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An Econometric View on the Estimation of Gravity Models and the Calculation of Trade Potentials

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Abstract

The revival of the gravity model in the last decade was mainly based on its use for the calculation of bilateral trade potentials. I apply five different panel estimators for the calculation of EU export potentials in the 10 Central and Eastern European Countries in order to demonstrate the relevance of the estimator choice and its interpretation. Unfortunately, from a pure econometric point of view there seems no way at all to derive appropriate information about so-called trade potentials in the traditional manner. Large sytematic differences between observed and predicted trade flows only indicate model misspecification and econometric problems.

Key words: Gravity equation; Trade potentials; Economic Integration

JEL classification: C33; F14; F15

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1 Introduction[1]

In the last decade, the application of gravity models enjoyed a big revival. This has been not so much driven by its more rigorous theoretical foundation (Anderson, 1979, Bergstrand, 1985, 1989, 1990, Helpman & Krugman, 1985, Helpman, 1987, etc.) but by the opportunity to project bilateral trade relations (see Wang & Winters, 1991, Hamilton & Winters, 1992, Baldwin, 1994, and successors). The first applications have been undertaken within the context of the Fall of the Iron Curtain and the *new* potential integration effects between the EU (OECD) and the former COMECON member states.

According to the traditional concept of the gravity equation, bilateral trade can be explained by GDP and GDP per capita figures and both trade impediment (distance) and preference factors (common border, common language, etc.). Then, the residual of the estimated equation is interpreted as the difference between potential and actual bilateral trade relations. The econometric concept in most cases was cross-section analysis (Wang & Winters, 1991, Hamilton & Winters, 1992, Nilsson, 2000, etc.). Only a few authors made use of (random effects) panel econometric methods (Baldwin, 1994, Gros & Gonciarz, 1996)[2].

However, the estimator choice is an important issue for the interpretation of the coefficients, which depends on the underlying interests. Different estimators not only give different parameter estimates but also different residuals, i.e. actual-to-potential trade ratios. For future research four important

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[1] I would like to thank Michael Pfaffermayr for helpful comments

[2] Mátyás (1997, 1998) provides insights in the question of proper econometric specification without dealing with the issue of trading potentials.

econometric problems should be considered:

1. The traditional cross-section approach probably is affected by a severe problem of misspecification. Mátyás notes that the most natural representation of bilateral trade flows is a three-way specification. Then, eliminating one of the three dimensions (time) implies that the natural representation of time-averaged gravity model is a two-way panel with (fixed or random) exporter and importer effects. Since these are the most important dimensions of variation, convenient OLS estimates are very likely to result in inconsistent estimates.

2. We should care about the association of different estimators with short-term and long-term time-horizons when comparing results (see Pirotte, 1999). Whereas fixed effects (and consistent random effects) model estimates reflect short-run parameters, between model estimates are closer to long-run parameters.

3. Finally, from a consistent and efficient estimator we should expect white-noise residuals, which do not have any more systematic variation. If an estimator reveals large systematic differences between observed and predicted values (such as large unexhausted East-West trade potentials), this should be interpreted as an indication either for misspecification, parameter inconsistency, or the inefficiency of the estimator.[3]

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[3] The application of the random effects approach is problematic because of the likelihood of its inconsistency due to correlation between some of the explanatory variables and the unobserved individual effects

I focus on panel estimators. In my application the previously used estimators result in large unused trade potentials at least for intra-CEEC trade. I demonstrate that the large actual-to-potential trade ratios stem from two sources. First, the correlation of the explanatory variables with the unobserved effects leading to inconsistent parameter estimates for the random effects model (REM) as used by Baldwin (1994) and Gros & Gonciarz (1996). Second, from serial correlation of the residuals. The consistent and most efficient estimator in the application is an AR(1) model in the spirit of Hausman & Taylor (1981), which has not been used previously neither in trade nor in other fields of economic research. This estimator eliminates the systematic difference between observed and predicted trade flows. However, I fear that the traditional approach to the calculation of trade potentials is misleading since properly specified econometric models cannot obtain systematic variations in residuals at all.

The paper is organized as follows. Section 2 briefly introduces the specification. Section 3 presents the estimation results and projections of export potentials of the EU member states (EU15), Hungary, Poland, and the Czech Republic (henceforth CEEC3) in 10 CEEC (CEEC10).[4] Section 4 concludes.

2   The Econometric Specification

According to the endowment-based new trade model with Dixit & Stiglitz (1977) preferences, bilateral trade is an increasing function of bilateral sum

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[4]The 10 CEEC are: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia, and Slowakia.

of factor income (G), relative country size (S), and the difference in relative factor endowments (R; compare Helpman & Krugman, 1985; Helpman 1987; and others). Accordingly, bilateral exports can be estimated by

$$Y_{ijt} = \beta_0 + \beta_1 G_{ijt} + \beta_2 S_{ijt} + \beta_3 R_{ijt} + \beta_4 V_{it} + \beta_5 V_{jt} + \beta_6 RL_{it} + \beta_7 RL_{jt} + \tag{1}$$

$$\beta_8 E_{ijt} + \beta_9 D_{ij} + \beta_{10} B_{ij} + \beta_{11} L_{ij} + \lambda_t + u_{ijt}$$

where all variables are real figures and expressed in logs, and the error term can be written as

$$u_{ijt} = \mu_{ij} + \nu_{ijt} \tag{2}$$

with μ_{ij} as the (fixed or random) unobserved bilateral effect and ν_{ijt} as the remaining error. In line with Helpman (1987) the Heckscher-Ohlin determinants can be formulated in the following way:

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\begin{aligned}
G_{ijt} &= \ln(GDP_{it} + GDP_{jt}) \\
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} &= \left|\ln\left(\frac{GDP_{it}}{N_{it}}\right) - \ln\left(\frac{GDP_{jt}}{N_{jt}}\right)\right|
\end{aligned}
\tag{3}
$$

where N denotes a country's population and GDP per capita is as commonly used as a proxy for a country's capital labor ratio. Moreover, I use four variables, which reflect a country's freedom with respect to international exchange and therefore transport costs in a broad sense[5]. These are exporter (importer) viability of contracts ($V_{it}^{(+)}$, $V_{jt}^{(+)}$) and exporter (importer) rule

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[5]See the next section for more details on data sources

of law $(RL_{it}^{(+)}, RL_{jt}^{(+)})$. They influence an exporter's (importer's) costs of international exchange, since a higher level of contract viability reduces a firm's risk (e.g. of bankruptcy) and a higher level of rule of law also reduces the probability of losing money, since contract breakers have to take their responsibility and are more likely to lose their case. Additionally, bilateral trade is affected by more traditional measures of transport costs, which are commonly in use. These are the real bilateral exchange rate $(E_{ijt}^{(+)})$, distance $(D_{ij}^{(-)})$, common borders $(B_{ij}^{(+)})$ and common language $(L_{ij}^{(+)})$, where the latter two are dummy variables.[6]

For the projection of potential bilateral trade, researchers have concentrated on the random effects model (REM), which requires that $\mu_{ij}\tilde{\ }IID(0,\sigma_\mu^2)$, $\nu_{ijt}\tilde{\ }IID(0,\sigma_v^2)$, and the μ_{ij} are independent of the ν_{ijt}. Moreover, the X_{ijt} (i.e. the explanatory variables) have to be independent of the μ_{ij} and the ν_{ijt} for all cross sections (ij) and time periods (t). Whereas the fixed effects model (FEM) is consistent rain or shine, the REM is only consistent if these conditions are fulfilled. Then, the REM has the advantage of more efficiency as compared to the FEM. If these conditions do not hold, only the FEM is consistent since it wipes out all the time-invariant effects (μ_{ij}). The decision between FEM and REM can be based on a Hausman (1978) test. However, in the FEM time-invariant variables cannot be estimated any longer and it also throws out the baby with the bathwater in terms of efficiency, since the μ_{ij} may be correlated only with a few explanatory variables. Therefore, Hausman & Taylor (1981) provide an alternative which makes use of the several

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[6] Note that the econometric arguments below are fully independent of the underlying theoretical context and also hold for the traditional set-up à la Linnemann (1966)

dimensions of panel data in order to overcome this correlation without any variables from outside the model. The appropriateness of the latter can be based on a Hausman & Taylor test for over-identifying restrictions. Finally, the mentioned models assume that there is no serial correlation of the error term ν_{ijt} and the only correlation over time is due to equicorrelation (i.e. the presence of the same individuals over time).[7] If ν_{ijt} follows an autoregressive process and this is ignored, it results in consistent but inefficient parameter estimates and standard errors also rendering the Hausman (1978) and Hausman & Taylor (1981) tests inappropriate, since they require to use the efficient estimator under the null.[8]

When trade potentials are projected, researchers usually focus on residuals rather than parameters. This paper demonstrates, that the choice of the econometric set-up is of great relevance for the calculation of bilateral trade potentials (in the traditional interpretation) I estimate six different models: a FEM, a REM, the corresponding Hausman & Taylor model (HTM), and a Between model all assuming no autocorrelation of the error term. According to Pirotte (1999) the consistent FEM (and consequently also the REM or the HTM) can be associated with short-term parameter estimates, whereas the Between estimator gives parameter estimates, which reflect the long-run. Since I find autocorrelation of the residuals, a REM and a HTM for the case of first order autocorrelation (AR(1)) are estimated in addition (see the

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[7] Baltagi (1995) and Mátyás (1996) provide an overview of the literature on autocorrelation in panel data

[8] Noteworthy, if one finds systematic country or country-pair specific differences between observed and predicted trade flows this automatically implies the presence of autocorrelation in the residuals

Appendix for a derivation of the latter).

3   Data, Estimation Results and Projections

I estimate a panel of exports of OECD countries to other OECD members
and the 10 Central and Eastern European countries over the period 1986-
1997. I use real exports, GDP, and exchange rates with 1995 as the base
year. Nominal exports in current USD are from OECD (Monthly Statistics
of International Trade), IMF (Direction of Foreign Trade), and the Vienna
Institute of Comparative Economic Studies (hereafter WIIW). Nominal GDP
in USD and GDP deflators are from OECD (Economic Outlook and National
Accounts Volume 1), IMF (International Financial Statistics), and WIIW.
Exchange rate indices are collected from IMF (International Financial Statis-
tics) and WIIW. Population numbers are available from OECD (Economic
Outlook and National Accounts Volume 1), IMF (International Financial
Statistics) and WIIW. The economic freedom variables are provided by Eco-
nomic Freedom Network (Economic Freedom of the World) and account for
legal structure and property rights (Area V of the database) and international
exchange (part of Area VI of the respective database). Transport costs in
a narrow sense are proxied by distance between two countries' capitals in
miles.

> Table 1 <

Table 1 presents the estimation results for six different panel estimators.
Note that the Between model should reflect long-term influences. All other
estimators reflect short-run impacts if the parameters can be consistently

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estimated (see Pirotte, 1999). According to the test statistics we should not ignore cycle effects (F-tests for time effects) and the presence of heteroskedasticity in the cross-section (F-test and Honda test).[9] However, the Hausman test statistic reveals that the REM suffers from correlation and gives inconsistent parameter estimates (which are more close to the Between estimates). The HTM seems most appropriate as is indicated by the over-identification test. It comes close to the FEM in terms of parameter estimates but it is more efficient. The time-invariant variables cannot be estimated significantly, which is due to the explanatory variables at hand. Testing for autocorrelation reveals that the Hausman & Taylor model is not efficient and both the Hausman test statistic and the Hausman & Taylor test for over-identification are inappropriate. Due to large differences in the parameters between the FEM and the REM, the Hausman test also rejects the appropriateness of the REM AR(1). In our application, the HTM AR(1) is consistent and most efficient among the *short-term* estimators. It additionally allows to estimate

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[9]The latter reveals the inappropriateness of pure OLS analysis. Hence, one should specify the problem as a two-way panel also when estimating a time-averaged specification. If one finds - which is very likely the case - correlation among country-specific effects and exogenous variables, there are 2 possibilities: When estimating a new trade theory model à la Helpman (1987), all important explanatory variables vary in the bilateral rather the country-specific dimension. Then, the model could be estimated with fixed exporter and importer effects. If a specification à la Linnemann (1966) is used, the coefficients for country-specific factors like GDP or GDP per capita can no more be estimated. In contrast, distance, common borders, common language can be estimated. Then, the proper model would be a two-way HTM in order to obtain properly estimated coefficients for GDP and GDP per capita. This model could provide consistent estimates of the GDP and GDP per capita coefficients in contrast to usually applied OLS

the impact of common borders with more success.

> Table 2 <

In order to underpin the relevance of model choice for the projection of bilateral trade potentials, I calculate trade potentials of EU15 countries and three Central and Eastern European economies (CEEC3) in the CEEC10. As usually, the exponent of minus one times the bilateral residual is interpreted as the bilateral trade potential and, for the moment, it is interpreted in the traditional manner.

Obviously, in terms of actual-to-potential trade ratios the REM lies in between the HTM and the Between model. As compared to the HTM, the REM overestimates the trade potential of the CEEC3 in the CEEC10 by more than 210 percent. In contrast, it underestimates the potential of the EU15 by about six percent. This is even more pronounced if autocorrelation is accounted for. As compared to the HTM AR(1) approach, the REM AR(1) overestimates the EU15 trade potential in the CEEC10 by about 49 percent and that of the CEEC3 by about 367 percent. According to the HTM AR(1) model there is no export potential to CEEC10 left for both the EU15 and the three CEEC. The EU15 export potential to CEEC10 is about 34 percent (16 percent) higher in the HTM (the HTM AR(1)) approach than in the Between set-up, where the former can be associated with the short-run and the latter with the long-run. The opposite holds true for export potentials of the CEEC3, which are 71 percent (76 percent for AR(1)) smaller in the short-run than in the long-run.

Unfortunately, from a pure econometric point of view such experiments of thought are inappropriate since proper specification should always result

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in white-noise residuals, which is the case for the HTM AR(1). This reveals the difficulty of the approach to trade potentials as it is commonly in use. I propose to interpret evidence for a large overlap of predicted over observed trade relations as an indication of misspecification rather than of unused trade potentials. In the above example the REM, the REM AR(1), and the Between model exhibit non-white-noise residuals indicating specification and consistency/efficiency problems.

4   Conclusions

This paper provides insights into the relevance of the appropriate estimator choice for the analysis of bilateral trade flows. I compare different estimators part of which have been used in previous studies and provide insights that none of the previously used estimators is appropriate in terms of consistency and/or efficiency in my application. I mention argue that three problems should be kept in mind when estimating gravity models and/or calculating trade potentials. First, traditionally estimated time-averaged cross-section gravity models are very likely to be misspecified since they ignore the presence of exporter and importer effects without testing for their relevance. Second, one should be careful with comparing estimation results between different econometric concepts, which refer to different time horizons with respect to responses of trade flows on changes in explanatory variables. Third and in contrast to previous research, I do not see any way to derive information about so-called trade potentials in the traditional manner. Rather, I suggest that any large systematic difference between observed and predicted trade

flows indicates misspecification of the econometric model instead of unused (or overused) trade potentials.

In the present application, the consistent and most efficient model is a Hausman & Taylor AR(1) estimator, which has never been used before. According to econometric theory, which demands for white-noise residuals in the case of proper (i.e. consistent and efficient) specification, this estimator fails to identify large systematic differences between residuals among country groups. Large unused export potentials, which have been identified previously in the context of European integration reveal nothing other than inherent problems of misspecification in terms of consistency and efficiency of the estimators and the econometric models in use.

5 Appendix: A Hausman & Taylor AR(1) Model

Following Baltagi & Wu (1999) in the notation, we have to Prais-Winsten transform the data by[10]

$$C_i^*(\rho) = (1 - \rho^2)^{1/2} \cdot \tag{4}$$

$$\begin{bmatrix} 1 & 0 & \cdots & 0 & 0 \\ -\left(\frac{\rho^{2(t_{i,2}-t_{i,1})}}{1-\rho^{2(t_{i,2}-t_{i,1})}}\right)^{1/2} & \left(\frac{1}{1-\rho^{2(t_{i,2}-t_{i,1})}}\right)^{1/2} & \cdots & 0 & 0 \\ \vdots & \vdots & \vdots & & \\ 0 & 0 & \cdots & & 0 \\ 0 & 0 & \cdots & -\left(\frac{\rho^{2(t_{i,n_i}-t_{i,n_i-1})}}{1-\rho^{2(t_{i,n_i}-t_{i,n_i-1})}}\right)^{1/2} & \left(\frac{1}{1-\rho^{2(t_{i,n_i}-t_{i,n_i-1})}}\right)^{1/2} \end{bmatrix}$$

Accordingly, one can transform the Amemiya within-type residuals from the initial FEM to obtain the variance component of the remainder disturbance $(\hat{\sigma}_\varepsilon^2)$. Therefore, we have to define

$$u^* = diag\left[C_i^*(\rho)\right] u = diag\left[C_i^*(\rho)\right] diag(\iota_{n_i})\mu + diag\left[C_i^*(\rho)\right] v, \tag{5}$$

$$\begin{aligned} g_i &= \left[C_i^*(\rho)\right] \iota_{n_i} \tag{6} \\ &= (1-\rho^2)^{1/2} \left(1, \frac{1-\rho^{(t_{i,2}-t_{i,1})}}{(1-\rho^{2(t_{i,2}-t_{i,1})})^{1/2}}, \cdots, \frac{1-\rho^{(t_{i,n_i}-t_{i,n_i-1})}}{(1-\rho^{2(t_{i,n_i}-t_{i,n_i-1})})^{1/2}}\right)' \tag{7} \end{aligned}$$

and $P_{g_i} = g_i(g_i'g_i)^{-1}g_i'$, $Q_{g_i} = I_{n_i} - P_{g_i}$ in order to obtain

$$\hat{\sigma}_\varepsilon^2 = u^{*\prime} diag(Q_{g_i})u^* / \left(\sum_{i=1}^{N}(n_i - 1)\right), \tag{8}$$

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[10] Note that in contrast to Baltagi & Li (1991), Baltagi & Wu (1999) allow for unequally spaced panel data and missing observations, which is relevant in my application

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where N refers to the number of cross sections and n_i is the number of observations in cross-section i. This corresponds to $\varepsilon'\varepsilon$, where ε is the residual vector from the OLS regression on the Within transformed model where each variable corresponds to

$$y_{i,t_{i,j}}^{W**} = y_{i,t_{i,j}}^* - g_{i,j} \left(\sum_{s=1}^{n_i} g_{i,s} y_{i,t_{i,s}}^* \right) / \left(\sum_{s=1}^{n_i} g_{i,s}^2 \right). \tag{9}$$

In the presence of correlation between (some of) the explanatory variables (X) and the unobserved effects (μ_{ij}) we have to average the Within residuals over time (i.e. to construct pseudo-averages) and to run 2SLS of these residuals on the time-invariant, Prais-Winsten transformed variables with the exogenous time-variant variables as instruments.[11] This regression not only obtains a parameter estimate for the time-invariant variables, but it also produces residuals, which are used to derive the second required variance component. I call the residuals from this second regression η^*. We can obtain an estimate of the second required variance component by

$$\widehat{\sigma}_\omega^2 = \eta^{*\prime} diag(P_{g_i}) \eta^*. \tag{10}$$

Accordingly, one can derive an estimate for the cross-sectional variance component via

$$\widehat{\sigma}_\mu^2 = \left(\eta^{*\prime} diag(P_{g_i}) \eta^* - N\widehat{\sigma}_\varepsilon^2 \right) / \sum_{i=1}^{N} g_i' g_i, \tag{11}$$

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[11] In contrast to Hausman & Taylor (1981) we consider all time-invariant variables as correlated with the μ_{ij}. According to Cornwell et al. (1992), we call the correlated variables as *singly exogenous* and the uncorrelated ones as *doubly exogenous*.

which gives

$$\widehat{\omega}_i^2 \;=\; g_i' g_i \widehat{\sigma}_\mu^2 + \widehat{\sigma}_\varepsilon^2 \text{ and} \tag{12}$$

$$\theta_i \;=\; 1 - \left(\frac{\widehat{\sigma}_\varepsilon^2}{\widehat{\omega}_i^2}\right)^{1/2} \tag{13}$$

Finally, we can transform our data according to Fuller & Battese (1973, 1974) by premultiplying the Prais-Winsten transformed data by $\sigma_\varepsilon \Omega^{*-1/2}$ to get $y^{**} = \sigma_\varepsilon \Omega^{*-1/2} y^*$ with the typical elements

$$y_{i,t_{i,j}}^{**} = y_{i,t_{i,j}}^* - \theta_i g_{i,j} \left(\sum_{s=1}^{n_i} g_{i,s} y_{i,t_{i,s}}^*\right) \Big/ \left(\sum_{s=1}^{n_i} g_{i,s}^2\right) . \tag{14}$$

Running 2SLS on the transformed model with the proper set of instruments (A) yields the consistent and efficient AR(1) estimator in the spirit of Hausman & Taylor (1981). A consists of the Within transformed time-variant variables (according to (9)) and of pseudo-averages over time of the *doubly exogenous*, time-variant variables (in our case S_{ijt}, R_{ijt}, V_{it}, V_{jt}, RL_{it}, RL_{jt}, and E_{ijt}). The latter are derived from the transformation

$$\overline{y}_{i,t_{i,j}}^* = g_{i,j} \left(\sum_{s=1}^{n_i} g_{i,s} y_{i,t_{i,s}}^*\right) \Big/ \left(\sum_{s=1}^{n_i} g_{i,s}^2\right) . \tag{15}$$

In our application, the set of time-invariant, *singly exogenous* variables comprises D_{ij}, B_{ij}, and L_{ij}. Since we have more time-variant, *doubly exogenous* variables than time-invariant, *singly exogenous* variables at hand, the AR(1) Hausman & Taylor type estimator is more efficient than the corresponding AR(1) Within (FEM) estimator.

6 References

Anderson, James (1979), A theoretical foundation of the gravity equation, *American Economic Review* **69**, pp. 106-116.

Baldwin, Richard (1994) *Towards and Integrated Europe* (London: Centre for Economic Policy Research)

Baltagi, B.H. (1995), *Econometric Analysis of Panel Data* (Wiley, Chichester).

Baltagi, B.H., and Q. Li (1991), A transformation that will circumvent the problem of autocorrelation in an error component model, *Journal of Econometrics* **48**, pp. 385-393.

Baltagi, B.H., and P.X. Wu (1999), Unequally spaced panel data regressions with AR(1) disturbances, *Econometric Theory* **15**, pp. 814-823.

Bergstrand, J. H. (1985), The gravity equation in international trade: Some microeconomic foundations and empirical evidence, *Review of Economics and Statistics* **67**, pp. 474-481.

Bergstrand, J. H (1989), The generalized gravity equation, monopolistic competition, and factor proportions theory in international trade, *Review of Economics and Statistics* **71**, pp. 143-153.

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Bergstrand, J. H. (1990), The Heckscher-Ohlin-Samuelson model, the Linder hypothesis and the determinants of bilateral intra-industry trade, *Economic Journal* **100**, pp. 1216-1229

Bhargava, A., L. Franzini, and W. Narendranathan (1982), Serial correlation and the fixed effects model, *Review of Economic Studies* **49**, pp. 533-549

Cornwell, C., P. Schmidt, and D. Wyhowski (1992), Simultaneous equations and panel data, *Journal of Econometrics* **51**, pp. 151-181.

Dixit, A., and J.E. Stiglitz (1977), Monopolistic competition and optimum product diversity, *American Economic Review* **67**, pp. 297-308.

Fuller, W.A., and G.E. Battese (1973), Transformations for estimation of linear models with nested error structure, *Journal of the American Statistical Association* **68**, pp. 626-632.

Fuller, W.A., and G.E. Battese (1974), Estimation of linear models with cross-error structure, *Journal of Econometrics* **2**, pp. 67-78.

Gros, D., and A. Gonciarz (1996), A note on the trade potential of Central and Eastern Europe, *European Journal of Political Economy* **12**, pp. 709-721

Hamilton, C.B., and A.L. Winters (1992), Opening up international trade

with Eastern Europe, *Economic Policy* **14**, pp. 77-116.

Hausman, J.A. (1978), Specification tests in econometrics, *Econometrica* **46**, pp. 1251-1271.

Hausman, J.A., and W.E. Taylor (1981), Panel data and unobservable individual effects, *Econometrica* **49**, pp. 1377-1398.

Helpman, E. (1987), Imperfect competition and international trade: Evidence from fourteen industrial countries, *Journal of the Japanese and International Economies* **1**, pp. 62-81.

Helpman, E., and P.R. Krugman (1985), *Market Structure and Foreign Trade* (Cambridge, Mass.: MIT Press).

Honda, Y. (1985), Testing the error components model with non-normal disturbances, *Review of Economic Studies* **52**, pp. 681-690.

Hsiao, C. (1986), *Analysis of Panel Data* (Cambridge University Press, Cambridge).

Mátyás, L. (1996), Error components models, in: L. Mátyás and P. Sevestre (eds.), *The Econometrics of Panel Data. A Handbook of the Theory with Applications* (Kluwer Academic Publishers, Dordrecht), pp. 50-76.

Mátyás, L. (1997), Proper econometric specification of the gravity model, *The World Economy* **20**, pp. 363-368.

Mátyás, L. (1998), The gravity model: Some econometric considerations, *The World Economy* **21**, pp. 397-401.

Nilsson, L. (2000), Trade integration and the EU economic membership criteria, *European Journal of Political Economy* **16**, pp. 807-827.

Pirotte, A. (1999), Convergence of the static estimation toward the long run effects of dynamic panel data models, *Economics Letters* **63**, pp. 151-158.

Wang, Z.K., and A.L. Winters (1991), The trading potential of Eastern Europe, Discussion Paper No. 610 (London: CEPR).

Table 1: Panel Regression Results for Bilateral OECD Exports in OECD and 10 Central and Eastern European Countries

Independent Variables[1]	Fixed Effects	Random Effects	Hausman-Taylor	Between	First order autocorrelation - AR(1)	
					Random Effects	Hausman-Taylor
Bilateral Sum of GDP	2.470 ***	1.817 ***	2.454 ***	1.757 ***	1.815 ***	2.624 ***
	(0.114)	(0.027)	(0.109)	(0.030)	(0.027)	(0.154)
Similarity in Country Size	0.504 ***	0.853 ***	0.498 ***	0.918 ***	0.879 ***	0.556 ***
	(0.087)	(0.031)	(0.084)	(0.034)	(0.031)	(0.109)
Difference in Relative Factor Endowments	0.377 ***	-0.055 *	0.383 ***	0.606 ***	-0.138 ***	0.338 ***
	(0.062)	(0.031)	(0.059)	(0.129)	(0.033)	(0.077)
Exporter Viability of Contracts	0.039	0.290 ***	0.028	2.499 ***	0.331 ***	0.059
	(0.045)	(0.043)	(0.050)	(0.297)	(0.053)	(0.057)
Importer Viability of Contracts	0.684 ***	0.653 ***	0.688 ***	-0.186	0.548 ***	0.615 ***
	(0.038)	(0.038)	(0.037)	(0.255)	(0.043)	(0.044)
Exporter Rule of Law	-0.091 **	-0.081 *	0.001	-0.242	-0.104 **	-0.134 **
	(0.045)	(0.043)	(0.025)	(0.230)	(0.051)	(0.053)
Importer Rule of Law	0.175 ***	0.152 ***	0.176 ***	-0.236 *	0.098 ***	0.107 ***
	(0.028)	(0.028)	(0.027)	(0.140)	(0.030)	(0.032)
Real Exchange Rate	0.023 ***	-0.005	0.025 ***	-0.263 ***	0.003	0.027 ***
	(0.006)	(0.006)	(0.006)	(0.091)	(0.007)	(0.008)
Distance	-	-0.915 ***	0.783	-0.178 ***	-0.914 ***	0.002
		(0.027)	(17.079)	(0.046)	(0.027)	(0.008)
Common Border	-	0.308 ***	17.375	-0.931 ***	0.290 **	0.911 **
		(0.123)	(119.945)	(0.029)	(0.122)	(0.383)
Common Language	-	0.731 ***	-0.367	0.291 **	0.698 ***	-0.474
		(0.130)	(66.611)	(0.121)	(0.129)	(0.298)
Constant	-49.091 ***	-23.939 ***	-55.999	-28.217 ***	-23.488 ***	-55.994 ***
	(3.063)	(0.723)	(134.058)	(1.964)	(0.735)	(5.353)
Number of Observations	9375	9375	9375	9375	9375	9375
Number of Bilateral Relations	837	837	837	837	837	837
R^2	0.9994	0.9966	0.9992	0.9988	0.9978	0.9996
Average θ_i	-	0.857	0.997	-	0.772	0.984
Time Effects: $F_{(11, 8520)}$	5.39 ***	92.91 ***	6.01 ***	5.92 ***	82.71 ***	2.86 ***
Bilateral Effects: $F_{(836, 8520)}$	49.20 ***					
Hausman Test: $\chi^2(18)$		328.17 ***			5213.36 ***	
Honda Lagrange Multiplier Test[2]		170.53 ***				
Hausman Over-identification Test: $\chi^2(3)$			0.59			0.88
Canonical Correlations[3]			0.30			0.37
Durbin-Watson[4]					0.82	0.85
Baltagi-Wu LBI[5]					1.11	1.13

1) Standard errors in parentheses. - 2) One-sided test statistic based on square root figures of the traditional Breusch-Pagan test statistics; asymptotically following a standard normal distribution. - 3) Geometric mean of canonical correlation coefficients. - 4) According to Bhargava et al. (1982). - 5) Locally best invariant test statistic according to Baltagi & Wu (1999). ***) significant at 1 percent; **) significant at 5 percent; *) significant at 10 percent.

Table 2: Actual-to-Potential Export Ratio in 10 Central and Eastern European Countries

Exporting Country	Random Effects	Hausman-Taylor	Between	First order autocorrelation - AR(1)	
				Random Effects	Hausman-Taylor
Belgium-Luxembourg	0.61	0.88	0.74	0.59	0.88
Denmark	0.94	0.88	1.15	0.89	0.88
Germany	0.63	0.95	0.63	0.56	1.22
Finland	0.59	0.83	0.87	0.58	0.85
France	1.44	0.90	1.43	1.33	0.90
Greece	0.75	0.79	0.55	0.77	0.98
Great Britain	1.14	0.91	1.34	1.09	0.92
Ireland	0.73	0.83	1.19	0.74	0.85
Italy	0.85	0.83	1.03	0.82	0.84
Netherlands	0.57	0.93	0.64	0.54	0.91
Austria	0.73	0.96	0.90	0.68	1.27
Portugal	2.59	0.75	4.14	2.71	0.78
Sweden	0.72	0.89	0.94	0.69	0.88
Spain	1.40	0.75	1.82	1.39	0.79
EU15	0.98	0.92	1.24	0.72	1.07
Hungary	0.33	0.98	0.34	0.36	1.14
Poland	0.45	0.95	0.34	0.48	1.15
Czech Republic	0.12	1.04	0.13	0.13	1.37
CEEC3	0.32	1.00	0.29	0.27	1.26