# Modeling international trade flows between Eastern European countries and OECD countries

*Christophe RAULT*,
*LEO, University of Orleans and IZA*[1]

*Robert* SOVA,
*CES, Sorbonne University and A.S.E*[2]

*Ana Maria* SOVA,
*CES, Sorbonne University and EBRC*[3]

*May 25, 2008*

**Abstract:** Our paper deals with econometric developments for the estimation of the gravity model, which lead to convergent parameter estimates even when a correlation exists between the explanatory variables and the specific unobservable characteristics of each unit. We implement panel data econometric techniques to characterize bilateral trade flows between heterogeneous economies. Our econometric results based on a sample of Eastern European countries (EEC) and OECD countries over a 18-year period highlight the importance of the taking into account of unobservable heterogeneity to obtain a specification in accordance with data properties and unbiased coefficients. The fixed effect factor decomposition (FEVD) technique appears the more suitable for this purpose. We focus more specifically on EEC countries belonging to the last wave of adhesion (Bulgaria and Romania). Since 1990, these countries have moved towards a market economy and more democracy. Our econometric results provide clear evidence in favor of the traditional trade theory based on comparative advantage, which suggests a reallocation of labor-intensive industry towards EEC, generating a complementary specialization.

**Keywords**: Gravity models, Unobserved Effects, Panel Data Models, International trade, comparative advantage

**JEL Classification :** F13, F15**,** C23.

---

[1] Rue de Blois-B.P.6739, 45067 Orléans Cedex 2, France. E-mail : chrault@hotmail.com, web-site: http://membres.lycos.fr/chrault/index.html (**Corresponding author**).
[2] Center of Economics Studies Paris I, 106-112 bd. de L'Hôpital, 75647 Paris Cedex 13, France, and Academy of Economic Studies, Bucharest, Romania, E-mail: robertsova@yahoo.com.
[3] Center of Economics Studies Paris I, 106-112 bd. de L'Hôpital, 75647 Paris Cedex 13, France, and Economic & Business Research Center, E-mail: anamariasova@yahoo.fr.

**Contents**

## 1. Introduction

The aim of this paper is to examine and characterize trade relationships between a set of transition and developed countries using recent advances in the econometrics of panel data techniques with fixed effects, which permit to take the unobserved heterogeneity of country behavior over time into account. Our database includes 2 Eastern European countries[4] (EEC), and 19 OECD countries[5]. Our analysis is all the more important since 15 countries of all 19 OECD countries considered are the core of the European Union. In our mind, this set of heterogeneous economies constitutes a relevant framework worth analyzing.

In this context, an analyze of trade flow volume, trade pattern and trade specialization between these two groups of heterogeneous economies, represent crucial issues that we address in this study. More specifically, we are interested in determining whether EEC countries continued to specialize in labor-intensive industries with their comparative advantage of less expensive labor costs and hence have developed an inter-industry trade, or on the contrary, have generated an intra-industry trade related to an economic convergence. EEC countries aim at reducing their economic development gap and intensifying the convergence process between these two groups of economies[6] and hence the competition in the area. However, the levels of remunerations in these countries or the gaps in technological level could entail a massive reallocation of labor industries of developed countries towards EEC.

The various theories of international trade permit to release the most relevant ones in the analysis of trade flows between EEC and OECD[7] countries. Our approach is based on the gravity model, which is suitable to the analysis of intra-industry trade but also well adapted to the analysis of inter-industry trade. More precisely it allows to characterize the type of trade and hence the specialization at a certain moment.

[4] Bulgaria, Romania, which became new member states of the European Union on January 2007.
[5] EU-15: Austria, Belgium-Luxemburg, Denmark, England, Finland, France, Germany, Greece, Holland , Ireland, Italy, Portugal, Spain, Sweden; non-EU countries : Australia, Canada, Japan, Switzerland, the United States of America.
[6] EEC and OECD countries.
[7] Organization for Economic Cooperation and Development

In international trade, the gravity model is widely used as a benchmark model to estimate the effect of regional agreements, the effect of the monetary union on trade flows and to simulate the trade potential[8].

The gravity model allows the introduction of a large number of trade flow determinants, the objective being to obtain the best model for the analysis of bilateral trade flows between countries under study. Even if the proposed estimates often remain at an aggregated level, these actually depend on the nature of existing bilateral relationships. Consequently in order to examine the possible existence of a new trade configuration, it appears particularly relevant to us to grant a significant importance to the modeling of heterogeneity behaviors of each pair of countries in trade flows. This can be achieved for instance by the introduction of individual fixed effects, but one can also be willing to take the specific evolution of countries behaviors in time into account through temporal fixed effects (which can capture for example, economical or political events)[9]. For all these reasons, we find convenient to introduce temporal and pair countries effects into our regressions.

From an econometric point of view, the choice of the econometric methodology is in accordance with the recent developments of panel data methods, which explicitly take unobserved heterogeneity into account. In fact, the standard cross-section estimates tend to ignore the unobservable characteristics of bilateral trade relationships (historical, cultural and linguistic links). The existence of a potential correlation between the unobservable characteristics and a subset of the explanatory variables run the risk of obtaining biased estimated (cf. Baltagi, 2001). A possible method to eliminate this correlation relies on the within estimator. In transforming the data into deviations from individuals means, the within estimator provides unbiased and consistent estimates. However, all time invariant variables are eliminated by the data transformation. To overcome this problem, Hausman Taylor (1981), propose an instrumental variable estimator for panel data regression. However, the Hausman Taylor (HT) method can lead to biased results for small samples. In this case, the most appropriate estimator is provided by the fixed effect vector decomposition (FEVD) technique proposed by Plümper and Troeger (2004).

[8] See for instance Wei and Frankel (1998), Bayoumi and Eichengreen (1997), Rose (2000), Soloaga and Winters (2001), Carrère C. (2006), Baier and Bergstrand (2007), Rault and Sova (2007).

[9] See for instance Matyas (1997), Egger (2002) Egger et Pfaffermayr (2003).

In the former part of our analysis, we highlight the existence of strong asymmetries in trade relationships between countries of the two groups (OECD and EEC). In the latter, we estimate different (alternative) econometric specifications in the line of the gravity model, which enables to emphasize the specificity of bilateral relationships between countries under study. Once the best model has been chosen, we carefully investigate the main explanatory variables of trade flows between countries.

The remainder of the paper is organized as follows. Section 2 presents an overview of trade flows between EEC and OECD countries. Section 3 briefly recalls the theoretical foundations of the gravity model. Section 4 exposes the panel data methodology. Section 5 reports the empirical investigation as well as the econometric results and finally section 5 discusses the policy implications and concludes.

## 2. An overview of trade flows between EEC and OECD countries

The trade pattern of Eastern European countries with regard to OECD remains especially marked by strong asymmetries which result in problems of specialization or of technological gap, and which can play in their disfavor. This constitutes an effect of planned economy heritage, which has followed an extensive development policy rather than an intensive one. Eastern European countries largely directed their trade after 1989 towards Western economies. The economic and political considerations of moving towards democracy have led Eastern European countries to expressed preferences towards Western countries. Until 1989, these countries belonged to planned economies with a trade organization based on the monopoly of international trade, import and export planning and currency inconvertibility. Hence, the trade characteristic was a strong concentration inside the Council for Mutual Economic Assistance (CMEA).

Nevertheless, after the fall of the communist regime, these countries gave up their hermetic trade inside CMEA by adopting an open system where Western Europe became one of the most important partners. The economic opening towards Western Europe was very different from one country to another. For instance, in 1989, the trade openness index for

Romania was 19.3%, and respectively 18.4% and 43.2% for Bulgaria and Hungary. There was an heterogeneity between Central and Eastern European countries in terms of trade openness level.

The reorientation of trade flows towards Western countries is a natural situation in conformity with the gravity model. Consequently, trade reorientation is rather a reintegration of these countries in the zone. It can be explained by the effect of proximity and also by geographical, historical and even cultural effects which played an important role in the establishment of preferential relationships between the two zones. Before 1990, this reorientation was blocked by the political and ideological context of separation into two parts of Europe.

The reinforcement of the links between Eastern Europe countries and EU coincides with the historical context of EU enlargement. The evolution of trade flows has followed this tendency of trade reorientation to Western markets, particularly to EU.

EU countries dominate the trade flows between the two zones (the EEC – EU trade represents almost 90% from the total trade with 19 OECD countries)[10]. We are interested in analyzing the evolution of Eastern European countries' trade configurations following their access to a widened market. An examination of the evolution of trade flows over the 1987-2004 period should highlight a deep trade deficit with respect to EU15[11.]

Since 1990, Romania's exports to Western Europe have significantly dropped out, but this tendency has reversed after 1993, and they have increased again since the signature of the association agreement with UE15. Their fall after 1989 is due mostly to the reorientation of EU towards Central European countries to which EU have granted trade preferences since 1991. Since 1992, the trade balance has moved from a trade surplus to a trade deficit. If up to 1996 this deficit was easily negative, it has accentuated through time.

An opposite evolution can be observed for Bulgaria. The exports were much lower comparatively with the imports, which entailed a permanent deficit in trade balance. (see the Appendix).

For the two countries, the increasing tendency of trade is due to international trade liberalization and the opening of their economies to world markets. Nevertheless, the

---

[10] See the appendix, Graph nº 5

[11] See the Appendix, Graph nº 2

international trade liberalization policy has entailed a rise of imports higher than that of exports.

The pattern changes of exported goods were more complicated because it was conditioned by the speed of the reorganization of the overall economic activity. This is why from a structural point of view international trade is characterized by the existence of labor intensive industries. The less expensive cost of labour in eastern economies created an advantage for internal products especially for light industry. Romanian textile sectors have significantly increased since 1989, from 19% to 46% in 2004. A similar evolution can be observed for Bulgaria where the same sector has increased since 1989, from 13% to 36% in 2004[12].

The strong asymmetries existing between the two groups of countries led us to question about the increase in trade flow volume and also the degree of specialization taking the logic of integration into account. To shed some light on these issues section 4 proposes an econometric study based on the gravity model, whose foundations are briefly recalled in section 3.

## 3. The gravity model

Our theoretical framework to examine the trade flows between two groups of heterogeneous economies is the gravity model[13], in which trade flows from country ***i*** to country ***j*** are a function of the supply of the exporter country and of the demand of the importer country and trade barriers. In other words, national incomes of two countries, transport costs (transaction costs) and regional agreements are the basic determinants of trade.

Initially inspired by Newton's gravity law, gravity models have become essential tools in the analysis in the simulations of international trade flows. The first applications were rather intuitive, without great theoretical claims. These included the contributions of Tinbergen (1962) and Pöyhönen (1963). However, these studies were criticised for their lack of robust theoretical foundations. Subsequently, new international trade theory

[12] Graphs are reported in appendix.(Graph n° 3 and Graph n° 4)

[13] The popularity of the gravity model is highlighted by Eichengreen and Irwin (1995) who consider it "the workhorse for empirical studies of regional integration".

provided theoretical justifications for these models in terms of increasing returns of scale, imperfect competition and geography (transport costs).

Linnemann (1966) proposed a gravity model derived from a Walrasian, general equilibrium model. He explained exports of country i to country j in terms of the interaction of three factors: potential supply of exports of country i, potential demand of imports from the country j and a factor representing trade barriers. Potential export supply is a positive function of the exporting country's income level and can also be interpreted as a proxy for product variety. Potential import demand is a positive function of the importing country's income level. Barriers to trade are a negative function of trade costs, transport costs, tariffs. The model takes the following form:

$$X_{ij} = e^{\alpha_0} Y_i^{\alpha_1} N_i^{\alpha_2} Y_j^{\alpha_3} N_j^{\alpha_4} D_{ij}^{\beta_5} e^{\sum_k \gamma^k P_{kij}} \qquad (1)$$

where Y represents country income, N represents the population, D is the geographical distance and Pk includes dummy variables. Gravity models have received theoretical foundations due to the development of new international trade theories with imperfect competition Anderson (1979), Bergstrand (1985) and Helpman and Krugman (1985) provided further theoretical justifications for this model. The last authors propose a formalization of the gravity equation in which the intra-trade and inter-trade approaches are reconciled.

This equation was extended by Bergstrand (1989) by including per capita income, which is an indicator of demand sophistication (demand for luxury versus necessity goods). Bergstrand proposes the most complete version of the gravity model using for instance, variables like GDP, GDP per capita, distance, and monetary variables.

$$X_{ij} = e^{\beta_0} Y_i^{\beta_1} \left( \frac{Y_i}{N_i} \right)^{-\beta_2} Y_j^{\beta_3} \left( \frac{Y_j}{N_j} \right)^{-\beta_4} D_{ij}^{-\beta_5} e^{\sum_k \gamma^k P_{kij}} \qquad (2)$$

where $X_{ij}$ represents exports of country i to country j, $\beta_0$ is the intercept, $Y_i$ and $Y_j$ are the GDP of country i and j respectively, ($Y_i / N_i$) and ($Y_j / N_j$ ) stand for GDP per capita of country i and j respectively, $D_{ij}$ represents the geographical distance between the economic centers of two partners, $P_{kij}$ stands for other variables such as common language and historical bonds.

The gravity model has been widely used in the applied literature to evaluate the impact of regional agreements, the impact of a monetary union, the impact of Foreign Direct investments (FDI) on trade flows, and to simulate the trade potential. After this brief overview of the theoretical foundation of the gravity model, we are now interested in finding the appropriate empirical specification of this model to better characterize the trade flows between countries with a different economic development level (heterogeneous economies), more particularly between EEC and OECD countries. In the next section we present the econometric methodology which rests upon panel data techniques.

## 4. Econometric methodology

Most studies estimating a gravity model applied the ordinary least square (OLS) method to cross-section data. Recently several papers have argued that standard cross-section methods lead to biased results because they do not control heterogeneous trading relationships. For instance, the impacts of historical, cultural and linguistic links in trade flows are difficult to observe and to quantify, the presence of minorities, or past memberships in a common trade area can also lead to biased estimates. Panel data regressions allow to correct such effects. The use of panel data is preferred in our analysis because it allows to control specific effects (as fixed or random effects). The source of potential endogeneity bias in gravity model estimations is the unobserved individual heterogeneity.

Matyas (1997) argues that the cross-section approach is affected by misspecification and suggests that the gravity model should be specified as a “three – way model” with exporter, importer and time effects (random or fixed ones). Egger (2000) argues that panel data methods are the most appropriate for disentangling time-invariant and country- specific effects. Egger and Pfaffermayr (2003) underline that the omission of specific effects for country pairs can bias the estimated coefficients. An alternative solution is to use an estimator to control bilateral specific effects like in a fixed effect model (FEM) or in a random effect model (REM). The advantage of the former is that it allows for unobserved or misspecified factors that simultaneously explain the trade volume between two countries and lead to unbiased and efficient results[14]. The choice of the method (FEM or REM) is determined by economic and econometric considerations. From an economic point of view, there are unobservable time-invariant random variables, difficult to be quantified, which may simultaneously influence some explanatory variables and trade volume. From an econometric point of view, the inclusion of fixed effects is preferable to random effects because the rejection of the null assumption of no correlation between the unobservable characteristics and explanatory variables is less plausible (see Baier and Bergstrand 2007).

Theoretical econometric studies advocate the implementation of Hausman-Taylor's method for panel data incorporating time-invariant variables correlated with bilateral specific effects[15].

Plümper and Troeger (2004) have proposed a more efficient method called "the fixed effect vector decomposition (FEVD)" to accommodate time-invariant variables. Using Monte Carlo simulations, they compared the performances of the FEVD method to some other existing techniques, such as the fixed effects, or random effects, or Hausman-Taylor method. Their results indicate that the most reliable technique for small samples is FEVD if time-invariant variables and the other variables are correlated with specific effects, which is likely to be the case in our study.

We now briefly present the panel data econometric methods used in our paper to estimate the possible various specifications of our models: pooled ordinary least squares (POLS), random effect estimator (REM), within estimator (FEM), instrumental variables Hausman – Taylor estimator (HT) and fixed effect vector decomposition (FEVD).

### *4.1 Pooled Ordinary Least Squares (POLS)*

The class of models that can be estimated using a pooled ordinary least square estimator can be written as follows

$$y_{it} = x_{it}\beta + z_i\alpha + \varepsilon_{it} \qquad i = 1,2, \ldots, N, \; t = 1,2, \ldots, T \qquad (1)$$

[14] Matyas (1997)

[15] See for instance Hausman-Taylor (1981), Wooldridge (2002), Hsiao (2003).

, where $y_{it}$ is the dependent variable, $x_{it}$ are k regressors not including a constant term. The heterogeneity or individual effect is $z_i\alpha$ where $z_i$ contains a constant term and a set of individual or group specific variables, which may be observed or unobserved, all of which are taken to be constant over time t.

Ordinary Least Squares (OLS) is often used to estimate the gravity model but does not permit to control the individual heterogeneity and hence may yield biased results due to a correlation between some explanatory variables and some unobservable characteristics. If the Breusch-Pagan test rejects the null hypothesis in favor of random effects, the OLS method is not adequate.

### *4.2 Within estimator and random estimator (FEM and REM)*

The fixed effect model can be written as :

$$y_{it} = \sum_{k=1}^{K} \beta_k x_{itk} + \alpha_i + u_{it}, \text{ t = 1, 2,…, T, k=1, 2,,K regressors, i=1, 2,,N individuals} \qquad (2)$$

, where $\alpha_i$ denotes individual effects fixed over time and $u_{it}$ is the disturbance terms.

If we subtract from (2) average of this equation over time for each *t*, we obtain

$$y_{it} - \bar{y}_i = \sum_{k=1}^{K} \beta_k (x_{itk} - \bar{x}_{ik}) + (u_{it} - \bar{u}_i) \qquad (3)$$

where : $\bar{y}_i = T^{-1}\sum_{t=1}^{T} y_{it}$ , $\bar{x}_i = T^{-1}\sum_{t=1}^{T} x_{it}$ and $\bar{u}_i = T^{-1}\sum_{t=1}^{T} u_{it}$ ;

$y_{it} - \bar{y}_i$ , $x_{itk} - \bar{x}_{ik}$ and $u_{it} - \bar{u}_i$ are the time-demeaned data on *y*, x and u. In the fixed effect transformation, it can remark the disappearance of unobserved effect $\alpha_i$, which yields unbiased and consistent results. This pooled OLS estimator that is based on the time-demeaned variables is called the fixed effects estimator or the *within* estimator.

The *random* model has the same form as before (2)

$$y_{it} = \beta_0 + \beta_1 x_{it1} + \beta_2 x_{it2} \ldots\ldots\ldots\ldots\ldots + \beta_k x_{itk} + \alpha_i + u_{it} \qquad (4)$$

, where an intercept $\beta_0$ is included. Equation (4) can became a random effect model in assumption that the unobserved effect $\alpha_i$ is uncorrelated with each explanatory variable:

$$\mathrm{Cov}(x_{itk}, \alpha_i) = 0,\ t = 1,2,\ldots, T;\ j = 1,2,\ldots, k. \qquad (5)$$

In the presence of correlation of the unobserved characteristics with some of the explanatory variables the random effect estimator leads to biased and inconsistent estimates of the parameters[16.] In this case, even if there is correlation between unobserved characteristics and some explanatory variables, the *within* estimator provides unbiased and consistent results.

The Hausman (chi$^2$) test consists in testing the null hypothesis of no correlation between unobserved characteristics and some explanatory variables and allows us to make a choice between random estimator and within estimator. The within estimator has however, two important limits:

- It may not estimate the time invariant variables that are eliminated by data transformation;
- The fixed effect estimator ignores variations across individuals. The individual's specificities can be correlated or not with the explanatory variable. In traditional methods, these correlated variables are replaced with instrumental variables uncorrelated to unobservable characteristics.

### *4.3 The Hausman Taylor method (HT)*

The Hausman and Taylor (1981)[17] estimator (hereafter HT) overcomes these problems using a method which allows to estimate time-invariant variables and also to consider some explanatory variables included in the model as instruments. In this case the major difficulty of the instrumental method which consists in finding external instruments uncorrelated with unobservable characteristics is avoided.

In HT explanatory variables are divided into four categories: time varying ($X_{it}^1$) uncorrelated with individual effects $\alpha_{ij,}$ time varying ($X_{it}^2$) correlated with individual effects $\alpha_i$, time-invariant ($Z_i^1$) uncorrelated with $\alpha_i$ and time-invariant ($Z_i^2$) correlated with $\alpha_i$. More precisely, the considered equation writes as follows:

---

16 Wooldridge (2002)

[17] The Hausman -Taylor method relies on a hybrid specification of both the fixed-effect model and the random effect one (see Gardner, 1988).

$$Y_{it} = \beta_0 + \beta_1 X_{it}^1 + \beta_2 X_{it}^2 + Z_i^1\gamma_1 + Z_i^2\gamma_2 + \alpha_i + \theta_t + \eta_{it} \qquad \textbf{(6)}$$

, where :

- $\beta_1, \beta_2$ , are $k_1$, $k_2$, vectors of coefficients associated with time-varying and $\gamma_1, \gamma_2$ are $g_1$ , $g_2$ vectors of coefficients associated with time-invariant, uncorrelated (index 1) and correlated (index 2) variables respectively;
- $\theta_t$ is the time-specific effects common to all cross section units that is used to correct the impact of all the individual invariant determinants (obtained by the inclusion of T-1 dummy variables);
- $\alpha_j$ are individuals effects that account for the effect of all possible time invariant determinants, which are assumed to be a time-invariant latent random variable, distributed independently across individuals with variance $\sigma_\alpha^2$ and that might be correlated with $X_{it}^2$ and/or $Z_i^2$.
- $\eta_{it}$ is a zero mean idiosyncratic random disturbance uncorrelated within cross-section units and over time periods.

The explanatory variables are not correlated with $\eta_{it}$, even if some of them are correlated with $\alpha_i$. The HT approach consists in using the explanatory variables uncorrelated with $\alpha_i$ as instruments for the correlated explanatory variables.

The $X_{it}^2$ regressors are instrumented by the deviation from individual means (as in the Fixed Effect approach) and the $Z_i^2$ regressors are instrumented by the individual average of $X^1_{it}$ regressors.The Hausman Taylor estimator allows us to estimate the effect of time-invariant variables such as distance, common border, and common languages etc… using only internal regressors as instruments.

The (HT) procedure follows 4 steps in the estimation:

**(i)** *Identification of variables* $X_{it}^1$ , $Z_{it}^1$ uncorrelated with the unobservable characteristics $\alpha_i$ and $X_{it}^2$, $Z_{it}^2$ correlated with the unobservable characteristics $\alpha_i$.

**(ii)** *Transformation of variables* $X_{it}^{1}$, $X_{it}^{2}$ of the model into deviations from individual means $\Delta(X^1)$, $\Delta(X^2)$ and uncorrelated variables $X_{it}^{1}$ into individual means $\Lambda(X^1)$. Under the assumption of the absence of correlation between deviations from individual means of varying variables and $\alpha_i$, HT provides unbiased instruments for the β coefficients. If the number $k_1$ of variables $X_{it}^{1}$ is equal to or higher than $g_2$, then the individual means of $X_{it}^{1}$ are valid instruments for $Z_{it}^{2}$ and the HT estimator is then more efficient than the *within* estimator. The instrument set proposed by HT is $[\Delta(X^1), \Delta(X^2), Z^1, \Lambda(X^1)]$[18] with the condition $k_1 \geq g_2$.

**(iii)** *Selection of instruments*. When any variable is of type $Z_i^2$, we use deviations from individual means of $X_{it}^{1}$ as instruments, as well as variables $Z_i^1$. On the other hand, in the presence of $Z_i^2$ variables, it is necessary to add to the set of instruments individual means of variables $X_{it}^{1}$.[19] The HT estimator resulting from this procedure is unbiased, but it is not efficient.

**(iv)** *Improving the efficiency of the estimator*. HT suggest to apply the instrumental variable method to the transformed model:

$$Y_{it} - (1 - \phi_i Y_i) = \left[X_{it} - (1-\phi_i)X_i\right]\beta + \phi_i Z_i \gamma + \phi_i \mu_i + \left[\eta_{it} - (1-\phi_i)\eta_{it}\right] \quad (7)$$

where :

$$\phi_i = \left( \frac{\sigma_\eta^2}{\sigma_\eta^2 + T_i \sigma_\alpha^2} \right)^{\frac{1}{2}}$$

But the model of Hausman -Taylor suffers at least from three serious imperfections:[20]

a) It is very hard to estimate which explanatory variables are likely to be correlated

[18] **Δ** is the operator which transforms the variables into deviation from their individual means and **Λ** is the operator which transforms the variables into their individual means.

[19] If $Z_2$ is empty, the gain obtained by adding individual means of $X_1$ as instruments is marginal

[20] T. Plümper and V. E. Troeger (2004)

with the unit effects, because the last are unobserved. Unfortunately, the results depend largely on this decision. The best that is possible is to seek specifications which give results close to those obtained by a fixed effect model (FEM).

b) The non-correlated variables should not be adequate instruments for the correlated variables, which can lead to inefficient estimations. The model of Hausman-Taylor depends on large samples and consequently is less effective for the small series.

c) In conclusion, we will not have to wait truly impartial evaluations in the presence of the omitted variables what are correlated with both, of the variable dependent and at least of that of the explanatory variables. Procedures as OLS, FEM, REM, Hausman Taylor can largely reduce the bias omitted variables.

### *4.4 Fixed effect vector decomposition (FEVD)*

Plümper and Troeger (2004) suggest an alternative to the estimation of time-invariant variables in the presence of unit effects. The alternative is the model discussed in Hsiao (2003). It is known that unit fixed effects are a vector of the mean effect of omitted variables, including the effect of time-invariant variables. It is therefore possible to regress the unit effects on the time-invariant variables to obtain approximate estimates for invariant variables. Plümper and Troeger propose a three-stage estimator, where the second stage only aims at the identification of the unobserved parts of the unit effects, and then uses the unexplained part to obtain unbiased pooled OLS (POLS) estimates of the time-varying and time-invariant variables only in the third stage. The unit effect vector is decomposed into two parts: a part explained by time-invariant variables and an unexplainable part (the error term). The model proposed by Plümper and Troeger yields unbiased and consistent estimates of the effect of time-varying variable and unbiased for time-invariant variables if the unexplained part of unit effects is uncorrelated with time-invariant variables.

This model has the robustness of fixed effect model and allows for the correlation between the time-variant explanatory variables and the unobserved individual effects. In brief, the fixed effect vector decomposition (FEVD) proposed by Plümper and Troeger involves the three following steps:

► estimation of the unit fixed effects by the FEM excluding the time-invariant explanatory variables;

► regression of the fixed effect vector on the time-invariant variables of the original model (by OLS);

► reestimation of the original model by POLS, including all time-variant explanatory variables, time-invariant variables and the unexplained part of the fixed effect vector. The third stage is required to control for multi-collinearity and to adjust the degrees of freedom[21].

A general form of regression equation can be written as :

$$y_{it} = \alpha + \beta X_{it} + \gamma Z_i + \varepsilon_{it} \quad (8)$$

where :

$\beta X_{it}$ = time-variant variable vector;

$\gamma Z_i$ = time-invariant variable vector;

$\varepsilon_{it}$ = normal distributed error component;

In the presence of unobserved time-invariant variables the equation (8) can be written as

$$y_{it} = \alpha + \beta X_{it} + \gamma Z_i + u_i + \varepsilon_{it} \quad (9)$$

where $u_i$ = unobserved time-invariant variable whose unobserved effects are a random variable rather than an estimated parameter.

The FEVD approach is implemented as follows.

**First step**

Recall the data generating process of equation (8). The *within* estimator quasi de-means the data and removes the individual effects $u_i$:

$$y_{it} - \bar{y}_i = \beta_k \sum_{k=1}^{K} (x_{kit} - \bar{x}_{ki}) + \varepsilon_{it} - \bar{\varepsilon}_i \equiv \tilde{y}_{it} = \beta_k \sum_{k=1}^{K} \tilde{x}_{ki} + \tilde{\varepsilon}_{it} \quad (10)$$

---

[21] The program STATA proposed (ado-file) by the authors executes all three steps and adjusts the variance-covariance matrix. Options like AR (1) error-correction and robust variance-covariance matrix are allowed.

The authors consider that the variance not used by the fixed effect estimator is most important. The unit effects are explained by:

$$\hat{u}_i = \bar{y}_i - \hat{\beta}_k^{FEM} \sum_{k=1}^{K} \bar{x}_{kit} = \hat{\alpha} + \gamma_j \sum_{j=1}^{J} z_{ji} + \eta_i + \bar{\varepsilon}_i \quad (11)$$

where :

$\eta_i$ is the unexplained part of the unit effects and $\bar{\varepsilon}_i$ are the average unit means of the FEM estimation (indicating panel heteroskedasticity if $\bar{\varepsilon}_i \neq 0$)

**Second step**

Given equation (11), it is simple to regress the $\hat{u}_i$ on the z-variables.

$$\hat{u}_i = \omega + \gamma_j \sum_{j=1}^{J} z_{ji} + \eta_i \text{ and } \hat{\eta}_i = \hat{u}_i - \omega - \gamma_j \sum_{j=1}^{J} z_{ji} \quad (12)$$

where ω is the intercept of the stage 2 equation and $\eta_i$ is the unexplained part of the unit effects as in equation (11). Equations (11) and (12) show that the exclusion of variables that are simultaneously correlated with the unit-effects $\hat{u}_i$ and the time-invariant variables $z_i$ lead to biased estimates. In other words the estimates are unbiased only if $\eta_i \cong 0$ for all *i* or if $E(z_i \mid \eta_i) = E(z_i) = 0$.

**Third step**

The full model is rerun without the unit effects but including the decomposed unit fixed effect vectors comprising $\hat{\eta}_i$ obtained in step 2. The third step is estimated by pooled OLS (or Prais-Winston in the presence of serial correlation).

$$y_{it} = \alpha + \beta_k \sum_{k=1}^{K} x_{kit} + \gamma_j \sum_{j=1}^{J} z_{ji} + \hat{\eta}_i + \varepsilon_{it} \quad (13)$$

By construction, $\hat{\eta}_i$ is no longer correlated with the vector of the z's.

By including the error term of step 2 it is able to account for individual specific effects that cannot be observed. The coefficient of $\hat{\eta}_i$ is either equal to 1.0 or at least close to 1.0 (by accounting for serial correlation or panel heteroskedasticity) at step 3.

Estimating stage 3 by pooled OLS further requires that heteroskedasticity and serial correlation must be eliminated beforehand.

At least in theory this method has three obvious advantages[22] :

a) the fixed effect vector decomposition does not require prior knowledge of the correlation between time-variant explanatory variables and unit specific effects,

b) the estimator relies on the robustness of the within-transformation and does not need to meet the orthogonality assumptions (for time-variant variables) of random effects,

c) *FEVD* estimator maintains the efficiency of OLS.

Essentially FEVD produces unbiased estimates of time-varying variables, regardless of whether they are correlated with unit effects or not, and unbiased estimates of time-invariant variables that are not correlated. The estimated coefficients of the time-invariable variables correlated with unit effects, however, suffer from omitted variable bias. To summarise, FEVD produces less biased and more efficient coefficients. The main advantages of FEVD come from its lack of bias in estimating the coefficients of time-variant variables that are correlated with unit-effects.

## 5. Econometric investigation

We carry out several panel data estimations in order to compare the results across specifications and to identify the most robust one. We first make a test for individual effects and if this confirms their presence, then to control the individual effects we carry out an REM and FEM estimate. To eliminate the unobservable heterogeneity due to bilateral specific effects and avoid the potential bias of the estimators taking the invariant time variables into account it is advisable to use Hausman Taylor and FEVD estimators. Hausman test indicates by the value of $chi^2$ whether the specific effects are correlated or not with the explanatory variables.

The specification retained here to characterize the trade between EEC and OECD countries can be written as follows:

$$X_{ijt} = e^{a_0} GDP_{it}^{a_1} GDP_{jt}^{a_2} DGDPT_{ijt}^{a_3} Dist_{ij}^{a_4} Tchr_{ijt}^{a_5} e^{a_6 Acc_{ijt}} e^{a_7 Cl_{ij}} e^{u_{ij}} e^{\varepsilon_{ijt}} \qquad (14)$$

[22] T. Plümper and V. E. Troeger (2004)

where :

- $X_{ij}$ denotes the bilateral trade between countries ***i*** and ***j*** at time ***t*** with i # j (CHELEM – CEPII French data base);
- $a_o$ is the intercept;
- $GDP_{it}$, $GDP_{jt}$ represents the Gross Domestic Product of country ***i*** and country ***j*** (CHELEM CEPII – data base)
- $DGDPT_{ijt}$ is the difference of GDP per capita between partners and is a proxy of economic distance or of comparative advantage intensity[23],

$$DGDPT_{ijt} = \left| \frac{GDP_{it}}{POP_i} - \frac{GDP_j}{POP_j} \right| \qquad (15)$$

where $POP_{i(j)}$ is the population (CHELEM CEPII data base);

- $Dist_{ij}$ represents the geographical distance between two countries, (CEPII data base);
- $Tchr_{ijt}$ is the real exchange rate which indicates the competitiveness of price;

$$Tchr_{ijt} = Tcn_{ijt} \times {P_{it}}/{P_{jt}} \qquad (16)$$

where: $Tcn_{ijt}$ is the real exchange rate (CHELEM CEPII data base)

$P_{i(j)}$ is consumer price index (WORLD BANK – World Tables)

- $Acc_{ijt}$ is a dummy variable that equals 1 if country ***i*** and country ***j*** have signed a regional agreement, and zero otherwise,
- $Cl_{ij}$ is a dummy variable that equals 1 if country ***i*** and country ***j*** are members of an International Organization (Francophone International Organization), and zero otherwise,
- $\varepsilon_{ijt}$ is the error term,
- $u_{ij}$ is bilateral effect.

After log linearization, equation (14) becomes:

[23] When we use GDP per capita in our estimates, we observe a strong correlation between GDP of the exporting country and their GDP per capita. Consequently, we propose to use the difference of GDP per capita between partners instead of using two variables of GDP per capita for both partners.

$$Ln(X_{ijt}) = a_0 + a_1 ln(GDP_{it}) + a_2 ln(GDP_{jt}) + a_3 ln(DGDPT_{ijt}) + a_4 ln(Dist_{ij}) + a_5 ln(Tchr_{ijt}) + a_6 Acc_{ijt} + a_7 Cl_{ij} + u_{ij} + \varepsilon_{ijt} \quad (17)$$

We will show later that the use of a specific effect estimator is more adequate. Indeed, specific effects allow to accommodate unobservable specificities and hence to eliminate the possible source of bias affecting the estimation of some coefficients as it is the case with the OLS method.

The expected signs for the estimators associated with the variables are based on traditional arguments. Theoretically, we expect a positive effect of the variables like the countries size, the association agreement on trade flows and a negative impact of the geographical distance and of the real exchange rate. The more the real exchange rate index drops the more there is a depreciation of the exporter currency with respect to the currency of his partner and export competitiveness is improved. Concerning the sign of the difference of GDP per capita, the negative or positive impacts of this variable globally compensates. Generally, it has a positive impact on exports for two different countries if the Heckscher-Ohlin (H-O) assumptions are empirically confirmed. On the contrary, according to the new trade theory, the income per capita variable between countries is expected to have a negative impact. In the classical theory, an increase in the intensity of the comparative advantages should involve an increase in trade flows. Countries different in factor endowments and thus, in comparative advantages would exchange more between one another. Geographical distance has always theoretically a negative impact being a proxy of transport costs. Our estimates are organized in a panel with 2 EEC[24] and 19 OECD countries[25] including EU -15 countries which are the main partners for EEC-2. The data used cover a 18 year period (from 1987 to 2004).

The results of OLS, FEM, REM, HT, FEVD estimations are reported in table $n^0$.1 that summarizes the results of our estimations for the whole sample.

[24] Bulgaria, Romania

[25] *EU-15*: Austria, Belgium-Luxemburg, Denmark, England, Finland, France, Germany, Greece, Holland , Ireland, Italy, Portugal, Spain, Sweden; *non-EU* countries : Australia, Canada, Japan, Switzerland, the United States of America.

**Table n° 1**

| VARIABLES | POLS | FEM | REM | HT | FEVD |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| | xij | Xij | xij | xij | xij |
| $GDP_{it}$ | 0.940 | 1.451 | 1.085 | 1.470 | 1.451 |
| | (42.29)*** | (11.08)*** | (16.78)*** | (11.54)*** | (11.08)*** |
| $GDP_{jt}$ | 0.872 | 1.444 | 1.016 | 1.425 | 1.444 |
| | (39.26)*** | (11.03)*** | (15.71)*** | (11.18)*** | (11.03)*** |
| $Dist_{ij}$ | -1.175 | 0.000 | -1.263 | -1.449 | -1.546 |
| | (35.70)*** | (.) | (12.05)*** | (7.70)*** | (20.44)*** |
| $DGDPT_{ijt}$ | 0.433 | 0.334 | 0.392 | 0.334 | 0.334 |
| | (6.22)*** | (4.42)*** | (5.38)*** | (4.42)*** | (18.64)*** |
| $Tchr_{ijt}$ | 0.000 | -0.039 | -0.032 | -0.036 | -0.039 |
| | (0.01) | (2.20)** | (2.10)** | (2.10)** | (2.14)** |
| $Acc_{ijt}$ | 0.378 | 0.379 | 0.397 | 0.379 | 0.379 |
| | (17.01)*** | (20.61)*** | (22.39)*** | (20.59)*** | (21.39)*** |
| $Cl_{ij}$ | -0.024 | 0.000 | -0.068 | 0.628 | -0.184 |
| | (0.94) | (.) | (0.79) | (1.21) | (11.94)*** |
| Residuals | | | | | 1.000 |
| | | | | | (64.93)*** |
| Constant | -5.720 | -14.979 | -6.773 | -10.230 | -9.732 |
| | (20.69)*** | (14.01)*** | (11.90)*** | (9.10)*** | (160.99)*** |
| Observations | 1368 | 1368 | 1368 | 1368 | 1368 |
| R-squared | 0.74 | 0.54 | 0.74 | - | 0.90 |
| Number of groups | - | 76 | 76 | 76 | - |
| VIF | 1.31 | - | - | - | - |
| Ramsey-Reset Prob>F | 19.87 (0.00) | - | - | - | - |
| White's test (before correction) Prob>chi2 | 148.67 (0.00) | - | - | - | - |
| Fischer test for individuals effects | - | - | 27.54 (0.00) | - | - |
| Fischer test for time effects | - | - | 27.72 (0.00) | - | - |
| Hausman test | - | - | - | 20.73 (0.00) | - |
| Absolute value of statistics in parentheses | | | | | |
| * significant at 10%; ** significant at 5%; *** significant at 1% | | | | | |

A comparison between the five estimations leads to the following conclusion.
In all the estimations, we can note that the variable of income per capita has the expected positive sign, which is in accordance with the H-O theory, i.e. the trade between two zones is based on comparative advantage. It is a complementary inter-industry trade where less developed countries are specialized in labor intensive industries and where wage costs are less expensive. Moreover, an access to a larger market increases the volume of trade flows (according to the coefficient of the size of the importer country). The variables like country size, difference of incomes per capita, which have the most important coefficients explain better the level of bilateral exchanges. The international organization membership has a low influence on trade flows. On the contrary, the distance variable (proxy costs of

transport) represents an obstacle for trade. It should be noted that the distance between countries has an important elasticity and hence has an important explanatory capacity. The elasticity of the geographical distance is systematically high, close to (-1.5), indicating that trade flows are extremely sensitive to transport costs. However, the impact of the geographical distance remains high, which means that technical improvements (infrastructure) did not improve international trade.

The results of the random estimator are different from those obtained with the within estimator, for some explanatory variables. This means that there exists a correlation between some of the explanatory variables and the bilateral specific effect. Moreover, the Hausman test confirms the presence of a correlation and rejects the null assumption of absence of a correlation between the individual effects and explanatory variables. Random estimate is biased, and in this case, the use of Hausman-Taylor instrumental variables methods (1981) to correct the bias is justified. Using HT we obtain some similar coefficients to FEM. The results for FEVD are similar to those obtained by *within* which confirm the robustness of the estimation but also we highlight, like in HT method, the time - invariant variables and their important influence on the trade flows. In our case, the last method is more appropriate taking the size of our sample into account, the value of $R^2$= 0.90.

## 6. Conclusion

In this paper we have investigated trade flows between EEC and OECD countries using recent developments of panel data techniques with fixed effects which permit to control the individual heterogeneity and hence to avoid biased results. Indeed, it is now well known that the use of conventional time-series and cross-section methods do not allow to control unobservable heterogeneity and hence are likely to produce biased results[26]. Our empirical results enable us to draw the following conclusions:

(i) From an econometric point of view, the use of FEVD method to estimate the gravity model appears the most convenient for our study. More particularly in the presence of a

[26] See Baltagi (2001)

correlation between some explanatory variables and the unobserved characteristics (here the unobserved bilateral effect) this method produces consistent parameter estimates contrary to the GLS method. Besides, in contrast to the standard within estimator the FEVD method allows to derive parameter estimates for time invariant variables (such as geographic distance). In this case, the FEVD method is more appropriate if we take the size of the sample into account.
Our econometric estimations reveal that the country size and geographical distance variables have a important impact in the international trade flow explanation and are the most important sources of this correlation.

(ii) From an economic point of view, trade flows existing between EEC and OECD countries, that is, two sets of heterogeneous economies with different levels of economic developments are inter-industry. This type of trade was stimulated also by the multinational firms which developed in EEC countries a labor intensive production segment due to their comparative advantage and their less expensive labor costs than in developed countries. The positive coefficient of the DGDPT variable which represents a proxy of comparative advantage intensity emphasized that the economic distance between OECD and EEC countries constitutes the specialization determinant of these countries on various branches according to their comparative advantages (inter-industry trade). Similar results are obtained by Andreff (1998) who finds that highly exported products by EU with comparative advantages for them are products incorporating medium or high technology and high added value. On the contrary, products highly imported by EU or with comparative disadvantages for them belong to CEEC traditional sectors, and are intensive in labor or in raw materials.

But this type of trade do not actually lead to convergence, the main goal of Central and Eastern European countries. Indeed, economic convergence is associated rather to a horizontal intra-industry trade, which assumes the existence of simultaneous exports and import flows of comparable sizes inside the same branch, that is similar products of the same quality, of the same technology and an important added value. Consequently horizontal intra-industry trade is an indicator of the convergence degree between countries. However, this type of trade is less developed between EEC and OECD countries and the tendency to an economic convergence is less optimist for EEC countries in the short run since no competition exists but only complementary market segments. In fact, trade flows are essentially stimulated by price competitiveness.

Finally, variables such as countries size, economic distance, or agreement membership have the highest (significant) coefficients in our regression, and hence explain better the level of bilateral trade as well as the attraction between partners for a deeper integration. On the contrary, the distance variable plays as a rejecting factor. The other variables have a low explanatory power. A positive and significant effect of economic distance which can be attributed to a traditional trade explanation (inter-industrial trade is favored by differences in factorial endowments) is highlighted. In addition, the importance of using a model in accordance with data properties clearly emerged from our investigation. The choice of an unbiased estimator and the variable definition is also of crucial importance.

In conclusion, our results highlight that there are no statistically significant modifications of trade flows between EU and EEC in terms of specialization trade and trade pattern.

# References

[1] Anderson J.E., "A Theoretical Foundation for the Gravity Equation", *American Economic Review*, Vol 69 (1), pp 106-116, 1979.

[2] Andreff. M. "La spécialisation du commerce entre l'Union européenne et les pays d'Europe centrale et orientale : quelle évolution *?", East/West comparative Studies*, Vol 29 (4), pp.161-189, 1998.

[3] Baier S.L., Bergstrand J. H., "Do free trade agreements actually increase members' international trade?", *Journal of International Economics*, Elsevier, vol. 71(1), pp 72-95, 2007.

[4] Bayoumi T., Eichengreen B., "Is regionalism simply a diversion? Evidence from the evolution of the EC and EFTA", *NBER Working Paper*, 5283, 1997

[5] Baltagi B.H., "Econometric Analysis of Panel Data", *John Wiley & Sons Ltd,*
New York, 2nd edition, 2001

[6] Bergstrand J.H., "The Gravity Equation in International Trade: some Microeconomic Foundations and Empirical Evidence", *Review of Economics and Statistics*, Vol. 67 (3), pp. 474-481, 1985

[7] Bergstrand J.H., "The Generalized Gravity Equation, Monopolistic Competition, and the Factor-Proportions Theory in International Trade", *Review of Economics and Statistics,* Vol. 71 (1), pp. 143-153, 1989.

[8] Carrere C.,"Revisiting the effects of regional trading agreements on trade flows with proper specification of the gravity model", *European Economic Review,* vol. 50 (2), pp. 223-247, 2006

[9] Egger P., "A note on the proper econometric specification of the gravity equation", *Economics Letters*, Vol. 66 (1), pp.25-31, 2000.

[10] Egger P., "An Econometric View on the Estimation of Gravity Models and the Calculation of Trade Potentials", *The World Economy,* Vol 25 (2), pp. 297-312, 2002

[11] Egger P., Pfaffermayr M., “The proper panel econometric specification of the gravity equation: A three-way model with bilateral interaction effects”, *Empirical Economics*, Vol 28 (3), pp. 571-580, 2003.

[12] Eichengreen B., Irwin D.A., “Trade blocs, currency blocs and the reorientation of world trade in the 1930s”, *Journal of International Economics,* Vol 38, (1), pp 1-24.,1995

[13] Gardner R.., “Unobservable individual effects in unbalanced panel data”, *Economics Letters*, Vol 58 (1), pp.39-42., 1998.

[14] Hausman J.A., Taylor W.E.,“Panel Data and Unobservable Individual Effects”, E*conometrica*, Vol 49 (6), pp. 1377-1398, 1981.

[15] Helpman E., Krugman P.**, “**Market Structure and Foreign Trade: Increasing Returns, Imperfect Competition, and the International Economy*”,* MIT Press, Cambridge, MA, 1985.

[16] Hsiao C., “Analysis of Panel Data”, 2nd edition, *Cambridge University Press*, 2003.

[17] Linnemann, H., “An Econometric Study of International Trade Flows”, *North Holland Publishing Company, Amsterdam*, 1966.

[18] Matyas L., “Proper Econometric Specification of the Gravity Model”, *The World Economy*, Vol 20 (3), 363-368, 1997

[19] Plumper, T. and Troeger, V.E. (2004). The estimation of time-invariant variables in panel analyses with unit fixed effects. *Social Science Research Network*, Working Paper,2004

[20] Pöyhönen P., “A tentative model for the flows of trade between countries”, *Welwirtschftliches Archiv*, 90, pp. 93-100, 1963.

[21] Rose A.K., One money, one market: The effect of common currencies on trade, *Economic Policy* 15 (30), pp. 7-45, 2000.

[23] Soloaga, I., Winters L., (2001). “Regionalism in the Nineties: What Effect on trade?” *North American Journal of Economics and Finance*, Vol 12 (1), pp 1-29, 2001.

[24] Rault C., Sova, R. and Sova, A, "The Role of Association Agreements Within European Union Enlargement to Central and Eastern European Countries", *IZA* Discussion Paper No. 2769, 2007

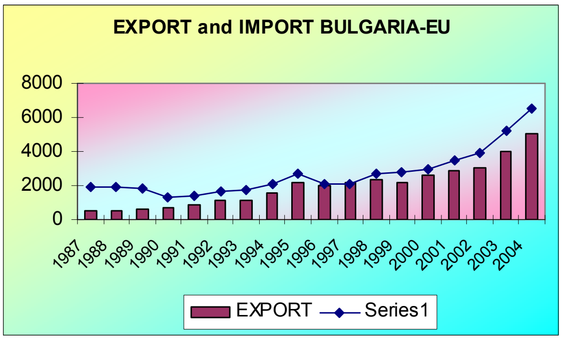
[25] Tinbergen J., “Shaping the World Economy: Suggestions for an International Economic Policy”, *Twentieth Century Fund,* New York*,* 1962.

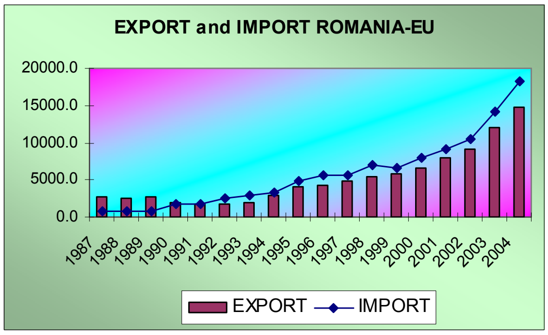
[26] Wei S.J, Frankel J.A.,“Open Regionalism in a World of Continental Trade Blocs,” IMF *Staff Papers*, Vol 45 (3), pp. 440-453, 1998.

[28] Wooldridge J.M, “Econometric Analysis of Cross Section and Panel Data” 2rd Edition” *The MIT Press Cambridge, Massachusetts London, England*,,2002.

# Appendix

### Graph nº 1: Evolution of the exports and imports of Romania and Bulgaria (in %) 1987 → 2004

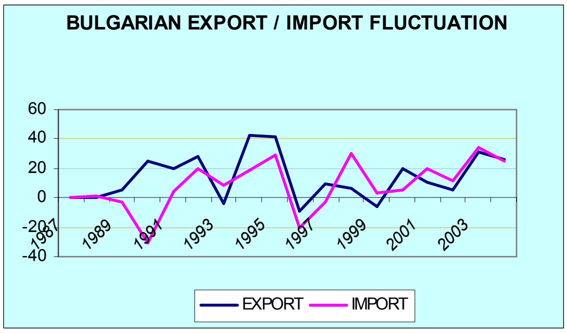


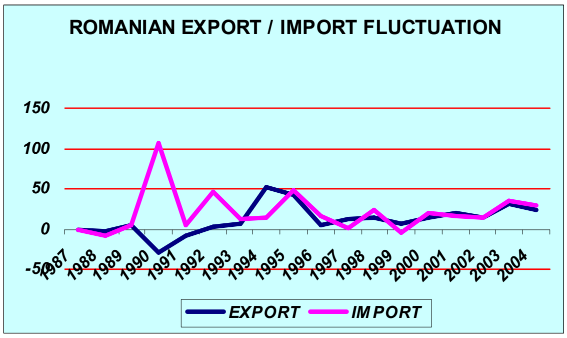



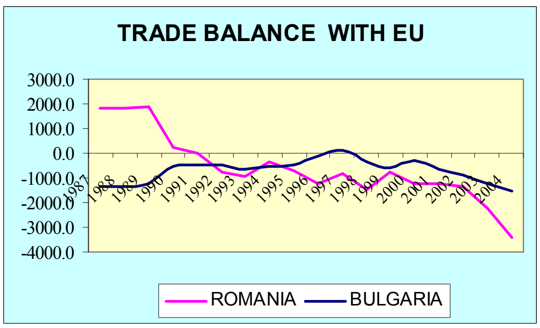

Source: CHELEM – CEPII French database

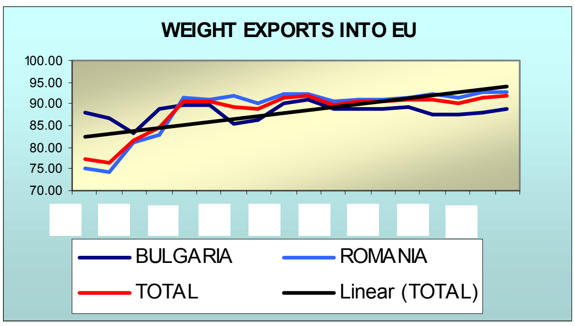
Romania's exports have experienced a decrease up to 2679.8 million USD in 1991 and then a restarting and a significant growth up to 4768.6 in 2004. On the contrary, imports have regularly grown up to 805.9 in 1989, reaching a maximum of 18185.9 in 2004. (Graph 1).

### Graph nº 2: Variation of the exports and imports of Romania and Bulgaria (in %) 1987 → 2004



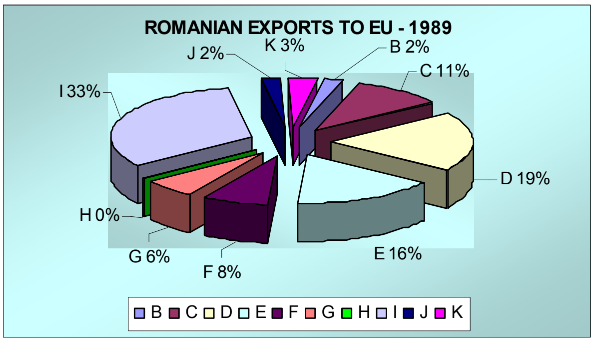



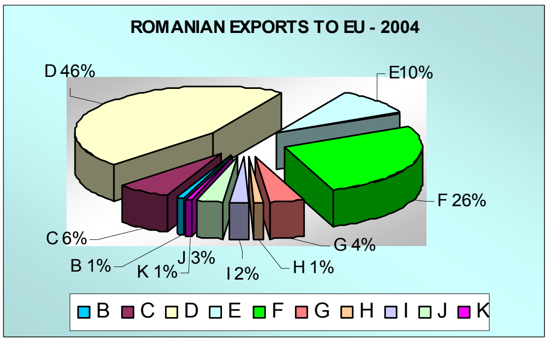

Trade balance with EU

The weight of exports towards EU

Source: CHELEM – CEPII French database

**Graph nº 3: Sector-based exports of Romania (in %)**




Source: CHELEM – CEPII French Database

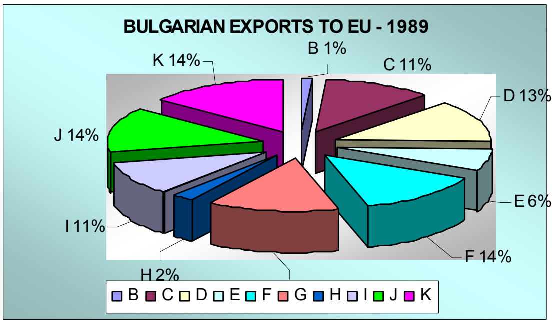
**notes:**

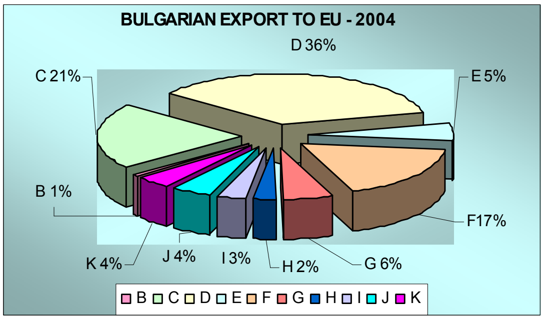
| Code | Sector | Code | Sector |
|---|---|---|---|
| **B** | Building materials | **G** | Chemistry |
| **C** | Iron industry, metal industry | **H** | Minerais |
| **D** | Textiles, leathers | **I** | Energy |
| **E** | Woods, paper | **J** | Agriculture |
| **F** | Electric, mechanics | **K** | Food |

Concerning the structure of Romania trade with EU countries, we can observe evolutions towards industry reallocation. In 1989, Romania exported products of the energy sector (33%), textiles (19%), woods paper (16%), mechanics electric (8%), chemistry (6%), and produced building materials, agricultural and food (2.3%). In 2004, statistical examination confirms our intuition of specialization in sectors where the labor factor comparative advantage has a key role. Therefore, reallocations are concentrated essentially in the textile sector reaching 46 % (in 2004) comparatively with 19 % (in 1989), followed by the mechanics electric sector reaching 26% (in 2004) compared to 8% (in 1989), a sector where segments of production resting on assembly operations were particularly developed. With regard to the other sectors, one can note a continuous decreasing level of exports. There have been reductions in 2004 compared to 1989, for the sector of iron and steel industry from 11% to 6%, for the energy sector from 33% to 2%, for the woods paper sectors from 16% to 10% (due to the fall of paper production), for the chemistry sector from 6% to 4%, followed by agricultural products from of 2% to 1% and food products from 3% to 1%.

A similar evolution can also be observed in Bulgaria where the textile sector has increased by 13% (in 1989) to 36% (in 2004), the iron and steel industry sectors from 11% to 21%, and the electric and mechanic sectors from 14% to 17%. In the other sectors there has been a fall of the export levels of about 1% in 2004. This situation puts in evidence a strengthening of the specialization process with a positive impact on complementary specialization. However, the production development of these low added value sectors cannot lead to a convergence improvement, but on the contrary entails a strengthening of the divergence between developed and the less developed.

## Graph nº 4: Sector-based exports of Bulgaria (in %)

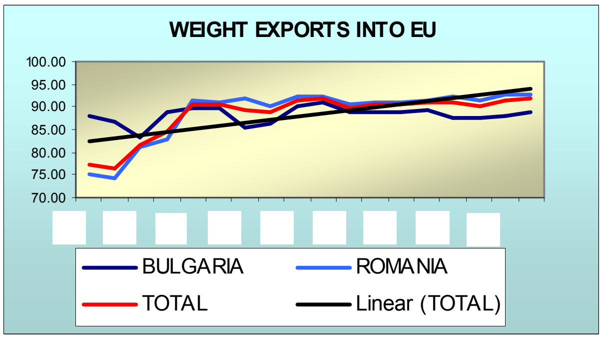



Source: CHELEM – CEPII French database

## Graph nº 5: Weight of exports to EU from OECD - 19

| Year | Bulgaria | Romania | Romania and Bulgaria |
|---|---|---|---|
| 1987 | 87.96 | 75.32 | 77.25 |
| 1988 | 86.78 | 74.39 | 76.34 |
| 1989 | 83.27 | 81.24 | 81.60 |
| 1990 | 88.89 | 82.82 | 84.43 |
| 1991 | 89.52 | 91.39 | 90.76 |
| 1992 | 89.79 | 90.82 | 90.42 |
| 1993 | 85.32 | 91.90 | 89.40 |
| 1994 | 86.13 | 90.12 | 88.70 |
| 1995 | 90.00 | 92.43 | 91.57 |
| 1996 | 91.14 | 92.50 | 92.06 |
| 1997 | 88.93 | 90.36 | 89.91 |
| 1998 | 88.82 | 91.05 | 90.38 |
| 1999 | 88.96 | 91.11 | 90.52 |
| 2000 | 89.26 | 91.60 | 90.93 |
| 2001 | 87.44 | 92.41 | 91.03 |
| 2002 | 87.50 | 91.28 | 90.30 |
| 2003 | 87.99 | 92.58 | 91.38 |
| 2004 | 88.87 | 92.79 | 91.75 |




Source: CHELEM – CEPII French database