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ROMANIA'S EXPORTS IN CENTRAL AND EASTERN EUROPEAN COUNTRIES. A GRAVITY MODEL APPROACH

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Abstract

A popular approach to estimating the size of barriers to trade is the use of distance to infer trade costs in the framework of a gravity model. In this paper we are employing a classical gravity model with panel data in an attempt to identify the main determinants for Romania's trade outflows towards Central and Eastern Europe, over the 1999-2013 periods. Based on different panel model specifications, we found that geographical distance, economic distance (captured by absolute GDP differentials between countries) and the level of development of the trade partners (provided by GDP per capita) are highly significant predictors for the volume of Romanian exports. The models indicated a strong negative influence of geographical distance, with an estimated coefficient slightly higher

compared to the predictions of the traditional gravity models, a particular feature already detected in other empirical investigations on Southeast European trade.

Keywords: export, gravity model, panel data, Romania

JEL classification: C23, R15

1. Introduction

Romania had a long tradition of close trade relationships with the former socialist countries in Central and Eastern Europe (CEE). The fall of the Council for Mutual Economic Assistance (COMECON) in 1991 and the accession to EU of many counties from this region reshaped the international trade flows in the last decades. In this context Romania diverted a large part of its exports from traditional regional destinations to its current biggest trade partners: Germany, Italy, France and Turkey. Nevertheless, geographic proximity, as well as economic and politic similarities, seem to have preserved some of the old economic links, as well as a significant part of the bilateral trade flows among the former members of COMECON.

The recent global financial crisis has had negative effects on Romania's foreign trade, which suffered from lower demand for imports in relation to all our trade partners, the regional scale of this impact depending on the magnitude, sustainability and importance of trade links between the economy of each region or country and the European economy. Even so, Romania has been more successful in mitigating the negative impact of the economic crisis on the foreign trade than in the case of GDP (Zaman and Goschin, 2016).

Romania's exports are mainly competitive in textile and furniture industries, of low technological level, as well as in chemical industry, having a medium technological level (Iorga, 2010). As Romanian exports are mainly "poorly specialized or dominated by products at a relatively low level of processing" (Zaman and Vasile, 2012, p. 22), foreign trade is not competitive enough in the EU market. In this context, to maintain traditional export markets, such as the ones in the former socialist countries of CEE, seems an appropriate and efficient strategy.

Starting from these overall considerations, we aim to estimate the size of barriers to trade, by using distance to infer trade costs by means of a classic gravity model. In line with the findings in empirical literature, we expect trade flows to fall substantially with geographic distance. As a novelty compared to previous research on Romanian trade, this paper is focused on the traditional trade partners in Central and Eastern Europe. It employs panel data analysis, which is recommended in the

literature as an instrument for improving the efficiency of the results (Hsiao, 1986), based on its ability to capture specific country and time series effects.

The remainder of this paper proceeds as follows. The next section briefly reviews the relevant literature on the importance of the gravity model in analyzing trade flows. Section 3 explains the method to be employed in our research, introducing the gravity model in its panel data form. Section 4 presents the results from estimating the parameters of the gravity model, comparing different model specifications and discussing the statistic and economic significance of the outcomes. Section 5 concludes by summarizing the main findings and tracing the directions for future research.

2. Literature review

Exports have been largely acknowledged in the literature as an important factor of economic development, both in the framework of Solow's classical model of economic growth and in the context of endogenous growth models (Frankel et al, 1997; Baldwin and Forslid, 2000). Theory and empirical research showed that various factors could impede international trade, such as transportation costs, tariff barriers, and administrative obstacles (including corruption).

A largely-employed method for capturing the overall trade costs is the gravity model, as the gravity equation implicitly infers trade costs by using the geographical distance from one country to another. Starting with the seminal papers of Tinbergen and Poyhonen (Tinbergen, 1962; Poyhonen, 1963) extensive empirical research in the international literature addressing trade determinants relied on a gravity – type framework, with market size (proxied by GDP) and geographical distance providing high explanatory power. Empirical studies on this topic clearly showed that the gravity equation can successfully predict trade costs that increase with distance (e.g., Helpman and Krugman, 1985; Christie, 2003; Bussière et al., 2005; Ruiz and Vilarrubia, 2007; Bussière et al., 2008; Disdier and Head, 2008; Krisztin and Fischer, 2015). Moreover, this method is currently used to analyze other bilateral flows, such as migration and Foreign Direct Investment (e.g., Karemera et al., 2000).

Given that spatial dependence in flow data is very likely, recent developments in this field acknowledged the presence of spatial autocorrelation issues and addressed them by introducing linear spatial econometric modeling (LeSage and Pace, 2008; Behrens et al., 2012; Koch and LeSage, 2015) as well as non - parametric modeling (Krisztin and Fischer, 2015; Patuelli et al., 2015).

In Romania, the scholars frequently addressed the topic of international trade, analyzing various aspects, such as magnitude, structure, trends and economic growth effects (e.g. Georgescu, 2003 and

2012; Zaman and Vasile, 2005; Anghelache et al., 2009; Savoiu et al., 2010; Iorga, 2010; Zaman et al., 2011; Rădulescu et al., 2012; Savoiu et al., 2012; Herciu, 2013; Sandu and Ciocanel, 2014, etc.), but there were only a few studies that used the gravity model for Romanian trade analyses (Ferragina et al, 2005; Viorica, 2012; Draghescu et al., 2015).

Focusing on the main trade partners of Romania within EU (France, Germany, Italy, Spain and UK) for the period 1995 to 2001, Ferragina et al. (2005) revealed an important trade potential (double than the actual trade) that should be exploited after accession. According to the authors, larger economic and financial co-operation, as well as technical and scientific assistance, are the key factors for accelerating Romania's trade expansion. In the same register, Bussière et al. (2008) stated that CEECs have significant scope to strengthen trade links with the euro area, while Romania seems to have built strong trade relations with this region and has already reached in 2003 its trade potential (Bussière et al., 2005). More recently, Viorica (2012) successfully tested the gravity model for Romanian overall exports to the main 74 trade partner countries (for the year 2009), while Draghescu et al. (2015), using panel data, found both static and dynamic gravity models to be highly significant for Romania, in the case of flat glass exports.

In the context of the challenges brought about by the recent economic crisis that depressed international trade flows, we believe that studies based on trade gravity model might bring new insights on this important topic for the future economic growth of Romania.

3. Method

The gravity model estimates the bilateral trade flows between country i and j based on their economic dimension and geographical distance. The gravity model was inspired by Newton's Law of Gravity, which is stating that the gravitational attraction between objects increases with their masses and decreases with the distance. The classic gravity model, first introduced by Tinbergen (1962), was used for estimating trade flows TF_{ij} from country *i* to country *j*, depending on their GDPs (as a measure of economic mass) and the distance *Dij*:

$$TF_{ij} = G\frac{GDP_i^{\alpha} GDP_j^{\beta}}{D_{ij}^{\delta}}, \qquad (1)$$

where G is a gravity constant.

In order to estimate the previous equation, relation *(1)* is usually transformed into a log-log model by taking logs of both its sides, as follows:

$$\ln TF_{ij} = \ln G + \alpha \ln GDP_i + \beta \ln GDP_j - \delta \ln D_{ij}, \qquad (2)$$

where α, β and δ are elasticities. Constant G now is part of the intercept.

Some researchers extended the basic gravity equation by including additional variables and found that the most significant factors for the trade flows are "prices" and "exchange rates".

Our aim is to analyze the Romanian export flows by country, focusing on distance as a major factor of influence, therefore the gravity model is an appropriate choice. The selection of explanatory variables is based on the international literature, in the context of the current data availability limitations. Since Romania is the only reference country in this model, we dropped the index *j* from equation *(2)* and replaced GDP by the variable "economic distance", computed as absolute difference between the GDP of each trade partner and the GDP of Romania. This variable reflects the comparative advantage as an explanatory factor of trade volumes and its expected sign is positive (Serlenga and Shin, 2007; Kabir and Salim, 2010).We also introduced the variable GDP per capita, as a measure of the development level of the countries.

$$\ln Export_i = \beta_0 + \beta_1 \ln Econ\text{-}Distance_i + \beta_2 \ln Geo\text{-}Distance_i + \beta_3 \ln GDP\text{-}cap_i + \varepsilon_i. \qquad (3)$$

According to the theory, the larger the GDP of a country the larger its domestic market, generating bigger import demand and export supply. On the other hand, developed countries have a more diversified production potential that should foster trading. Consequently, both variables are expected to exert positive influence on the export flows. Conversely, the exports should be hindered by bigger geographical distance, as it generates higher trade costs.

The empirical analysis will be conducted in the framework of the gravity model, using panel data. The panel data structure enables to account for specific cross section and/or period influence by means of the fixed-effects model. The model specification in *(3)* changes accordingly:

$$\ln Export_{it} = \beta_{0i} + \gamma_t + \beta_1 \ln Econ\text{-}Distance_{it} + \beta_2 \ln Geo\text{-}Distance_i + \beta_3 \ln GDP\text{-}cap_{it} + \varepsilon_{it} \qquad (4)$$

i - country, i = 1,…, 10; ; t – year, t = 1999 – 2013.

where γ_t represents period fixed effects (such as general shifts in business cycle, economic crises, new technology, etc.) that affect all countries in a similar manner, while β_{0i} reflects cross-section fixed effects (country characteristics that are constant over the period of interest: territory, clime, customs; economic policy).

The random effects (RE) model captures regional individuality by including region-specific errors e_i alongside ε_{it} into the general errors u_{it}, resulting the following equation specification:

$$ln\ Export_{it} = \beta_0 + \beta_1\ ln\ Econ\text{-}Distance_{it} + \beta_2\ ln\ Geo\text{-}Distance_i + \beta_3\ ln\ GDP\text{-}cap_{it} + u_{it}. \qquad (5)$$

The unobserved effect in the RE model must be uncorrelated with the regressors. Such models have to be estimated by generalized least squares (GLS) method due to the composite structure of errors (Wooldridge, 2002).

In order to validate the choice of the fixed effects model instead of POLS, we check for the existence/absence of individual effects by applying an F test. The null hypothesis of the test is H_0: $\beta_{0i} = 0,\ i=1,...,N$, which implies the absence of individual effects and recommends POLS, while the alternative is the fixed effects model. The F test statistic is:

$$F = \frac{(ESS_{POLS} - ESS_{FE})/(N-1)}{ESS_{FE}/((T-1)N-K)} \qquad (6)$$

where ESS_{POLS} and ESS_{FE} denote error sum of squares (ESS) in POLS and in FE models, respectively, N is the number of regions, T is the number of years and K the number of regressors in the FE model. If we fail to reject the null hypothesis, regional individual effects are denied, and POLS model is the right one for our dataset; otherwise, panel estimation techniques are preferable.

If the panel data model proves to be more appropriate for our dataset, we will have to choose between the fix effects (FE) and random effects (RE) model by applying the Hausman test. For the case of panel data, the null hypothesis of the test is that the FE and RE estimators do not differ significantly. If the test rejects the null hypothesis, random effects should not be used because they may be correlated with the independent variables in the model. If the test does not reject the null hypothesis, it is considered that the estimators of the two models produce similar results.

Table 1. The variables

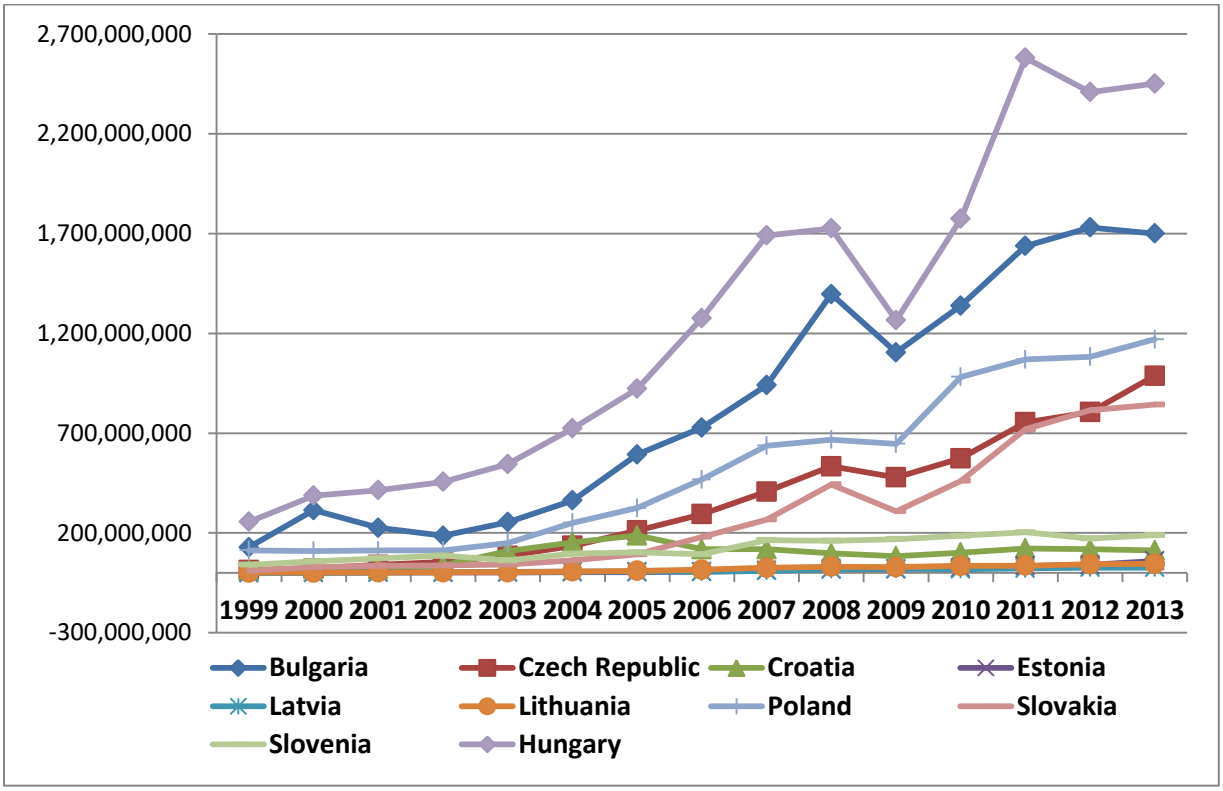
Variable name	Description	Data source
EXPORT	The value of export flow from Romania to each CEE country (euro)	National Institute of Statistics
GEO-DISTANCE	The distance between Bucharest and the capital city of each trade partner country, in kilometers (road distance).	DistanceFromTo.Net
ECON-DISTANCE	Romania's GDP minus the GDP of each trade partner country (in PPP $, absolute value). Gross Domestic Product is converted in dollars using purchasing power parity rates (PPP)	World Bank database and own computations
GDP/cap	Gross Domestic Product per capita (in PPP $)	World Bank database

The variables of the models are presented in Table 1. The data used for estimating the models cover the period 1999 to 2013 and include ten former socialist countries in CEE region: Bulgaria, Czech Republic, Croatia, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia.

4. Results and discussion

Romania's exports showed good resilience, recovering quickly after the recent economic crisis: compared to 2008, the overall exports increased by 10.8% in 2010 and by 55.6% in 2014. In 2014 the exports accounted for about 13.9% of total Romanian economic output. As regards their territorial distribution, 73.5% of Romanian exports were delivered to other European Union members and the CEE countries included in our analysis (Bulgaria, Czech Republic, Croatia, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, Slovenia) accounted together for 15.31% of the total.

Figure 1. Romania's exports in CEE countries (Euro), 1999-2013



Source: own processing

Over the period 1999 to 2013, Romanian exports increased steadily in most CEE countries, except for the Baltic States and Slovenia. Romania's most important trade partner from the CEE countries in the same period was Hungary, followed by Bulgaria and Poland (Figure 1). Exports temporarily declined amid the recent economic and financial crisis, but resumed quickly, suggesting that international trade in this region has a good resilience to economic shocks such as the crises.

Our modelling attempt on Romania's exports in the CEE countries started with the pooled OLS regression, followed by the fixed-effects model (equation 4) and the random-effects model (equation 5), all based on the same general gravity model (equation 3). The models were estimated using data for the Romanian exports towards the former socialist countries of CEE that became members of the EU. The time span envisaged in the analysis is 1999 to 2013.

Table 2 reports the estimated coefficients for the three specifications of the gravity panel data model. The models yield good results and the variables of interest are significant in all specifications.

Table 2. The results

Pooled data Model			
Variable	**Coefficient**	**Std. Error**	**Prob**
Constant	24.6783	1.8713	0.0000
GEO-DISTANCE	-2.4434	0.2069	0.0000
ECON-DISTANCE	-0.2386	0.0765	0.0022
GDP/cap	1.2736	0.0943	0.0000
R-squared	0.7466		
F statistic	143.364		0.0000
Fixed Effects Model			
Variable	**Coefficient**	**Std. Error**	**Prob**
Constant	26.7327	1.1178	0.0000
GEO-DISTANCE	-2.4923	0.1229	0.0000
ECON-DISTANCE	-0.2551	0.0458	0.0000
GDP/cap	1.1242	0.0567	0.0000
R-squared	0.9193		
F statistic	88.5017		0.0000
Random Effects Model			
Variable	**Coefficient**	**Std. Error**	**Prob**
Constant	7.7562	5.6013	0.1682
GEO-DISTANCE	-2.1215	0.6448	0.0013
GDP/cap	2.4568	0.2583	0.0000
R-squared	0.4368		
F statistic	57.013		0.0000

Pooled data regression was rejected based on the results from the Redundant fixed effects test and the Hausman test pointed to the fixed-effects as a better choice compared to random-effects model. Therefore, the fixed effects model is the most appropriate for our dataset, although all three models estimated in this study display a good overall performance from the perspective of the standard statistical tests. The result corresponds to our expectations based on preliminary statistical analysis, given the heterogeneity that exists among CEE countries. Since GEO-DISTANCE is invariable, the cross-section FE model is inapplicable and we estimated only the period fixed effects model**.** Period fixed effects capture time-specific events (e.g. the recent global economic crisis) that might affect export variation on long-term.

The GEO_DISTANCE coefficient is slightly bigger than other estimates reported in the literature. It seems that most estimates of the coefficient for distance fall within the interval 0.28 - 1.55 (Disdier and Head, 2008). Our result of 2.1215, according to the best model specification, indicates a

stronger than average preference towards shorter export distances. This result is in line with the findings of previous research on Southeast Europe trade flows that noticed the existence of values far from the standard estimations of classical gravity models (e.g., Christie, 2003). Perhaps this strong influence of geographical distance makes ineffective the expected positive impact of economic distance, which might explain why trade flows are not directly proportional to countries' economic size, as predicted by theory. In our model specifications the economic mass of the trade partners, captured by the GDP differential between Romania and the export country, exerts a significant negative influence on the volume of bilateral exports. Still, GDP per capita has a positive and highly significant impact on the Romanian export outflows, as expected.

Geographical distance between countries' capitals, the distance measure commonly used in gravity models, might not accurately reflect the real transportation costs. An alternative to geographical distances could be the transport times, but such a replacement does not seem to improve significantly the gravity models (e.g., Christie, 2003).

5. Conclusion and directions for further research

This paper analyzed the Romanian export flows in CEE countries, focusing on economic and geographic distances as potential factors of influence in the framework of a classic gravity model. Although relatively simple, gravity models, especially in panel data form, provide high explanatory power and have been used extensively in recent years in the empirical analyses of international trade.

In line with the international literature, the volume of Romanian exports tends to fall sharply with geographic distance. Compared to the literature, our findings point to an even stronger than expected preference towards shorter export distances in the CEECs region. This preference might be caused, among other factors, by the underdevelopment of transport infrastructure in Romania, which is taking long to build.

The recent economic crisis revealed the vulnerability of Romania's foreign trade, which suffered of lower demand for imports in relation to all our trade partners. Romania's exports, weakly specialized and of medium-low technological level, are not competitive enough and fail to harvest all potential benefits brought about by an open economy on the EU market. In this context it is important to preserve the traditional export markets, such as the ones in the former socialist countries of CEE, which are geographically closer.

Since trade linkages represent a potential instrument to foster economic development, this sector needs to be supported in the future by an adequate policy-mix able to encourage the expansion

and improvement of exports of medium and high-tech goods and services, with higher value added contribution within internal and international value chains.

Further research on this topic should test the robustness of these results on a longer time span, as new data become available and by introducing additional explanatory variables in the gravity model in order to capture a better image of the potential factors that influence the Romanian export flows in the CEE region.

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