution $G^l(c)$, with support $[0, c_A^l]$, which varies across countries. The upper bound of the support c_A^l determines the upper bound of the marginal cost $m_A^l \equiv m^l(c_A^l) = B\omega^l c_A^l$. If $\left(m_{A,s}^l/m_{A,r}^l\right) < \left(m_{A,s}^h/m_{A,r}^h\right)$, relative to entrants in l, entrants in h are more likely to get lower marginal cost draws in sector r than in sector s. In this sense, countries h and l can be said to have a (probabilistic) comparative advantage in sectors s and r respectively.

National markets are segmented. Nevertheless, firms can produce in one country and sell in another by incurring a per-unit trade cost. We interpret such cost in a wide sense as resulting from all impediments to trade. Specifically, the delivery of a unit of any variety from country l to country h requires the shipment of $\tau^{lh} > 1$ units, where $(\tau^{lh} - 1)$ is the frictional trade cost. We also allow for costly trade within a country with $\tau^{lh} > \tau^{ll} \geq 1$.

Since the entry cost F^l is sunk, only entrants that can cover their production and trade costs survive and produce. All other entrants exit without even starting production. Survivors maximize their profits facing the demand function (1) taking the average price $\bar{p}^l$ and number of competitors N^l as given. Since we assume that national markets are segmented and production faces constant returns to scale, firms independently maximize the profits in each country they sell to. Let $\pi^{lh}(c)$ denote the maximized value of the profits that sales to country h generate for firm c located in country l. Let $p^{lh}(c)$ and $q^{lh}(c)$ denote the corresponding profit-maximizing price and quantity. Then, they must satisfy $\pi^{lh}(c) = \left[p^{lh}(c) - \tau^{lh}m^l(c)\right]q^{lh}(c)$ and $q^{lh}(c) = \left(L^h/\upsilon\right)\left[p^{lh}(c) - \tau^{lh}m^l(c)\right]$.

Only firms earning non-negative profits in a market will choose to serve that market. This implies that the decision whether to serve a market or not obeys a cutoff rule. For example, firm c producing in country l will not serve country h if the cost of producing and delivering a unit of its variety is larger than the maximum price consumers in h are willing to pay. Given (2), that is the case if $\tau^{lh}m^l(c) > p^h$. Hence, only firms in country l that are efficient enough (i.e. have a low enough c) will serve country h. Let m^h denote the marginal cost inclusive of trade frictions faced by a producer in country h that is just indifferent between serving its local market or not. Then, by definition, we have $m^h = p^h$. Since firm c producing in country l serves country h when $\tau^{lh}m^l(c) < m^h$, does not serve it when $\tau^{lh}m^l(c) > m^h$, and is indifferent when $\tau^{lh}m^l(c) = m^h$, we call m^h the 'cutoff cost' in country h.

A useful property of our setup is that all performance measures of firm c in a certain market can be written as simple functions of the cutoff cost. In particular, independently of any specific assumption on the distribution $G^l(c)$, profit maximizing price and quantity evaluate to:

$$p^{lh}(c) = \frac{1}{2}\left[m^h + \tau^{lh} m^l(c)\right] \tag{5}$$

$$q^{lh}(c) = \frac{L^h}{2\gamma}\left[m^h - \tau^{lh} m^l(c)\right] \tag{6}$$

with corresponding markup and profit

$$\mu^{lh}(c) = \frac{1}{2}\left[m^h - \tau^{lh} m^l(c)\right] \tag{7}$$

$$\pi^{lh}(c) = \frac{L^h}{4\upsilon}\left[m^h - \tau^{lh} m^l(c)\right]^2. \tag{8}$$

Moreover, if one is ready to make specific assumptions on $G^l(c)$, also industry-level performance measures can be simply linked to the cutoff cost. While Combes et al (2008) have shown that the model is theoretically tractable for any $G^l(c)$, our empirical implementation requires us to impose a specific parametrization, whose empirical relevance will then be tested. In particular, we assume that firms draw their efficiency from a Pareto distribution implying

$$G^l(c) = \left(\frac{c}{c_A^l}\right)^\gamma = \left[\frac{m^l(c)}{m_A^l}\right]^\gamma \qquad \text{with} \quad c \in [0, c_A^l]. \tag{9}$$

The shape parameter γ is the same in all countries and indexes the dispersion of draws. When $\gamma = 1$, the distribution is uniform on $[0, c_A^l]$. As γ increases, density is increasingly concentrated close to the upper bound c_A^l. As γ goes to infinity, the distribution becomes degenerate at c_A^l. The theoretical appeal of (9) comes from the fact that any truncation of $G^l(c)$ from above maintains its distributional properties. For instance, the distribution of firms producing in l and selling to h is given by $G^{lh}(c) = \left(c/c^{lh}\right)^\gamma$, with $c \in \left[0, c^{lh}\right]$, where $c^{lh} \equiv m^h/(B\omega^l\tau^{lh})$ is the UIR of the producer in country l that is just indifferent between serving country h or not.

2.2 Industry equilibrium

Firms choose a production site l prior to entry and sink the corresponding entry cost $F^l = \omega^l f^l$. Free entry then implies zero expected profits in equilibrium:

$$\sum_{h=1}^{M}\left[\int_0^{c^{lh}} \pi^{lh}(c) dG^l(c)\right] = F^l \tag{10}$$

One can, therefore, derive the equilibrium cutoff costs for the M countries by substituting (8) into (10) and solving the resulting system of M equations for $l = 1, ..., M$. This yields:

$$m^h = \Phi\left(\frac{r^h}{L^h}\right)^{\frac{1}{\gamma+2}} \tag{11}$$

where $\Phi \equiv [2\upsilon(\gamma+1)(\gamma+2)]^{\frac{1}{\gamma+2}}$ is a positive bundling parameter and $r^h\left(P, \psi^1, ..., \psi^M\right) \equiv \left[\sum_{l=1}^{M}\left|C^{lh}\right|(1/\psi^l)\right]/|P|$ measures the 'remoteness' of country h. To see this consider the various components of r^h. First, $|P|$ is the determinant of a matrix P whose element in row l and column h is $\rho^{lh} \equiv \left(\tau^{lh}\right)^{-\gamma} \in (0, 1]$ with corresponding cofactor $\left|C^{lh}\right|$. Being inversely related to the trade cost parameter τ^{lh}, ρ^{lh} measures the 'freeness of trade' from country l to country h. Henceforth, we will refer to P as the 'trade freeness matrix'. Second, the bundling parameter $\psi^l \equiv \left[f^l\omega^l\left(m_A^l\right)^\gamma\right]^{-1}$ captures various exogenous determinants of country l's ability to generate low cost firms: low factor prices ω^l, low entry cost f^l and low probability of inefficient draws by entrants (low m_A^l) all foster the creation of low cost firms. Hence, for given ψ^l's, r^h is large when high trade barriers separate country l from its trading partners. Viceversa, for given trade barriers, r^h is large when the trading partners of country l tend to generate high cost firms.

The information provided by ψ^h has to be compared with that conveyed by the cutoff cost m^h. In particular, ψ^h captures the exogenous ability of country h to generate low cost firms abstracting from the size of its domestic market L^h and its remoteness r^h. The cutoff cost m^h determines, instead, the endogenous cost of producers in country h that survive a selection process in which market size and remoteness play key roles. For this reason, we will refer to ψ^h as (an inverse measure of) the 'exogenous competitiveness' of country h and to m^h as (an inverse measure of) its 'endogenous competitiveness'. Section 3.3 will show that the endogenous competitiveness and the exogenous competitiveness of a country can be pretty different.

According to (11), a larger local market and closer proximity to countries with high exogenous competitiveness reduce m^h, thus decreasing the average cost of producers in country h. To see this, note that, under the distributional assumption (9), the average marginal cost of firms selling in country h (inclusive of trade frictions) equals

$$\overline{m}^h = \frac{\gamma}{\gamma+1} m^h \tag{12}$$

Hence, a percentage change in the cutoff cost causes an equal percentage change in the average marginal cost. Result (12) follows from the fact that the average cost of firms selling to country h from any country l is the same whatever the country of origin: $\overline{m}^h \equiv \left[1/G^l(c^{lh})\right] \int_0^{c^{lh}} \tau^{lh} m^l(c) dG^l(c)$ for any l (h included). This property holds for all other average performance measures of firms selling in country h, which can therefore be expressed as simple functions of m^h. In particular, average markups, prices, quantities and operating profits evaluate to:

$$\begin{array}{ll} \overline{\mu}^h = \frac{1}{2(\gamma+1)} m^h, & \overline{p}^h = \frac{2\gamma+1}{2(\gamma+1)} m^h \\ \overline{q}^h = \frac{L^h}{2\upsilon(\gamma+1)} m^h, & \overline{\pi}^h = \frac{L^h}{2\upsilon(\gamma+1)(\gamma+2)} (m^h)^2 \end{array} \tag{13}$$

where the average of a performance variable $z^{lh}(c)$ is defined as $\overline{z}^h \equiv \left[1/G^l(c^{lh})\right] \int_0^{c^{lh}} z^{lh}(c) dG^l(c)$. Thus, a smaller cutoff cost generates smaller average costs, smaller average markups and lower average prices for varieties sold in h. As the average cost and the average markup are both multiples of m^h, a percentage change in the cutoff has the same percentage impact on both the average markup $\overline{\mu}^h$ ('pro-competitive effect') and the average delivered cost $\overline{m}^h$ ('selection effect'). Through these channels, a given percentage change in the domestic cutoff translates into an identical percentage change in the average price. Finally, average quantities and profits are multiples of m^h and $(m^h)^2$ respectively: a percentage change in m^h causes the same percentage change in average quantity and a percentage change in profit in the same direction but larger in size.

Also the number of varieties sold in country h can be expressed as a simple function of the local cutoff cost. This can be shown by solving (2) for N^h after substituting $p^h = m^h$ and $\overline{p}^h$ from (13) in order to get:

$$N^h = \frac{2\upsilon(\gamma+1)}{\eta} \frac{\alpha - m^h}{m^h} \tag{14}$$

which points out that a reduction in the cutoff cost leads to an increase in the number of varieties sold.

Finally, given the demand function (1), the surplus of a consumer in country h can also be written as a simple function of the cutoff cost:

$$U^l = \frac{1}{2\eta} \left(\alpha - m^h\right) \left(\alpha - \frac{\gamma+1}{\gamma+2} m^h\right) \tag{15}$$

Note that, due to the law of large numbers, profits exactly match the entry cost not only ex ante in expected values, as implied by the free entry condition (10), but also ex post in average values. Specifically, we can write $\sum_{h=1}^{M} G^l(c^{lh})\overline{\pi}^h = F^l$ as $G^l(c^{lh})$ is not only the ex ante probability of successfully selling from country l to country h but also the ex post fraction of entrants in l that serve h. This allows us to take consumer surplus (15) as a measure of welfare generated by the industry. Then (15) implies that welfare is a decreasing function of the cutoff cost due to the three concurrent effects: a lower cutoff entails a larger number of varieties, a lower average price (thanks to both lower average cost and lower average markup), and a higher average quantity.

3 Estimation

Our aim is to estimate and simulate our model industry by industry in order to investigate the effects of trade frictions in different thought experiments. As just shown, a key feature of our model is that the cutoff costs in the different countries are sufficient statistics for industry performance. This allows us to focus only on their percentage changes in the different experiments with respect to a benchmark estimation. Specifically, each thought experiment will propose a counterfactual scenario affecting the trade freeness matrix and hence countries' remoteness. If we call P_* the counterfactual trade freeness matrix and r_*^h the corresponding remoteness, then (11) implies the percentage cutoff change due to turning P into P_* equals

$$\frac{m_*^h - m^h}{m^h} = \frac{\left(r_*^h\right)^{\frac{1}{\gamma+2}} - \left(r^h\right)^{\frac{1}{\gamma+2}}}{\left(r^h\right)^{\frac{1}{\gamma+2}}} \tag{16}$$

which maps exogenous remoteness changes into endogenous competitiveness changes showing that the exact value of the industry-specific constant Φ is immaterial.

For our benchmark estimation we focus on 18 manufacturing industries across 20 countries in the year 2000. Our data set is detailed in Appendix A. We choose 2000 because of the quality of the data and the fact that no major economic change took place in that specific year. On the one hand, 2000 is prior to both the adoption of the paper euro and the large fluctuations of its US dollar exchange rate that could have biased our results. On the other hand, in 2000 the effects of the Single Market had been already felt after eight years since its creation in 1992.

The 18 industries are listed in Table 13. Each industry is modelled as in the previous section and we do not consider any interaction among them. We include all EU-15 countries (except Luxembourg) as well as Norway, and further consider Australia, Canada, Japan, Korea and the US as the 'rest of the world' (henceforth ROW). In 2000 our 18 industries accounted for 22.6% of EU-15 GDP. In that year trade among EU-15 countries accounted for 60% of their imports and 59% of their exports while trade between the EU-15 and the ROW accounted for an additional 17% of EU-15 imports and exports. Data limitations prevent us from including other interesting countries such as the new accession countries that joined the EU after 2000 or China. However, in 2000 China represented only 3.2% of the imports and 1.6% of the exports of EU-15 countries.

By (11), the structural parameters needed to compute the benchmark country-and-industry specific cutoff cost m^h (up to the industry-specific constant Φ) are: the industry specific shape parameter γ, the country specific matrix of trade freeness P, and the country specific exogenous competitiveness parameters ψ^l. As we are interested in percentage cutoff changes, we do not need to estimate Φ and, therefore, υ. To recover all other parameters, we proceed industry by industry in three steps:

1. For P, we estimate gravity equations using data on industry trade flows and distance (Section 3.1).

2. For γ, we use firm-level data to recover γ from a regression that exploits the features of the distributional assumption (9) (Section 3.2)

3. For ψ^l, we first derive the cost cutoff m^h in each country from industry prices, then we use (11) to back out the country values of ψ^l consistent with the values of P, γ and m^h derived in the previous steps (section 3.3). Specifically, inverting (11), for each industry we calculate the set of exogenous competitiveness values that make the remoteness r^h of each country h satisfy

$$\left(m^h\right)^{\gamma+2} L^h = \Phi^{\gamma+2} r^h \left(P, \psi^1, ..., \psi^M\right) \tag{17}$$

up to the industry-specific constant $\Phi^{\gamma+2}$. Making use of bootstrap techniques applied to the first two steps, we finally provide confidence interval for the estimated ψ^l.

3.1 Trade freeness matrix

In the first step of the benchmark estimation procedure, trade freeness is estimated through standard gravity regressions. We start with showing that our theoretical framework indeed yields a gravity equation for aggregate bilateral trade flows. Calling N_E^l the number of entrants in country l, the number of exporters from l to h equals $N_E^l G^l(c^{lh})$. Each exporter c from l to h generates f.o.b. export sales equal to $p^{lh}(c)q^{lh}(c)$. Then, aggregating over all exporters yields the aggregate exports from l to h. These, by (5), (6) and (9), evaluate to:

$$T^{lh} = \frac{1}{2\upsilon\left(\gamma+2\right)} \rho^{lh} \left(m_A^l\right)^{-\gamma} N_E^l \left(m^h\right)^{\gamma+2} L^h \tag{18}$$

which is a gravity equation in so far as it determines bilateral exports as a (log-linear) function of bilateral trade barriers and country characteristics. In particular, (18) reflects the combined effects of market size, technology, and geography on both the number of exporters (the so called 'extensive margin' of trade) and the amount of exports per exporter (the so called 'intensive margin' of trade). It shows that a lower cutoff cost in the country of destination dampens exports by cutting both margins.[8]

In equation (18), the only term that depends on both l and h is ρ^{lh}. Following Head and Mayer (2004), we assume that $\rho^{lh} = (d^{lh})^\delta \exp(\theta_B + \theta_{LB}\ Lang^{lh} + \theta_{CB}\ Cont^{lh})$ if $l \neq h$ and $\rho^{lh} = (d^{lh})^\delta$ if $l = h$, where d^{lh} is the distance between l and h, θ_B is a coefficient capturing the fall in exports due to crossing the l-h border (the so called 'border effect'), $Lang^{lh}$ is a dummy variable that takes value one if l and h share a common language, and $Cont^{lh}$ is a dummy variable indicating contiguity between l and h. In other words, as is standard in the gravity literature, trade costs are a power function of distance, while crossing a border, not sharing the same language or not being contiguous impose additional frictions.

As for the other terms in equation (18), these depend either on the origin country only $[N_E^l(m_A^l)^{-\gamma}]$, or on the destination country only $[\left(m^h\right)^{\gamma+2} L^h]$, or are constant $[1/(2\upsilon\left(\gamma+2\right))]$. As in Hummels (1999) and in Head and Mayer (2004), we can isolate the effects of these country-specific terms using dummies for origin (ex^l) and destination (im^h) countries. This approach avoids the specification problems discussed by Anderson and van Wincoop (2003) and produces parameters that are very similar to those obtained using their multilateral resistance terms to control for remoteness. Thus, our estimating gravity equation is

$$T^{lh} = ex^l\ im^h\ (d^{lh})^\delta\ \exp\left(\left[\theta_B + \theta_{LB}\ lang^{lh} + \theta_{CB}\ cont^{lh}\right] bord^{lh}\right)\ \epsilon^{lh}. \tag{19}$$

where $bord^{lh}$ is a dummy variable that equals one whenever $l \neq h$. Our reference year is 2000 but, to get more precise parameter estimates, we consider data from 1997 to 2001 and add a full set

[8]See Eaton and Kortum (2002), Helpman et al. (2008), and Chaney (2008) for similar results derived from different models.

of year dummies. The population of interest consists of the EU-15 countries plus the 5 countries representing the ROW.

A first issue to address in the estimation of (19) is how to deal with the selection bias due to presence of zero trade flows (Helpman et al, 2008). In our case, that is not likely to be too problematic as less than 1% of trade flows are zero in our sample at the chosen level of industry disaggregation. A second issue is that, as stressed by Santos Silva and Tenreyro (2006), the standard practice of interpreting the parameters of log-linearized models estimated by ordinary least squares (OLS) as elasticities can be highly misleading in the presence of heteroskedasticity in ϵ^{lh}. To tackle this issue, we take as our benchmark their Poisson Pseudo Maximum Likelihood (PPML) estimator of the non-linear equation (19). In Section 5 we will argue that our results are robust with respect to the more common strategy of estimating the log-linearized model by OLS. The last issue concerns the specification of the border parameter θ_B. In order to be both parsimonious and obtain precise estimates, we assume that $\theta_B = \theta_B^W + \theta_B^{EU} EU^{lh}$, where EU^{lh} is a dummy that takes value one if both l and h belong to the EU-15. The two parameters θ_B^W and θ_B^{EU} broadly account for differences in impediments to internal and external EU-15 trade flows.

Table 1 reports the results of our PPML estimations. Overall, parameters have the expected sign and magnitude. In particular, the average elasticity δ of trade to distance across sectors is -0.80. This value compares with the -0.91 mean value observed by Disdier and Head (2008) in their meta-analysis of 1467 estimates referring to 103 papers. The most notable feature of Table 1 is the considerable heterogeneity in trade barriers across industries. Some industries, such as 'T', 'C' and 'L&F', are characterized by small distance frictions (low absolute value of δ), but high border frictions (large absolute value of θ_B^W). The latter are, however, much lower for internal than external EU-15 trade (i.e. $\theta_B^W + \theta_B^{EU}$ has smaller absolute value than θ_B^W). In other industries, such as 'Ma' and 'EMa', border frictions are much smaller and it is not possible to distinguish between θ_B^W and $\theta_B^W + \theta_B^{EU}$. The industries most affected by trade frictions include 'P&C' and 'P&P', which exhibit both large distance friction and large border frictions. Unsurprisingly, sharing a common language is extremely important in the latter industry as revealed by its large positive θ_{LB}.

3.2 Shape parameter

In the second step of the benchmark estimation, we turn to the productivity analysis that will allow us to estimate the industry-specific shape parameter γ. In so doing, we exploit the structure of the theoretical model to obtain consistent estimates from value added data. In principle, proper firm-level productivity estimation would require either direct information on the quantities a firm produces or, if only revenues or value added are available, information on the prices at which the firm sells. Both types of information are very seldom present in firm-level data sets and our data set is no exception.[9]

To see the issues arising when individual quantity or price information is unavailable, consider the performance measures of a firm in its domestic market h. By (3) the firm's output is $q^{hh}(c) = c^{-1}x^{hh}(c)$, which suggests to estimate c based on $c = x^{hh}(c)/q^{hh}(c)$. This requires, however, information on inputs $x^{hh}(c)$ and physical output $q^{hh}(c)$. When data do not cover the latter but cover instead revenues $r^{hh}(c) = p^{hh}(c)q^{hh}(c)$, one can use the individual price index $p^{hh}(c)$ to recover physical output from revenues. When also individual prices are not available, the standard practice is to consider the revenue based measure $\widetilde{c}^h(c) \equiv x^{hh}(c)/r^{hh}(c) = c/p^{hh}(c)$ as a good proxy for c. Our model shows that this would bias the estimated c. Indeed, by (7), as c increases, firms have smaller markups and are, therefore, attributed a $\widetilde{c}$ that grows less steeply than the actual c. Moreover, this bias implies that, even though c follows (9), $\widetilde{c}(c)$ does not and thus its distribution cannot be used to estimate γ.[10]

[9] See, e.g., Jaumandreu and Mairesse (2005) and Foster et al. (2008) for two exceptions in which information on firm-level physical output is available.

[10] One could be tempted to stress the fact that these problems are specific to our linear demand structure, being

Our theoretical framework suggests a simple correction to be applied to $\widetilde{c}$ in order to recover an unbiased estimate of c. This is derived by using (4) and (5) to rewrite $\widetilde{c}^h(c)$ as

$$\widetilde{c}^h(c) = \frac{2\left(\tau^{hh}B\omega^h\right)^{-1}c}{c^{hh}+c} \tag{20}$$

where $c^{hh} \equiv m^h/(\tau^{hh}B\omega^h)$ is the UIR of firms based in h that are just able to serve the domestic market. These firms price at marginal cost so that $p^{hh}(c^{hh}) = m^h$ and, thus, $\widetilde{c}^h(c^{hh}) = c^{hh}/p^{hh}(c^{hh}) = \left(\tau^{hh}B\omega^h\right)^{-1}$.[11] This allows us to restate (20) as

$$\frac{c}{c^{hh}} = \frac{\widetilde{c}^h(c)}{2\widetilde{c}^h(c^{hh}) - \widetilde{c}^h(c)} \equiv \widehat{c}^h(c) \tag{21}$$

This expression shows how to transform the observable variable $\widetilde{c}^h(c)$ with unknown distribution into another observable variable $\widehat{c}^h(c)$ that, being equal to c/c^{hh}, follows a distribution like (9) with the same shape γ and support $\widehat{c}^h(c) \in [0,1]$. Accordingly, we can recover the shape parameter by first estimating $\widetilde{c}^h(c)$, then transforming the estimated $\widetilde{c}^h(c)$ into an estimate of $\widehat{c}^h(c)$, and finally using the distribution of the estimated $\widehat{c}^h(c)$ to retrieve γ.

For each firm c, $\widetilde{c}^h(c)$ is obtained by estimating the parameters of the logarithmic transformation of the production function (3), computing the fitted value of firm c's output, and deriving $\widetilde{c}^h(c)$ as the inverse of (the exponential of) the difference between actual and fitted output ('Solow residual'). We use data on value added, capital, labor and investments drawn from the Amadeus database provided by the Bureau Van Dijk, which has been extensively used in several recent empirical studies, such as Helpman et al. (2004) and Javorcik and Spatareanu (2008). The dataset is an unbalanced panel of 137,284 observations covering 32,840 firms in our 18 manufacturing industries.

It is well known that a simple OLS estimation of (3) would yield biased results due to simultaneity. We address this issue by relying on the semi-parametric estimation methods suggested by Olley and Pakes (1996) (henceforth OP) and Levinsohn and Petrin (2003) (henceforth LP). We will use the former in our benchmark analysis and present results based on the latter in our robustness checks. Since both OP and LP assume that labour is a fully variable input, which may not be the case, we implement the two methods following the correction suggested by Ackerberg et al. (2006).[12]

Before applying the transformation (21), two comments are in order. First, $\widetilde{c}^h(c^{hh})$ can be mis-measured due to the presence of outliers. To deal with this issue, we use the 'rreg' robust regression routine in STATA, which is precisely meant to deal with outliers (see Berk, 1990).[13] Second, equation (20) is valid for sales to a given market h and the corresponding inputs $x^h(c)$. However, exporters may sell to different markets at different prices and a breakdown of input usage by destination market is not available. Therefore, there might be a bias as long as export prices are systematically lower or higher than domestic ones. This is probably not such a big issue as typically domestic sales represent most of exporters' revenues and exporters are themselves a tiny fraction of all European producers (see, e.g., Mayer and Ottaviano, 2007). Nonetheless, we prefer

not that relevant for the more frequently used CES demand structure where the markup is the same for all c (see, e.g. Melitz, 2003). In this case, however, the problem with using $\widetilde{c}(c)$ is even worse. To see this, call σ the constant demand elasticity. Then, one has $\widetilde{c} = [(\sigma-1)/\sigma]\left(\tau^{hh}B\omega^h\right)^{-1}$, which is completely uniformative about c. We thank Jonathan Eaton for bringing this point to our attention.

[11] Interestingly, it can be shown that the expected value of $\widetilde{c}^h(c)$ equals $A\ \widetilde{c}^h(c^{hh})$ with $A \equiv 2\left[1-\gamma\sum_{n=0}^{\infty}(-1)^n/(\gamma+n)\right]$. This implies that the average of $\widetilde{c}^h(c)$ is completely uninformative about average UIR and, therefore, average firm productivity. This casts an additional shadow on the use of revenue based measures of TFP that are standard in the literature.

[12] The routine strictly follows the description in Del Gatto et al. (2008b), to which the reader is redirected for additional details.

[13] This routine begins by excluding outliers, defined as observations with values of Cook's $D > 1$. It then weighs observations based on absolute residuals so that large residuals receive lower weights.

to deal with this issue by comparing the benchmark estimates obtained for all European firms with those obtained for non-exporting French firms.[14]

Substituting $\widetilde{c}^h(c)$ into (21) generates an auxiliary variable $\widehat{c}^h(c)$ whose realizations can be used to jointly test the distributional assumption (9) and estimate the shape parameter γ. Specifically, define $F(z)$ as the cumulative distribution of the realizations of $z \equiv 1/\widehat{c}^h(c)$. Then, if (9) perfectly held, the R^2 of the OLS regression of $\ln(1 - F(z))$ on $\ln(z)$ plus a constant would be equal to one and the slope parameter in the regression would provide a consistent estimator of γ (see Norman et al, 1994). In other words, if the R^2 of the regression is close to one, then (9) provides a good description of the data and the estimated coefficient of $\ln(z)$ gives a good estimate of the shape parameter.

For each industry, Table 2 reports the R^2 of the foregoing OLS regression, the estimated shape parameter (γ), the estimated input shares (β_L and β_K), and the corresponding standard errors. The high R^2 reveals that (9) fits the data well: the average cross-industry R^2 is 0.94 (0.90) in the case of all European firms (French non-exporters). Input shares give some mild evidence of decreasing returns to scale in some industries but the magnitude is quite small. Concerning the γ's, these are very precisely estimated in all cases. A striking feature is that there is much less heterogeneity across industries in terms of γ's than in terms of trade costs. The two groups of estimates, obtained for all European firms and for French non-exporters only, are not identical but the means across industries are very close: 1.79 and 1.96 respectively. Estimates based on $\widetilde{c}^h(c)$ are always larger than those based on $\widehat{c}^h(c)$, which suggests that neglecting firm heterogeneity in prices leads to the underestimation of firm heterogeneity in productivity. This is consistent with the theoretical results in Del Gatto et al. (2008a) and the empirical evidence in Foster et al. (2008), who report a smaller standard deviation in the TFP estimates based on value added with respect to those based on physical output. In Section 5, we will show that our results are robust to alternative estimates of the shape parameter.

3.3 Exogenous competitiveness

In the third and last step of the benchmark estimation, we start with deriving the cost cutoff m^h in each country from industry prices, then we use (17) to back out the set of exogenous competitiveness values ψ^l consistent with m^h and the previously estimated values of P and γ. The cost cutoff can be readily obtained as a function of the average price by rearranging the corresponding expression in (13) to yield:

$$m^h = \frac{2(\gamma + 1)}{2\gamma + 1}\overline{p}^h \tag{22}$$

As evident from (16), the factor multiplying $\overline{p}^h$ in (22) plays no role in the evaluation of counterfactual percentage changes. Hence, we do not need to use the estimated γ to recover the domestic cutoff from average prices. Only data on average producer prices, comparable across countries at the industry level, are needed for subsequent simulation. These are provided by Timmer et al. (2007) for 1997 at the level of Nace 2 digit industry. We convert these data from 1997 to 2000 using country-industry specific value added deflators and match our 18-industry classification weighing Nace 2 digit prices in each of our industies by total hours worked in 2000.[15] Results are listed in Table 3.

We are now ready to use (17) to derive the exogenous competitiveness values ψ^l, up to a multiplicative constant, using point estimates of P and γ as well as m^h. We further bootstrap 1,000 times the residuals obtained from the estimation of P and γ to create alternative values for trade costs and the shape of the productivity distribution. We then use such values to solve 1,0000 times

[14]The choice of French firms is dictated by the very precise information about their export status in the Amadeus database.

[15]See Appendix A for additional details.

for ψ^l in (17) and obtain the distribution of each exogenous competitiveness parameter. Figure 1 plots the computed (log) values of ψ^l for the EU-15. The hollow dots depict the 5th and 95th percentiles of their distributions obtained by bootstrapping. The figure reveals both substantial heterogeneity across industries and, with the exception of few cases, tight confidence intervals. To better understand the relation between endogenous competitiveness $1/m^h$ and exogenous competitiveness ψ^h, Table 4 reports two country rankings, obtained by aggregating $1/m^h$ and ψ^h based on the corresponding industry production shares. The fourth column shows the difference between the positions in the two rankings. These are quite dissimilar and (11) explains why. Three countries with high exogenous competitiveness, namely Finland, Norway and Sweden, are too small and too peripheral to fully exploit their potential, thus ending with a lower endogenous competitiveness rank. By contrast, centrally located countries like Belgium, and the Netherlands benefit from their central geography, ending up with a higher rank in terms of endogenous than exogenous competitiveness. Finally, large countries (France, Germany, Great Britain, Italy and Spain) owe part of their endogenous competitiveness to market size. Once discounted for population, their exogenous competitiveness is revised downwards.

3.4 Validation

Before turning to counterfactuals, it is important to evaluate the capacity of our model to reproduce patterns of the data that have not been directly used for its benchmark estimation. We choose to focus on France because it has the best data coverage and quality in the Amadeus database. Moreover, we are able to complement the Amadeus data with detailed information on French firms provided by the database EAE (Enquete Annuelle Entreprises).[16]

The share of firms that export. In 2000, the share of exporters in the whole population of French manufacturing firms was equal to 22.26 %.[17] This figure can be considered as fairly stable over time (see Eaton et al., 2004). Our model actually predicts that 22.28% of French firms should be exporters.

The size advantage of exporters. When size is measured by domestic sales, exporters in the EAE dataset are 4.33 times bigger than non-exporters. This compares to a simulated size advantage of 2.20 in our model.

The productivity advantage of exporters. The (OP) productivity advantage of exporters over firms serving the French market is equal to 13.16%. This compares with a 55.2% predicted by our model.

The fraction of revenues from export. Table 5 compares the predictions of our model on the ratio of export revenues to total revenues with the actual distribution across French exporters. The second column, taken from Eaton et al. (2004), shows the actual percentage of exporting French firms getting a given share of their revenues from exports while the third columns reports predicted percentages. Our model does not match the high share of exporters declaring small export volumes, but we are able to predict that quite a few firms have very high (90 to 100%) export intensity.

[16]See Appendix A for additional details.

[17]We thank Benjamin Nefussi of CREST-INSEE for computing this figure for us.

Revealed comparative advantage. Finally, we investigate to what extent lower computed domestic cutoffs (i.e. average producer prices) are indicative of a stronger competitive position. In so doing, we calculate the following index of export specialization by industry ('revealed comparative advantage')

$$RCA_s^h = \frac{\sum\limits_l T_s^{hl} / \sum\limits_{l,s} T_s^{hl}}{\sum\limits_h \sum\limits_l T_s^{hl} / \sum\limits_h \sum\limits_{l,s} T_s^{hl}}, \tag{23}$$

where the term T_s^{hl} stands for export flows from h to l in industry s. Table 6 reports its correlation with the computed cost cutoffs (deflated by the industry mean). Countries are expected to specialize in industries where they have relatively lower cutoffs with respect to industry averages, which should lead to a negative correlation between average producer price and revealed comparative advantage across industries. Table 6 confirms that this is indeed the case for 13 of our 15 European countries.

Overall, our model picks up some crucial qualitative features of data on export, productivity, and sales. Concerning magnitudes, it is always difficult to say whether they are sufficiently good or not. For the sake of comparison, the model by Bernard et al. (2003) has a worse performance in terms of the match between actual and predicted share of exporters (51% of US firms are predicted export compared with the observed 21%) but a better performance in terms of the fraction of revenues from export. As for the size and productivity advantages of exporters, Bernard et al. (2003) use them to calibrate their model and, therefore, cannot be used to validate its predictions.

4 Counterfactuals

Having recovered all required parameter values, we can now simulate our model industry by industry to investigate the effects of trade frictions in different counterfactual scenarios. This is achieved by recomputing for each country the remoteness associated with a counterfactual trade freeness matrix P_* while keeping exogenous competitiveness and shape parameters at the values computed in the benchmark scenario. The resulting remoteness $r_*^h\left(P_*, \psi^1, ..., \psi^M\right)$ is then substituted into (16) to obtain the percentage changes in the cutoff costs. These in turn map into percentage changes in average productivity, delivered costs, markups, prices, quantities sold and profits that we are able to quantify by (13), as well as into variations in the number of available varieties and welfare that we are able to sign by (14) and (15) respectively. In particular, (13) implies the following relation between average performance variables and cutoff cost changes:

$$\frac{\overline{m}_*^h - \overline{m}^h}{\overline{m}^h} = \frac{\overline{\mu}_*^h - \overline{\mu}^h}{\overline{\mu}^h} = \frac{\overline{q}_*^h - \overline{q}^h}{\overline{q}^h} = \frac{m_*^h - m^h}{m^h}, \; \frac{\overline{\pi}_*^h - \overline{\pi}^h}{\overline{\pi}^h} = \frac{\left(\overline{m}_*^h\right)^2 - \left(\overline{m}^h\right)^2}{\left(\overline{m}^h\right)^2} \tag{24}$$

where the asterisk labels counterfactual values. Moreover, according to (14) and (15), the number of varieties sold in a country and the welfare of its residents change in the opposite direction of its cutoff cost.

Non-Europe.[18] As already mentioned, in 2000 60% of the imports and 59% of the exports of EU-15 countries concerned other EU-15 countries. Besides its dominant share, intra-EU15 trade involves countries belonging to a common geographical area characterized both by a high

[18]The expression 'cost of non-Europe' was introduced to refer to the economic cost of failing to complete the common market. This is the subject of a landmark study by the European Commission, the Cecchini report, presented in March 1988.

level of economic integration and a homogenous level of development. In order to provide an order of magnitude for subsequent counterfactuals, in Section 4.1 we consider a situation in which intra-European trade barriers are prohibitive but European countries can still trade with the ROW.

More Europe 1: Removal of technical barriers to trade (TBT). Trade impediments, and in particular behind-the-border barriers, still persist across European countries. In the context of achieving the free trade objectives of the Single Market Programme in Europe, the Mutual Recognition Principle (MRP) states that products manufactured and sold in one EU country should be legally accepted for sale in all other member states. However, EU member states have the right to restrict intra-EU imports on the grounds of health, safety, environmental hazards and consumer protection. These restrictions are known as technical barriers to trade (TBT). In 1996, about 79% of intra-EU trade was still affected by TBT. Despite the efforts of the European Commission, only few of these frictions could be removed (European Commission, 1998). We provide an assessment of the potential gains stemming from the removal of TBT in section 4.2.

More Europe 2: Removal of linguistic and cultural barriers to trade. Linguistic and cultural differences are a peculiar feature of Europe. Despite deep market integration, European countries are still unable to 'speak the same language' in many areas: business relationships, official documents, country regulations. Indeed, 43% of European retailers perceive language differences as an obstacle to trade.[19] At the same time, European authorities spend 1.1 billion euros per year in translation costs. The failure to approve a new European Constitution also reveals how large and persistent are the cultural differences. In section 4.3 we catch a glimpse of what Europe may be missing by neglecting the economic impact of the lack of a common linguistic and cultural identity.

More Europe 3: European integration and regional imbalances. The EU has a strong and longstanding interest in regional imbalances. Structural and Cohesion funds for the period 2007-2013 account for 347 billion euros, i.e. almost half of the EU budget. Despite this interest, imbalances in terms of unemployment, wages, innovation and GDP per capita are still large and persistent, virtually within all European countries. A key policy question is whether further integration would reduce or amplify such differences.[20] We address this issue by looking at how a reduction in trade costs affects regional imbalances across French regions (section 4.4).

4.1 The costs of Non-Europe

In this section we look at the effect that inhibiting intra-EU trade has on endogenous competitiveness. In this counterfactual scenario, intra-EU trade barriers are set at prohibitive levels while keeping trade barriers between the EU-15 and the ROW at their actual levels. Specifically, the counterfactual trade freeness matrix is such that $\rho_*^{lh} = 0$ when l and h are two distinct EU-15 countries and $\rho_*^{lh} = \rho^{lh}$ otherwise.

The second and third columns in Table 7 report the simulated percentage changes in EU-15 endogenous competitiveness $1/\overline{m}^h$ and average cutoff costs $\overline{m}^h$ with respect to the benchmark estimation. Industry-country changes are aggregated at the country level weighting each industry by its share of total EU-15 manufacturing (value of) production in the year 2000.[21] Country changes

[19]Source: Flash Eurobarometer 186 on Business attitudes towards cross-border trade and consumer protection.

[20]A number of studies have addressed this question using data on employment, industry composition and GDP per capita (see Midelfart-Knarvik et al, 2002; Overman and Puga, 2002; Quah, 1996; among others). What we add, with respect to previous studies, is endogeneous productivity through selection effects.

[21]We prefer not to use industry-country production shares because in the counterfactual scenario industries experience different output variations in different countries that our analysis is not able to quantity. Even if this constraint had not been binding, the use of a constant weighting scheme would have had the advantage of boosting

are further aggregated at EU-15 level weighting each country by its share of EU-15 manufacturing production in that year. The Table shows that inhibiting intra-European trade would yield a 13.14% decrease in endogenous competitiveness accompanied by an average increase in firms' costs, markups and prices of 15.88%. By (24) also average output and profit would rise by 15.88% and 35.19% respectively. Finally, (14) and (15) imply that the average number of varieties sold in each country as well as consumer surplus would fall. Recalling that profits are entirely absorbed by the entry costs, that implies that welfare would decrease too. In short, the second and third columns of Table 7 depicts a counterfactual situation in which things get worse because (prohibitively) higher trade barriers weaken intra-European competition.

Aggregate results hide a variegated cross-country pattern with endogenous competitiveness losses ranging from 6.10% (Germany) to 27.59% (Finland). As implied by (11), that happens because countries differ in terms of exogenous competitiveness, own market size and distance from other countries' markets and these interact with trade freeness in complex ways. Short of performing cumbersome and unpromising comparative statics exercises on (11), a simple shortcut to characterize those complex interactions is to regress the percentage cutoff cost change $\left(\overline{m}_*^h - \overline{m}^h\right)/\overline{m}^h$ on own population L^h, peripherality proxied by distance from Belgium (taken as the EU-15 centre of gravity), and exogenous competitiveness ψ^h. Running this regression for each sector separately reveals that smaller population, stronger peripherality and higher exogenous competitiveness lead to higher losses from non-Europe.[22] As in Anderson and van Wincoop (2003), size matters as small economies are those who gain the most from trade and would lose the most from its elimination. At the same time, geography matters too, and countries that have better access to the European market would suffer the most from autarky. Finally, trade magnifies exogenous competitiveness: inhibiting trade barriers would especially hurt more competitive economies.

The second and third columns of Table 8 report the effects of inhibiting intra-European trade by industry. Industry-country changes are aggregated at the industry level weighting each country by its share of total EU-15 manufacturing production in the year 2000. The heterogeneity across industries is pronounced. As before, we use a simple regression as a shortcut to get insight on what drives such heterogeneity. Specifically, we regress the percentage cutoff cost change on the estimated border effects ($\theta_B^W + \theta_B^{EU}$), the distance elasticity (δ), as well as the common language (θ_{LB}) and contiguity (θ_{CB}) indicators reported in Table 1. These regressions show that industries characterized by lower trade frictions, i.e. more distant from autarky, experience higher losses from non-Europe.

4.2 The gains from More Europe 1: Removal of technical barriers

The parameter θ_B in (19) captures all impediments to international trade that are not related to distance, language or contiguity. In line with the results derived since the seminal paper by McCallum (1995) in several applications of the gravity equation across different countries and time spans, our gravity estimations in Table 1 document the importance of those impediments within Europe. This raises a natural question: how large would be the gains from reducing such impediments? We address this questions by looking at the effect of reducing intra-European TBT, modelled as a reduction in the border effect parameter θ_B^{EU}.

The magnitude of the border effect is somehow controversial but, as shown by Anderson and van Wincoop (2003), it is perfectly reasonable that its estimated magnitude differs according to country size and geography. However, one puzzling aspect of the estimated border effect is that

intuition by controlling for composition effects. For a discussion of related issues, see Caves, Christensen and Diewert (1982). Production data come from CEPII.

[22] In the 18 sector-by-sector regressions, the elasticity of the cutoff change to population is negative in 17 cases (significantly so in 5 of them); its elasticity to peripherality is negative in 17 cases (significantly so in 14 of them); its elasticity to exogenous competitiveness is positive in 17 cases (significantly so in 15 of them). Although there are only 15 cross-country observations in each sector, for each regression we obtain an R^2 close to 0.7.

it is not clear what it is truly measuring. Head and Mayer (2000) show that non-tariff barriers to trade do not explain border effects in Europe while Hillberry (1999) finds little evidence that tariffs, regulations, information and communication costs are related to border effects either. On the other hand, Chen (2004) shows that TBT do play a significant role. The data she uses have been collected by the European Commission in only 78 of the 246 manufacturing industries that compose the Nace rev.1 classification. It is, therefore, impossible to evaluate directly the level of TBT in our 18 manufacturing industries.

The results in Chen (2004) contain, nonetheless, enough information to construct an interesting counterfactual: the 78 Nace industries she considers span all our 18 industries, TBT affect 83% of those Nace industries, and the estimated border coefficient is around 40% smaller in industries where TBT are not at work.[23]. Accordingly, we model the complete elimination of TBT as a reduction of intra-European border effect by 33%. This number results from multiplying the 40% gap in the border effect between TBT and non-TBT industries by the 83% share of industries affected by TBT. As the border effect falls by a third, in the counterfactual scenario we impose $\theta_B^* = (2/3)(\theta_B^W + \theta_B^{EU})$ for each pair of EU-15 countries.[24]

The fourth and fifth columns in Table 7 report the cross-country effects of removing TBT. On average EU-15 countries enjoy a 8.90% increase in endogenous competitiveness. Average costs, markups, prices and quantities fall by 7.58%. Profits fall by 16.23%, while the number of varieties available to each consumer and welfare both increase.[25] Running again our shortcut regression approach we find that small, competitive and centrally located countries are those who benefit the most. The intuition is symmetric to the one discussed for the effects of non-Europe. The fourth and fifth columns in Table 8 report the cross-industry effects of removing TBT. In this case, shortcut regressions show that larger gains in competitiveness accrue to industries where border effects are initially stronger and thus their counterfactual absolute reductions are larger. The more so the larger the fraction of trade frictions due to border effects. Finally, in accordance with the predictions of Melitz and Ottaviano (2008) on the effect of a preferential trade agreement, the ROW countries lose competitiveness from further European integration. This is due to the fact that preferential trade agreements make entry less attractive in third countries.

4.3 The gains from More Europe 2: Removal of linguistic and cultural barriers

In the gravity regression (19) the common language dummy ($lang^{lh}$) is both positive and significant in all industries. This reveals the importance of trade impediments stemming from not speaking the same language or not sharing a common culture. Although other factors (such as the barriers associated with legal differences, heterogeneity in tastes, etc.) are probably captured by the common language parameter (θ_{LB}), it is still interesting to catch a tentative glimpse of what Europe may be losing with respect to the US because of the lack of a common linguistic and cultural identity. We do so by setting $lang^{lh} = 1$ when both l and h belong to the EU-15 and compute a new trade freeness matrix P^* based on the estimate common language parameter θ_{LB}.

The sixth and seventh columns in Table 7 report the cross-country effects of the elimination of intra-European language frictions. On average EU-15 countries would experience a 9.08% increase in competitiveness with firm average cost, markup, price and output decreasing by 7.87%. Profits

[23]See Table 3, column 2, and the corresponding discussion in the third paragraph of page 107 in Chen (2004).

[24]It is interesting to point out that, in terms of the impact on bilateral trade freeness ρ^{lh}, a 33% fall in the border effect is equivalent to a 23% fall in the trade cost parameter τ^{lh}.

[25]A complete elimination of TBT is probably not feasible and perhaps not even desirable. The value consumers give to safety and the environment might well differ across countries. In this context TBT may help heterogeneous consumers to maximize their welfare. For this reason and because of the aforementioned data constraints, our counterfactual results should be interpreted as an upper bound to the gains the European economy could achieve by eliminating TBT.

would fall by 6.75%, while the number of available varieties and welfare would increase. Although the overall gains for Europe would be similar to dismantling TBT, country patterns would be rather different. This is because the elimination of language frictions entails an asymmetric trade cost reduction as some countries already share a common language.

Small, exogenously competitive and centrally located countries are still those who benefit the most. However, small countries that currently benefit of language ties (such as Austria, Belgium and Ireland) gains less in this scenario than in the TBT scenario with Belgium actually experiencing some losses. At the other extreme, Denmark, the Netherlands and Sweden enjoy larger gains here as a common language allows them to better exploit their exogenous competitiveness. Turning to the industry variation reported in the sixth and seventh columns of Table 8, gains are unsurprisingly larger wherever language barriers are higher and represent a larger share of trade costs.

4.4 The gains from More Europe 3: European integration and regional imbalances

Would deeper European integration reduce or exacerbate regional disparities? We use our theoretical framework to address this much debated question. In so doing, we replace France with its 21 NUTS-2 regions and consider each French region as an additional economy. We focus on France because we can complement the Amadeus database with the detailed French manufacturing firm survey EAE.

In applying our estimation procedure to French regions, we face two problems due to data constraints, which suggest that this counterfactual analysis should be interpreted more as a theoretical exploration than the previous ones. The first problem we face is that regional price indices are commonly not available and France is no exception. Hence, we are not able to estimate the cutoff cost of a region using its average producer price. Short of any information on regional cutoffs, we investigate the effects of deeper European integration through a thought experiment in which initially each French region is attributed the national cutoff cost of France. This situation would arise if, for instance, in all regions factor rewards were proportional to local productivity.

In constructing the initial trade freeness matrix, we face a second problem. As trade flows by industry are not available for French regions, we cannot apply the gravity regression (19) to origin-destination pairs involving those regions. We circumvent this limitation by building on results by Combes et al. (2005). Using data on trade for the whole manufacturing sector within France, Combes et al. (2005) find a distance elasticity in line with what is usually obtained in comparable estimations based on international data. Accordingly, we can reasonably approximate trade freeness between French regions as well as between a French region and a foreign country by applying our previously estimated coefficients for international flows to compatible regional distance measures.[26]

The initial scenario is, thus, a situation in which: all French regions share the same endogenous competitiveness estimated for France as a whole; trade freeness measures involving French regions are calculated by applying the gravity coefficients estimated from international data to regional distances. Together with the shape parameters previously estimated from Amadeus data and the regional populations obtained from Eurostat, initial endogenous competitiveness and trade freeness can be used in (17) to recover the underlying exogenous competitiveness (up to the industry-specific constant $\Phi^{\gamma+2}$).

Starting from this initial scenario, we simulate the effects of a 10% reduction in international trade costs. Table 9 reports the resulting percentage changes in endogenous competitiveness across the 21 French regions, as well as their identifying codes and Gross Regional Products in 2000 (GRP). The Table shows a lot of variation across regions. The Paris region ('Ile de France') is virtually unaffected, and even slightly damaged, by further European integration. This suggests

[26] See Corcos et al. 2007 for additional details.

that this region is so dense and central that all potential gains stemming from competition and selection have been already exhausted. Three internal regions ('Pays de la Loire', 'Limousin' and 'Auvergne') also experience a negligible decrease in productivity, again due to their centrality within France. The remaining seventeen regions gain from further European integration. As shown in Figure 2, the main beneficiaries are the border regions, in particular those located close to the core of the European market (North-East and North-West regions).

The fact that geography plays a key role in determining the distribution of gains across regions implies that deeper European integration may actually foster regional divergence. First, the correlation between GRP and distance to the closest European country is negative (-0.21). Second, the correlation between competitiveness gains and GRP is positive (0.34 disregarding the Paris region as a clear outlier for reasons stated above). Therefore, not only border regions are already richer but they are also those that would benefit the most from further integration with the rest of Europe. Hence, as long as peripheral regions are not able to compensate their disadvantaged geography with better exogenous competitiveness, our model suggests that more regional imbalances should be expected from deeper European integration.

5 Robustness Checks

In what follows we show that our results are robust to alternative trade costs and productivity measures. Percentage changes in the endogenous competitiveness of European countries and French regions are shown in Tables 10 and 11 respectively. For each counterfactual scenario we compare the results obtained in the previous section with those with those obtained in the various robustness checks.[27]

Trade Costs Estimations: OLS The PPML estimator used to recover the trade costs from (19) has many advantages with respect to OLS implemented on the log-linearized model. However, while PPML is relatively new in the literature, it is well known that it delivers very different results from OLS. In particular, the distance elasticity obtained by PPML is usually smaller than that obtained by OLS and one may wonder whether and how this would affect our results.

Productivity Estimations: LP One key drawback of the Olley and Pakes (1996) methodology and its refinements is that it restricts production function estimations to the sample of firms with positive investments. This reduces considerably the number of available firms while introducing a possible selection bias. In order to check the robustness of our results, we use the Levinsohn and Petrin (2003) methodology (LP) that requires intermediate inputs consumption to be positive thus imposing a much weaker selection constraint. Following the same procedure as in Section 3.2, we first apply this technique to estimate $\widetilde{c}(c)$ and then recover the shape parameter γ from the distribution of $\widehat{c}(c)$.

Measurement Error in Value Added: BEJK An issue raised by Bernard et al. (2003) is that value added at the firm level is likely to be measured with error. Value added is the dependent variable in the estimation of value-added productivity. Measurement error in the dependent variable is not an issue for the consistency of the production function parameter estimates. It may be, instead, an issue for the estimation of $\widetilde{c}(c)$. Specifically, being measured as a residual, $\widetilde{c}(c)$ is likely to display a much higher variance due to measurement error. In our model the shape parameter γ is inversely related to the variance of the UIR distribution and might be, therefore,

[27] Apart from the robustness checks discussed in this section, we have experimented also with different distance and common language indicators (see Appendix A). The corresponding results are available upon request and are virtually identical to the ones reported here.

underestimated. In order to provide insights on the potential bias for our results, we experiment with a higher value of $\gamma = 3.6$ borrowed from Bernard et al. (2003).[28]

6 Conclusion

We have suggested how standard computable equilibrium models of trade policy could be enriched with selection effects without missing other important channels of adjustment. This has been achieved by carefully estimating and simulating a partial equilibrium model derived from Melitz and Ottaviano (2008). Applying the model to European data we have shown that, even in a relatively integrated economy as the E.U., dismantling residual trade barriers would deliver relevant welfare gains stemming from lower production costs, smaller markups, lower prices, larger firm scale and richer product variety.

To better understand the importance of selection effects and look at our contribution in perspective, it is interesting to compare our results with those obtained in closely related models where selection is absent. Eaton and Kortum (2002) and, more recently, Finicelli et al. (2008) quantify the costs of autarky in a probabilistic Ricardian model. Among various experiments, they calculate the fall in 'endogenous competitiveness' (measured as GDP per worker) due to autarky for a sample of 19 OECD countries in 1990. The only difference with respect to our sample of countries is that they do not have data for Ireland and include New Zealand instead of Korea in the ROW. For the EU-15 countries appearing both in our and their data set, they calculate an average decrease in competitiveness of 3.86%, much smaller than our 13.14%. The discrepancy is not due to the marginal differences in the two country samples but to two circumstances: first, Eaton and Kortum (2002) simulate a perfectly competitive model; second, their base year predates ours by a crucial decade for European integration. The relevance of the latter is testified by the considerably higher costs of autarky (9.4%) that Finicelli et al. (2008) report for the same model and the same set of countries in 2002. The residual discrepancy then gives a feeling of the importance of imperfect competition and selection.

Similar exercises are reported also by Bernard et al. (2003) and by Smith and Venables (1988), who are interested in the gains from trade associated with 5% and 8% reductions in trade costs respectively. For the sake of comparison, we have simulated the same counterfactuals in our model. In the first counterfactual, we have obtained a 2.97% competitiveness gain. This is a sizeable number, although smaller than the 4.7% productivity increase obtained by Bernard et al. (2003) for the U.S. by extending the model of Eaton and Kortum (2002) to allow for Bertrand oligopoly. Besides differences in the underlying models, the discrepancy is probably due to the fact that the U.S. are a very productive country and we do not consider intermediate goods, whose price reduction is the main driver of the gains in Bernard et al. (2003).

Smith and Venables (1988) simulate the effects of a reduction of intra-EU trade costs in a 'computable general equilibrium' (CGE) model with increasing returns to scale, segmented markets and product differentiation. Firms are identical within countries but they are allowed to differ in size and product lines between countries. Market structure is alternatively modelled as Cournot or Bertrand oligopoly with free or restricted entry. Firms are not heterogeneous. Thus, while our model stresses the impact of trade on firm selection, their model focuses instead on scale economies. As in our model, they also obtain that a decline in trade costs makes competition fiercer, decreases prices, and expands sales. Due to increasing returns to scale, average costs fall, especially with free entry. However, as firms are identical within countries, no market share reallocations take place towards more productive firms. Though simulations are run for many industries, only for 'Domestic

[28] In Bernard *et al.* (2003), the lowest cost exporter is the only supplier to any destination. If all potential exporters draw their productivity from a Pareto distribution with shape parameter γ, then the productivity distribution of the lowest cost exporter is Fréchet, with shape parameter γ (see Norman et al., 1994). Bernard et al. (2003) directly assume that the productivity distribution of the lowest cost exporter is Fréchet and calibrate the value of γ.

electrical equipment' reported results allow for a reasonable comparison with our analysis. For this sector, Smith and Venables (1988) obtain that a 8% reduction in trade costs yields a 0.76% drop in average production costs. This is much smaller than the 3.79% decrease in average costs that we find for the sector 'EMa' as a response to the same reduction in trade costs. We interpret this difference as capturing the relative importance of the scale and selection effects. Indeed, as argued by Tybout and Westbrook (1996), the neglect of firm heterogeneity implies that scale effects may be even overstated in CGE models such as Smith and Venables (1988). On the one hand, exporting plants are typically the largest in their industry, so they are not likely to exhibit much potential for further scale economies exploitation. On the other hand, large plants also account for most of the production in any industry, so foregone economies of scale due to downscaling in import-competing sectors are also likely to be minor.

We believe that our analysis provides enough ground to support the inclusion of firm heterogeneity and selection effects in the standard toolkit of trade policy evaluation. The next step would be to embed our partial equilibrium approach into existing computable general equilibrium (CGE) models.

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A Appendix: Data sources

Gravity measures: Trade flows. Data on trade flows are drawn form the Trade and Production database (*http://www.cepii.fr/anglaisgraph/bdd/TradeProd.htm*), provided by the Centre d'Etude Prospectives et d'Informations Internationales (CEPII). The dataset, used in Mayer and Zignago (2005), comprises trade and production figures in an ISIC 3-digit classification, which is consistent across a large set of countries over the 1976-2001 period.

Gravity measures: Distance. The distance measures provided by CEPII are in km and can be divided into simple measures (*dist* and *distcap*) and weighted measures (*distw* and *distwces*). In all reported estimations we use *distw*. In unreported estimations, available upon request, we have tried the other 3 measures obtaining similar results.

Simple geodesic distances are calculated following the great circle formula, which uses latitudes and longitudes of the most important cities/agglomerations (in terms of population) for the dist variable and the geographic coordinates of the capital cities for the *distcap* variable. These two variables incorporate internal distances (d^{hh}) that (as trade costs) we allow to be non zero. They are based on the area of a country as in Head and Mayer (2004). In particular, the formula used to convert area into distance is $d^{hh} = (2/3)\sqrt{area^h/\pi}$. This formula models the average distance between a producer and a consumer on a stylized geography where all producers are centrally located and the consumers uniformly distributed across a disk-shaped region (see Head and Mayer (2002) for more details).

By contrast, weighted distances use city-level data on distances and the geographic distribution of population (in 2004) inside each nation. The basic idea is to calculate the distance between two countries as the weighted average bilateral distance between their biggest cities with the corresponding weights determined by the shares of those cities in the overall national populations. This procedure can be used in a totally consistent way for both national and international distances. Specifically, the general formula developed by Head and Mayer (2002) to calculate the distance between country l and h is:

$$d^{lh} = \left(\sum_{p \in l} \sum_{r \in h} (S^p/S^l)(S^r/S^h) \ (d^{pr})^{\delta} \right)^{1/\delta} \tag{25}$$

where S^p (S^r) denotes the population of agglomeration p (r) belonging to country l (h). The parameter δ measures the sensitivity of trade flows to bilateral distance d^{pr}. For the *distw* variable, δ is set equal to 1. The *distwces* calculation sets it equal to -1, which corresponds to the usual coefficient estimated from gravity models.

Gravity measures: Common Language Indicators. For each country, the CEPII provides 3 different common language indicators. The first one ($langoff$) considers that two countries share a language if the language is officially used by public administrations of both countries. The second one ($lang9$) attributes a common language to a country pair if at least 9% of the population of both countries speaks the same language. Finally, $lang20$ attributes a common language to a country pair if at least 20% of the population of both countries speaks the same language. Our preferred measure is $langoff$ but unreported estimations, available upon request, show that the other 2 measures lead to similar results.

Firm-level data for productivity estimation. To estimate individual productivity we rely on the information on value added, capital, labor and investments provided by Bureau Van Dijk in the Amadeus database, which contains the most comprehensive and accurate information on European firms balance sheets data.

This data has been extensively used in recent empirical studies like Helpman et al. (2004), and Javorcik and Spatareanu (2008) to cite a few. The data we use refers to years 1998-2003 and covers 13 out of the 15 European countries group, because value added for Greece and Ireland is not available due to differences in accounting regulations that make balance sheets data not comparable to that from other European countries. This confirms the attention paid by Bureau Van Dijk in making data comparable across countries.

The resulting dataset is an unbalanced panel of 137,284 observations covering 32,840 firms spanning our 18 manufacturing industries. Details on the sectoral and country coverage, as well on the estimation procedure, are reported in Tables 13 and 12.

Book sheets capital has been corrected using appropriate industry deflators.

Average producer prices for the domestic cutoff. Data on average producer prices, comparable across countries at the industry level, are provided by Timmer et al. (2007). The data represents an extension, in terms of both country coverage and accuracy, of the ICOP database provided by the Groningen Growth and Development Centre ($http://www.ggdc.net$). Data are originally available by Nace 2 digit industry and refer to the year 1997. To convert these data from 1997 to 2000 we use country-industry specific value added deflators. Finally, to match our 18-industry classification, we weigh Nace 2 digit prices in each of our sectors by total hours worked in 2000. Both are drawn from the Groningen Growth and Development Centre "60-Industry Database", available on line. The computed m_s^{hh} are listed in Table 3. We report them with two digits after the decimal point in order to save space.

The EAE database on French firms. The EAE (Enquete Annuelle Entreprises) database is provided by the SESSI (Service des Etudes et Statistiques Industrielles, French Ministry of Industry) and the SCEES (Service Central des Enquêtes et Etudes Statistiques, French Ministry of Agriculture and Fisheries). We use this dataset under the authorization of the French Conseil National de l'Information Statistique (CNIS). EAE provides detailed information on the balance sheets and location of all French manufacturing firms with more than 20 employees, as well as on a stratified sample of firms with less than 20 employees. It provides us with information about 23,203 manufacturing French firms, compared to 3,415 in the Amadeus database.

Table 1: Gravity estimations

Short	Industry	δ	θ_B^W	θ_B^{EU}	θ_{LB}	θ_{CB}
F	Food beverages and tobacco	-0.9126*	-3.2044*	0.8174*	0.6983*	0.2140*
		(0.0452)	(0.1153)	(0.0679)	(0.0702)	(0.0749)
T	Textiles	-0.5006*	-2.6492*	1.0568*	0.7435*	0.5350*
		(0.0396)	(0.0946)	(0.0688)	(0.0649)	(0.0574)
C	Wearing apparel except footwear	-0.3629*	-3.6615*	1.5527*	0.9682*	0.6306*
		(0.0622)	(0.1604)	(0.0976)	(0.0919)	(0.0931)
L&F	Leather products and footwear	-0.4499*	-2.1776*	0.7489*	0.7671*	0.2291*
		(0.0574)	(0.1502)	(0.1090)	(0.1088)	(0.0814)
W	Wood products except furniture	-1.3641*	-2.2210*	-0.0608	0.4297*	0.5911*
		(0.0535)	(0.1068)	(0.0980)	(0.0919)	(0.0883)
Pa	Paper products	-1.0984*	-1.8850*	0.5527*	0.5523*	0.3616*
		(0.0399)	(0.0984)	(0.0609)	(0.0626)	(0.0528)
P&P	Printing and Publishing	-0.8843*	-3.3079*	0.1175*	1.3097*	0.4586*
		(0.0419)	(0.0905)	(0.0569)	(0.0669)	(0.0739)
P&C	Petroleum and Coal	-1.0607*	-2.6820*	0.1910	0.8397*	0.3452*
		(0.0649)	(0.1826)	(0.1255)	(0.1344)	(0.1307)
Ch	Chemicals	-0.6944*	-1.4934*	0.2797*	0.4974*	0.0869*
		(0.0515)	(0.1044)	(0.1096)	(0.1024)	(0.0540)
R&P	Rubber and plastic	-0.8473*	-2.4758*	0.5267*	0.6022*	0.4965*
		(0.0297)	(0.0683)	(0.0510)	(0.0507)	(0.0432)
NMP	Other non-metallic mineral products	-0.9362*	-2.6070*	-0.0827	0.3640*	0.4727*
		(0.0350)	(0.0904)	(0.0591)	(0.0558)	(0.0607)
MP	Metallic products	-0.8242*	-1.7299*	0.7102*	0.8392*	0.3091*
		(0.0438)	(0.0815)	(0.0765)	(0.0888)	(0.0589)
FMP	Fabricated metal products	-0.9563*	-2.1512*	-0.0774	0.5825*	0.4328*
		(0.0619)	(0.0869)	(0.1063)	(0.1198)	(0.0565)
Ma	Machinery except electrical	-0.7942*	-0.8496*	-0.2023	0.5674*	-0.0400
		(0.0797)	(0.1488)	(0.1624)	(0.0894)	(0.0929)
EMa	Electric machinery	-0.6687*	-1.0280*	0.0673	0.5164*	0.2127*
		(0.0517)	(0.1240)	(0.0817)	(0.0652)	(0.0678)
PSE	Professional and scientific equipment	-0.5435*	-1.0887*	-0.3080*	0.2952*	0.1580*
		(0.0378)	(0.1005)	(0.0841)	(0.0650)	(0.0566)
Tr	Transport equipment	-0.9580*	-0.9447*	-0.0465	0.3198*	0.3319*
		(0.0544)	(0.1140)	(0.0887)	(0.0764)	(0.0711)
Oth	Other manufacturing	-0.5025*	-2.6216*	-0.3150*	0.3062*	0.6809*
		(0.0521)	(0.1450)	(0.0903)	(0.0997)	(0.0866)

Robust standard errors in parenthesis, with * denoting significantly different from zero at the 5% confidence level.

Table 2: Production function and γ estimations

	Production function estimations		γ Estimations on $\tilde{c}$: all firms		γ Estimations on $\tilde{\tilde{c}}$: French non-exporters		γ Estimations on $\bar{c}$: all firms	
Industry	β_L	β_K	γ	R^2	γ	R^2	γ	R^2
F	0.7243*	0.2716*	1.7823*	0.9249	1.9593*	0.9162	2.7615*	0.8613
	(0.0041)	(0.0042)	(0.0090)		(0.0195)		(0.0195)	
T	0.7667*	0.1613*	1.8465*	0.8828	1.3799*	0.8507	3.3056*	0.8590
	(0.0104)	(0.0106)	(0.0257)		(0.0685)		(0.0511)	
C	0.7735*	0.1546*	1.2833*	0.8683	2.7491*	0.9122	2.2672*	0.8594
	(0.0138)	(0.0145)	(0.0246)		(0.1581)		(0.0451)	
L&F	0.7980*	0.1435*	2.0488*	0.9230	1.3079*	0.4810	3.1758*	0.8555
	(0.0136)	(0.0112)	(0.0355)		(0.3032)		(0.0783)	
W	0.7500*	0.1836*	1.6808*	0.9060	1.8761*	0.9135	3.4716*	0.8615
	(0.0092)	(0.0099)	(0.0231)		(0.0302)		(0.0593)	
Pa	0.7883*	0.2281*	2.2444*	0.9540	2.4101*	0.9883	3.5196*	0.8773
	(0.0124)	(0.0088)	(0.0210)		(0.0395)		(0.0561)	
P&P	0.9957*	0.0271*	1.8222*	0.9481	1.9670*	0.9227	2.7084*	0.8979
	(0.0118)	(0.0060)	(0.0158)		(0.0306)		(0.0339)	
P&C	0.6390*	0.3916*	0.8097*	0.8184	2.5368*	0.5082	2.1565*	0.7524
	(0.0576)	(0.0286)	(0.0322)		(0.8841)		(0.1044)	
Ch	0.8705*	0.1576*	1.5566*	0.9204	1.7822*	0.8899	2.6413*	0.8440
	(0.0043)	(0.0041)	(0.0098)		(0.0587)		(0.0242)	
R&P	0.8032*	0.1878*	2.0361*	0.9070	2.3269*	0.9823	3.6417*	0.8463
	(0.0064)	(0.0064)	(0.0193)		(0.0245)		(0.0460)	
NMP	0.7661*	0.2291*	1.9303*	0.9225	2.0486*	0.9463	3.2528*	0.8611
	(0.0063)	(0.0053)	(0.0170)		(0.0236)		(0.0397)	
MP	0.7724*	0.2248*	2.3571*	0.9470	2.2769*	0.9639	3.4729*	0.8498
	(0.0082)	(0.0071)	(0.0197)		(0.0714)		(0.0515)	
FMP	0.8667*	0.1201*	2.3048*	0.9283	2.3285*	0.9245	3.7682*	0.8459
	(0.0049)	(0.0042)	(0.0150)		(0.0204)		(0.0377)	
Ma	0.9251*	0.0790*	1.9071*	0.9281	2.0464*	0.8960	3.5288*	0.8451
	(0.0057)	(0.0046)	(0.0123)		(0.0379)		(0.0351)	
EMa	0.8950*	0.1021*	1.6938*	0.9268	1.8714*	0.8157	2.7812*	0.8408
	(0.0075)	(0.0060)	(0.0140)		(0.0601)		(0.0355)	
PSE	0.8597*	0.1235*	1.4335*	0.9081	1.7974*	0.8674	2.7808*	0.8229
	(0.0146)	(0.0119)	(0.0210)		(0.0524)		(0.0594)	
Tr	0.8936*	0.1186*	1.5657*	0.8923	2.2440*	0.9350	3.0850*	0.8369
	(0.0070)	(0.0057)	(0.0164)		(0.0525)		(0.0410)	
Oth	0.8263*	0.1287*	2.1485*	0.9759	1.6857*	0.9245	3.2801*	0.8933
	(0.0064)	(0.0060)	(0.0110)		(0.0279)		(0.0369)	

Robust standard errors in parenthesis, with * denoting significantly different from zero at the 1% confidence level.

Table 3: Industry-country producer prices.

Industry	Country																			
	AT	AU	BE	CA	DE	DK	ES	FI	FR	GB	GR	IE	IT	JP	KO	NL	NO	PT	SE	US
F	1.06	0.98	1.04	0.98	1.04	1.11	0.91	1.06	1.26	1.27	1.32	1.20	1.06	2.64	1.96	1.01	1.46	1.16	1.21	1.18
T	2.06	1.52	0.90	0.94	1.39	1.63	0.86	1.07	1.16	1.16	1.07	1.15	1.11	1.11	1.06	1.13	1.53	0.91	1.65	1.00
C	2.23	1.24	1.78	1.24	1.95	1.60	1.06	1.91	2.49	1.37	1.32	1.54	1.72	1.49	1.20	1.23	3.28	1.08	2.63	1.03
L&F	1.56	0.81	1.46	1.10	1.33	1.40	0.66	1.54	1.08	1.47	1.20	1.32	0.65	1.84	1.13	1.27	1.98	0.85	1.36	0.94
W	1.60	1.42	1.28	0.96	1.20	1.46	0.77	0.91	1.17	2.00	0.81	1.26	1.00	1.90	1.43	2.29	1.34	1.05	0.97	1.05
Pa	1.12	1.28	0.88	1.11	1.04	1.02	0.97	1.17	1.28	0.93	1.30	1.15	0.96	1.18	1.37	1.09	1.45	1.12	1.09	1.19
P&P	1.17	1.32	1.20	1.04	1.32	2.26	0.83	0.99	1.36	1.20	0.86	1.62	0.97	1.62	1.23	1.43	1.70	1.25	1.91	1.13
P&C	1.54	0.77	2.54	1.55	3.85	1.14	1.86	1.88	1.46	1.13	1.93	0.94	1.33	2.42	1.15	2.68	1.92	1.62	1.77	1.11
Ch	0.86	1.06	0.89	0.81	0.97	0.99	0.75	0.62	0.95	0.96	0.71	0.74	0.83	1.24	0.63	0.71	1.29	0.72	0.93	1.01
R&P	0.72	1.12	0.56	0.99	0.82	1.09	0.53	0.91	0.72	0.68	1.59	0.81	0.53	1.37	0.89	0.76	1.30	0.45	0.97	1.00
NMP	0.97	1.07	0.81	0.91	0.82	1.15	0.51	1.05	0.93	0.96	0.61	1.02	0.60	1.28	0.72	0.92	1.29	0.62	1.30	1.08
MP	1.36	1.17	0.93	0.94	1.03	1.31	0.83	1.22	1.31	1.12	0.92	1.05	0.72	1.04	1.23	1.08	1.86	0.77	1.18	0.94
FMP	1.67	1.31	1.09	0.95	1.22	1.48	0.73	0.90	1.17	1.14	0.97	1.22	0.58	1.38	1.17	0.89	1.52	0.79	0.89	1.05
Ma	1.54	1.05	1.09	0.82	1.18	1.36	0.79	1.15	1.02	0.94	0.89	1.43	0.76	1.13	1.19	1.40	1.53	1.19	1.24	1.05
EMa	1.38	1.11	0.99	0.70	1.13	2.12	0.86	1.06	1.01	1.09	1.02	1.32	1.03	0.89	0.71	1.21	1.80	0.70	1.01	0.81
PSE	1.41	1.29	1.22	0.92	1.37	1.57	1.13	1.61	1.44	1.35	1.35	1.50	1.29	1.45	1.00	1.19	1.79	0.76	1.05	1.05
Tr	1.56	1.23	1.67	1.04	1.57	2.22	1.05	1.49	1.70	1.56	1.53	1.96	1.20	1.02	0.89	1.52	2.02	2.20	1.63	1.04
Oth	1.61	1.42	0.93	1.02	1.23	0.96	0.76	0.82	1.15	0.74	0.96	1.10	0.71	1.67	0.81	1.37	1.93	1.24	1.02	1.05

Country codes: AT' = Austria; 'AU' = Australia; 'BE' = Belgium; 'CA' = Canada; 'DE' = Germany; 'DK' = Denmark; 'ES' = Spain; 'FI' = Finland; 'FR' = France; 'GB' = Great Britain; 'GR' = Greece; 'IE' = Ireland; 'IT'= Italy; 'JP' = Japan; 'KO' = Korea; 'NL' = Netherlands; 'NO' = Norway; 'PT' = Portugal; 'SE' = Sweden; 'US' = United States.

Table 4: Endogenous vs Exogenous competitiveness

Country	Endogenous comp. rank	Exogenous comp. rank	Difference
Austria	13	10	3
Belgium	6	12	-6
Denmark	14	9	5
Finland	7	2	5
France	9	11	-2
Germany	12	15	-3
Great Britain	5	13	-8
Greece	4	4	0
Ireland	8	8	0
Italy	2	6	-4
Netherlands	10	14	-4
Norway	15	7	8
Portugal	3	1	2
Spain	1	3	-2
Sweden	11	5	6

Table 5: Frequency of Export intensity

Export intensity of exporters in %	Observed France	Our Simulations
0 to 10	69.2	17.6
10 to 20	12.3	16.1
20 to 30	6.7	14
30 to 40	4.1	7.7
40 to 50	2.2	5.6
50 to 60	1.4	6
60 to 70	0.8	6.2
70 to 80	0.4	8.7
80 to 90	0.3	12.3
90 to 100	2.6	5.8

Table 6: Correlation between prices and revealed comparative advantage

Country	Correlation
Austria	-0.446
Belgium	-0.035
Denmark	-0.128
Finland	-0.096
France	0.275
Germany	-0.395
Great Britain	-0.537
Greece	-0.028
Ireland	0.195
Italy	-0.409
Netherlands	-0.030
Norway	-0.379
Portugal	-0.213
Spain	-0.616
Sweden	-0.575

Table 7: Costs and gains by country

Country	costs of Non-Europe % decr. $1/\bar{m}$	costs of Non-Europe % incr. $\bar{m}$	gains from More Europe 1 % incr. $1/\bar{m}$	gains from More Europe 1 % decr. $\bar{m}$	gains from More Europe 2 % incr. $1/\bar{m}$	gains from More Europe 2 % decr. $\bar{m}$
Austria	21.54	27.45	48.27	32.56	4.39	4.21
Belgium	24.42	32.30	16.47	14.14	-3.48	-3.61
Denmark	17.94	21.86	9.36	8.56	22.51	18.38
Finland	27.59	38.10	25.04	20.03	26.41	20.89
France	9.92	11.02	2.84	2.76	8.52	7.85
Germany	6.10	6.50	0.64	0.64	1.73	1.70
Great Britain	7.63	8.27	5.66	5.35	5.08	4.84
Greece	14.79	17.36	12.35	10.99	17.45	14.86
Ireland	27.04	37.05	18.18	15.38	10.07	9.15
Italy	17.80	21.66	13.65	12.01	14.11	12.37
Netherlands	14.58	17.06	7.33	6.83	10.01	9.10
Norway	17.22	20.80	11.57	10.37	12.90	11.42
Portugal	21.44	27.28	17.38	14.81	10.51	9.51
Spain	22.98	29.83	20.19	16.80	26.34	20.85
Sweden	22.75	29.45	14.09	12.35	22.39	18.30
Europe	13.14	15.88	8.90	7.58	9.08	7.87

Table 8: Costs and gains by industry

Industry	costs of Non-Europe % decr. $1/\bar{m}$	costs of Non-Europe % incr. $\bar{m}$	gains from More Europe 1 % incr. $1/\bar{m}$	gains from More Europe 1 % decr. $\bar{m}$	gains from More Europe 2 % incr. $1/\bar{m}$	gains from More Europe 2 % decr. $\bar{m}$
F	4.54	4.76	5.54	5.25	3.98	3.83
T	14.39	16.80	8.10	7.49	8.62	7.93
C	13.66	15.82	9.33	8.54	8.64	7.95
L&F	19.01	23.47	4.24	4.06	11.73	10.50
W	10.18	11.33	6.63	6.22	9.42	8.61
Pa	9.31	10.26	3.01	2.93	6.07	5.72
P&P	2.21	2.26	4.62	4.42	5.37	5.09
P&C	12.18	13.87	16.61	14.25	24.24	19.51
Ch	15.47	18.30	15.82	13.66	7.91	7.33
R&P	11.37	12.83	19.12	16.05	19.41	16.26
NMP	6.63	7.10	5.69	5.38	4.03	3.87
MP	14.82	17.39	3.98	3.83	7.33	6.83
FMP	10.50	11.73	6.86	6.42	9.81	8.93
Ma	18.36	22.49	7.41	6.90	7.90	7.32
EMa	19.60	24.38	4.71	4.50	8.63	7.95
PSE	22.36	28.80	7.82	7.26	5.07	4.82
Tr	18.75	23.07	4.59	4.38	5.74	5.43
Oth	12.67	14.51	33.45	25.07	6.26	5.89

Table 9: European integration and regional imbalances

Code	French Region	Per capita GRP (France=100)	% incr. $1/\bar{m}$	% decr. $\bar{m}$
FR10	Ile de France	154.8	-0.05	-0.05
FR21	Champagne-Ardennes	93.55	0.54	0.54
FR22	Picardie	80.65	0.85	0.85
FR23	Haute-Normandie	90.86	3.00	2.91
FR24	Centre	88.46	0.52	0.52
FR25	Basse-Normandie	81.52	7.75	7.19
FR26	Bourgogne	87.46	0.33	0.33
FR31	Nord-Pas de Calais	77.09	0.96	0.95
FR41	Lorraine	81.48	4.96	4.72
FR42	Alsace	98.08	25.48	20.30
FR43	Franche-Comté	87.66	0.59	0.59
FR51	Pays de la Loire	89.3	-0.71	-0.72
FR52	Bretagne	85.22	5.26	5.00
FR53	Poitou-Charentes	81.58	0.37	0.37
FR61	Aquitaine	87.98	0.52	0.52
FR62	Midi-Pyrénées	86.38	0.44	0.44
FR63	Limousin	80.96	-0.02	-0.02
FR71	Rhône-Alpes	100.28	0.47	0.46
FR72	Auvergne	82.75	-0.09	-0.09
FR81	Languedoc-Roussillon	76.1	0.47	0.47
FR82	PACA	91.05	1.81	1.78

Table 10: Robustness checks for European countries

	costs of Non-Europe % decr. $1/\bar{m}$				gains from More Europe 1 % incr. $1/\bar{m}$				gains from More Europe 2 % incr. $1/\bar{m}$			
Country	Baseline	OLS	LP	BEJK	Baseline	OLS	LP	BEJK	Baseline	OLS	LP	BEJK
Austria	21.54	17.61	22.10	16.04	48.27	22.89	34.66	8.15	4.39	3.73	4.56	2.05
Belgium	24.42	20.35	24.85	20.07	16.47	10.05	16.83	16.93	-3.48	-1.39	-3.51	-2.53
Denmark	17.94	14.75	18.42	13.01	9.36	8.91	9.89	6.29	22.51	15.06	24.29	12.13
Finland	27.59	23.10	27.99	24.18	25.04	22.04	23.13	12.97	26.41	21.80	24.86	16.73
France	9.92	8.44	10.10	8.77	2.84	4.78	2.87	1.81	8.52	3.74	7.95	5.25
Germany	6.10	4.82	6.22	5.03	0.64	0.72	0.67	0.64	1.73	1.27	1.75	1.99
Great Britain	7.63	5.84	7.67	8.14	5.66	4.42	4.99	2.17	5.08	2.00	4.79	3.61
Greece	14.79	11.14	14.95	13.73	12.35	15.99	12.31	19.47	17.45	7.31	17.99	17.34
Ireland	27.04	22.40	27.66	21.03	18.18	21.22	19.11	12.20	10.07	14.87	9.49	5.09
Italy	17.80	15.34	17.73	19.14	13.65	14.16	11.40	12.81	14.11	8.80	12.69	17.87
Netherlands	14.58	12.09	14.83	11.92	7.33	7.20	7.28	5.00	10.01	12.60	27.63	10.33
Norway	17.22	13.91	17.93	10.22	11.57	18.41	12.31	4.54	12.90	8.98	14.08	4.53
Portugal	21.44	17.90	21.67	19.82	17.38	16.29	29.21	3.20	10.51	18.06	10.13	5.00
Spain	22.98	19.60	23.05	23.75	20.19	25.31	18.35	27.76	26.34	16.91	24.85	24.10
Sweden	22.75	19.22	23.20	18.88	14.09	23.12	44.61	10.10	22.39	14.55	57.41	18.24
Europe	13.14	10.93	13.29	12.19	8.90	8.97	9.08	6.84	9.08	6.04	10.37	8.16

Table 11: Robustness checks for French regions

French Region	% incr. $1/\bar{m}$			
	Baseline	OLS	LP	BEJK
Ile de France	-0.05	-0.04	-0.05	-0.05
Champagne-Ardennes	0.54	3.32	0.62	1.53
Picardie	0.85	0.79	0.89	0.80
Haute-Normandie	3.00	2.59	3.12	3.42
Centre	0.52	0.68	0.54	0.57
Basse-Normandie	7.75	7.09	8.34	3.13
Bourgogne	0.33	0.11	0.34	0.29
Nord-Pas de Calais	0.96	1.85	1.02	1.59
Lorraine	4.96	5.64	5.08	5.28
Alsace	25.48	13.96	25.73	5.31
Franche-Comté	0.59	0.81	0.62	0.25
Pays de la Loire	-0.71	-0.47	-0.73	-0.66
Bretagne	5.26	5.05	5.50	9.12
Poitou-Charentes	0.37	0.32	0.38	0.42
Aquitaine	0.52	0.70	0.56	0.52
Midi-Pyrénées	0.44	0.54	0.47	0.38
Limousin	-0.02	-0.03	-0.02	-0.03
Rhône-Alpes	0.47	0.50	0.48	0.38
Auvergne	-0.09	0.00	-0.08	-0.01
Languedoc-Roussillon	0.47	0.59	0.49	0.51
PACA	1.81	1.79	1.85	1.45

Table 12: Country coverage of our Amadeus dataset

Country	Number of Firms	Number of Observations
Austria	441	703
Belgium	1,872	9,227
Denmark	1,022	1,418
Finland	491	3,214
France	5,319	24,261
Germany	1,022	2,659
Great Britain	6,048	26,907
Italy	7,045	34,119
Netherlands	1,222	5,059
Norway	3,168	5,168
Portugal	422	1,032
Spain	3,415	15,901
Sweden	1,641	7,616

Table 13: Industry coverage of our Amadeus dataset

Industry	Number of Firms	Number of Observations
Food beverages and tobacco	4,905	20,375
Textiles	1,315	5,809
Wearing apparel except footwear	697	3,052
Leather products and footwear	394	1,877
Wood products except furniture	1,142	4,080
Paper products	1,035	4,596
Printing and Publishing	2,012	7,989
Petroleum and Coal	171	799
Chemicals	3,073	13,609
Rubber and plastic	1,779	7,759
Other non-metallic mineral products	1,622	6,905
Metallic products	1,262	5,595
Fabricated metal products	3,104	12,661
Machinery except electrical	3,431	14,397
Electric machinery	2,256	9,305
Professional and scientific equipment	861	3,522
Transport equipment	1,940	7,703
Other manufacturing	1,841	7,251

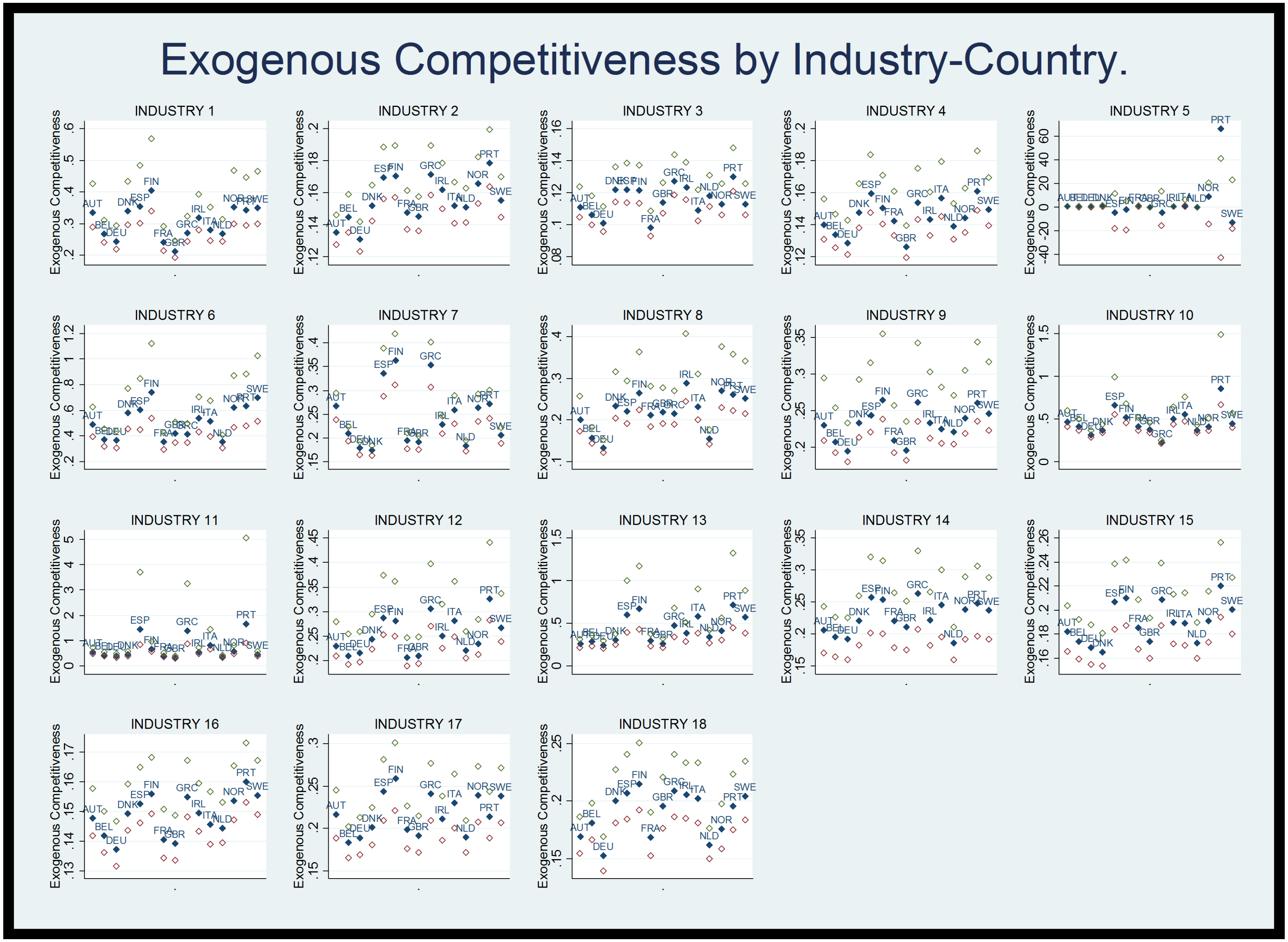

Figure 1: Exogenous Competitiveness.

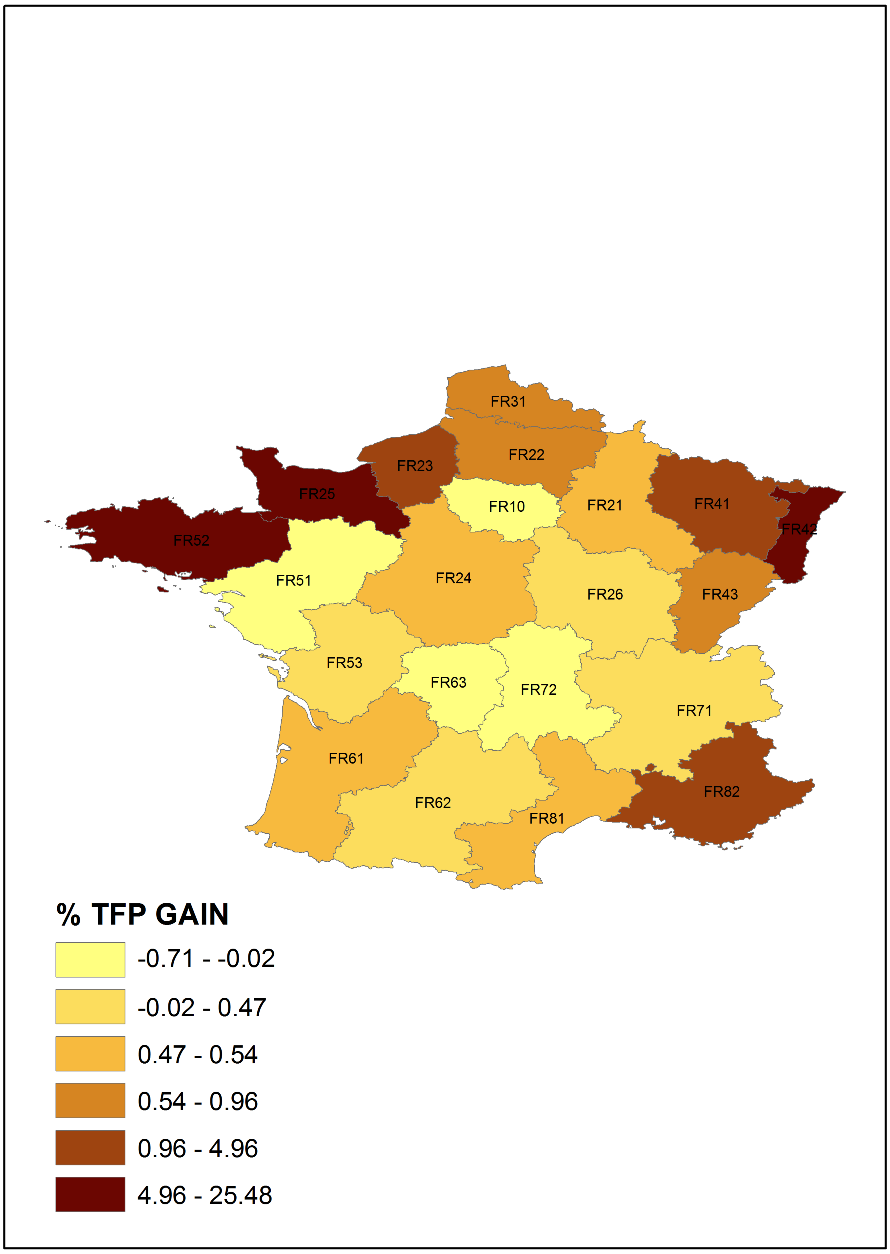

Figure 2: French Regions TFP gains from further European Integration.