Transportation Costs in A Multilateral World: Assessing the Poolability of Gravity Data

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Abstract

This paper proposes to account for the differences in the importance of transport costs depending on characteristics of trading partners. Empirically, this requires to relax the pooling assumption when estimating a gravity model. In a three-country model of trade in differentiated goods we expect a larger impact of transport costs on a country's export share in its world exports the smaller and/or relatively less endowed with capital the importer country is. We estimate a gravity SUR model with random exporter effects where each equation refers to another importer country. For bilateral export shares of the EU-countries, USA, and Japan into EU-member states there is strong support for the theoretical hypotheses: a significant and robust negative relationship between the absolute size of the transport cost parameter and both the importer country size and capital-labor ratio.

Key words: gravity equation, panel econometrics
JEL: C33, F14

1 Introduction[1]

The consideration of transportation costs within the endowment based model of horizontal product differentiation has been an important progress in trade theory (see Krugman, 1980; Helpman & Krugman, 1985; Bergstrand, 1989, 1990; as some of the most important proponents). There are now numerous examples where the basic implications of the model have rather successfully been tested for bilateral trade flows. Most of these applications have built on the $2 \times 2 \times 2$ New Trade Theory framework[2] where bilateral trade can be explained by three Heckscher-Ohlin determinants (see Helpman & Krugman, 1985; Helpman, 1987; etc.): the difference in relative factor endowments between the countries (R: measuring the distance from the endowment point from the diagonal in the factor box in graphical terms); the difference in absolute factor endowments (S: measuring relative country size along the diagonal in the factor box); and the size of bilateral economic space (G: measuring the size of the factor box in terms of its diagonal). The model has been tested for both bilateral overall trade (e.g. Egger, 2000) and intra-industry trade (Hummels & Levinsohn, 1995) yielding broad correspondence between the theoretical hypotheses and the empirical findings.

However, the reference to the two-country model had an important consequence for empirical research: it fostered the opinion that different countries would be similarly affected by identical changes in transport costs (and similarly for changes in other determinants). We will see that this is not justified by theory.

This paper presents a stylized three-country model of trade in differentiated varieties in the presence of iceberg transportation costs. In order to reduce the problem, let's think about export flows as composites of two components: a country's (i) openness to exports vis-à-vis the whole world and its distribution of export shares across importer (j) countries ($\Pi_{ij} = 100 * \frac{\text{exports}_{ij}}{\text{exports}_i}$)[3]. Throughout the paper, we concentrate on the latter and envisage the impact of percentage changes in transport costs on percentage changes rather than percentage point changes in Π_{ij}[4]. We derive the hypotheses by means of numerical simulations.

[1] I am indebted in Wilhelm Kohler and Michael Pfaffermayr for helpful suggestions and discussions. I should like to thank Josef Baumgartner, Fritz Breuss, Michael Landesmann, Peter Steiner, and Alan Winters for helpful comments.

[2] Two goods (one homogeneous, one horizontally differentiated), two factors (labor, capital), and two countries.

[3] This reduces the problem in so far, as exporter properties do no more play any role when looking at export shares.

[4] A concentration on percentage point changes in export shares would lead to more trivial conclusions because of the boundedness of an export share between 0 and 1.

This results in two important conclusions for the empirical analysis:

1. An increase in transportation costs between exporting country i and importing country j exhibits a negative effect on Π_{ij}. This effect is the larger, the smaller the respective importer country (j) is. This implies that theory casts doubt on the assumption of identical transport cost parameters across importer countries (also called "poolability") and yields the hypothesis that the transportation cost parameter should be expected to be the larger (the smaller in absolute value), the larger the respective importer country is with respect to the rest of the world.

2. The impact of transportation costs on bilateral export shares is also not independent of the importer's relative factor endowment. We show that the higher an importer's (j) capital labor ratio vis-à-vis all other countries, the lower the impact of transportation costs on the exporter's bilateral export share. This is a second argument which casts theoretical doubt on the poolability of gravity data.

We test our hypotheses estimating a gravity panel for bilateral export shares of 16 OECD countries (including 14 EU member countries, the USA and Japan) into the 14 EU countries over the period 1993-1997. This allows us to comprehensively account for all time-invariant influences as historic, geographical, cultural and other ties between countries as well as for all influences, which are invariant in the bilateral dimension like cycle effects by the inclusion of unobserved effects. The pooling assumption is relaxed by estimating a seemingly unrelated regression (SUR) set-up, which provides most efficient parameter estimates.

The assumption of poolability of the parameters across importers is significantly rejected. Moreover, the estimated parameters for transportation costs are analysed with respect to their relationship with the importer countries' size and capital-labor ratio. Empirical evidence strongly confirms our theoretical hypothesis for transport costs[5]: in absolute values, the transport cost parameters are significantly smaller for the largest importing countries and/or the importing countries with the highest capital-labor ratios.

In this way, the paper may contribute to the discussion about the "puzzle of home-bias", which has started with McCallum (1995) and has been surveyed by Obstfeld & Rogoff (2000). The latter provide also insights in the relationship between trade costs and home-bias. The present paper identifies a relationship between the importance of trade

[5] In our empirical application, we find that average transport costs for bilateral EU imports on the average amount to about 0.3 percent.

costs and characteristics of trading partners in terms of size and relative factor endowments. We may conclude that pooling the data is harmful, because one substantially underestimates the importance of transport cost reductions (in a broad sense) especially for the "poorer" and relatively labor-rich countries. Then, the potential effects of economic integration e.g. of the Central and Eastern European Economies in the process of Eastern Enlargement of the EU or the South-American countries in the economic integration of the two Americas are also downward biased.

The paper is organized as follows: section 2 presents the theoretical model; in section 3 the empirical set-up is described in more detail; empirical results are presented in section 4 and discussed in section 5; section 6 concludes.

2 Theoretical Background

Assume a model where a single horizontally differentiated good is traded between three countries of different size and/or capital-labor ratio. Especially, we are interested in how bilateral export shares (bilateral exports as percent of a country's overall exports, i.e. Π_{ij}) are affected by changes in iceberg transport costs. According to the above mentioned empirical interests we try to work out whether and how changes in transport costs will depend on both the size and the relative factor endowment of the importing country.

$>$ Figure 1 $<$

Imagine a world where one large (A), one medium-sized (B)[6], and one small (C) country produce and trade a single horizontally differentiated good with two factors of production (capital, K, and labor, L) at possibly different transport costs between pairs of countries (see Figure 1)[7]. For reasons of simplicity let's assume a rather simple and stylized production technology, which uses capital in the set-up of varieties (firm-specific fixed costs) and labor in the production process only. Here, we present the part of the model for country B; for the full set-up the reader is

[6] For our purpose the size of B is irrelevant, since we are only talking about shares.

[7] This implies that all bilateral trade is intra-industry goods trade. The choice of a model without a homogeneous sector besides model simplicity can also be justified when looking at the country sample in the empirical analysis. This contains almost only EU countries (note that only the USA and Japan are included as non-EU exporting countries). However, intra-industry trade of OECD countries in manufactures amounted to 87-89 percent over the period 1990-1994 (calculations based on the Grubel-Loyd index calculated from bilateral SITC 3-digit figures; OECD, 1998).

referred to the Appendix:

$$L_B = n_B(x_{BA} + x_{BB} + x_{BC}) \tag{1}$$
$$K_B = n_B$$

where x indicates the quantity of each variety produced in the respective exporter country being doubly indexed. The first subscript refers to the sending (producing) country, and the second subscript indicates the country, where the good is consumed: each country produces for the home market and for both foreign markets. Hence, a country's production for the foreign market possibly differs across partner countries and from the share of production for the home market. To be as simple as possible, the size of the capital stock is equivalent to the number of varieties produced (n)[8]. Note that factor supplies have been rescaled to come up with unitary input coefficients.

We apply the usual Dixit & Stiglitz (1977) CES demand assumptions for horizontally differentiated goods and assume iceberg transport costs. If a variety is exported, an exporter in B has to ship an amount of $t_\alpha = (1 + \tau_\alpha)$ or $t_\gamma = (1 + \tau_\gamma)$, respectively, which depends on the country of destination. According to our model formulation, quantities for a foreign market (x_{BA}, x_{BC}) already include the respective amount of the variety, which is wasted in the transportation process. $\varepsilon > 1$ is the elasticity of substitution between varieties. This yields demand for domestically produced goods

$$x_{BB} = p_B^{-\varepsilon} s_B^{\varepsilon-1} E_B \tag{2}$$

with E_B defining overall factor income in country B (GDP_B), the price aggregator (see e.g. Markusen & Venables, 1996)

$$s_B = [n_A(t_\alpha p_A)^{1-\varepsilon} + n_B p_B^{1-\varepsilon} + n_C(t_\gamma p_C)^{1-\varepsilon}]^{1/(1-\varepsilon)} \tag{3}$$

and the respective arbitrage conditions for foreign demand for country B's goods including the loss in quantitiy from the transportation process

$$\frac{x_{BA}}{x_{AA}} = \left(\frac{p_B}{p_A}\right)^{-\varepsilon} t_\alpha^{1-\varepsilon} \tag{4}$$
$$\frac{x_{BC}}{x_{CC}} = \left(\frac{p_B}{p_C}\right)^{-\varepsilon} t_\gamma^{1-\varepsilon}$$

[8] Note that a relaxation of this assumption would only complicate the model structure. Our main message that the impact of transport costs is related to importer country size and factor endowments is not crucially depending on this technology choice: the model could easily be extended to one where capital is also used in the production process, as long as the capital intensity for production is smaller than for fixed costs in the firm or variety set-up.

Profits of each firm in B (producing a single variety only) are given by

$$\pi_B = (p_B - w_{LB})(x_{BA} + x_{BB} + x_{BC}) - w_{KB} \tag{5}$$

where w_{LB} (w_{KB}) denotes the factor reward for labor (capital). From zero profits implied by free entry, the first order conditions and (1) we yield

$$\begin{aligned} p_B &= w_{LB}\frac{\varepsilon}{\varepsilon - 1} \\ w_{KB} &= \frac{w_{LB}L_B}{K_B(\varepsilon - 1)} \end{aligned} \tag{6}$$

Note that this last property that relative wages in each country are a linear function of its relative factor endowment stems from our restrictive technology choice. Finally, we need the restriction of balanced trade in each country in order to close the system

$$n_B p_B(x_{BA} + x_{BC}) = n_A p_A x_{AB} + n_C p_C x_{CB} \tag{7}$$

where the left hand side refers to country B's world exports and the right hand side to its world imports each including transport costs.

Because of the non-linearities involved by the consideration of transportation costs, the system cannot be solved analytically. We therefore solve the system numerically in order to derive the theoretical hypotheses about whether or not and how the effect of a change in bilateral transport costs depends on the receiving country's size and capital labor ratio (see the Appendix for the underlying parameter values). For country B this means whether and how its two export shares (Π_{BA} and Π_{BC}) are affected in different ways from a similar change in the two transport cost parameters. Using (2), (4), and (6) together, the two shares of country B can be rewritten as

$$\Pi_{BA} = 100 \cdot \left[1 + \left(\frac{w_{LA}}{w_{LC}}\right)^{-\varepsilon} \left(\frac{t_\gamma}{t_\alpha}\right)^{1-\varepsilon} \frac{x_{CC}}{x_{AA}}\right]^{-1} \tag{8}$$

$$\Pi_{BC} = 100 \cdot \left[1 + \left(\frac{w_{LC}}{w_{LA}}\right)^{-\varepsilon} \left(\frac{t_\alpha}{t_\gamma}\right)^{1-\varepsilon} \frac{x_{AA}}{x_{CC}}\right]^{-1} \tag{9}$$

Hence, the respective share only depends on the relative transport costs with country B, the relative wages and sales per brand in the home market of the two partner countries. Figure 2 demonstrates that a ceteris paribus change of the bilateral transport cost parameter negatively affects the respective export share, which as a general property is independent of the size and/or relative factor endowment of the importer country.

$>$ Figure 2 $<$

However, in the larger country (A) the bilateral import level is larger as compared to the smaller country (C). On the other hand, the larger country is less open than the smaller one. Hence, country A serves its home market more than proportionally more than the smaller one. We therefore find that the larger the respective importer country is, the less the exporter's share is affected by an increase in bilateral transport costs. This can be demonstrated by looking at the effects of small changes of transportation costs on bilateral export shares to both the small and the large importing country (see Figure 3)[9]. The conclusion is the following: larger countries are less open than smaller ones, and the larger this home market bias, the less sensitive are export shares (e.g. to an increase in bilateral transportation costs) as compared to a smaller country.

$>$ Figure 3 $<$
$>$ Figure 4 $<$
$>$ Figure 5 $<$

Figure 4 and Figure 5 demonstrate that the negative impact of transportation costs on bilateral exports is independent of whether the importing country is relatively well-endowed with capital or not. Moreover, we find that theory suggests that an importing country's relative factor endowment has an impact on how country B's export share to it is affected[10]. One can see that independently of whether the importing country is relatively large or not, its share in country B's world exports is the less strongly affected the larger its capital-labor ratio is. If a country is relatively well endowed with capital, it has a comparative advantage in running varieties (setting up firms). Dixit & Stiglitz (1977) consumer preferences then imply that country B's exports to countries with a higher comparative advantage in running products are less affected by changes in transportation costs, because love for variety dominates the pressure on costs. Capital-rich countries are less affected in terms of GDP than others with a comparative advantage in production, which are less protected by the consumers' taste for variety. This results in

[9] We again underpin that only percent changes are focussed. The differences in the slopes of the log export share curves for the two countries in Figure 2 can be approximated by plotting the changes in log export shares according to small changes in the respective log transportation cost parameters around an arbitrary point on the curves. Normalizing the outcome in relation to the initial shares gives two curves, which in this small area are close to straight lines of different slope.

[10] This again can be shown by plotting the changes in export shares according to small changes in the respective transportation cost parameters around an arbitrary point on the two curves, now corresponding to different capital-labor ratios.

a positive impact on the respective bilateral export relationship from country B's point of view. If we increase the capital-labor ratio of a single country in the world economy, this implies that the whole world will redistribute part of its export shares from each other country to this country with an increased comparative advantage in running product lines (in a dynamic context we would say an advantage in innovating new products).

To summarize, our comparative static analysis allows us to draw the following conclusions about the effects of a change in bilateral transport costs on an importing country's share in an arbitrary country's world exports (all changes are understood to be ceteris paribus):

- the larger the transportation costs between two countries, the smaller the importer country's share in the partner country's exports;
- this change in the export share is the smaller, the larger the importer country is;
- this change in the export share is the smaller, the higher the capital-labor ratio in the importing country.

Hence, from a theoretical point of view we expect an exporter's share to small countries with a low capital-labor ratio to be most negatively affected by a change in transport costs. On the other hand, we expect the minimum possible effect on its share to large capital-labor rich countries. This raises an additional explanation to the convenient new trade theory arguments of what explains bilateral trade relations: openness between country pairs (or even regions) of similar size but pairwise different relative factor endowments differs so much, because differences in factor endowments imply differences in the importance of bilateral transportation costs. On the other hand and similar to the latter, it also can explain why openness is so different across country pairs of different size, because they also face differences in the importance of bilateral transportation costs.

3 A SUR Error Components Gravity Model

According to the theoretical background, we have to account for the two mentioned aspects of possible differences between parameters (especially the transport cost parameter) across importing countries of different size.

This can be done by setting up the problem as a SUR model, where each equation refers to another importer country and exporter effects are treated as random. We follow Helpman (1987) and Hummels &

Levinsohn (1995) in the use of the Heckscher-Ohlin regressors, which are derived from any New Trade Theory framework with differentiated goods:

$$G_{ijt} = \ln(GDP_{it} + GDP_{jt}) \tag{10}$$
$$S_{ijt} = \ln\left[1 - \left(\frac{GDP_{it}}{GDP_{it} + GDP_{jt}}\right)^2 - \left(\frac{GDP_{jt}}{GDP_{it} + GDP_{jt}}\right)^2\right]$$
$$R_{ijt} = |\ln\frac{GDP_{it}}{N_{it}} - \ln\frac{GDP_{jt}}{N_{jt}}|$$

where G represents the size of the bilateral factor space in terms of real GDP, $-\infty < S \leq \ln(0.5)$ measures two countries' similarity in size in terms of real GDP, and $0 \leq R$ is a measure for the difference between two countries in terms of relative factor endowments. N refers to population and GDP per capita is commonly in use as a proxy for capital-labor ratios (see also Kaldor, 1963) . We additionally include a dummy (E_{ij}), which takes the value 1, if both the exporter and the importer country take part in the European Economic Area, and a 0 else. Finally, the log of bilateral transport costs enters as an explanatory variable (T_{ij}). The log of the share of country i's exports to country j as percent of country i's world exports is then explained as

$$\Pi_{ijt} = \beta_{1j}T_{ij} + \beta_{2j}G_{ijt} + \beta_{3j}S_{ijt} + \beta_{4j}R_{ijt} + \beta_{5j}E_{ij} + \alpha_j + \lambda_{tj} + u_{ijt} \tag{11}$$

where α_j is the constant, λ_{tj} are fixed time effects, and subscript j indicates that the coefficients are not pooled across importer countries. As mentioned above, we treat exporter effects as random, which implies

$$u_{ijt} = \mu_{ij} + \nu_{ijt} \tag{12}$$

with μ_{ij} as the unobservable exporter specific random error component, and ν_{ijt} denoting the remainder disturbance[11]. When thinking about country i's export share as possibly being dependent of its share to other countries, the standard covariance matrix for a (one-way) error components model has to be adjusted and additional cross-equations error components have to be estimated.

As in the standard case, the set of variables has to be transformed appropriately in order to account for this, where the transformation matrix depends on the weight of the estimated within and between variances

[11] Note that the importer-specific estimation of parameters brings this model's error structure close to one with bilateral unobserved effects (see Egger & Pfaffermayr, 2000).

$$\widehat{\Omega}^{-1/2}\Pi_{ijt} = \widehat{\Omega}^{-1/2}Z_{ijt}\beta_i + \widehat{\Omega}^{-1/2}u_{ijt} \quad (13)$$

where Π denotes the vector of export share observations, Z is the matrix of independent variables and

$$\widehat{\Omega}^{-1/2} = \Sigma_1^{-1/2} \otimes P + \Sigma_\nu^{-1/2} \otimes Q \quad (14)$$

where $P = I_N \otimes \overline{J}_T$, with I_N as an identity matrix of size N (i.e. the number of exporters, in our case 16), and $\overline{J}_T$ as a quadratic matrix of size T (i.e. the number of years each bilateral export relationship is observed, in our case 5) with $1/T$ as the entries in each cell. Q is defined as $I_{NT} - P$, where NT tells us how many observations are available for each importer. $\Sigma_1 = T\Sigma_\mu + \Sigma_\nu$ and Σ_ν both are $M \times M$ estimated variance component matrices, where M refers to the number of equations (i.e. of importers, in our case 14; note that importer equations are stacked in (13)). In our case, Σ_ν can be estimated by $U'QU/(N-1)(T-1)$ and Σ_1 by $U'PU/(N-1)$, see Baltagi (1995) p. 104. Following Amemiya (1971) we replace $U = [u_1, ..., u_M]$ by the $NT \times M$ matrix of residuals from Within regressions on each equation[12]. A typical gravity panel is unbalanced sui generis as no country reports exports to itself. Therefore, in our case the denominator of both Σ_1 and Σ_ν deviates from the usual formulation where $(N-1)$ is replaced by N. The unbalancedness also demands for a reformulation of U. Note that U has size $NT \times M$. Hence, to obtain proper estimates for the variance components matrices, U has the following entries

$$u_{ijM} = u_{ijM}^{Within-type}, \quad \text{if } i \neq j \text{ , else } 0. \quad (15)$$

Similarly, for the random transformation of the data matrix, we have to construct a balanced data set and replace the missing values for observations where $i = j$ with 0 to ensure proper transformation (of course, after transforming the data we can drop these observations again).

4 Data and Estimation Results

We estimate a panel of bilateral real export shares (bilateral exports as percent of a country's world exports) of 14 EU countries, the USA and

[12] Wallace & Hussain (1969) propose to use OLS residuals. Amemyia (1971) suggests to replace U by the respective Within-type residuals (see also Prucha, 1985; and Baltagi, 1995 for an overview). Note that importer specific residuals are now not stacked.

Japan in 14 EU countries (treating Belgium and Luxembourg together as a single country) over the period 1993-1997. Nominal export figures in USD are from OECD (Monthly Statistics of International Trade), and converted to real numbers by export price deflators (OECD, Economic Outlook) with 1995 as the base year. OECD's National Accounts (Volume 1) statistics provides data on population, nominal GDP in USD and GDP deflators (to convert GDP data to real numbers as well). The log of the relation between bilateral c.i.f. and f.o.b. figures measures transportation costs. According to the natural unbalancedness of bilateral trade data, we come up with 1050 observations.

$>$ Table 1 $<$

Table 1 reports information on average exports as percent of world exports of the 16 reporters of interest into the EU as a whole. Furthermore, the respective exporters' distance to the EU weighted by the importers' share of real GDP in total EU GDP is presented. According to the theoretical prior, relatively isolated countries (e.g. USA and Japan as two extreme examples) dedicate small shares of their exports to the EU.

$>$ Table 2 $<$

Table 2 presents two types of generalized least squares (GLS) regression results. In any regression time effects are treated as fixed. First, the pooling assumption is relaxed in a rigorous way and traditional error components regressions are estimated for each country pair assuming importers as independent from each other (labeled as EC). Second, OLS regressions on the properly transformed data give the requested SUR error components model coefficients (labeled as $EC - SUR$).

Regarding the Honda (1985) Lagrange multiplier tests in Table 2, we find that ignoring exporter-specific heteroskedasticity of the residuals and running simple OLS regressions among the importers would lead to inefficient estimates[13]. However, comparing the feasible GLS estimates (EC) with their fixed effects model counterparts (not reported) by a Hausman test indicates the superiority of the GLS estimator in terms of efficiency in our application. At a first glance we see that cross-equation variance components matter a lot resulting in relatively large differences between the importer-specific EC and the $EC - SUR$ standard errors. This reflects the exporter (or importer) countries' tastes in choosing their

[13]The test statistic is based on the square root of the Breusch-Pagan Lagrange multiplier statistic and correctly assumes that the alternative hypothesis is one-sided rather than two-sided.

trading partners also besides the influence of relative and absolute factor endowments. As one would have expected, in almost all cases bilateral transportation costs exhibit a significantly negative impact on bilateral export shares. Autocorrelation is no problem in our application leading to an insignificant correlation coefficient between the within residuals and the lagged within residuals for the average importer country[14].

5 Assessing Poolability

We follow two lines in assessing poolability of gravity data. First, we address a conventional test of pooling in the tradition of Roy (1957), Zellner (1961) and McElroy (1977). Secondly, we analyse the relationship between importer country size and the estimated transportation cost parameters in the spirit of Saxonhouse (1977)[15].

There is now a relatively rich literature on tests of data poolability when using panel data. However, if error components models are estimated the performance of most of the available test principles is relatively poor and either the Roy & Zellner test or McElroy's (1977) extension to the weaker mean square error (MSE) criteria should be used (see Baltagi, 1981). We follow the lines of McElroy (1977), who formulates also weaker MSE criteria in addition to the strong one[16]. We compare the estimation results in Table 2 with their pooled counterparts (the estimated parameters are then restricted: $\beta_{1k} = \beta_{2k} = ... = \beta_{Mk}$, where k refers to different explanatory variables) on the basis of their residual sum of squares (RSS). Accordingly, two different F-statistics can be calculated:

$$F^{EC}_{\text{observed}} = \left[\frac{RSS(\widehat{\beta}^*_{ECP}) - RSS(\widehat{\beta}^*_{EC})}{(M-1)K'}\right] \div \left[\frac{RSS(\widehat{\beta}^*_{EC})}{M(NT-K')}\right] \quad (16)$$

$$F^{EC-SUR}_{\text{observed}} = \left[\frac{RSS(\widehat{\beta}^*_{EC-SURP}) - RSS(\widehat{\beta}^*_{EC-SUR})}{(M-1)K'}\right] \div \left[\frac{RSS(\widehat{\beta}^*_{EC-SUR})}{M(NT-K')}\right]$$

[14]This is also not surprising regarding our choice of export shares rather than export levels.

[15]See also Winters (1981) for an application in the analysis of the determinants of estimated partial adjustment for British industry prices.

[16]The weakness of the respective MSE criteria depends on the parameter of noncentrality (λ_{MNT}) of the reference F-distribution: $F\prime_{\alpha_0} = ((M-1), M(NT-K'), \lambda^*_{MNT})$. The strong criterion requires $\lambda^*_{MNT} = 0.5$. The two weak criteria imply $\lambda^*_{MNT} = \phi_{MNT}$ (see McElroy, 1977, for further details) and $\lambda^*_{MNT} = (M-1)K'$, respectively. Baltagi (1995) gives an overview over different tests of poolability. Baltagi (1981) provides evidence on the well performance of McElroy's test as compared to the Roy & Zellner test.

where $K' = K + 1$, and K denotes the number of regressors, "P" refers to the pooled models.

$>$ Table 3 $<$

Table 3 presents the estimation results for the pooled regressions on transformed data. Comparing the pooled estimator including fixed importer effects with the two importer-specific approaches yields F-statistics of 4.391 (EC) and 12.821 ($EC - SUR$). Regarding the p-values of the corresponding noncentral F-distributions for the observed F-statistics, this significantly rejects the pooling assumption independent of whether strong or weak mean square error criteria are applied (see McElroy, 1977, for further details).

Given that pooling is rejected from an econometric po0int of view, we proceed to the second step of analysis: the explanation of the coefficient of the transportation cost factor. Following Saxonhouse (1977) an important question has to be addressed. The quality of the estimated parameters in terms of significance level differs across equations, which is a relevant information when explaining these parameters. Saxonhouse therefore suggests to transform the model and to estimate it by GLS rather than OLS. The appropriate GLS transformation is based on the variance covariance matrix estimates of the transportation cost parameters from the SUR model and an OLS regression of these parameters on importer size and capital labor ratio. The resulting standard error of this latter regression is the ingredient for the appropriate GLS transformation of both the dependent (i.e. the transportation cost parameters) and the independent variables (i.e. log of importer GDP and capital-labor ratio).

$>$ Table 4 $<$

Table 4 presents different regression results from this transformed model. First (I), the transportation cost parameter is explained by both importer size and capital-labor ratio. This gives a significantly positive coefficient for the latter variable (according to our theoretical expectations) but it leaves the former coefficient insignificant. However this is due to a multicollinearity between size and capital-labor ratio in the sample of EU countries. Second, three types of analysis of variance (ANOVA) are presented[17]. In the first (II), the country sample is splitted into 3 groups according to their size (the largest 4, the medium 6 and the smallest 4 countries) and into three groups according to their

[17] Note that the underlying data have previously been transferred according to Saxonhouse (1977).

capital-labor ratio (the capital-labor ratio of the 4 best, 6 medium and 4 worst capital-endowed importers). From the standard errors we see that this is too demanding according to the available degrees of freedom. Then (III) we run an ANOVA on the different groups of size only. We find a significantly positive difference in the transport cost parameters between the largest and the smallest group of importers[18]. Next (IV), the same is done for the different groups of capital-labor ratios only. Both, the most and the medium relatively capital-rich countries have significantly higher transport cost parameters than the least capital-rich ones. Finally, Spearman's (1904) rank correlation coefficient between transport cost parameter and both importer size and capital-labor ratio is calculated and gives a significantly positive correlation between the transportation cost parameter estimates and both importer country size and capital-labor ratio. In sum, we get a conclusive picture, which widely coincides with our theoretical priors. Indeed the importer country size and its capital-labor ratio have a positive impact on transportation cost parameter (at least when not entering simultaneously in regression analysis).

$>$ Table 5 $<$

Ignoring the importer-specific impact of transportation costs leads to a substantial underestimation of the importance of transportation costs, especially for the small and the relatively labor-rich countries. Table 5 displays the contribution of the partial sum of squares estimated by transport costs only (second column) and its share in the sum of squares estimated by all exogenous variables together (third column). For the unpooled model, the respective share amounts to about 4 percent. In the pooled model, transport costs account for about 2 percent of the variation[19]. This gets even more pronounced when looking at the importer country level, where transport costs explain more than 20 percent of the variation of export shares especially for the "poorer" EU economies like Greece, Portugal and Spain (except Belgium-Luxembourg). Likewise, the pooled model overestimates the importance of other explaining factors for these countries.

To sum up, we provide evidence that the commonly assumed poolability of bilateral trade flow data is likely to be rejected by the corresponding tests. Moreover, we can conclude from the results for the extreme cases of our analysis of variance (comparing the largest with the

[18] Note that the underlying split of the country sample seems justified when looking at their distribution in terms of real GDP.

[19] In a dynamic set-up Baier & Bergstrand (2001) find that transport cost reductions explain about 8 percent of the growth in trade for OECD countries.

smallest countries) that empirical evidence is widely in accordance with the theoretical hypotheses that both importer country size and capital-labor ratio are negatively correlated with the impact of transport costs on an exporters corresponding bilateral export share[20].

6 Conclusions

Previous empirical research on the determinants of bilateral trade volumes assumed that all the estimated parameters are identical across bilateral relationships. This paper concentrates on the analysis of bilateral export shares and investigates the question of poolability of parameters in the estimation of gravity models. A simple New Trade Theory model of three countries is used to formulate two hypotheses for bilateral trade relations in the presence of (not excessively high) transportation costs:

1. The larger an importing country, the less a change in trade costs affects its share for an arbitrary exporter. This contradicts the assumption of poolability.
2. The higher an importing country's capital labor ratio, the less a change in trade costs affects its share for an arbitrary exporter. This contradicts the assumption of poolability as well.

We find strong evidence that the poolability assumption is indeed rejected for bilateral export shares in a panel of the 14 EU member countries. Regarding the theoretical model we also find strong evidence that both a larger size and a higher capital-labor ratio of an importer country indeed significantly lower the negative impact of transport costs on its share in an arbitrary country's world exports. Our results allow us to conclude that transportation cost reducing measures would more work in favor of export shares to the relatively labor-rich and small countries than to the relatively capital-rich and large ones, which should be accounted for in empirical applications. In our application, the restriction of parameter homogeneity across importers leads to an underestimation of the importance of transportation costs by about 50 percent. Especially, the importance for the South-European economies goes underrated.

This provides insights that both the evaluation of policy measures and the projection of trading potentials should be based on unpooled

[20]The robustness of our results could be underpinned by their independence of whether transport costs are measured by c.i.f./f.o.b. relations or distance numbers. However, results on the latter are not reported in order to save space and because distance are held to be a weaker proxy for transport costs. However, results could be upon request from the author.

estimates if degrees of freedom allow for it, since pooled models likewise underestimate the potential integration effects of relatively labor-rich economies, e.g. the Central and Eastern European Countries or the South-American economies. In this way, further insights are provided into the relationship between the importance of trade barriers and characteristics of trading partners in terms of both their size and relative factor endowments.

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8 Appendix

The full system of the simulated equations in the three-country model is

Factor markets

$$L_A = n_A(x_{AA} + x_{AB} + x_{AC}) \tag{17}$$
$$L_B = n_B(x_{BA} + x_{BB} + x_{BC})$$
$$L_C = n_C(x_{CA} + x_{CB} + x_{CC})$$
$$K_A = n_A \tag{18}$$
$$K_B = n_B$$
$$K_C = n_C$$

Demand and Arbitrage Production for the respective home markets is given by

$$x_{AA} = p_A^{-\varepsilon} s_A^{\varepsilon-1} E_A \tag{19}$$
$$x_{BB} = p_B^{-\varepsilon} s_B^{\varepsilon-1} E_B$$
$$x_{CC} = p_C^{-\varepsilon} s_C^{\varepsilon-1} E_C$$

with the corresponding price aggregators

$$
\begin{aligned}
s_A &= [n_A p_A^{1-\varepsilon} + n_B (t_\alpha p_B)^{1-\varepsilon} + n_C (t_\delta p_C)^{1-\varepsilon}]^{1/(1-\varepsilon)} \\
s_B &= [n_A (t_\alpha p_A)^{1-\varepsilon} + n_B p_B^{1-\varepsilon} + n_C (t_\gamma p_C)^{1-\varepsilon}]^{1/(1-\varepsilon)} \\
s_C &= [n_A (t_\delta p_A)^{1-\varepsilon} + n_B (t_\gamma p_B)^{1-\varepsilon} + n_C p_C^{1-\varepsilon}]^{1/(1-\varepsilon)}
\end{aligned} \tag{20}
$$

and the arbitrage conditions for six different export flows

$$
\begin{aligned}
\frac{x_{AB}}{x_{BB}} &= \left(\frac{p_A}{p_B}\right)^{-\varepsilon} t_\alpha^{1-\varepsilon} \\
\frac{x_{AC}}{x_{CC}} &= \left(\frac{p_A}{p_C}\right)^{-\varepsilon} t_\delta^{1-\varepsilon} \\
\frac{x_{BA}}{x_{AA}} &= \left(\frac{p_B}{p_A}\right)^{-\varepsilon} t_\alpha^{1-\varepsilon} \\
\frac{x_{BC}}{x_{CC}} &= \left(\frac{p_B}{p_C}\right)^{-\varepsilon} t_\gamma^{1-\varepsilon} \\
\frac{x_{CA}}{x_{AA}} &= \left(\frac{p_C}{p_A}\right)^{-\varepsilon} t_\delta^{1-\varepsilon} \\
\frac{x_{CB}}{x_{BB}} &= \left(\frac{p_C}{p_B}\right)^{-\varepsilon} t_\gamma^{1-\varepsilon}
\end{aligned} \tag{21}
$$

Zero Profit Conditions

$$
\begin{aligned}
\pi_A &= (p_A - w_{LA})(x_{AA} + x_{AB} + x_{AC}) - w_{KA} = 0 \\
\pi_B &= (p_B - w_{LB})(x_{BA} + x_{BB} + x_{BC}) - w_{KB} = 0 \\
\pi_C &= (p_C - w_{LC})(x_{CA} + x_{CB} + x_{CC}) - w_{KC} = 0
\end{aligned} \tag{22}
$$

Trade Balance Restrictions

$$
\begin{aligned}
n_A p_A (x_{AB} + x_{AC}) &= n_B p_B x_{BA} + n_C p_C x_{CA} \\
n_B p_B (x_{BA} + x_{BC}) &= n_A p_A x_{AB} + n_C p_C x_{CB} \\
n_C p_C (x_{CA} + x_{CB}) &= n_A p_A x_{AC} + n_B p_B x_{BC}
\end{aligned} \tag{23}
$$

Simulation Details

In a first step, we assumed countries to differ only in size, although the basic result is not affected by a relaxation of this assumption. I presumed the following sizes for the countries' labor force: $L_A = 3500$, $L_B = 3000$, and $L_C = 2900$ together with the assumption of identical capital labor ratios of 0.3. Note that we can think about capital stocks as being measured in terms of a firm's capital demand (identical for all firms in the three countries). This would imply that we assume the same number of workers per firm around the world, when thinking of the number of varieties being equivalent to the number of firms. I assumed a constant elasticity of substitution parameter of $\varepsilon = 2$ and in the initial situation I set the transport costs parameters at the same value: $t_\alpha = t_\gamma = t_\delta = 1.1$. Hence, 10 percent of a firm's export volume gets lost in the shipment process. I then undertake two experiments. In the first one, I alter the value of the transport cost parameter between country B and country A (t_α) from 1.1 up to 1.17 and look at the associated changes in the share of exports from country B to country A in terms of country B's overall exports. In the second experiment I do the same for exports between country B and country C, but altering t_γ instead. Finally, I compare the changes in export shares resulting from identical changes in the two transport cost parameters and find that the negative effect on export shares is the larger, the larger the partner country is.

In a second step also differences in capital-labor ratios were analysed. The results in Figure 3 and 4 assume the above mentioned capital-labor ratio (0.3) for the exporter and one partner country while changing one importing country's capital-labor ratio to 0.25 and 0.35, respectiviely.

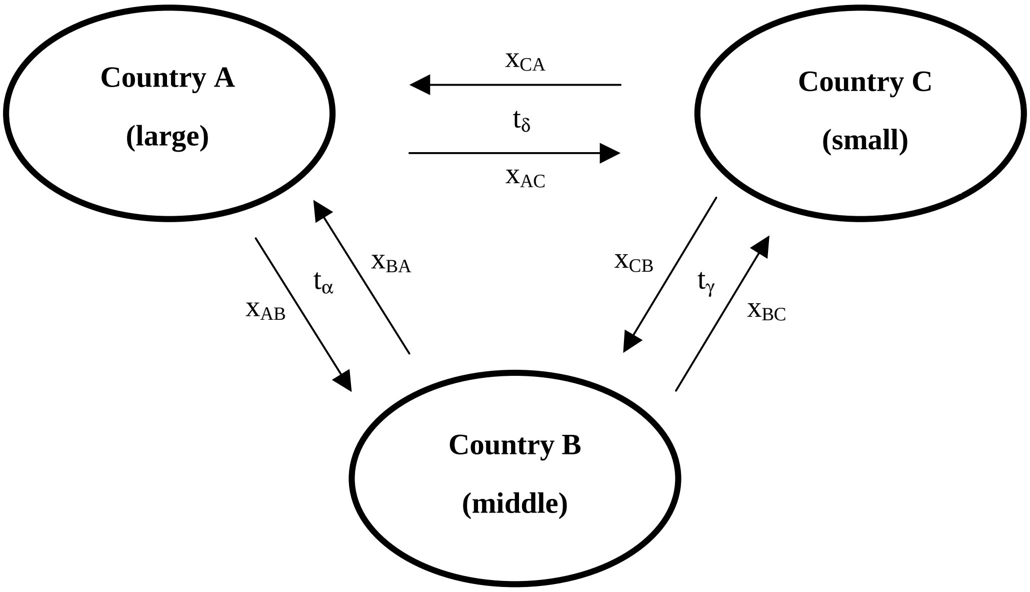


Figure 1: Trade Flows in a Three-Country World

Figure 2: Country B's Share of Export to a Large Country A (Π_{BA}) and a Small Country C (Π_{BC})

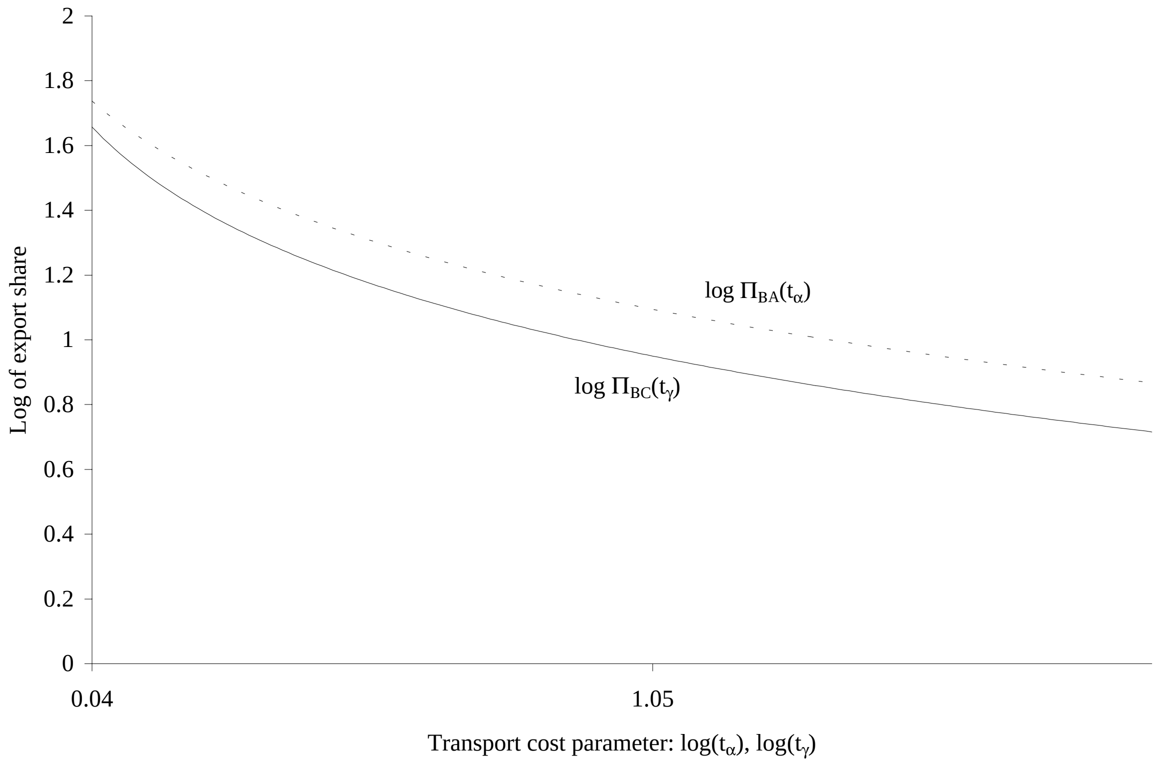
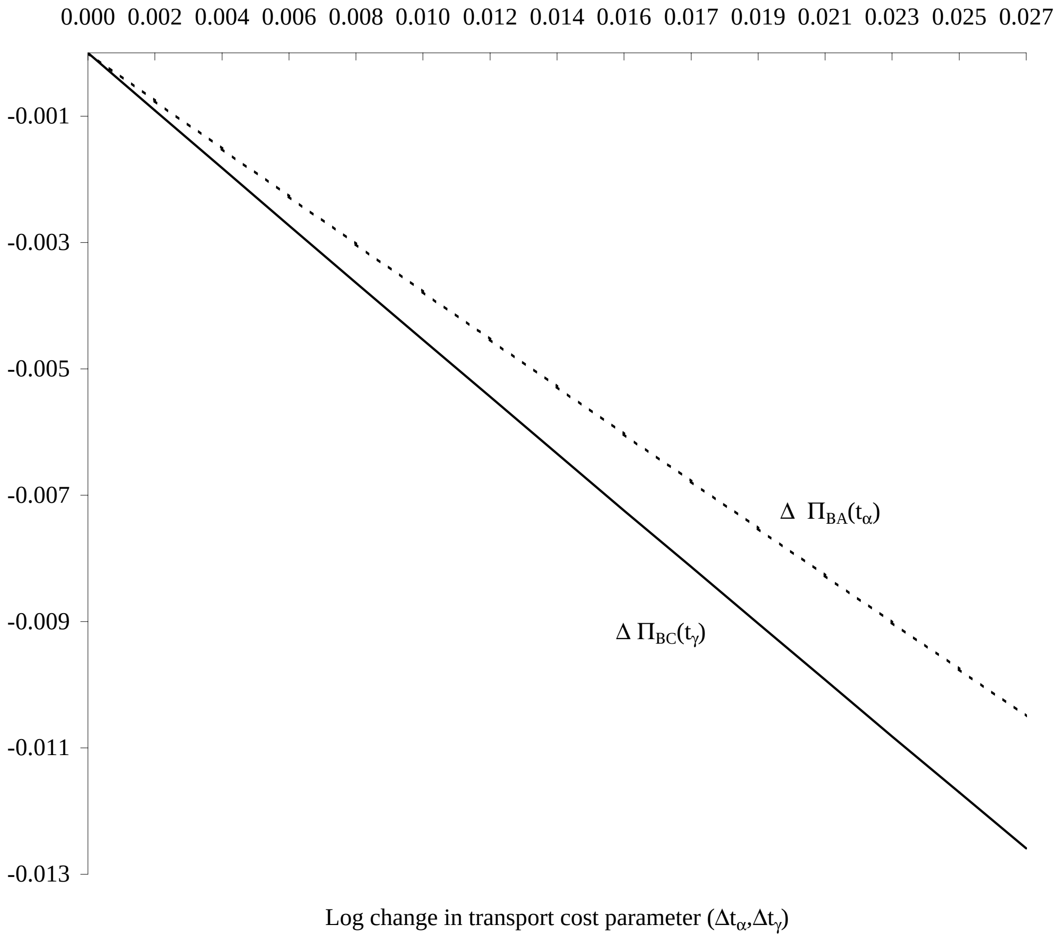
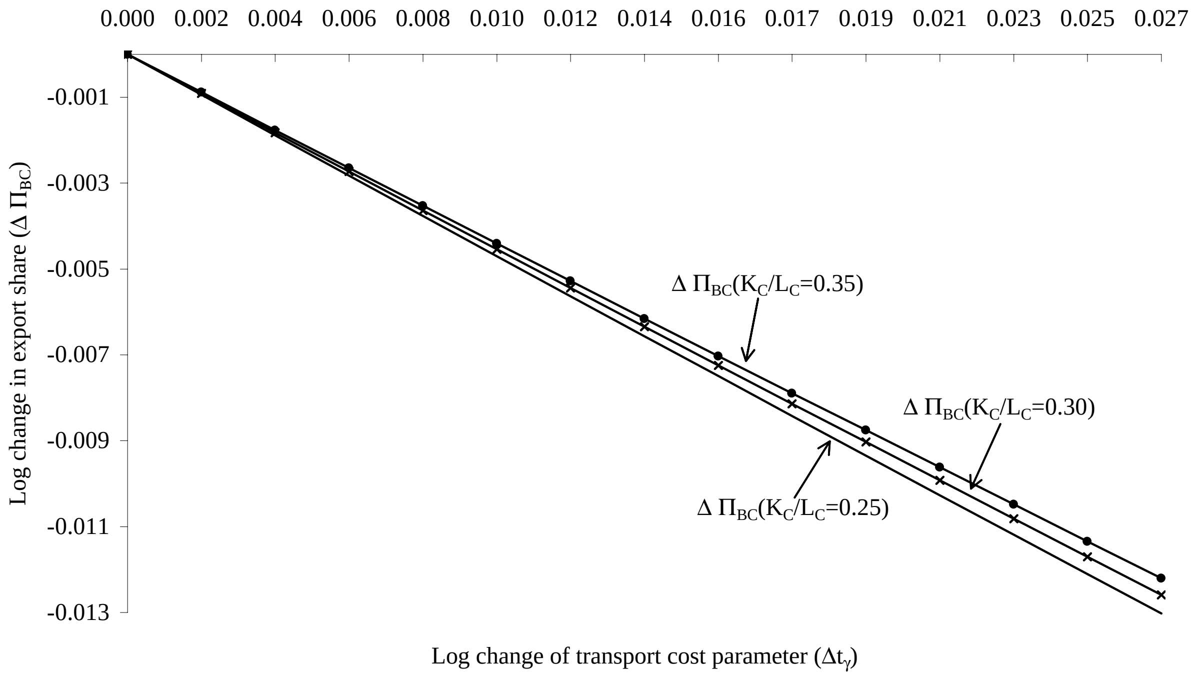


Figure 3: Country B's Share of Export to a Large Country A (Π_{BA}) and a Small Country C (Π_{BC})
Changing Transport Costs and Exports Relative to Initial Situation



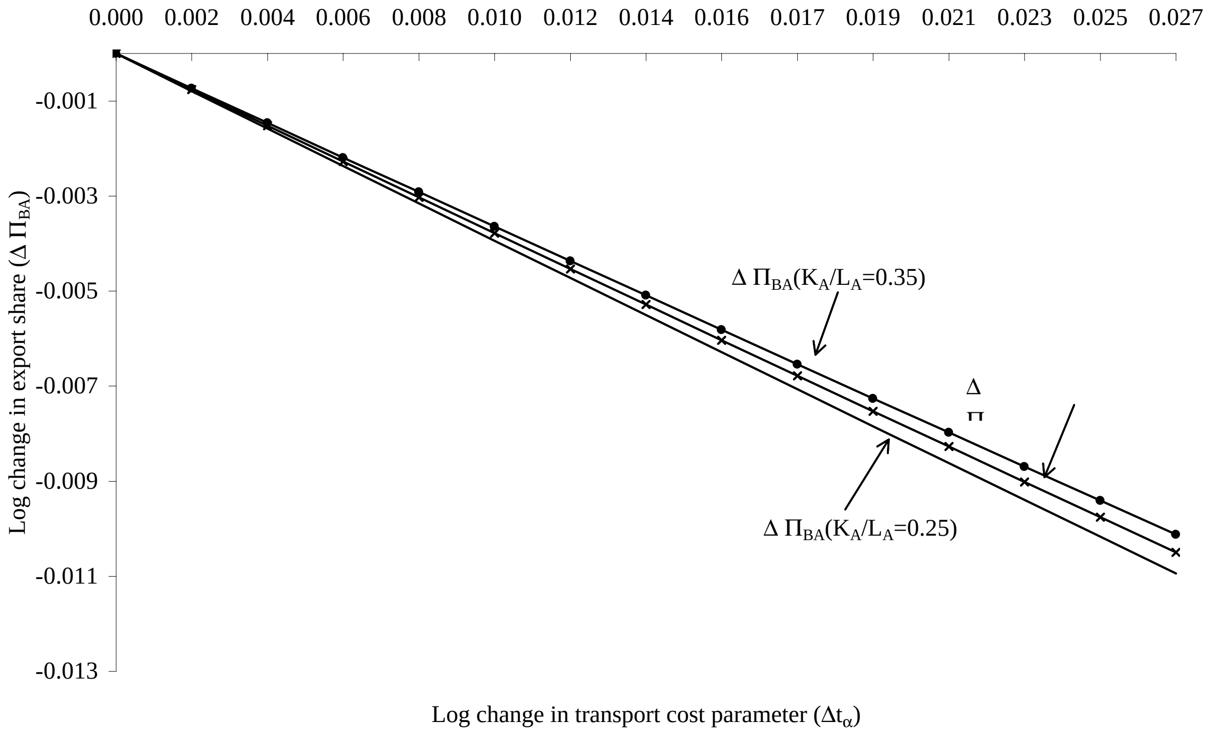
$\Delta\Pi_{BA}$ = log $\Pi_{BA}(t_\alpha)$ – log $\Pi_{BA}(t_\alpha = 1.1)$; $\Delta\Pi_{BC}$ = log $\Pi_{BC}(t_\gamma)$ - log $\Pi_{BC}(t_\gamma = 1.1)$; Δt = log(t) - log(1.1)

Figure 4: The Capital-Labor Ratio and a Log Change in Transport Costs in a Small Country
Changing Transport Costs and Exports Relative to Initial Situation



$\Delta\Pi_{BC} = \log \Pi_{BC}(t_\gamma) - \log \Pi_{BC}(t_\gamma = 1.1)$; $\Delta t_\gamma = \log(t_\gamma) - \log(1.1)$

Figure 5: The Capital-Labor Ratio and a Change in Transport Costs in a Large Country
Changing Transport Costs and Exports Relative to Initial Situation



$\Delta\Pi_{BA} = \log \Pi_{BA}(t_\alpha) - \log \Pi_{BA}(t_\alpha = 1.1)$; $\Delta t_\alpha = \log(t_\alpha) - \log(1.1)$

Table 1: Trade Relations with the EU
Average 1993 - 1997

	Export to the EU	Distance to the EU[1)]
	Shares in total exports as percent	Miles
Belgium-Luxembourg	74.8	513
Denmark	63.8	639
Germany	57.5	521
Finland	56.2	996
France	64.0	554
Greece	56.7	1,198
Great Britain	56.2	589
Ireland	70.2	757
Italy	56.4	620
Netherlands	76.9	536
Austria	64.4	668
Portugal	80.5	1,119
Sweden	57.7	847
Spain	70.8	892
Japan	15.8	5,821
USA	21.0	4,393
Average exporter	58.5	1,328

1) Bilateral distance weighted with the respective import country share of real GDP in total EU-GDP.

Table 2: Estimation Results: Dependent Variable is the Share of a Country's Export to EU-countries as Percent of Total Exports 1993 - 1997 (real figures)

Importing country	Estimation method	c.i.f/f.o.b.	Intra-EU relations	Sum of bilateral GDPs	Similarity of bilateral GDPs	Distance in relative factor endowments	Constant	Obser-vations	R^2	Likelihood Ratio test time effects	Honda (1985) Lagrange-Multiplier test	Hausman test
Belgium-Luxembourg	EC	-0.405	1.487	0.825	0.971	-0.534	-21.542	75	0.85	16.80	11.17	25.07
		(0.081)	*(0.789)*	*(0.329)*	*(0.553)*	*(0.389)*	*(8.918)*			*(0.00)*	*(0.00)*	*(0.00)*
	EC-SUR	-0.415	-7.859	0.333	-0.607	-1.509	-2.046	75	0.46	4.61	-	-
		(0.078)	*(4.767)*	*(0.165)*	*(0.468)*	*(0.319)*	*(2.586)*			*(0.00)*	-	-
Denmark	EC	-0.044	0.635	0.619	1.403	-0.002	-15.610	75	*0.52*	16.35	10.03	23.00
		(0.125)	*(0.781)*	*(0.473)*	*(0.683)*	*(0.358)*	*(12.262)*			*(0.00)*	*(0.00)*	*(0.00)*
	EC-SUR	0.057	0.017	0.071	1.127	-0.491	-4.887	75	0.47	5.29	-	-
		(0.114)	*(4.260)*	*(0.175)*	*(0.534)*	*(0.293)*	*(1.994)*			*(0.00)*	-	-
Germany	EC	-0.023	1.387	-0.069	-0.007	0.001	3.502	75	0.99	25.70	11.36	3.23
		(0.101)	*(0.697)*	*(0.653)*	*(0.159)*	*(0.190)*	*(19.509)*			*(0.00)*	*(0.00)*	*(0.92)*
	EC-SUR	-0.017	0.836	0.007	-0.351	-0.087	0.849	75	0.97	9.15	-	-
		(0.077)	*(0.162)*	*(0.011)*	*(0.136)*	*(0.231)*	*(0.357)*			*(0.00)*	-	-
Finland	EC	-0.918	-0.433	0.309	0.975	-0.454	-6.983	75	*0.58*	25.87	10.32	2.37
		(0.101)	*(0.757)*	*(0.579)*	*(0.811)*	*(0.354)*	*(14.673)*			*(0.00)*	*(0.00)*	*(0.97)*
	EC-SUR	-0.952	0.855	0.027	-0.323	-0.056	-0.994	75	0.92	8.19	-	-
		(0.123)	*(0.159)*	*(0.015)*	*(0.214)*	*(0.269)*	*(0.320)*			*(0.00)*	-	-
France	EC	-0.471	1.927	0.392	0.327	0.368	-10.474	75	0.96	24.66	10.99	0.85
		(0.099)	*(0.704)*	*(0.477)*	*(0.214)*	*(0.211)*	*(14.231)*			*(0.00)*	*(0.00)*	*(1.00)*
	EC-SUR	-0.446	5.275	-0.152	0.200	0.166	7.317	75	0.91	17.61	-	-
		(0.100)	*(1.235)*	*(0.046)*	*(0.079)*	*(0.143)*	*(0.747)*			*(0.00)*	-	-
Greece	EC	-0.697	1.902	0.420	0.203	-0.131	-13.125	75	*0.86*	15.34	9.67	3.30
		(0.137)	*(0.483)*	*(0.458)*	*(0.642)*	*(0.288)*	*(11.268)*			*(0.00)*	*(0.00)*	*(0.91)*
	EC-SUR	-0.750	0.869	0.019	0.153	0.458	-1.591	75	0.55	4.48	-	-
		(0.149)	*(0.395)*	*(0.021)*	*(0.140)*	*(0.226)*	*(0.312)*			*(0.00)*	-	-
Great Britain	EC	-0.256	1.563	0.541	-0.988	-0.295	-15.704	75	0.98	30.67	11.55	14.91
		(0.079)	*(0.619)*	*(0.361)*	*(0.233)*	*(0.253)*	*(10.820)*			*(0.00)*	*(0.00)*	*(0.06)*
	EC-SUR	-0.276	-0.157	0.043	-1.129	-0.568	-0.463	75	0.93	7.09	-	-
		(0.115)	*(0.241)*	*(0.016)*	*(0.169)*	*(0.249)*	*(0.478)*			*(0.00)*	-	-
Ireland	EC	-0.215	0.737	0.022	-0.359	-0.329	-2.511	75	*0.54*	4.51	11.37	3.09
		(0.103)	*(0.799)*	*(1.117)*	*(1.230)*	*(0.214)*	*(28.123)*			*(0.34)*	*(0.00)*	*(0.93)*
	EC-SUR	-0.151	-0.046	-0.026	-0.908	-0.578	0.343	75	0.58	3.46	-	-
		(0.083)	*(0.525)*	*(0.038)*	*(0.426)*	*(0.172)*	*(0.867)*			*(0.01)*	-	-
Italy	EC	-0.385	2.424	0.612	-0.347	-0.601	-18.115	75	0.93	12.35	11.78	46.94
		(0.143)	*(0.751)*	*(0.426)*	*(0.249)*	*(0.294)*	*(12.712)*			*(0.01)*	*(0.00)*	*(0.00)*
	EC-SUR	-0.323	1.966	-0.005	-0.597	-0.712	-1.497	75	0.54	7.55	-	-
		(0.103)	*(0.517)*	*(0.032)*	*(0.277)*	*(0.209)*	*(0.759)*			*(0.00)*	-	-
Netherlands	EC	-0.133	0.887	0.139	0.100	-0.318	-2.943	75	*0.94*	0.22	11.33	4.99
		(0.102)	*(0.669)*	*(0.228)*	*(0.434)*	*(0.336)*	*(6.520)*			*(0.99)*	*(0.00)*	*(0.76)*
	EC-SUR	-0.161	-0.185	0.072	0.233	0.272	-1.445	75	0.52	0.40	-	-
		(0.101)	*(0.475)*	*(0.024)*	*(0.137)*	*(0.307)*	*(0.282)*			*(0.81)*	-	-
Austria	EC	-0.457	3.056	-0.031	-1.138	0.036	-3.083	75	0.66	13.68	11.73	2.19
		(0.134)	*(0.721)*	*(0.350)*	*(0.570)*	*(0.378)*	*(9.215)*			*(0.01)*	*(0.00)*	*(0.97)*
	EC-SUR	-0.299	1.151	0.009	-0.991	-0.249	-1.034	75	0.85	2.97	-	-
		(0.153)	*(0.285)*	*(0.019)*	*(0.331)*	*(0.345)*	*(0.516)*			*(0.03)*	-	-
Portugal	EC	-0.669	1.951	1.529	1.374	-0.976	-40.789	75	*0.72*	5.80	11.63	1.86
		(0.183)	*(0.861)*	*(0.831)*	*(1.112)*	*(0.473)*	*(20.452)*			*(0.21)*	*(0.00)*	*(0.99)*
	EC-SUR	-0.714	-2.781	0.151	-0.291	-1.370	1.041	75	0.60	4.02	-	-
		(0.139)	*(2.119)*	*(0.074)*	*(0.264)*	*(0.678)*	*(1.042)*			*(0.01)*	-	-
Sweden	EC	-0.083	1.326	-0.963	-1.183	-0.238	24.385	75	0.59	8.47	11.87	6.55
		(0.088)	*(1.058)*	*(0.523)*	*(0.874)*	*(0.574)*	*(13.692)*			*(0.08)*	*(0.00)*	*(0.59)*
	EC-SUR	-0.174	0.164	0.021	-0.767	-0.559	-0.208	75	0.84	0.32	-	-
		(0.080)	*(0.244)*	*(0.014)*	*(0.198)*	*(0.339)*	*(0.309)*			*(0.86)*	-	-
Spain	EC	-0.369	1.760	0.316	0.086	-0.528	-8.965	75	*0.85*	7.04	11.24	9.87
		(0.195)	*(1.009)*	*(0.320)*	*(0.559)*	*(0.505)*	*(9.719)*			*(0.13)*	*(0.00)*	*(0.27)*
	EC-SUR	-0.552	-4.940	0.212	0.184	0.261	46.283	75	0.42	3.37	-	-
		(0.160)	*(20.287)*	*(0.749)*	*(0.443)*	*(0.277)*	*(31.437)*			*(0.01)*	-	-

Standard errors below coefficients in parentheses. For Likelihood-ratio, Lagrange multiplier and Hausman test statistics p-values are reported.

Table 3: Pooled Estimators for Transformed Data
Dependent variable: bilateral share of exports as percent (all variables in logs)

	Estimation method	
Explanatory Variables	EC	EC-SUR
c.i.f/f.o.b	-0.344	-0.202
	(0.031)	*(0.037)*
Sum of bilateral GDPs	1.038	0.032
	(0.081)	*(0.007)*
Similarity of bilateral GDPs	0.473	-0.328
	(0.090)	*(0.054)*
Distance in relative factor endowments	-0.153	-0.709
	(0.088)	*(0.086)*
Intra-EU relations	2.725	0.678
	(0.243)	*(0.110)*
Constant	-29.682	-0.350
	(2.322)	*(0.153)*
Observations	1,050	1,050
R^2	0.601	0.586
Poolability:		
$F_{observed}$	4.391	12.822
Strong criterion: p-value F'(F_{obs},143,896;0.5)	0.000	0.000
Weaker criterion: p-value F'(F_{obs},143,896;8.46)	0.000	0.000

Standard errors below coefficients in parentheses.

Table 4: Explaining the SUR C.I.F./F.O.B. Parameter

GLS regression results and Spearman (1904) rank correlation coefficients

Explaining factors	Dependent variable: SUR c.i.f./f.o.b. parameter (β_1)				
	GLS regressions after Saxonhouse (1977)				Rank correlation
	I	II	III	IV	Spearman (1904)
Constant	-5.423	-0.623	-0.640	-0.540	-
	(2.220)	*(0.142)*	*(0.125)*	*(0.136)*	-
GDP_j	0.030	-	-	-	0.163
	(0.067)	-	-	-	*(0.112)*
Capital-labor $ratio_j$	0.406	-	-	-	0.530
	(0.202)	-	-	-	*(0.111)*
Importer size					
Largest 4	-	0.382	0.375	-	-
	-	*(0.242)*	*(0.176)*	-	-
Medium 6	-	0.336	0.383	-	-
	-	*(0.216)*	*(0.161)*	-	-
Importer capital-labor ratio					
Largest 4	-	0.107	-	0.372	-
	-	*(0.243)*	-	*(0.192)*	-
Medium 6	-	-0.068	-	0.152	-
	-	*(0.216)*	-	*(0.176)*	-
Observations	14	14	14	14	14
R^2	0.69	0.79	0.77	0.73	-
Root MSE	0.30	0.33	0.30	0.30	-

Standard errors below coefficients in parentheses.

Table 5: Part of Estimated Sum of Squares (ESS)
Explained by Transportation Costs
Average 1993 - 1997

Importer	Partial ESS (Transport Costs)	hare in Model ESS[1)] as percent
Belgium-Luxembourg	39.9	50.5
Denmark	0.3	0.4
Germany	0.1	0.0
Finland	148.8	7.9
France	40.8	3.2
Greece	43.5	31.3
Great Britain	13.8	0.7
Ireland	3.8	3.7
Italy	12.9	12.4
Netherlands	4.8	3.6
Austria	7.8	1.1
Portugal	25.0	27.0
Sweden	6.5	1.4
Spain	16.7	24.8
Total EU	364.6	3.9
Pooled Model	132.1	2.1

1) Share of partial ESS of transport costs in transformed model ESS