Border Effects and East-West Integration

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Abstract

A new method for measuring trade potential from border effects is developed and applied to manufactured trade between the fifteen European Union members and ten Central and East European economies. Border effects are estimated with three theoretically compatible trade specifications and large trade potentials are obtained for CEE-EU trade even after almost a decade of trade liberalization. Disaggregate data for 27 industries shows that in 2000 CEE-EU trade integration was almost twice as weak as intra-EU integration, generating a huge potential for East-West European trade in the prospect of EU enlargement. This figure is much larger than predictions of usual trade potential models, highlighting the need to consider domestic trade opportunities. A discrimination test for monopolistic against perfect competition trade models is also developed. European trade brings evidence in support of national product differentiation, associated with perfect competition, but this result should be used with moderation.

1 Introduction

Trade integration policies such as the EU accession of CEE countries target the intensification of bilateral economic relationships. The latter is an important source of economic growth, but also a factor generating an improved functioning of a country's institutions, explaining the interest for these policies and their popularity. However, it is not always obvious how the expected amplification of trade flows is to be measured. Central in this issue is the benchmark used.

The additional trade resulting from an economic integration initiative is traditionally estimated in the literature by trade potential models that rely on the empirical success of the gravity equation. The essence of these models consists in comparing actual international trade to the gravity prediction, the so called "normal" level of trade, with the difference between the two capturing the trade potential.[1] A drawback of this method is the mis-specification of the gravity equation used in these models with respect to trade theory, and the sensitiveness of results upon the gravity specification used.

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[1] Wang and Winters (1991), Hamilton and Winters (1992), Baldwin (1993), Gross and Gonciarz (1996), Fontagné et al. (1999), and Nilsson (2000).

The gravity equation is a basic tool in international economics usually used to express the volume of trade between two countries. It relates trade volume positively to the size of the two countries and negatively to the distance between them. Its wide use comes from its simplicity and good fit of empirical data. There is a large and growing international trade literature based on the empirical use of the gravity. However, its compatibility with the predictions of international trade theory remained questionable for a long time. Until recently the neoclassical trade theory seamed unable to predict a gravity-type relationship, and gravity-based works were considered therefore as lacking theoretical foundation.

Important progress has been made lately in deriving gravity-like equations from different trade models, showing that gravity is compatible with trade in both differentiated and homogeneous products.[2] Trade models with differentiated goods account by far for the largest part of this literature. Product differentiation can be defined in many ways, yielding different but rather complementary explanations for why gravity works. Helpman and Krugman (1985) and Bergstrand (1989) reach a gravity equation in a monopolistically competitive setting with goods differentiated at firm level. Anderson (1979) and Anderson and van Wincoop (2003) use differentiation by country of origin to derive the gravity in a perfect competition setup. Deardorff (1998) obtains a gravity equation in a neoclassical framework with different factor intensities. Eaton and Kortum (2002) enrich the theoretical underpinning of gravity with a Ricardian model of trade with homogeneous goods and differences in technologies.

The last two results dissipate the tacit belief that the success of gravity should be attributed to the presence of increasing returns to scale in the detriment of traditional trade theories. In the same context, Hummels and Levinshon (1995)'s empirical study reveals that gravity works for a wide range of countries, suggesting that it is consistent with different trade models, and, as Deardorff (1998) states, "is therefore not evidence of anything, but just a fact of life".

Another weakness of trade potential models is that they disregard the large amount of trade taking place inside national borders and base their predictions on an analysis carried exclusively on international trade. A different method for evaluating trade integration and estimating the trade potential, taking into account the fact that a lot of trade is already "missing" at the international level, is developed below.

Recent empirical work in international trade reveals an interesting phenomenon: A higher volume of trade takes place inside countries, within national borders, than between them, i.e. across borders. It's rather the size than the very presence of this phenomenon that is surprising. Even highly integrated countries as Canada and US trade about twenty times less with each other than with themselves (McCallum (1995)). The lower intensity of international transactions than what could be potentially justified on the basis of transportation costs alone pointed out by Trefler (1995) and Rauch (2001) is another indicator of this 'mystery of missing trade'. 'Under-trading' across national borders is usually referred to in the literature as the *border effet.* [3]

To McCallum (1995) the border effect reflects how much more in average a region trades with another region of the same country than with a region of equal size and

[2] For a detailed review of literature on gravity see Deardorff (1998), Feenstra, Markusen and Rose (2001), Head (2000), and Harrigan (2003).

[3] Rogoff and Obstfeld (2000) call this phenomenon the home bias in trade.

situated at equal distance but abroad. He uses a dummy variable for the border along with country GDPs and bilateral distance in a standard gravity equation to capture this effect. A negative and significant estimate of the coefficient on the border dummy reveals a large border effect: a large amount of 'missing' international trade. Helliwell (1996) and Wei (1996) confirm McCallum's finding of large border effects between some highly integrated economies using identical or very similar equations on different data sets. Unlike McCallum and Helliwell who use region level data, Wei (1996) estimates the value of missing trade from country data. He computes unavailable intranational trade as the difference between a country's production and its exports,[4] and introduces a remoteness variable (multilateral distance) in the trade equation to control for the relative isolation of a country from its trading partners.[5] Under this specification border effects equal to the ratio of intranational to international trade after controlling for economic size and distance.

Differently from trade potential models, we use the level of trade within a country as benchmark for its trade with partner countries. The rationale for this is that a country is a highly integrated and homogeneous economic space, where full economic integration is achieved. Indeed, in the light of some recent studies,[6] the presence of a single legislative system, central administration, currency, communication network, and set of economic policies contributes to an important reduction of transaction costs and fosters exchange.

We define the level of trade integration of two or more countries by referring to the intensity of trade inside these very countries. The more the volume of trade across national borders approaches that of internal trade when controlling for variables such as size and distance, the more integrated trading countries are. We expect trade integration to continue until a lower limit intra-group border effect is reached. Thus, the estimation of trade potentials is reduced to the estimation and comparison of within and cross group border effects, with a lower border effect signaling a higher trade integration. We refer to this approach as to *integration in terms of border effects*. By its very construction this approach partially incorporates 'missing' international trade and produces higher trade potentials.

Although all trade theories are compatible with gravity-type trade equations, each of them produces a different specification of the latter. This aspect ignored by trade potential models is incorporated in our approach through the use of theoretically derived trade equations in the estimation of border effects. One can estimate border effects from a national product differentiation setting as Anderson and van Wincoop (2003), with monopolistic competition and firm-specific varieties like Wei (1996) and Head and Mayer (2000), or yet estimate an average bilateral border effect as Head and Ries (2001). Three alternative specifications for domestic and foreign trade flows are used. The first consists in using country-specific effects to capture importer and exporter groups of variables, allowing the estimation of coefficients on bilateral variables alone. The second approach involves a deeper use of the theoretical framework, in particular the production

[4]This permitted the estimation of border effects for a large number of trade flows removing the limits set by the unavailability of regional trade data, and therefore the expansion of this literature.

[5]This correction of the gravity was embraced by further works such as Wolf (2000), Nitsch (2000), and Evans (2001).

[6]Brunetti et al. (1997), Rauch (2001).

side of a DSK monopolistic model, and the last approach implies the computation of average trade 'freeness'.

The choice of the trade model, however, may have a direct impact on the magnitude of trade potentials. It is important therefore to identify and use the model that best replicates trade flows for considered countries. We address this question in more detail in the section before the last one by constructing a test for national product differentiation with perfect competition, and monopolistic competition with endogenously selected firms and varieties trade models.

EU enlargement will have mainly a East-West European trade creation effect, which may or not be accompanied by trade diversion in the detriment of 'old' EU members. We assume that trade integration between the two groups of countries will deepen and converge towards the intra-EU level before enlargement. The part of intra-EU trade in total EU trade remaining at a steady level during the last decade suggests that the latter might well correspond to the long term equilibrium.

Specifically, our approach implies two steps. First, the amount of missing international trade relative to trade within national borders is estimated for each group of countries. Put differently, these resumes to estimating intra-EU and CEE-EU border effects. Secondly, the two border effects are compared and their ratio gives the potential of trade between CEE countries and the European Union. This corresponds to the actual trade creation that will occur once East-West European trade integration reaches the current intra-EU level, or the trade potential induced by full integration of these countries in terms of border effects.

While strengthening trade between 'old' and new members, EU enlargement is very likely to have a non negligible impact on trade between new joiners (e.g. between Hungary and Poland). As revealed by the literature,[7] the reintegration of CEE countries into the world economy in the early 1990s marched side-by-side with their disengagement in regional integration. The decline of trade with other CEE partners was beyond its normal level, pointing out the strong competition between former socialist economies for obtaining a higher share of the much larger EU market, and which is more important, for a positive evaluation from the EU and augmented chances for accession. These tendencies have been reduced and even reversed occasionally with the implementation of regional free trade initiatives. With most of CEE countries joining the union and becoming members of the same economic block, this rivalry will be significantly reduced, and intra-CEE trade will most probably return to its 'normal' level. Moreover, it may even expand beyond that level, as part of the new intra-EU trade. In this paper we assume that trade among CEE countries joining the union will reach in the long run the intra-EU level. CEE trade potential is then obtained by taking the ratio between intra-CEE and intra-EU border effects prior to enlargement.

Trade both between CEE and between CEE and EU countries improved remarkably during the last decade of the XXth century, both in terms of border effects and trade potentials. Our results predict much higher trade potentials for both CEE-EU and intra-CEE trade than usually found in the literature and based on trade potential gravity models. Results are very robust and are obtained with all theoretically sound specifica-

[7] Maurel (1998), Gros and Gonciarz (1996), Baldwin (1993), Nilson (2000).

tions. Thus, at the beginning of the XXst century trade between CEE and EU countries represented about half of its attainable level, suggesting a possible 100% increase with further EU integration. The possible upsurge of regional CEE trade in the following years, despite the impressive reduction of bilateral border effects, is even higher.

The paper is divided as follows: Section 2 describes the theoretical trade model and three different specifications used to estimate border effects. Within and cross group border effect estimates are presented and discussed in the next section. Main results of the paper are included in section 4. Trade potentials for different European trade flows with different approaches and their evolution are compared. The monopolistic competition model is tested against a perfect competition model of trade in section 5, and the last section concludes.

2 Theoretical Discussions

In this section we develop three specifications of trade flows, basing our theoretical modelling on two trade models used in the literature: the national product differentiation model *à la* Armington (1969), and the monopolistic competition model of Dixit and Stiglitz (1977) and Krugman (1980).

We start by describing an underlying preference structure with differentiated goods, common to all trade specifications. The trade equation obtained includes variables that are unobserved or inaccurately measured. This makes the trade equation unsuitable for direct estimation. The issue of reaching an estimable equation is solved in three particular ways, generating an equal number of trade flows specifications. Each specification is further considered into details in a separate subsection.

2.1 A basic differentiated-goods trade structure

We consider a trade structure with differentiated goods and n_i varieties produced in each country i. The model has a slightly different interpretation depending on the used data. Each industry (when using industry-level data) or the entire manufactured sector (when using aggregate data) is considered to be composed of a single differentiated product of which multiple varieties are available. Product differentiation can be at country level or by firm. National product differentiation was introduced by Armington (1969) who proposed an utility function in which consumers distinguish products by the place of origin. It can also arise from a Heckscher-Ohlin model with no factor price equalization as in Deardoff (1998). An alternative approach is that of Dixit-Stiglitz-Krugman (DSK) type monopolistic competition models. In the latter each variety is associated with a distinct firm, and the number of varieties n_i (and firms) is endogenously determined by the model.

Consumer preferences are homothetic and represented by a CES utility function. Importing country j's representative consumer utility is given by:

$$u_j = \left[\sum_i n_i \left(a_{ij} x_{ij} \right)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \tag{1}$$

with a_{ij} standing for country j's consumers preference for country i products, and x_{ij} for the volume of goods produced in i and consumed in j. Coefficients a_{ij} are introduced in order to allow for different preferences across countries.[8]

We assume that consumers of each product are charged with the same price augmented by trade costs. The difference in the price of the same good in two different locations is therefore entirely explained by the difference in trade to these locations. We use 'iceberg' trade costs and express the price to country j consumers of a good from i, p_{ij}, as the product of its mill price p_i and the trade cost from i to j, t_{ij}: $p_{ij} = p_i t_{ij}$. Bilateral trade costs are further decomposed into transport costs proportional to the shipping distance,[9] and costs due to the presence of trade barriers such as tariffs, non-tariff barriers, information costs, partner search costs, institutional costs, etc. The latter are assumed null for trade within a country and positive for trade across borders:

$$t_{ij} \quad = \quad \underbrace{{d_{ij}}^{\rho}}_{\substack{\text{transport}\\ \text{costs}}} \underbrace{\exp\left[(1 - home_{ij})\, b_{ij}\right]}_{\substack{\text{border-specific}\\ \text{costs}}}. \tag{2}$$

d_{ij} stands for distance between countries i and j, ρ is an elasticity coefficient, $home_{ij}$ is a dummy variable equal to one for intranational trade and to zero for trade across national borders. The second term of the equation reflects border-specific trade barriers and is the salient source of international 'under-trading'. $[\exp(b_{ij}) - 1] \times 100$ gives the tariff equivalent of trade barriers for country j imports from i. In section 3 we introduce a more complex trade costs function by decomposing the second left hand side term of equation (2) in order to account for the presence of a common land border or language, and different trade flows types.

Consumers face a budget constraint in the sense that a country's expenditure E is bounded by its revenues:

$$\sum_i n_i x_{ij} p_{ij} = E_j. \tag{3}$$

Consumers choose quantities that maximize their utility function (1) under the budget constraint given by (3). This optimization program generates the following expression of total country j's demand for (imports of) country i products:

$$m_{ij} \equiv x_{ij} p_{ij} = a_{ij}^{\sigma-1} \left(\frac{p_i t_{ij}}{P_j}\right)^{1-\sigma} n_i E_j, \tag{4}$$

$$\text{with} \qquad P_j \equiv \left[\sum_k a_{kj}^{\sigma-1} \left(p_k t_{kj}\right)^{1-\sigma} n_k\right]^{\frac{1}{1-\sigma}} \tag{5}$$

representing a price index of the importing country j nonlinear with respect to the unknown parameter σ. It receives slightly different specifications under national and firm

[8] Two forms of preferences are usually found in the literature: identical for all countries, $a_{ij} = a_i \ \forall j$, yielding symmetric utility functions (e.g. Anderson and van Wincoop (2003)), and more pronounced for domestic products, $a_{ij} = \exp(e_{ij})$ if $i \neq j$ and $a_{jj} = \exp(e_{jj} + \beta)$, producing asymmetric functions (e.g. Bergstrand (1989), Head and Mayer (2000)).

[9] As shown by Hummels (1998) and other empirical studies.

level product differentiation. The particular form of the denominator, combined with unobserved or inaccurately measured country-specific number of varieties and mill prices, complicates the estimation of trade equation (4).

In the rest of the paper we adopt the following notation $\phi \equiv (t_{ij}/a_{ij})^{1-\sigma}$, imported from the economic geography literature, and representing trade freeness (or ϕ-ness). Consumer preferences can also be expressed as a function of bilateral variables, similar to trade costs. However, we have no means to disentangle the impact on preferences from the impact on tarde costs of identical variables (e.g. common language). Estimated coefficients on the latter will actually produce the global effect on trade costs and consumer preferences. We shall therefore assume throughout the rest of paper unitary preferences for all products and consumers, and shall discuss this in more detail in section 3.

The rest of the section is reserved to the presentation and discussion of three alternative strategies to address these issues. The first consists in using country-specific effects to capture importer and exporter groups of variables, allowing the estimation of coefficients on bilateral variables alone. We shall refer to it as the *fixed-effects* approach. The second procedure involves a deeper use of the theoretical framework, in particular the production side of a DSK monopolistic model, and the last approach implies the computation of average trade 'freeness'. We call those the *odds* and *friction* specifications respectively.

2.2 The fixed-effects specification

The method presented bellow relies uniquely on the elements of the differentiated-goods structure presented above. As a result, it holds independently from the specific market structure, and any assumptions associated with it, being equally compatible with perfect and imperfect competition, national and firm level differentiation of products. As implied by the name, it resides in using importer and exporter specific dummies to account for market and supply capacities, as by Rose and van Wincoop (2001) and Redding and Venables(2004).

An estimable trade specification can be derived directly from (4) by grouping i and j terms of the equation, using the definition of trade freeness, and taking logarithms on both sides:

$$\ln m_{ij} = FE_i + \ln \phi_{ij} + FM_j. \tag{6}$$

Country fixed effects are used as proxies for supply and demand terms of the equation with $FE_i \equiv \ln(n_i p_i^{1-\sigma})$, and $FM_j =\equiv \ln(E_j \sum_k n_k p_k^{1-\sigma} \phi_{kj})$. Under this approach only bilateral variables are left in the equation, and all structural parameters, in particular the elasticity of substitution between varieties σ, cannot be estimated. This represents the major drawback of this approach.

Differently from the cited authors, we are interested in the estimation of border effects, and consequently estimate equation (6) for international and domestic trade. We use the trade freeness definition along with the decomposition of trade costs to reach the trade equation form which allows the estimation of border specific effects:

$$\ln m_{ij} = FE_i + FM_j + \rho(1-\sigma)\ln d_{ij} + (1-\sigma)b_{ij} + (\sigma - 1)b_{ij}home_{ij}. \tag{7}$$

Accordingly, a higher coefficient on the last variable designates higher cross-border barriers for country i's exports to j. As suggested by (7) higher barriers can arise not only from larger trade costs (larger b_{ij}), but also from a higher elasticity of substitution. Home bias in preference as well as any other country-specific trade barriers drop from this measure of border effects and are seized by country specific effects.

Differently we can first derive a gravity-type trade equation following Anderson and van Wincoop (2003)'s approach for national product differentiation, and only afterwards group supply and demand variables separately into country specific effects. This will produce identical estimation equations and results; the difference lays in the interpretation of country and partner effects FE_i and FM_j.

Summing bilateral imports across destinations gives the production level at origin. This identity can be further used to express the unknown amount $n_i {p_i}^{1-\sigma}$, which is then re-introduced in the trade equation (4). Differently from Anderson and van Wincoop (2003), this can be accomplished without imposing market clearance ($y_i = E_i$) using data on importer's expenditure.[10] A nice gravity equation is thus obtained:[11]

$$m_{ij} = \frac{y_i E_j \phi_{ij}}{\bar{P}_i^{1-\sigma} P_j^{1-\sigma}} \tag{8}$$

$$\text{with} \qquad P_j^{1-\sigma} = \sum_k n_k p_k^{1-\sigma} \phi_{kj}, \quad \text{and} \qquad \bar{P}_i^{1-\sigma} \equiv \sum_k \phi_{ik} {P_k}^{\sigma-1} E_k. \tag{9}$$

P_j is the importer specific price index, reflecting the average price of country j's imports. Higher the average price paid by consumers of an importing country, the higher is the value of exports to that market. $P_j^{1-\sigma}$, on the contrary, corresponds to the relative isolation of a country in geographical terms, in terms of trade costs, or consumer preferences, and reduces bilateral flows. $\bar{P}_i$ is an exporter specific weighted average of price indexes of all its trading partners including itself. Note that the expression of $\bar{P}_i^{1-\sigma}$ in (9) is very similar to the market access used in economic geography models. Consequently, we can associate it to the access of country i's products to all markets, including the domestic one. The average partners' price index reflects their purchasing power and is positively related to trade. An improved global market access enjoyed by a country's products translates by higher total shipments to its partners. The impact on a bilateral basis depends on the effect on the partner's market capacity.

Symmetric trade costs ($t_{ij} = t_{ji},\ \forall\ i,j$), and identical preferences across countries ($a_{ij} = a_i,\ \forall\ i,j$) yield the symmetric solution $\bar{P}_i = P_i$ used by Anderson and van Wincoop (2003) to reach a more elegant version of (8). In our specific case of East-West European trade this assumption is irrelevant because the two groups of countries followed

[10] Market clearance is a quite restrictive assumption for it implies balanced international trade (see Appendix B), which occurs only at national level and in the long run. This assumption is not completely inconsistent with the CEE-EU industry level pattern of trade. In 2000 net trade amounted to 20 percent of total industry level trade between EU and Central and Eastern Europe, leaving four fifths of CEE-EU trade to intraindustry trade. Trade imbalances are less important for the entire manufactured sector, but not sufficiently low to suggest that realistic predictions shall be obtained by assuming market clearance at aggregate level. Therefore we choose to use expenditure data, computed as the sum of domestic production and net foreign trade.

[11] Deardorff (1998) reaches a similar trade equation from a Heckscher-Ohlin trade model with differences in factor prices across countries and complete specialization.

uneven trade liberalization timetables, a difference that we attempt to measure in the following sections.

As before, country and partner binary variables are used to capture demand and supply terms in equation (8) in logarithmic form, and equation (6) is reached. Only this case gives a different interpretation for the two categories of fixed effects:

$$FE_i \equiv \ln\left(y_i P_i^{\sigma-1}\right), \tag{10}$$

$$FM_j \equiv \ln\left(\sum_k \phi_{ij} P_k^{\sigma-1} E_k\right). \tag{11}$$

Supply capacity, the exporter specific effect FE_i in equation (6), is equal to the country's production divided by its average partner's price index. Market capacity reflected by the importer specific effect FM_i is actually the ratio between the partner's expenditure and average price.

2.3 The odds specification

This subsection presents an alternative trade model with monopolistic competition as in Dixit and Stiglitz (1977) and Krugman (1980), increasing returns to scale and firm-level differentiated products. Similar trade models have been developed by Head and Ries (2001) and Head and Mayer (2000).

In a DSK setting firms set prices as if they face a constant price elasticity of demand, equal to the elasticity of substitution between two varieties. Their prices, free of trade costs, are expressed as a constant markup over the marginal cost of production c_i:

$$p_i = c_i \frac{\sigma}{\sigma - 1} \tag{12}$$

We consider labor the only factor of production and homogeneous wages within countries. Then a unique mill price is charged for all varieties produced in the same country. Production technologies are assumed identical across countries and wages are the only source of difference in production costs. Identical production functions $qp_i = Fw_i + \mu q w_i$ are considered, with the second term denoting marginal costs. Firms enter the market until all profits vanish away, and the equilibrium price becomes equal to the average cost. This implies equal outputs q for all firms and varieties:

$$q = \frac{F(\sigma - 1)}{\mu}, \tag{13}$$

where F and μ represent invariable fixed and marginal cost coefficients. The number of varieties produced and firms in each country, n, is endogenous to the model. Combining equations (12) and (13), and using the fact that a country's revenue is the sum of its firms' revenues, we can express the number of varieties produced by a country as follows:

$$n_i = \frac{y_i}{w_i \sigma F}. \tag{14}$$

Given the expression of the number of locally produced varieties, equation (4) rewrites to:

$$m_{ij} = p_i^{1-\sigma} \frac{\phi_{ij}}{P_j^{1-\sigma}} \frac{y_i E_j}{\sigma w_i F}, \tag{15}$$

$$\text{with} \qquad P_j^{1-\sigma} = \sum_k p_k^{1-\sigma} \phi_{kj} \frac{y_k}{\sigma w_i F}. \tag{16}$$

Internal prices are given by $p_i = \mu w_i(\sigma/(\sigma - 1))$.

Using relative demands as explained variables, i.e. the ratio of trade flows to the same destination, considerably simplifies the specification by eliminating destination specific right hand side terms. Applied to our trade equation (15) this means the elimination of non linear importer's price index and expenditure. Thus the set of explained variables shrinks to the characteristics of the two origins. Particularly interesting for us is the case when the destination country is taken as reference. When using foreign-to-internal trade ratios with bilateral flows given by equation (15) one gets:

$$\frac{m_{ij}}{m_{jj}} = \frac{y_i}{y_j} \left(\frac{p_i}{p_j}\right)^{1-\sigma} \frac{w_i}{w_j} \left(\frac{\phi_{ij}}{\phi_{jj}}\right). \tag{17}$$

The price ratio in (17) can be written as the ratio of marginal costs, which given the above assumptions concerning the production function becomes equal to the wage ratio, w_i/w_j. Note that unknown technological coefficients simplify when using relative demands.

We are able to estimate border specific costs from equation (17) with destination country as reference and the sample restricted to foreign-relative-to-domestic shipments (exclude observations of the m_{jj}/m_{jj} type). Use the definition of trade freeness and the decomposition of trade costs (2) in (17), and take logarithms to obtain:

$$\ln \frac{m_{ij}}{m_{jj}} = \ln \frac{y_i}{y_j} - \sigma \ln \frac{w_i}{w_j} - \rho(\sigma - 1) \ln \frac{d_{ij}}{d_{jj}} - (\sigma - 1) b_{ij} \tag{18}$$

The opposite of the constant term in the above equation reflects border-specific trade barriers. In this case border effects are obtained as the ratio of domestic-to-cross-border trade, deflated by relative production, wage and distance. More specifically, the border effect for imports of j from i is obtained from (18) by taking the exponential of the negative free term: $\exp[(\sigma - 1)b_{ij}]$.

If consumer preferences were to vary with the goods' origin, any disproportionate preference for domestic varieties would be captured by the border effect. With a generally accepted perception of positive domestic biases in preferences, one should expect larger border effects estimates with the *odds* specification.

2.4 The friction specification

The last approach regards the use of a transformation used by Head and Ries (2001). The left hand side variable is the inverse index of 'friction' to trade, defined as:

$$\Phi_{ij} = \left(\frac{m_{ij}}{m_{jj}} \frac{m_{ji}}{m_{ii}}\right)^{1/2} \tag{19}$$

It reflects the geometric mean of foreign firms' success relative to domestic firms' success in each home market. Head and Ries (2001) assimilate the inverse of this index to the actual border effect between Canada and United States.

To remain consistent to the theoretical model, trade flows in the expression of Φ_{ij} are replaced using equation (17). Take logarithms on both sides to obtain:

$$\ln \Phi_{ij} = \ln \left(\frac{\phi_{ij}}{\phi_{jj}} \frac{\phi_{ji}}{\phi_{ii}} \right)^{1/2} \tag{20}$$

Equation (20) can also be obtained following the same steps directly from (8) or even (4). Its application is not therefore restricted to monopolistic trade models. According to the above specification the index Φ_{ij} actually represent the average trade freeness between countries i and j relative to their internal freeness. In the light of economic geography literature which assumes unitary internal freeness (null internal trade costs) and symmetric trade costs, the inverse friction index Φ_{ij} becomes precisely the trade freeness ϕ_{ij}.

Note that equation (20) imposes unitary coefficients on production variables, as suggested by the model, and is therefore closer to the theoretical specification than the previous two approaches. However, it allows only for the estimation of the average border effect for any two trading partners, rather than for two distinct effects, one for each trade directions. Replace trade freeness ϕ using its definition and the expression of trade costs (2) in the above equation and rewrite it in logarithmic from to get:

$$\ln \Phi_{ij} = \rho(1-\sigma) \ln \frac{d_{ij}}{(d_{jj} d_{ii})^{1/2}} - (\sigma - 1) \left(\frac{b_{ij} + b_{ji}}{2} \right) \tag{21}$$

Another advantage of the *friction* specification is that it removes the need even for origin specific variables, which is an important gain when accurate production, price and/or wage data is not available. As previously, the constant term refers to the magnitude of border effects when null unitary trade friction observations are excluded. It captures as well any bias in consumer preferences for both countries when these are allowed to vary across countries.

The use of relative demands in the last two specifications introduces spatial autocorrelation in the error term. This is corrected through a robust clustering procedure, which allows residuals of the same importing country to be correlated.

With different consumer preferences, we can decompose the preference term as follows:

$$\ln a_{ij} = \ln a_i + \ln a_j + e_{ij} + \sum \zeta C_{ij} \tag{22}$$

a_i and a_j reflect the origin and respectively destination specific components of the preference term, $\sum C_{ij}$ is a set of bilateral variables that may induce a bias in preferences, such as common borders or spoken languages, and e_{ij} is an error term. This form can integrate both a home bias in preferences (large a_i) and a higher preference for goods from neighbor countries (large ζ).

Without correcting for differences in preferences in the above trade specifications, the estimated coefficients will reflect altered effects. Thus in the *fixed effects* specification country specific terms a_i and a_j including home biases are be attributed to country and partner fixed effects. The *odds* and *friction* specifications neglect the destination specific term a_j and impute the origin specific term a_i to the border effect. Coefficients on bilateral variables present in the structure of both trade costs and consumer preferences actually reflect the sum of the separate effects on each element. And the error part e_{ij} is attributed for all approaches to the error terms of the model.

Border effects under all specifications have two components: one reflecting the true level of border specific trade costs (b_{ij} for the first two approaches and $(b_{ji} + b_{ij})/2$ for friction), and another coming from the elasticity of substitution between variables $(\sigma - 1)$. This means that even tiny trade barriers may generate important deviations of trade towards the domestic market when the substitution elasticity is sufficiently high. None of the specifications presented in this section permits the estimation of all structural parameters. Therefore we can only estimate entire border effects with each approach, without being able to distinguish the part ascribed to each of the two elements. We proceed in the next section to estimations of European border effects.

3 Estimating Border Effects Across Europe

The method proposed in section 1 estimates trade potentials from border effects for trade within and between country groups. To analyse trade creation effects of European integration we divide European trade into four types: EU imports from CEE, CEE imports from EU, intra-EU trade, and trade among CEE countries. The European Union enlargement to the Eat will drive CEE-EU trade integration to the level of integration between the fifteen 'old' EU members. To picture further (post integration) increase in reciprocal trade we compare the intra-EU integration level to the CEE-EU level. The deepening of East-West European integration was repeatedly argued and feared by politicians to harm regional integration in Central and Eastern Europe. With CEE countries joining the EU, trade between them becomes intra-union trade and will probably regain attraction. The above mentioned partition of European trade permits to evaluate each of these aspects.

We estimate border effects for each type of trade according to the trade specifications exposed in section 2. All border effects are obtained at each time from a single estimation on the entire sample of countries. This method is preferred to estimating border effects separately for each type of trade since it has the advantage of imposing the same coefficients of independent variables for all trade types and yields more comparable results. Border effects are estimated with the *fixed-effects*, *odds*, and *friction* specifications presented in section 2. For comparison reasons estimates of simple gravity equations with international, and domestic and foreign flows are also presented. Estimations are carried separately for total manufactured imports and for industry level imports.

Different trade costs for each type of trade are reflected through a more complex specification of the trade costs function (2):

$$\begin{aligned}\ln t_{ij} &= \rho \ln d_{ij} + b_1 homeEU_{ij} + b_2 homeCEE_{ij} + b_3 CEEtowardsEU_{ij} \\ &\quad + b_4 EUtowardsCEE_{ij} + b_5 intraEU_{ij} + b_6 intraCEE_{ij} \\ &\quad + c_1 contig_{ij} + c_2 comlang_{ij} + u_{ij}\end{aligned} \tag{23}$$

Six dummies for domestic trade of 'old' EU members and Eastern European countries, Central and East European exports to and imports from Western European countries, and regional Western and Eastern European trade are used to capture specific trade costs. The first two account for lower than average internal trade costs, and have negative coefficients, while the last four allow for different trade costs across trade types. Similar to most empirical studies on international trade, we control for a common land border between countries i and j, and a common language for both countries by including the binary variables $contig_{ij}$ and $comlang_{ij}$ respectively in the structure of trade costs. As both linguistic and neighbor relations are likely to reduce trade costs, negative coefficients c_1 and c_2 are expected.

Observe that the sum of the first six dichotomic variables in the above trade costs specification equals to unity. The use of (23) along with a constant term in the trade flows equation does not permit therefore the estimation of all parameters b_r. We choose to drop the intra-EU trade dummy, whose effect will then be reflected by the constant term. Estimated coefficients on the left five group dummies represent in this case deviations from the intra-EU trade level. Accordingly, a positive b_1 coefficient reflects to which degree internal EU trade exceeds intra-EU trade. In the case of the *odds* and *friction* trade equations lower trade costs for domestic shipments is directly accounted by the specific form of the left hand side variable, and home dummies become irrelevant. With the *fixed-effects* procedure the use of all group dummies, country and partner specific effects is impossible due to collinearity problems. A tractable equation is reached by imposing similar differences between foreign and domestic trade costs for all European countries through the use of unique *home* variable, and by replacing the variables $CEEtowardsEU_{ij}$ and $EUtowardsCEE_{ij}$ by their sum. Differently from other specifications, we prefer to exclude the *home* variable from the estimation and express coefficients on group dummies relative to average European domestic trade.

The gravity equation used in estimations is very similar to the one used by McCallumn (1995) and takes the following form:

$$\begin{aligned} \ln m_{ij} = \; & \alpha_1 GDP_i + \alpha_2 GDP_j + \alpha_3 d_{ij} + \beta_0 + \beta_1 homeEU_{ij} + \beta_2 homeCEE_{ij} \\ & + \beta_3 CEEtowardsEU_{ij} + \beta_4 EUtowardsCEE_{ij} + \beta_5 intraCEE_{ij} \\ & + \gamma_1 contig_{ij} + \gamma_2 comlang_{ij} + \epsilon_{ij} \end{aligned} \tag{24}$$

We use exporter and importer GDPs as proxies for national revenues for aggregate manufactured trade. They are replace with exporter's production and importer's consumption values for trade disaggregated by industry. Variables $CEEtowardsEU_{ij}$, $EUtowardsCEE_{ij}$, $intraCEE_{ij}$, $homeEU_{ij}$, and $homeCEE_{ij}$ are dummies indicating the affiliation of each observation to a particular trade type. The constant term captures the specificity of intra-EU trade. And a positive and significant estimate of β_1 shows how much more does in average a EU member buy from itself than from other EU member countries.

The border effect for EU imports from CEE reflects how much less do EU countries import from CEE partners than from domestic ones. It is obtained from comparing EU imports from CEE countries to domestic EU trade while controlling for size, distance, and other trade costs elements, and equals to the exponential of the difference between the coefficients of corresponding dummy variables: $\exp(\beta_1 - \beta_3)$. Similarly, the border effect for CEE imports from EU is given by $\exp(\beta_2-\beta_4)$. The intra-EU trade being the reference in trade equation (24), the intra-EU border effect is simply equal to the exponential of the coefficient on $homeEU_{ij}$: $\exp(\beta_1)$. The intra-CEE border effects is obtained by taking the exponential of the difference between the home and intra-group dummies: $\exp(\beta_2 - \beta_5)$.

The gravity equation (24) can also be used for international trade alone, in which case the two variables for group specific domestic trade are to be excluded. Naturally, no border effects can be estimated when this option is used. One can only appreciate how much more or less CEE countries trade with others from their group or with 'old' EU members relative to intra-EU trade.

The estimated equation for the *fixed-effects* approach is obtained by integrating the more detailed trade costs function (23) in equation (6):

$$\begin{aligned} \ln m_{ij} &= FE_i + FM_j + \alpha \ln d_{ij} + \beta_0 + \beta_7 CEE-EU_{ij} + \beta_6 intraEU_{ij} \\ &\quad + \beta_5 intraCEE_{ij} + \gamma_1 contig_{ij} + \gamma_2 comlang_{ij} + \varepsilon_{ij} \end{aligned} \tag{25}$$

As noted above, all country, partner and group dummies can not be simultaneously used in the same equation due to collinearity. The inclusion of all country specific effects is imperative for the estimation of average effects for the entire sample, not relative to an excluded country pair. But under these conditions three of the six groups variables in (23) become a linear combination of the other group, country and partner dummies. To compute East-West and intra-East European trade potentials according to the method presented in section 1, we need border effect estimates for the respective trade flows and intra-EU trade. These can be obtained by assuming that both Eastern and Western European countries have equal preferences for domestic relative to foreign partners, which translates in the use of a single indicator variable for domestic trade, captured in (25) by the constant term β_0. Thus, with all group dummies set equal to zero equation (25) gives the expression of domestic European trade. In this case we are unable to differentiate trade flows between CEE and 'old' EU according to their origin and destination. Only average East-West European border effects can thus be estimated in this case.

The border effect for trade between 'old' EU and CEE countries reflects how much less do EU countries import from CEE partners, and CEE countries import from EU partners, than from domestic ones. It is obtained from comparing CEE-EU to internal trade while controlling for origin and destination markets, distance, and other trade costs elements, and equals the exponential of the the coefficients of the corresponding dummy variable: $\exp(\beta_7)$. Accordingly, the border effects for intra-group imports are given by $\exp(\beta_6)$ and $\exp(\beta_5)$ respectively.

For the *odds* specification the final estimation equation takes the following form:

$$\begin{aligned} \ln \frac{m_{ij}}{m_{jj}} &= \alpha_1 \ln \frac{y_i}{y_j} + \alpha_2 \ln \frac{w_i}{w_j} + \alpha_3 \ln \frac{d_{ij}}{d_{jj}} + \beta_0 + \beta_3 CEEtowardsEU_{ij} \\ &\quad + \beta_4 EUtowardsCEE_{ij} + \beta_5 intraCEE_{ij} + \gamma_1 contig_{ij} + \gamma_2 comlang_{ij} + \upsilon_{ij} \end{aligned} \tag{26}$$

Home variables are inappropriate in this case and are excluded from the equation. Relative production values are used for output or revenue ratios. Of all specifications exposed in section 2, this is the only that estimates border effects for each of the four European trade types. The amount of 'missing' international trade is given by the exponential of the difference between the coefficients of corresponding dummy variables and the constant term: $\exp(-\beta_3 - \beta_0)$ for Central and East European exports to 'old' EU countries, $\exp(-\beta_4 - \beta_0)$ for opposite flows, $\exp(-\beta_5 - \beta_0)$ for intra-CEE trade, and of the constant term alone for trade between 'old' EU members: $\exp(-\beta_0)$.

The *friction* approach estimates average two-way trade within and between the two country groups. Differently from the *fixed-effects* method we are able to include dummies for both CEE exports to and imports from EU. But by construction identical coefficients should be observed for these variables, corresponding to average CEE-EU trade. With this approach the equation estimated is:

$$\begin{aligned} \ln \Phi_{ij} &= \alpha \ln \frac{d_{ij}}{\sqrt{d_{jj} d_{ii}}} + \beta_0 + \beta_3 CEEtowardsEU_{ij} + \beta_4 EUtowardsCEE_{ij} \\ &\quad + \beta_5 intraCEE_{ij} + \gamma_1 contig_{ij} + \gamma_2 comlang_{ij} + u_{ij} \end{aligned} \tag{27}$$

As in the previous case, intra-EU trade is the reference, obtained when all group variables are set null. Border effects are obtained exactly as in the *odds* specification. Thus, $\exp(-\beta_3 - \beta_0)$ shows how much more domestic products prevail over products originating from Central and Eastern Europe in EU consumers' purchases.

Group dummies' coefficients also capture the part of consumer preferences common to all countries of the panel, including any particular preference for domestic products, and the part common to EU, and respectively CEE countries. In the *fixed-effects* specification any home or group bias in consumer preferences is reflected at least partially in the country and partner fixed effects. The last two trade equations, therefore, might produce higher estimates of border effects.

We estimate border effects for total manufactured bilateral imports of fifteen EU countries and ten Central and East European countries with ordinary least squares and report results in table 1. Estimates in the first column correspond to the simple gravity used on cross-border trade flows. As a reference, we also estimate border effects using the gravity equation (24) with country GDPs (column 2), and production at origin and consumption of the destination market (column 3). Setting all dummy variables equal to zero yields in all three cases an estimation of intra-EU level of trade. All variables have coefficients of the expected sign and statistically significant. GDP, production and consumption coefficients are close to unity, and the distance elasticity of trade is not significantly different from -1, like in most empirical studies in the literature. The key parameters of interest are the coefficients on the home variables and the dummies corresponding to particular trade types.

The estimate of β_3 in column 1 is equal to -0.61 and is significant at the one percent level. This suggests that a EU member country buys in average about 46% $[= (1 - \exp(-0.61)) \times 100]$ times less from a Eastern European country that from another EU country, when holding sizes and trade costs constant. Similarly, trade between two Central and East European countries represents only 43% $[= (1 - \exp(-0.85)) \times 100]$ of intra-EU trade. This reflects the fact that both East-West and regional East European trade integration lies bellow the level reached by the fifteen 'old' EU members. EU imports from CEE lie slightly below the intra-EU trade level while CEE imports of EU products are not significantly different from intra-EU trade. Also, when controlling for country size

Table 1: European trade integration: total manufactured imports

Model :	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable:	$\ln m_{ij}$	$\ln m_{ij}$	$\ln m_{ij}$	$\ln m_{ij}$	$\ln \frac{m_{ij}}{m_{jj}}$	$\ln \frac{m_{ij}}{m_{jj}}$	Φ_{ij}
intercept	-8.00^a	-13.08^a	-8.31^a	24.46^a	-3.20^a	-2.60^a	-2.90^a
	(0.51)	(0.44)	(0.47)	(0.32)	(0.22)	(0.07)	(0.14)
ln production exporter	0.83^a		0.82^a				
	(0.01)		(0.01)				
ln consumption importer	0.76^a		0.75^a				
	(0.01)		(0.01)				
ln distance	-1.08^a	-1.04^a	-1.01^a	-0.99^a			
	(0.04)	(0.03)	(0.04)	(0.03)			
ln gdp exporter		0.90^a					
		(0.01)					
ln gdp importer		0.88^a					
		(0.01)					
ln relative production					0.71^a	1.00	
					(0.06)		
ln relative wage					-0.15^a	-0.41^a	
					(0.12)	(0.03)	
ln relative distance					-0.53^a	-0.85^a	
					(0.15)	(0.03)	
ln average relative distance							-0.69^a
							(0.08)
CEE exports to EU	-0.61^a	-0.20^a	-0.62^a		-1.21^a	-1.04^a	-1.20^a
	(0.06)	(0.05)	(0.06)		(0.33)	(0.09)	(0.15)
EU exports to CEE	-0.59^a	-0.06^a	-0.62^a		-1.23^a	-1.23^a	-1.20^a
	(0.06)	(0.05)	(0.06)		(0.28)	(0.09)	(0.17)
CEE-EU				-3.47^a			
				(0.09)			
intra EU				-2.33^a			
				(0.10)			
intra CEE	-0.85^a	0.10^c	-0.85^a	-4.22^a	-1.92^a	-1.90^a	-1.87^a
	(0.08)	(0.07)	(0.07)	(0.12)	(0.23)	(0.07)	(0.18)
home EU		2.26^a	2.30^a				
		(0.11)	(0.12)				
home CEE		4.24^a	3.39^a				
		(0.14)	(0.15)				
common land frontier	0.87^a	0.77^a	0.95^a	0.92^a	1.44^a	1.09^a	1.17^a
	(0.07)	(0.06)	(0.07)	(0.05)	(0.17)	(0.08)	(0.15)
common official language	-0.09	0.10	-0.09	-0.25	0.14	0.21	0.28^b
	(0.12)	(0.11)	(0.12)	(0.18)	(0.16)	(0.16)	(0.14)
N	3387	4261	3554	4261	3143	3143	3988
R^2	0.835	0.874	0.862	0.899	0.692	0.571	0.509
RMSE	.980	.921	.970	.829	1.149	1.216	1.027
Durbin-Wu-Hausman *p-value*						0.002	

Note: Standard errors in parentheses: ^{a}, ^{b} and ^{c} represent respectively statistical significance at the 1%, 5% and 10% levels.

and bilateral distance, trade between CEE countries is about 27% larger than between EU members. The positive and very significant coefficient on the common land border variable confirms the intuition that neighborhood to increases trade. This comes not only from lower trade costs with partners just on the other side of the border, but also from more similar preferences among consumers. The negative non significant coefficient for the common language is most probably due to its high correlation with the common border variable.[12]

Including internal trade in the regression (column 3) keeps the coefficients on all variables unchanged, and sets forward the fact that both EU and CEE countries rely much more on domestic than foreign partners. A EU member country buys in average about 10 [= exp(2.30)] times more from itself than from another EU country, while a similar country from Eastern Europe about 30 times more. For similar (in terms of size, distance, presence of a common border or language) countries East-West European trade is resents slightly more than a half of trade between EU members. Using country GDPs to control for size (column 2), suggests that EU imports from CEE lie slightly below the intra-EU trade level while CEE imports of EU products are not significantly different from intra-EU trade. It also generates a positive, although not vary significant coefficient for intra-CEE trade. We prefer the gravity equation estimated in column 3 as it uses more precise measures for the size of supply and demand.

Correspondingly, border effects for the four trade types can be computed from these estimations whenever domestic shipments are considered and results are displayed in table 2. Thus, under the gravity specification a EU country imports about 19 [$= \exp(2.30 - (-0.62))$] times more from itself than from a Central or East European partner with which it does not share a common land frontier or language. Likewise, CEE countries' imports from EU are about 55 [$= \exp(3.39 - (-0.62))$] times less than domestic ones, all other things equal. Intra EU trade integration is significantly higher than for CEE-EU trade in either direction, but also than the one observed between CEE countries. The latter trade 59 [$= \exp(3.39 - (0.85))$] times less with each other than with themselves.

Column 4 shows estimates of the *fixed-effects* model for the entire manufacturing sector. Negative coefficients for all group variables confirm the existence of border effects, which are larger between Eastern countries and lower for Western countries. Trans-European trade is about 32 [$= \exp(3.47)$] times higher than either domestic trade.

In the next two columns we present results from the *odds* approach. In column 5 we simply estimate equation (26) with ordinary least squares. We correct for endogeneity problems due to production and wage variables reflected by a significant Durbin-Wu-Hausman statistic in column 6. A unitary coefficient on relative production, as predicted by the theoretical model, is imposed and per capita GDPs and employment levels (size of labour force) are used as instruments for wages. Standard errors take into account the correlation of the error terms for a given importer. This is required because the dependent variable is domestic imports divided by bilateral imports of the same country j. All estimates except the common language coefficient are statistically significant at the 1% level. The low coefficient on wages comes from the fact that the latter reflect quite poorly product prices. A 'better' estimate is not obtained even when wages are replaced

[12]Indeed, in Europe most countries that speak the same language share also a common border: e.g. Belgium with its neighbors, Austria and Germany.

Table 2: Border effects for European total manufactured trade

Model :	gravity	gravity*	FE	odds	odds IV	friction
	for countries with no common border or language					
CEE to EU	11.7	18.7	32.2	81.7	35.8	60.6
EU to CEE	73.2	54.9	32.2	83.5	51.0	60.6
Intra EU	9.6	10.0	10.3	24.4	13.7	18.2
Intra CEE	62.5	69.4	68.3	167.3	92.1	118.3
	for countries sharing a common border and language					
CEE to EU	4.9	7.9	19.0	16.7	9.6	14.2
EU to CEE	30.6	23.3	19.0	17.1	13.7	14.2
Intra EU	4.0	4.3	6.0	5.0	3.7	4.3
Intra CEE	26.1	29.5	40.2	34.3	24.7	27.8
	Average border effects with 'all' EU					
CEE to EU	6.8	10.0	17.1	45.3	25.5	30.1
EU to CEE	43.8	29.0	17.1	34.1	27.4	30.1
Intra EU	5.8	5.6	5.8	11.7	8.4	9.1
Intra CEE	35.5	35.2	34.8	71.1	51.5	54.7
	Average border effects with 'core' EU					
CEE to EU	1.0	1.4	4.1	5.9		13.0
EU to CEE	11.2	5.9	4.1	24.5		13.0
Intra EU	2.3	2.0	2.5	4.2		4.4
Intra CEE	18.8	17.8	21.3	55.1		53.0

Note: * production at the origin and consumption of the destination market rather than GDPs are used to control for country sizes.

by price indices.[13]

Larger border effects than in all previous cases in columns 5 and 6 come at least partially from the use of a functional form which attributes home biased consumer preferences to group coefficients. Higher in absolute value coefficients are obtained for the wage and distance variables when endogeneity is controlled for. This also induces a drop in European border effects which approach the estimates of the *fixed-effects* model. Intra-EU trade is the reference in this model. According to it, Western countries trade with each other when there are no common borders or languages 14 times more than with themselves. The relationship between CEE-EU border effects in both directions established

[13]In reality the labor is not the unique factor of production and there are many additional distortion in price structure not captured by the model.

with the gravity is also maintained: EU domestic purchases overcome their imports from CEE partners by $51 = [\exp(-2.60 - (-1.04))]$ times, 40% more the extent to which CEE domestic purchases overcome EU-originating imports. The larger border effect for CEE exports to the EU market has a double possible explanation: a high similarity in preferences of EU consumers, and higher actual trade costs. It applies also for larger border effect estimates for regional trade in Eastern Europe.

The last column in tables 2 and 1 sets out estimates and border effects of the *friction* specification. Bilateral variables used to expresse trade costs are the only explanatory variables of the model. By construction, error terms are not independent across observations, but are assumed independent across importer-exporter couples. A lower distance elasticity of trade in absolute terms is obtained, but in the range of values replicated in the literature. A larger beneficial effect of sharing a land border and a positive significant effect for a common language are also found.

The model estimates that CEE-EU trade is in average $61 = [\exp(-2.90-(1.20))]$ times inferior to domestic trade when keeping size and trade costs components constant, three times more than within 'old' EU members, and twice as less as within CEE countries. The *friction* specification generates the highest border effects, almost double those of the *fixed-effects* approach. As both models rely on the same hypothesis of identical domestic-to-foreign trade preferences for all European countries, the underlined difference can be explained only by the variance in consumer preferences captured by fixed effects in the last specification and attributed to border effects in the former one. If one is to ignore 'missing' foreign trade due to biases in consumer preference, estimates in column 4 should be used.

The first set of results in table 2 shows border effects with all specifications for countries without a common land border or language. These refer to most countries in the sample. The second set displays to which extend countries that are direct neighbors and speak the same language engage in bilateral trade relations relative partners from the same country. These are obtained by subtracting the impact of common border and language on trade from border effect estimates above, and refer to country-pairs like Austria-Germany, Great Britain -Ireland, France-Belgium, etc. Obviously, in this case all border effects are considerably lower. Interesting, the relationship between border effects under different specifications is reversed, and larger results are obtained with the gravity and *fixed-effects* approach. This reveals that consumers from these countries have also more similar preferences. The original relation is restored when gains in trade costs due to contiguity and common language are disregarded and border effects for average European countries are computed (the next set of results). Finally, border effects for each trade type when EU is resumed to its six founding members are presented. Trade integration between the so-called 'core' EU is twice as strong in terms of border effects than average integration within all fifteen member countries, confirming the core-periphery structure of the European economy. As for CEE countries, they have stronger commercial links with the 'core' EU, as suggested by lower border effects. Lower border effects for CEE-EU trade than within the 'core' EU comes from non significant positive coefficients on CEE-EU trade and should be disregarded. In this case even regional CEE trade appears to be unreasonably less abandoned.

Results of estimations with industry data are set forth in table 3 and corresponding border effects in table 4. When trade is broken down by product sector, an important number of zero value trade flows is observed. The problem with null trade flows is that they do not occur randomly, but rather from a selection procedure (low exporter production values, low importer demand, high prices, etc.). We correct for this sample self-selection by giving a positive weight to the zero trade mass via two-stage Heckman estimations (a first-stage probit model and a second-stage OLS model). Significant coefficients on Mills' ratio in the bottom of the table indicate the necessity of this adjustment. When non significant (not shown in the table) the Heckman procedure is not justified and we use simple OLS. In all estimations the two distinct tests signal the presence of heteroscedasticity in th data.[14] However, both estimated coefficients and their statistical significance are almost unchanged when using a panel data GLS estimator. Therefore we restrict ourselves to the presentation and discussion of estimates obtained with the Heckman and OLS models. Still, for the odds and friction specifications we correct for intra-group heteroscedasticity which arises from the use of ratio dependent variables.

Estimates of the three trade specifications in line with the theoretical model are shown in the last four columns and correspond to the same columns in tables 1 and 2. As before, results in columns 1, 2 and 3 reflect estimates of comparable gravity specifications. Coefficients on standard variables are very close to the aggregate manufactured sector with the difference that slightly lower coefficients are obtained for the consumption variable and larger in absolute terms for the distance. The positive and significant effect on trade of a common language spoken by the exporter and the importer is more pronounced and appear in four out of seven specifications. Border effects are also larger with industry level data. This is not surprising: The use of total manufacturing data underestimates the amount of 'missing' international trade because aggregate data disproportionately reflects large sectors with low barriers to trade (border effects).

With standard gravity variables (column 2) the gap between East-West European and intra-EU trade is virtually inexistant. When country GDPs are substituted with true production and consumption data (column 3), much higher discrepancies between the four trade types are observed. Moreover, the gravity produces erroneous results even with industry level demand and supply data because it ignores remote resistance terms suggested by the theory. This can be seen when results are compared with estimates of either of the three theory-consistent specifications described in section 2. We can conclude, thus, that gravity equations produce invalid estimates of border effects for industry data.

Different from the aggregate case, with industry data the theoretically consistent *odds* specification shows that CEE exports to EU face higher trade barriers (border effects) than flows in the opposite direction. This result is robust to changes in the estimation procedure or country panel. The apparent paradox can be explained by the fact that EU countries have greatly liberalized their home markets in large industries but kept relatively important barriers for several small and sensible industries, while CEE countries have adopted a distinct if not contrary strategy.

The logical relationships between border effects for different country groups identified above for aggregate trade hold also when industry level data is used (table 4). According

[14] Breusch and Pagan Lagrangian multiplier test and a likelihood ratio test of the GLS model with heteroscedasticity against the homoscedastic GLS model.

Table 3: European trade integration: bilateral imports at industry level

Model :	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable:	$\ln m_{ij}$	$\ln m_{ij}$	$\ln m_{ij}$	$\ln m_{ij}$	$\ln \frac{m_{ij}}{m_{jj}}$	$\ln \frac{m_{ij}}{m_{jj}}$	Φ_{ij}
intercept	-1.55^a	-18.43^a	-2.51^a	21.59^a	-3.24^a	-2.79^a	-3.22^a
	(0.18)	(0.20)	(0.17)	(0.11)	(0.23)	(0.04)	(0.17)
ln production exporter	0.76^a		0.77^a				
	(0.01)		(0.01)				
ln consumption importer	0.59^a		0.59^a				
	(0.01)		(0.01)				
ln distance	-1.26^a	-1.15^a	-1.16^a	-1.16^a			
	(0.02)	(0.01)	(0.02)	(0.02)			
ln gdp exporter		1.00^a					
		(0.01)					
ln gdp importer		0.86^a					
		(0.01)					
ln relative production					0.83^a	1.00	
					(0.04)		
ln relative wage					-0.34^b	-0.56^a	
					(0.14)	(0.02)	
ln relative distance					-0.81^a	-1.13^a	
					(0.14)	(0.04)	
ln average relative distance							-0.91^a
							(0.08)
CEE exports to EU	-1.49^a	0.01	-1.50^a		-1.47^a	-1.70^a	-1.17^a
	(0.03)	(0.02)	(0.02)		(0.34)	(0.07)	(0.12)
EU exports to CEE	-1.09^a	0.06^a	-1.11^a		-0.88^a	-0.83^a	-1.17^a
	(0.03)	(0.02)	(0.03)		(0.30)	(0.05)	(0.17)
CEE-EU trade				-3.92^a			
				(0.05)			
intra EU				-2.75^a			
				(0.05)			
intra CEE	-2.23^a	0.73^a	-2.19^a	-4.42^a	-1.65^a	-2.01^a	-1.50^a
	(0.05)	(0.03)	(0.04)	(0.06)	(0.26)	(0.12)	(0.19)
home EU		2.77^a	2.63^a				
		(0.05)	(0.05)				
home CEE		5.12^a	3.46^a				
		(0.07)	(0.08)				
common land frontier	1.12^a	0.86^a	1.20^a	0.94^a	1.24^a	1.03^a	1.15^a
	(0.03)	(0.03)	(0.03)	(0.03)	(0.13)	(0.03)	(0.12)
common official language	-0.07	0.37^a	-0.09	-0.03	0.46^a	0.40^a	0.47^a
	(0.06)	(0.05)	(0.06)	(0.05)	(0.15)	(0.07)	(0.13)
Mills' ratio	1.86^a		1.98^a			0.68^b	
	(0.12)		(0.12)			(0.25)	
N	59215	103785	62180	103785	58308	58308	65238
R^2	0.621	0.581	0.674	0.602	0.486	0.299	0.278
RMSE	1.875	2.037	1.841	1.986	2.057	2.077	1.745
Durbin-Wu-Hausman *p-value*						0.005	

Note: Standard errors in parentheses: ^{a}, ^{b} and ^{c} represent respectively statistical significance at the 1%, 5% and 10% levels.

Table 4: Border effects for European industry level trade

Model :	gravity	gravity*	FE	odds	odds IV	friction
	for countries with no common border or language					
CEE to EU	15.8	62.0	50.5	110.7	89.4	80.1
EU to CEE	156.7	97.3	50.5	61.5	37.3	80.1
Intra EU	16.0	13.8	15.7	25.4	16.3	25.0
Intra CEE	80.5	286.2	82.7	132.9	121.2	111.8
	for countries sharing a common border and language					
CEE to EU	4.6	20.3	20.4	20.2	21.4	15.8
EU to CEE	45.6	31.8	20.4	11.2	8.9	15.8
Intra EU	4.7	4.5	6.3	4.6	3.9	4.9
Intra CEE	23.4	93.5	33.4	24.2	29.0	22.1
	Average border effects with 'all' EU					
CEE to EU	8.4	31.1	25.6	68.5	58.4	37.7
EU to CEE	86.2	36.3	25.6	27.7	19.3	37.7
Intra EU	8.7	8.3	8.2	13.0	10.3	11.5
Intra CEE	41.47	82.3	40.0	61.2	50.9	47.6
	Average border effects with 'core' EU					
CEE to EU	2.9	10.9	8.0	25.9		21.6
EU to CEE	19.8	5.4	8.0	19.9		21.6
Intra EU	3.8	3.6	3.9	5.8		6.1
Intra CEE	27.5	48.4	28.8	66.7		48.4

Note:* production at the origin and consumption of the destination market rather than GDPs are used to control for country sizes.

to table 4, CEE-EU trade for non neighbor countries is between 50 and 89 times lower that domestic trade of European countries, and only 9 to 20 times lower for neighbors. Cross European integration is also two or more times lower with central EU countries ('core' EU).

The next section addresses the estimation and computation of trade potentials, the central issue of this paper.

4 Trade Potential and East-West European Integration

The important steps undertaken by the two groups of European countries for the removal of politically imposed trade distortions, as well as efforts engaged with the scheduled EU enlargement translated into a continuous increase in trade between CEE and EU countries. The reintegration of the world economy by Central and Eastern European countries was accompanied by reorientation of their foreign trade towards the European Union. Not only did these countries increase the share of their imports from the EU; they also improved their positions on Western markets. As shown in table 5, the share of CEE exports oriented to the Western markets in region's total exports increased during the period between 1993 and 2000 with ten percentage points, reaching the share observed for imports and which did not evolve during the same period. The evolution was the most remarkable for the Baltic countries which were the least integrated at the beginning of 1990's (see table 5). Both exports to and imports from the EU of ten Central and East European states grew during the 1990s at a higher pace than their trade with other geographical regions. Consequently, the European Union became not only their main foreign supplier of manufactured products, but also by far the most attractive dispatch market for CEE countries' products. In 2000 more than 70% of CEE foreign trade was with EU partners, three-fourths of which was with the six founding members of the union.

In the view of EU enlargement to the East, the convergence of countries from Central and Easter Europe towards the EU market is expected to arise in all economic areas,

Table 5: Geographical structure of CEE foreign trade in 2000 and change relative to 1993

Country	Imports				Exports			
	from EU		from core EU		to EU		to core EU	
	2000, %	change, p.p.	2000, %	change, p.p.	2000, %	change, p.p.	2000, %	change, p.p.
Bulgaria	70,4	(3,7)	47,4	(4,5)	84,1	(39,1)	60,4	(30,7)
Czech Republic	76,2	(6,4)	60,6	(6,8)	67,5	(21,8)	52,7	(17,3)
Estonia	61,9	(29,8)	21,0	(12,2)	66,5	(44,5)	11,9	(5,7)
Hungary	67,7	(-17,9)	52,5	(-7,4)	72,8	(-3,7)	57,6	(-0,1)
Lithuania	69,8	(31,0)	45,9	(16,3)	57,7	(30,0)	32,9	(15,1)
Latvia	78,7	(17,4)	46,5	(9,4)	66,9	(36,7)	35,8	(17,8)
Poland	74,2	(-6,6)	57,8	(-5,3)	70,8	(-8,4)	55,0	(-8,7)
Romania	75,5	(3,5)	61,2	(0,5)	81,7	(31,4)	65,2	(23,8)
Slovakia	60,0	(17,9)	46,6	(15,6)	63,0	(32,2)	51,0	(25,7)
Slovenia	86,6	(-0,8)	65,9	(-5,2)	63,0	(-3,4)	50,0	(-6,9)
Central and Eastern Europe	72,5	(0,0)	55,3	(0,7)	70,0	(13,3)	53,5	(9,1)

Source: WTO Trade Statistics. Calculations by the author.

including the manner to trade. It is thus not unreasonable for us to assume that in the perspective CEE preference for domestic relative to foreign products will approach that of fifteen 'old' EU members. We define therefore the potential of trade between CEE and the EU as the ratio of border effects of the two groups of countries:

$$\text{Trade potential CEE-EU} = \frac{\text{CEE-EU border effect}}{\text{intra-EU border effect}}, \tag{28}$$

and for trade between CEE countries as the ratio between the intra-CEE and intra-EU border effects. Trade potentials obtained in this way correspond to trade integration in terms of border effects. Results for with industry level trade for each year are laid out in tables 6 and 7. We estimate border effects using equations (24) to (27) as explained in section 3 for each year and compute trade potentials for CEE exports to and imports from the EU, and between CEE countries. We also compute the average trade potential for CEE-EU trade in both directions by using a single dummy for cross-European trade.

European trade potentials are computed using six different approached. First we estimate international trade flows with simple gravity as in the first column in tables 1 and 3:

$$\begin{aligned} \ln m_{ij} &= \alpha_1 GDP_i + \alpha_2 GDP_j + \alpha_3 d_{ij} + \beta_0 + \beta_3 CEEtowardsEU_{ij} \\ &\quad + \beta_4 EUtowardsCEE_{ij} + \beta_5 intraCEE_{ij} + \gamma_1 contig_{ij} + \gamma_2 comlang_{ij} + v_{ij} \end{aligned} \tag{29}$$

The constant of the model refers to trade between the 'old' EU member countries, and coefficients on group variables reflect deviations from the intra-EU trade level. According to this model trade potentials are obtained by taking the exponential value of estimated group coefficients β_3, β_4, and β_5. This approach suggests that CEE-EU trade integration already reached its potential by 1996. Regarding trade between CEECs, the models suggests that its potential was reached even prior to 1993. While intra-CEE trade might have been indeed far above its potential due to the particular economic links inherited from the planned economy, it is very surprising to see such a rapid and complete absorption of the trade potential between East and West European countries. Moreover, shall trade potential obtained under this approach be correct, why did not trade between these countries seize to grow? By the year 2000 CEE-EU trade is appreciated to exceed its potential by 22% (table 6).

Secondly, we use a trade potential model that also relies exclusively on international trade data. In line with the literature on trade potential,[15] simple gravity equations are estimated for trade of the reference group, intra-EU trade in our case. Obtained coefficient estimates are used along with GDP levels and bilateral distance to predict the 'normal' level of trade for the rest of the flows using the identical gravity formula. The difference between actual and predicted (or 'normal') trade levels gives the potential of trade, expressed in table 6 in percent of actual trade. Similarly, this method claims relatively low trade potentials for the four trade types. It advocates a slow East-West trade integration: During nine years trade potential reduced only with seven percentage points. As for intra-CEE trade, the model does not predict a increased regional integration.

[15] Wang and Winters (1991), Hamilton and Winters (1992), Baldwin (1993), Gross and Gonciarz (1996), Fontagné et al. (1999), and Nilsson (2000).

Next we apply the gravity equation for both internal and external trade. Much larger trade potentials are obtained with this specification. The coefficients on the CEE exports to and imports from EU, however, are rarely significant. This explains the disproportionate trade potentials obtained. Average CEE-EU trade potential, obtained by replacing the two CEE-EU and two home dummies respectively with their sum, has a higher statistical significance and is therefore more credible. Although trade potential was high at the beginning of the period, this dropped considerably to reach only 38% in 2000 for CEE-EU trade and 171% for intra-CEE trade (table 6).

The last three approaches used to infer the East-West and East European trade potentials refer to the three trade specifications derived in the section 2. Results are displayed in table 7. All three specifications produce very close results for East-West trade and situate its potential between 106 and 122% in 2000, much higher than any of the previous models. Depending on the approach, CEE-EU trade regained between 300 and 400% of its potential in 1993. The *odds* specification is the only to produce differentiated results by flows' direction. Contrary to models that rely exclusively on international data, CEE exports to EU are more distant from their potential than opposite flows, a gap more or less maintained throughout the entire decade. This matches the lower access of Eastern products to Western markets found in the last section. All three approaches in table 7 signal that CEE countries traded very few with each other in the first half of 1990s. In 1993 regional East-European trade amounted to one fifteenth - one sixteenth of its potential. It reflects the drastic reorientation of trade by these countries in the first years following the collapse of the socialist system. Advances in the process of transition and the development of regional economic agreements (CEFTA, the Free Trade Agreement of Baltic states) encouraged regional trade, which augmented enormously in terms of its potential. Hence, in 2000 *odds* and *friction* specifications show that regional East European trade was slightly less than half of its potential level. For the same trade type the *fixed-effects* specification produces results closer to the gravity with both foreign and domestic trade flows.

Trade potentials obtained with all six approaches, shown in tables 6 and 7, confirm the necessity to account for domestic trade in predicting the trade creation effects of regional agreements. The disregard of internal trade opportunities is likely to largely underestimate trade potentials. Globally, the access of CEE goods to the EU markets improved considerably during the 1990s, a large part of the potential European trade creation being already accomplished. Nevertheless, by the year 2000 the left CEE-EU trade potential was larger that actual trade, implying a possible twofold increase of trade in the years to follow.

In contrast to trade integration in terms of border effects obtained with models making use of both domestic and foreign trade in general, and the theoretically compatible estimations presented in section 2, models based exclusively on foreign trade predict much lower potentials. The huge difference comes from the use of different criteria for evaluating trade integration. Trade potential models ignore domestic trade and assign 'normal' trade to the prediction of the gravity equation. The method presented in this paper compares regional to intra-EU integration using trade within the domestic market as benchmark. Thus, it takes into account the discrepancy between domestic and cross-border trade integration. It is important to signal that in this case 'missing' international trade is not

Table 6: European Trade Potential (in % of actual trade)

Trade flows	CEE → EU	EU → CEE	CEE-EU	Intra CEE
	Gravity with international trade only			
1993	15.9	15.5	15.7	-42.8
1994	20.5	-1.6	8.9	-50.1
1995	7.5	2.5	5.0	-45.1
1996	-0.4	-0.4	-0.4	-45.8
1997	-1.3	-9.4	-5.5	-49.3
1998	-9.0	-9.7	-9.4	-50.6
1999	-19.8	-24.2	-22.0	-62.9
2000	-27.2	-17.4	-22.5	-60.0
	Trade potential model			
1993	33.2	35.0	34.5	17.4
1994	34.2	40.4	37.5	32.1
1995	31.3	35.9	34.1	29.6
1996	32.7	36.8	34.5	37.3
1997	28.9	33.2	29.3	34.2
1998	26.9	28.6	26.1	31.4
1999	29.0	32.9	29.4	34.8
2000	26.5	29.6	28.1	33.6
	Gravity with international and internal trade (McCallum)			
1993	25.4	2646.4	218.1	1383.0
1994	25.3	1256.3	186.6	596.6
1995	10.2	1023.0	154.8	500.8
1996	1.8	972.2	133.5	483.4
1997	1.1	761.3	112.2	382.3
1998	-6.8	693.2	96.6	336.1
1999	-17.4	648.9	70.8	270.8
2000	-25.6	457.7	38.7	171.2

Note: Trade potentials are computed from year-by-year estimates of trade flows equations corresponding to each of model.

Table 7: European Trade Potential (in % of actual trade)

Trade flows	CEE → EU	EU → CEE	CEE-EU	Intra CEE
		Fixed-effects specification		
1993	515.1	515.1	515.1	1472.2
1994	325.1	325.1	325.1	604.4
1995	279.3	279.3	279.3	580.1
1996	249.8	249.8	249.8	543.8
1997	210.4	210.4	210.4	423.8
1998	188.5	188.5	188.5	377.6
1999	158.8	158.8	158.8	289.8
2000	105.7	105.7	105.7	174.8
		Odds specification		
1993	393.3	486.5	438.0	1523.8
1994	516.9	179.3	317.7	748.4
1995	549.7	111.4	271.5	964.8
1996	311.0	185.5	243.6	539.5
1997	341.8	129.9	220.4	329.2
1998	323.1	93.2	187.8	313.3
1999	243.0	87.6	155.4	266.2
2000	161.4	64.8	108.8	112.6
		Friction specification		
1993	424.6	424.6	424.6	1383.6
1994	303.8	303.8	303.8	508.7
1995	255.9	255.9	255.9	479.4
1996	232.4	232.4	232.4	389.2
1997	202.4	202.4	202.4	281.7
1998	167.1	167.1	167.1	275.1
1999	160.4	160.4	160.4	213.7
2000	122.2	122.2	122.2	139.4

Note: Trade potentials are obtained by taking the ratio between the border effect for a particular trade flow and the intra-EU border effect.

entirely imputed to trade potential, but only in the proportion in which impediments to trade between the EU and Central and Eastern Europe are reduced to the level of impediments to trade between the fifteen 'old' EU members. Such an integration will result in increased trade with more distant partners and a weaker concentration of trade in the immediate neighborhood.

We show industry level effects on trade of European integration with the *fixed-effects* and *friction* specifications in table 8.[16] The first four columns refer to trade potentials in 1993, and the last four for the year 2000. The first thing to notice is that with a few exceptions trade creation effects are observed for all industries, both CEE-EU and intra-EU trade, and under both specifications. As previously trade creation potentials are generally larger with the *fixed-effects* approach. Trade creation effects (the relative change in trade potential between 1993 and 2000) for CEE-EU trade are also more pronounced under this specification. The largest trade creation for both two-way East-West and Est European trade was observed in the wood industry, followed by fabricated metal products, the rubber, and footwear industries. For the former two trade has literally reached its potential by 2000. Paper, leather, and non-metallic mineral products industries also enjoyed important trade creation, but mainly for regional East European trade. The lowest trade integration is found in the tobacco industry, subject to specific domestic regulations especially in EU countries. In the case of intra-CEE trade, however, this comes from the fact that trade in tobacco production between East European countries was bellow its potential level even in 1993. Moderate effects on trade are obtained for the rest of industries. By the year 2000 CEE-EU trade remains largely inferior to its potential (less than one fourth) only in seven industries: food, beverages, tobacco, chemicals, and basic metal industries(iron and steel, and non-ferrous metals). As expected, their number increases for intra-CEE trade.

Changes in trade potentials described above can be also inferred from the evolution of regional border effects. Figures 1 and 2 picture a similar evolution of CEE-EU and intra-CEE border effects relative to intra-EU border effects generated with the *odds* and *fixed-effects* approaches respectively. The most pronounced regional trade integration was the one among Central and Eastern European countries. By the year 2000 trade integration in terms of border effects within this group has reached, or even surpassed the level of CEE-EU trade. Less spectacular, the drop in CEE-EU border effects is more than remarkable. Meanwhile, intra-EU trade integration remained unchanged, advocating its use as reference for other regional trade flows in order to compute trade potentials. Similar evolutions can be seen with respect to the level of integration within the 'core' EU (figures 4 and 5 in the Appendix D). As expected, trade integration is considerably more pronounced when only the six founding EU members are retained.

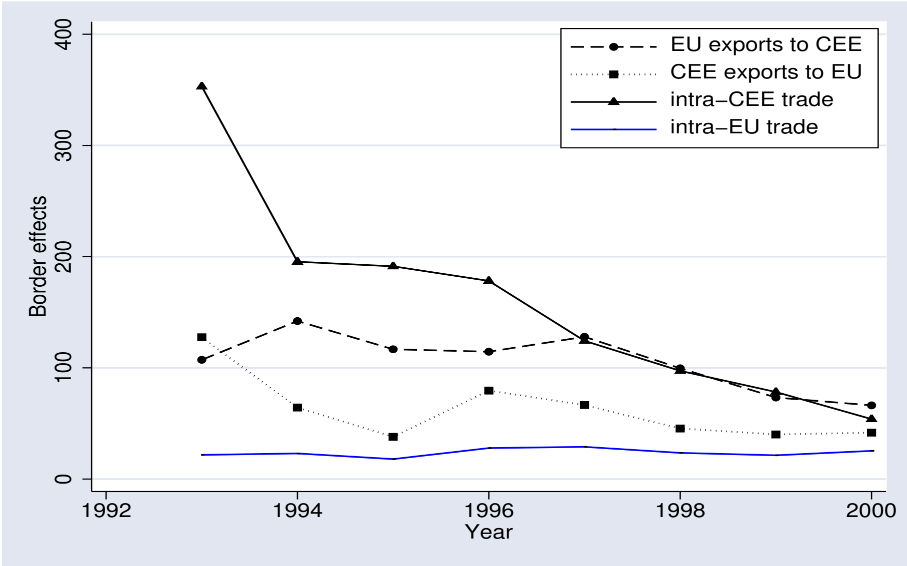
[16]The term European integration is used for all 24 European countries considered in this paper. This is different from its wide but inaccurate employment in the literature to designate integration within the European Union.

Table 8: Trade potential with respect to intra-EU trade (in %of actual trade)

Trade flows	CEE-EU	CEE-EU	Intra CEE	Intra CEE	CEE-EU	CEE-EU	Intra CEE	Intra CEE
Model	FE	friction	FE	friction	FE	friction	FE	friction
Industry	1993	1993	1993	1993	2000	2000	2000	2000
Food	496	423	962	975	350	331	243	277
Beverage	944	814	2005	1099	655	695	473	230
Tobacco	367	254	-16	-60	361	355	-39	0
Textiles	768	727	4004	4270	36	66	236	170
Wearing apparel	434	276	3674	920	196	378	2269	0
Leather	237	167	3551	4407	47	78	205	330
Footwear	147	138	1574	2655	231	145	923	1595
Wood Products	163	147	1293	622	-3	3	2	5
Furniture	179	150	4236	2555	78	123	676	555
Paper products	876	643	1181	883	128	107	44	17
Printing, publishing	608	429	765	885	160	109	157	108
Industrial chemicals	559	516	713	795	355	316	799	353
Other chemical products	1218	829	2030	1840	365	342	230	228
Products of petroleum and coal	326	295	995	532	152	212	164	144
Rubber products	747	616	1316	2083	59	27	121	117
Plastic products	650	626	1211	1344	68	83	184	93
Pottery, china and earthenware	597	531	6813	19651	164	168	415	979
Glass and glass products	315	244	798	727	73	44	74	11
Other non-metallic mineral products	289	216	412	324	79	82	48	-14
Iron and steel	1239	1057	3158	2180	351	367	1050	291
Non-ferrous metals	632	477	767	549	463	302	989	416
Fabricated metal products	301	288	618	721	15	2	20	-7
Machinery	1294	869	5311	1811	154	256	474	539
Electrical apparatus	608	569	1656	1980	97	111	343	225
Transport equipment	1557	1287	2902	4774	199	137	353	558
Professional, scientific, etc. goods	783	958	1255	2934	143	179	334	239
Other manufacturing	932	667	7744	5848	171	160	603	503

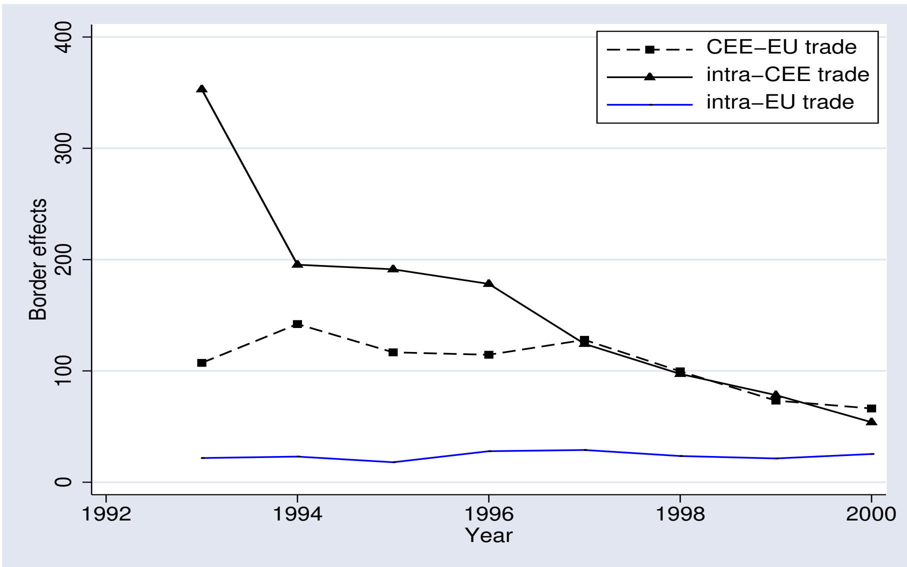
Note: The trade potential is obtained by taking the ratio between the border effect for a particular trade flow and the intra-EU border effect.

Figure 1: European trade integration: odds specification



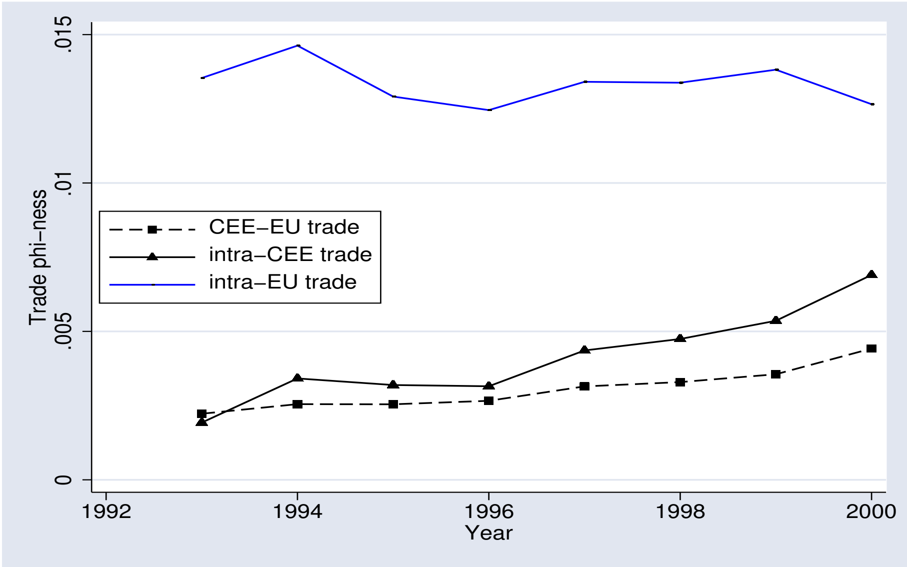
Note: Border effects are computed using estimated coefficients of equation (26) for each year with industry level data. Effects for countries with no common land border or language are represented.

Figure 2: European trade integration: fixed-effects specification



Note: Border effects are computed using estimated coefficients of equation (27) for each year with industry level data. Effects for countries with no common land border or language are represented.

Figure 3: European trade ϕ-ness (free-ness)



Note: Trade ϕ-ness for each year and type of trade are given by respective median values of Φ_{ij} computed with industry level data.

The reduction of both trade barriers (reflect by border effects) and trade potentials for CEE-EU trade coincided with an even more impressive evolution for trade within Central and Eastern Europe. These results disseminate the fears formulated by politicians and some authors that that CEE-EU trade integration will be accompanied by a lower commitment of CEE countries to regional integration, reflected here by very larger intra-CEE border effects and trade potentials at the beginning of the period. Still, trade potential figures in table 7 show that manufactured trade between CEE countries may expand to as much as twice its actual value.

Finally, the evolution of regional trade freeness is replicated in figure 3. The figure shows the evolution of median industry trade freeness of manufactured trade between CEE and EU countries, and separately for EU and CEE intra-group trade. Trade freeness ϕ_{ij}, as defined in section 2, reflects the easiness with which two countries participate to reciprocal trade, and is an alternative measure of trade integration, usually employed in new economic geography (e.g. Baldwin et al., 2003). Note that trade increases in freeness under all previously presented specifications. With frictionless internal trade (null trade costs within countries) and symmetric trade costs ($\phi_{ij} = \phi_{ji}$), trade freeness is equal to the inverse 'friction' index Φ_{ij} used by the *friction* trade specification. Since true trade costs are unknown and only estimated, this can represent an additional benchmarks of our results. This method ignores internal trade costs, that usually increase with the size of the country,[17] and produces lower levels of trade integration. When trade costs arise only for cross-border transactions, foreign partners are more distant from domestic ones.

As can be seen in figure 3, trade freeness for trade between EU countries varies through-

[17] Larger shipping distances generate higher average transport costs.

out the period without a clear tendency. Other European trade flows benefited from an increase in trade freeness, larger for Eastern European regional trade. Trade freeness for between 'core' EU is significantly higher than for all fifteen EU countries. CEE countries' trade with 'core' countries is characterized by lower trade costs (higher freeness), but convergence in this case is much less evident (figure 6 of Appendix D). One can conclude that trade integration enjoyed by 'core' EU countries reflects an integration level too high to be reached by CEE-EU trade.

5 National Product Differentiation vs. Monopolistic Competition

The *odds* specification derived from the theoretical model in section 2 is based on hypothesis characteristic to the Krugman (1980) monopolistic model of trade. Its predictions in terms of border effects and trade potentials, are quite close to those obtained with the other theoretically consistent approaches. Is this a sufficient indicator of the fact that a monopolistic structure replicates fairly well trade between European nations? Does such a model produce better results than a perfect competition approach? These questions we pose and attempt to answer in this section.

In a monopolistic model of Dixit-Stiglitz-Krugman type traded varieties and the number of firms that produce them at the equilibrium are endogenously generated by market forces, and is proportional to a country's output. Alternatively, trade can arise in a perfect competition setting with identical locally produced varieties. National product differentiation fits the perfect competition structure because it imposes a much higher competition among the firms of a country. We take a step further and assume marginal cost pricing in this model, similar to Head and Ries (2001). Market power and scale economies are features specific to imperfect competition structures and nonexistent in this type of models. We shall thus refer to the models based on monopolistic and perfect competition also as the DSK and national product differentiation (NPD) models respectively.

We use the *fixed-effects* approach from section 2 to construct a test for monopolistic versus perfect competition trade models. Independently from the form of competition and the market structure, trade between two countries can be expressed using equation (6). The difference induced by the two trade models refers to the particular structure of country and partner fixed effects.

According to the theoretical structure shared by both NPD and DSK models, the exporter and importer fixed effects are given by the following expressions:

$$\exp(FE_i) = n_i p_i^{1-\sigma}, \tag{30}$$

$$\exp(FM_j) = E_j \left[\sum_k n_k p_k^{1-\sigma} \phi_{kj} \right]^{-1}. \tag{31}$$

These correspond to the (4) expression of bilateral trade. Since total imports of a country, plus the purchase by domestic consumers of nationally produced goods gives the expenditure level or that country, the following identity holds:

$$E_j = \exp(FM_j) \sum_k \phi_{kj} \exp(FE_k). \tag{32}$$

Summing the exports of a country and its internal shipments yields the country's level of output. Using the above expressions of country fixed effects and trade equation (4), this generates a second identity:

$$y_i = \exp(FE_i) \sum_k \phi_{ik} \exp(FM_k). \tag{33}$$

The relationships between country fixed effects and output and expenditure levels set by equations (32) and (33) are equally verified under monopolistic and perfect competition. Features (assumptions) specific to each model are used then to construct importer and exporter fixed effects. Introducing the latter in expression (32) induces the simplification of country and partner fixed effects:

$$\hat{E}_j = E_j \left[\sum_k n_k p_k^{1-\sigma} \phi_{kj} \right]^{-1} \sum_k \phi_{kj} n_k p_k^{1-\sigma} = E_j. \tag{34}$$

Therefore we use exporter specific effects computed separately for each model along with importer specific effects estimated using equation (25) to obtain expenditure level:

$$\hat{E}_j = \exp(F\hat{M}_j) \sum_k \phi_{kj} n_k p_k^{1-\sigma}. \tag{35}$$

The computation of the level of output is possible without the use of estimated country fixed effects $F\hat{M}_j$ and $F\hat{E}_i$:

$$\hat{y}_i = n_i p_i^{1-\sigma} \sum_k \phi_{ik} E_k \left[\sum_s n_s p_s^{1-\sigma} \phi_{sk} \right]^{-1}. \tag{36}$$

Confronting the such obtained estimates of expenditure and production levels for each model with observed data represents the final step of the test.

A number of simplification hypotheses are necessary to make possible the accomplishment of the test. Labor is the only production factor in both monopolistic and perfect competition trade models. This greatly simplifies the computation of country fixed effects because marginal production costs become a linear function of wages.[18] As previously, invariant consumption preferences are ignored and trade freeness resumes to trade costs. The latter are decomposed as in the *fixed-effects* estimation equation (25) into distance-induced costs, gains from common border and language, and region specific trade costs. The latter refer to trade costs caused by trade within EU countries, within the group of Central and Eastern European countries, and between the two groups. The choice of the *fixed-effects* specification as basis is motivated by its very use in the construction of

[18] A unitary marginal cost coefficient μ is also assumed.

the test. We use the exact estimates of the (25) to find trade costs, necessary in the computation of output and expenditure values for the two models.

The DSK trade model used is the one presented in section 2.3. The number of locally produced varieties is found as in expression (14). Local prices are constant markups over marginal costs: $p_i = w_i(\sigma/(\sigma-1))$. In the trade equation predicted by the monopolistic competition model the amount $\frac{\sigma^{-\sigma}}{F(1-\sigma)^{1-\sigma}}$ appears both at the numerator (in the expression of $p_i^{1-\sigma}$) and the denominator (inside the price index $P_i^{1-\sigma}$ in the expression of $p_i^{1-\sigma}$), that simplify. Therefore we can consider that importer and exporter fixed effects do not include this term. This reduces importer and importer fixed effects to:

$$\exp(FE_{DSKi}) = y_i {w_i}^{-\sigma}, \tag{37}$$

$$\exp(FM_{DSKj}) = E_j \left[\sum_k y_k {w_k}^{-\sigma} \phi_{kj}\right]^{-1}. \tag{38}$$

Hence, the following detailed structures for a country's expenditure and output levels are obtained with the DSK model:

$$\hat{E}_{DSKj} = \exp(F\hat{M}_j) \sum_k \phi_{kj} y_k {w_k}^{-\sigma}, \tag{39}$$

$$\hat{y}_{DSKi} = y_i {w_i}^{-\sigma} \sum_k \phi_{ik} E_k \left[\sum_s y_s {w_s}^{-\sigma} \phi_{sk}\right]^{-1}. \tag{40}$$

We use national product differentiation to introduce perfect competition in trade. With a single variety produced in each country, $n_i = 1, \forall i$, firms face the highest level of competition,[19] and returns to scale are constant. Marginal cost pricing translates as in Head and Ries (2001) to equality between local prices and salary: $p_i = w_i$. The expression of fixed effects, and expenditure and output level is straightforward:

$$\hat{E}_{NPDj} = \exp(F\hat{M}_j) \sum_k \phi_{kj} w_k^{1-\sigma}, \tag{41}$$

$$\hat{y}_{NPDi} = w_i^{1-\sigma} \sum_k \phi_{ik} E_k \left[\sum_s w_s^{1-\sigma} \phi_{sk}\right]^{-1}. \tag{42}$$

Expenditure values that enter in equations (40) and (42) are the ones predicted by each model: (39) respectively and (41). Trade freeness in all the above equations is the same, obtained with the *fixed-effects* estimation:

$$\begin{aligned} \phi_{ij} \;=\; & d_{ij}^{\rho(1-\sigma)} \exp(\beta_7 CEE - EU_{ij})^{1-\sigma} \exp(\beta_6 intraEU_{ij})^{1-\sigma} \\ & \times \exp(\beta_5 intraCEE_{ij})^{1-\sigma} \exp(\beta_0)^{1-\sigma} \exp(\gamma_1 contig_{ij})^{1-\sigma} \exp(\gamma_2 comlang_{ij})^{1-\sigma}. \end{aligned} \tag{43}$$

Coefficients in (43) are parameter estimates of (25), presented in table 3.

[19] Product differentiation is a well-known source of market power in the literature.

Table 9: Testing NPD versus DSK models: predicted versus observed expenditure and output values

σ	y_{NPD}	E_{NPD}	y_{DSK}	E_{DSK}
2	0.00	0.00	3.0e+08	0.00
3	0.00	0.00	5.2e+08	0.00
3.85	0.96	0.00	1.1e+12	0.00
3.86	1.05	0.00	1.2e+12	0.00
4	3.68	0.00	4.2e+12	0.00
5	29676.45	0.00	3.4e+16	0.00
6	2.4e+08	0.00	2.7e+20	0.04
6.70	1.3e+11	0.00	1.5e+23	0.98
6.71	1.3e+11	0.00	1.5e+23	1.02
7	1.9e+12	0.00	2.2e+24	3.77
8	1.6e+16	0.00	1.5e+14	338.47
9	1.3e+20	0.27	1.6e+16	30383.53
9.29	1.7e+21	0.99	6.1e+16	1.1e+05
10	25772.73	24.24	2.6e+11	2.7e+06

Note: The figures are estimated coefficients on the output y_i and respectively expenditure E_j variable in the regression of values predicted by the NPD and the DSK trade models without a constant term and y_i and respectively E_j the unique right hand side variable.

The last difficulty regarding the computation of expenditure and output levels with the two models comes from the presence of the unknown parameter σ. Estimates of the substitution elasticity σ in the literature suggest that it takes values between 1 and 10. We compute expenditure and output levels with both models for different values of σ, searching for those which yield the lowest deviation from observed production and consumption values, i.e. a unitary ratios $\hat{E}_j/E_j$ and $\hat{y}_i/y_i$. This corresponds to unitary coefficients on the explanatory variable in a simple regression of expenditure and output values predicted by the two models on actual consumption and respectively production levels. Results are displayed in table 9.

The equality between the expenditure predicted by the DSK monopolistic model of trade and actually observed expenditure levels is reached for a substitution elasticity of 9.29. The identical relation in the case of the perfect competition model is obtained for $\sigma = 6.7$. Both elasticities are compatible with empirical studies. We are thus unable to discriminate on this basis which of the two models is more appropriate for use. In what concerns the relationship between predicted and observed output levels, the equality is reached only in the case of the NPD model. Output values computed with the DSK model overestimate true production at even for very low σ. Combined, these results argument in favor of the perfect competition trade model. This result is in line with Head and Ries (2001)'s result who build a discrimination test based on the relationship between output shares and demand share in a national product differentiation and an increasing returns model.

Note that although unitary ratios between computed and actual values are obtained

Table 10: Testing NPD versus DSK models: predicted versus observed output values

σ	y_{NPD}	y_{DSK}
σ =1.00	0.39	0.85
σ =1.25	0.37	0.81
σ =1.50	0.33	0.75
σ =1.75	0.29	0.68
σ =2.00	0.24	0.59
σ =2.25	0.19	0.49
σ =2.50	0.14	0.38
σ =2.75	0.09	0.29
σ =3.00	0.06	0.21

Note: The figures are estimated coefficients on the output y_i and respectively expenditure E_j variable in the regression of values predicted by the NPD and the DSK trade models without a constant term and y_i and respectively E_j the unique right hand side variable.

with the perfect competition model for expenditures as well as for outputs, the equality for the former is with a double value of σ than for the latter. With sufficiently high elasticities of substitution, both trade models overestimate countries' true expenditures and outputs. This signals the possible presence of one or more sources of mismeasurement of expenditure and output values through the use of equations (39) to (42). In table 10 outputs are computed according to (40) and (42) for the monopolistic and the perfect competition models using true expenditure data rather than the one predicted by each model.

Table 10 shows that output values computed according to each model and using true (observed) expenditures underestimate observed outputs for any reasonable values of σ. This suggests that the unitary coefficient for the $\hat{y}_{NPDi}/y_i$ ratio for $\sigma \simeq 3.85$, and very high $\hat{y}_{DSKi}/y_i$ ratios in table 9 come from an overestimation of countries' expenditures. One should therefore use with considerable moderation the test's outcome obtained previously. Further investigation is required in order to construct more accurate expenditure and outcome measures for the NPD and DSK trade models.

6 Conclusions

Trade both between CEE and between CEE and EU countries improved remarkably during the last decade of the XXth century, both in terms of border effects and trade potentials. The paper shows that there is still place for important growth in bilateral CEE-EU transactions. This result contradicts with most trade potential gravity models who claim that East-West European trade have already reached its highest integration level. Much higher trade potentials for both CEE-EU and intra-CEE trade are obtained when one controls for the amount of trade within national borders. Results are very robust and are confirmed by three different theoretically compatible trade specifications used. Thus, at the beginning of the XXst century trade between CEE and EU countries represented about half of its attainable level, suggesting a 100% increase with further EU integration. As for regional CEE trade, its potential ranges depending on the model between 112 and 175%. And this is regardless the strong reduction of bilateral border effects between these countries. A discrimination test for monopolistic against perfect competition trade models, based on the estimation of bilateral trade flows with country and partner specific effects, is developed. According to it, European trade is better replicated with national product differentiation associated with perfect competition models, but this result should be used with moderation.

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A Perfect Competition and Balanced Trade

The income of a country is given by the sum of revenues from its shipments inside the country as well as abroad: Goods produced internally are sold on the domestic market or are exported. Noting by x_{ij} country j's demand for country i products, and by p_{ij} the price of goods produced in i and consumed in j, the income of country i can be written as:

$$y_i = x_{ii}p_{ii} + \sum_{k \neq i} x_{ik}p_{ik}$$

(The shipping costs are supported by the exporter.) A country's expenditure is equal to the sum of domestic consumption and the value of its imports:

$$E_i = x_{ii}p_{ii} + \sum_{k \neq i} x_{ki}p_{ki}$$

Market clearance (13) implies equality between (20) and (21). Using the notation introduced by (5) we have:

$$x_{ii} + \sum_{k \neq i} x_{ik} = x_{ii} + \sum_{k \neq i} x_{ki} \Longleftrightarrow \sum_{k \neq i} x_{ik} = \sum_{k \neq i} x_{ki}$$

Observe that the left side of the equation gives the expression of country i's exports, while the right side gives the expression of i's imports. Thus, we have:

$$\text{Exports}_i = \text{Imports}_i \Longleftrightarrow \text{Trade Balance} = \text{Exports}_i - \text{Imports}_i = 0$$

and excludes the possibility of having unbalanced trade for each industry i.

B Data

The empirical application of theoretically derived trade equations encounters both data availability and comparability problems. The use of different classifications, definitions and registration criteria even for such 'standard' economic variables as production and trade is an additional source of errors and biases in results. The latter are yet more pronounced in the estimation of border effects when internal trade volumes are computed as the difference between national production and total exports in absence of regional data.

The study carries over a sample of 25 countries: fifteen 'old' EU members with Belgium and Luxembourg aggregated under a single observation, and ten Central and East European countries, and a eight-year period from 1993 to 2000. Of the ten CEE countries of the panel eight have joined the EU in May 2004 and two are candidate countries that may join the Union as early as in 2007. Two levels of aggregation are considered: total manufacturing industry, and 27 product industries according to the ISIC Rev.2 classification.

Data on total manufactured bilateral imports is obtained from the COMEXT (Eurostat) database for trade flows engaging at least one EU partner, and from the COMTRADE (World Bank) database for intra-CEE trade. GDP in current US dollars are from the World Development Indicators (World Bank) database. Total manufacturing production and wages, and consumption are obtained from the New Cronos (Eurostat) database. Industry level trade, production, and wage data are from the Trade and Production (UNIDO, World Bank) database, with missing data on production and wage being complemented with New Cronos (Eurostat) and OCDE data. Trade, production, and consumption are expressed in thousand of US dollars, and wages are in thousands of US dollars per year per employee.

In order to ensure compatibility of different data sources, data has been adjusted by applying a conversion rate equal to the average ratio of the value from the base source and the value from the secondary source, and estimated for each country for observations present in both databases.

C Distance Calculation

As simple as it can seem, measuring the distance is not always obvious. This is because we seek the distance between two territorial units with positive area and non uniformly distributed economic activity, rather than between two points. There is some constancy in the literature regarding bilateral distances: Distance between two countries is usually defined as the distance between their capitals or largest cities. The first to introduce internal distance in the estimation of border effects was Wei (1996). The necessity to compute intra-national distances, d_{jj} in his and our model arises from the use of internal trade values. The latter includes all commercial transactions between any two agents of the same country.[20] Wei himself computes internal distance as one fourth of the distance

[20] McCallum (1995) and Helliwell (1996), (1997) identify trade within national borders with trade between Canadian provinces or American states, ignoring transactions that take place within each sub

between a country's capital city and that of its closest neighbor. Wolf (2000) uses the distance between a country's largest two cities. Nitsch (2000) takes the radius R of a circle of an area equal to that of the country. Head and Mayer (2000) develop a similar measure for a particular country geography with producers located in the origin and consumers uniformly distributed on the area of the circle:

$$d_{jj} = \int_0^R \frac{2\pi r}{\pi R^2} r = \frac{2}{3} R. \tag{44}$$

Following Helliwell and Verdier (1997), and Head and Mayer (2000), (2002) we compute both international and internal distances as the weighted average of inter-regional distances, with regions production (or population) as weights:

$$d_{ij} = \sum_{l \in j} \left(\sum_{k \in i} d_{kl} \frac{y_k}{y_i} \right) \frac{y_l}{y_j}. \tag{45}$$

Table 11 gives internal distances for the countries in the study computed as described above, with 1995 population as weights. Inter-regional distances are geodesic distances between the largest central cities of any two regions.

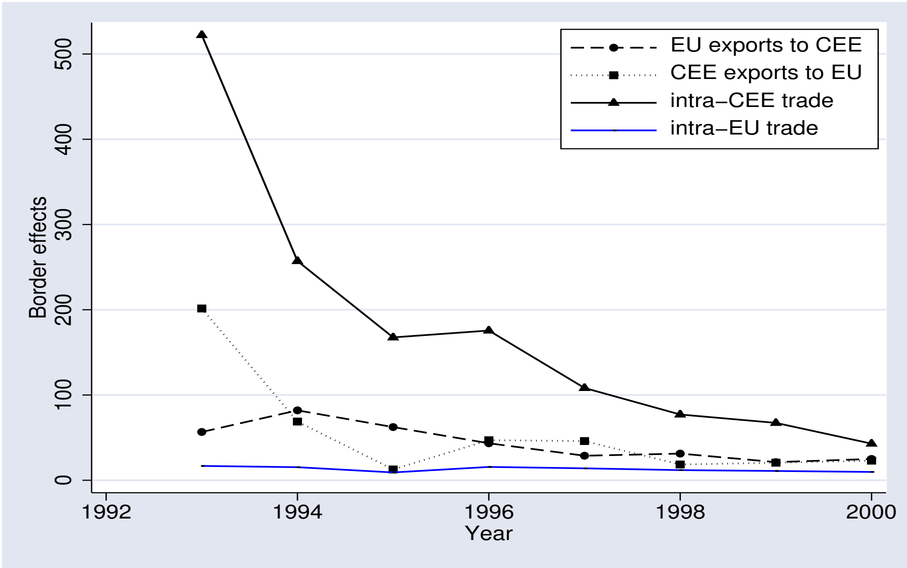
national unit.

Table 11: Internal distances d_{jj} in km

Country	internal distance
Spain	522
Italy	487
France	413
Sweden	387
Germany	376
Poland	359
Romania	319
Portugal	295
United Kingdom	290
Finland	264
Czech Republic	256
Greece	252
Bulgaria	234
Austria	232
Hungary	194
Slovakia	192
Netherlands	130
Belgium and Luxembourg	113
Ireland	99
Lithuania	96
Latvia	96
Estonia	78
Denmark	78
Slovenia	54

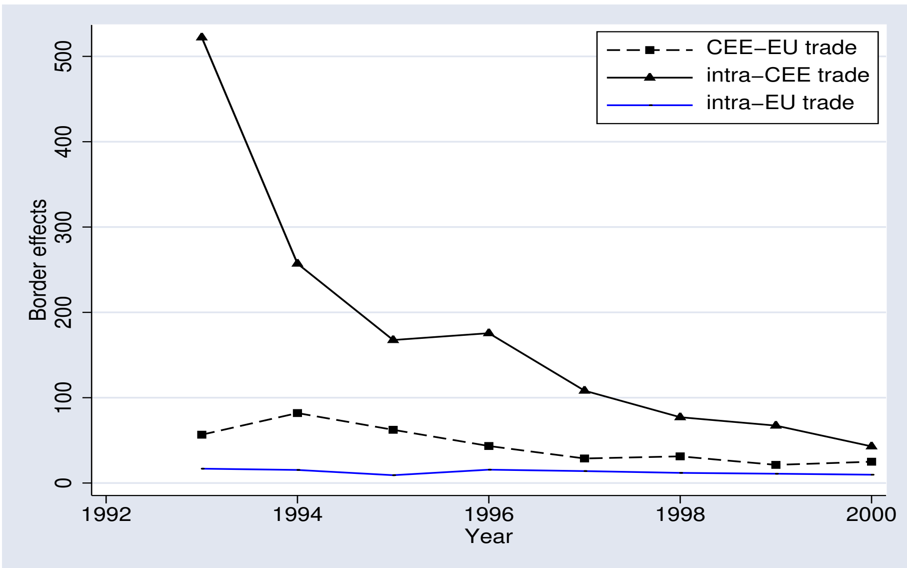
D Additional Results

Figure 4: European trade integration: core EU and odds specification



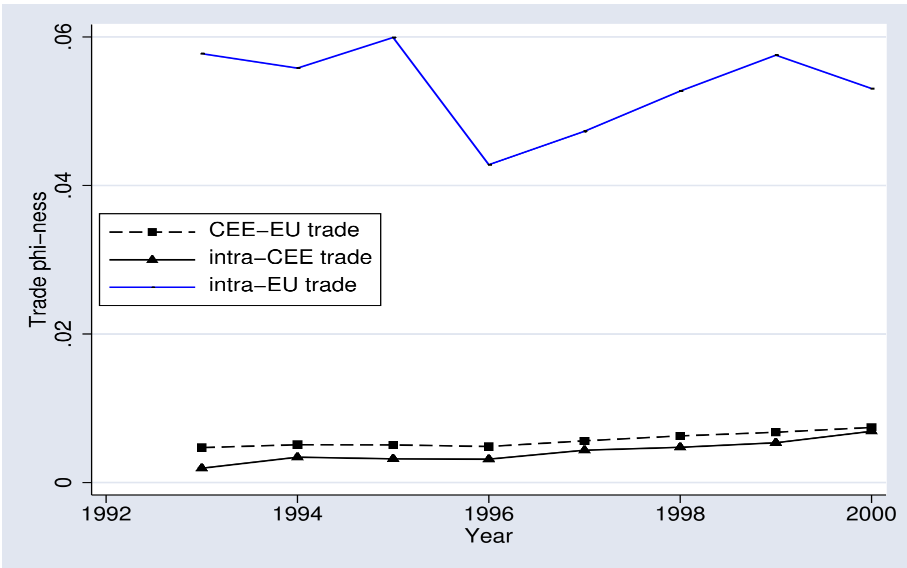
Note: Border effects are computed using estimated coefficients of equation (26) for each year with industry level data. Effects for countries with no common land border or language are represented.

Figure 5: European trade integration: core EU and fixed-effects specification



Note: Border effects are computed using estimated coefficients of equation (25) for each year with industry level data. Effects for countries with no common land border or language are represented.

Figure 6: European trade ϕ-ness (free-ness): core EU



Note: Trade ϕ-ness for each year and type of trade are given by respective median values of Φ_{ij} computed with industry level data.