

**IMPACTS OF THE INTEGRATION ON TRADE OF EU MEMBERS -  
A GRAVITY MODEL APPROACH**

**AZ INTEGRÁCIÓ HATÁSA AZ EU TAGORSZÁGOK  
KÜLKERESKEDELMÉRE - VIZSGÁLATOK GRAVITÁCIÓS  
MODELLEL**

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**Keywords:** gravity model, trade issues, FTA, Regional Trade Agreements, EU enlargement, panel data

### **Abstract**

The gravity model has been extensively used in international trade research for the last 40 years because of its considerable empirical robustness and explanatory power. Since their introduction in the 1960's, gravity models have been used for assessing trade policy implications and, particularly recently, for analyzing the effects of Free Trade Agreements on international trade. The objective of this dissertation is to review the recent empirical literature on gravity models, highlight best practices and provide an overview of EU integration effects on international trade as reported by relevant gravity model-based studies over the past decade. Examining the trade prospects for the new European Union (EU) member states is an important issue in the context of European eastward enlargement and greater economic integration with its immediate neighbours. I use a gravity equation for a panel data set of bilateral export flows from EU12, EU15 over the 2000-2010 period. The potential trade volumes are calculated from a gravity model.

**Kulcsszavak:** gravitációs modell, kereskedelmi forgalmak, szabadkereskedelmi egyezmények, modellek, EU bővítés, panelelemzés

### **Kivonat**

A gravitációs modellt széles körben használják a nemzetközi kereskedelmi kutatások során az elmúlt 40 évben a tekintélyes empirikus erőteljessége és magyarázó ereje miatt. Az 1960-as évekbeli bevezetése óta a gravitációs modellt a kereskedelempolitika vonatkozásainak értékelésére használják, továbbá különösen a közelmúltban, a szabadkereskedelmi egyezmények nemzetközi kereskedelemre gyakorolt hatásainak elemzése céljából is igénybe veszik. A dolgozat célja, hogy ismertesse a gravitációs modellekről szóló korszerű empirikus irodalmakat, kiemelve a legjobb gyakorlatokat, és áttekintést az EU bővítés hatásairól a releváns gravitációs modell által.

A gazdaságok csatlakozásának legfontosabb oka a nemzetközi kereskedelem fellendítése. A regionális kereskedelmi mintákban bekövetkező drasztikus változások megkövetelik a közgazdászoktól, hogy újabb elméleti megfontolásokkal és empirikus megközelítéssel álljanak elő annak érdekében, hogy pontosan meghatározhassák a nemzetközi kereskedelmi folyamatok szerepét a regionális integrációban, illetve a bilaterális kereskedelmi kapcsolatok változását a résztvevő országok között.

Az immár 28<sup>1</sup> tagú Európai Unió az egységes piaccal és a monetáris unióval eljutott a gazdasági integráció legmagasabb fokáig. Ez a folyamat nemcsak Európában, de világszinten is egyedülálló, mert nem volt eddig még egy olyan integrációs együttműködés, amely ilyen messzire jutott volna. Az Unió szintjén közös politikák alakultak ki, amelyek köre az integráció mélyülésével fokozatosan bővült. Az integrációs folyamat logikájából következően az integráció egyik meghatározó politikája a közös kereskedelempolitika, amely az EU egységes külgazdasági viszonyulása a kívülálló országok felé. A tagállamok nem folytathatnak önállóan

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<sup>1</sup> Horvátország csatlakozott 2013 júliusában, az elemzésemben nem vesz részt EU tagként, mert az adatok korábbi időszakot ölelnek fel.

kereskelempolitikai tárgyalásokat és nem köthetnek kereskedelmi megállapodásokat, szabályozott az egyes intézmények szerepe is.<sup>2</sup>

Az alapító szerződésből a kívülálló országok tekintetében háromféle viszony kialakítása következik: a csatlakozás, a társulás és a kereskedelmi megállapodások megkötése.

A 10 közép- és kelet-európai országgal megkötött ún. Európai Megállapodások lényege az ipari szabadkereskedelem 10 éven belüli megteremtése volt, amelyet az EU tagországai előbb és szélesebb körben valósított meg, a társult országok pedig bizonyos időbeli késleltetéssel vezettek be, emellett a mezőgazdaságban bizonyos kedvezményeket adtak egymásnak a felek. A 2004-es és 2007-es kibővítéssel az Európai Megállapodással rendelkező valamennyi közép- és kelet-európai ország csatlakozott az EU-hoz.

A bővítés eredménye nem csupán kereskedelem-növekedés volt az EU12 és EU15 között, hanem az EU12 kereskedelmi szabályozásának megváltozása is a világ többi része felé is. Az EU-ba történt bekerülésük nyomán az új tagállamoknak is kötelezően alkalmazniuk kellett a közös EU vámtarifarendszert, beleértve a fejlődő országok preferenciális hozzáférését. A legtöbb esetben ez a kereskedelmi szabályok liberalizálását jelentette (Avery és Cameron, 1998, valamint Buch és Piazzolo, 2001). Ennek a kereskedelmi nyitásnak az eredményeként mindenképpen a kereskedelem erősödését várták annak költségei csökkenésével (Bchir és munkatársai, 2003), bár új kelet-európai tagok nem élvezik még magas szintű intézményi infrastruktúrát és némi időbe telik, amíg beilleszkednek a kereskedelmi integrációba és felzárkóznak.

## INTRODUCTION

While trade is growing fast, the multilateral trading system faces a number of internal difficulties linked to the size of its membership and the diversity of economic situations, trade interests, and previous commitments. But the multilateral trading system is also challenged by the outside rapid development of regional and bilateral free trade agreements raising serious challenges for it.

There has been a rapid growth in the number of regional trade agreements (RTAs) in recent years. It has raised the question as to whether RTAs pose a threat to the multilateral trading system. The trend in the growth of RTAs should express strong concerns about the negative effects of growing regionalism. We should tend to regard regionalism much more as a complement to multilateralism. International economic order is rapidly changing. Until the early 1990s, multilateralism was dominant and regional remained marginal. Today, however, regionalism is well acknowledged as one of the two pillars of international economic order, together with multilateralism. It will be thus important to explore the harmony between regionalism and multilateralism. The question is whether regionalism may be a faster way to reach multilateralism or, rather, hurt multilateral liberalization. There is an increased attention being paid to regional arrangements. The threat to the multilateral trading system does not appear to be as large as is often reported. The debate about whether RTAs are "building blocks or stumbling blocks", in Jagdish

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<sup>2</sup> A kereskelempolitika témaköre érinti a fejlődő országok irányában kialakított nemzetközi fejlesztéspolitikát is

Bhagwati's phrase [] for global freer trade, which was so virulent in the 1990s, faded because, whatever the answer to the question, in practice RTAs have made so little difference either way. The impact on the global trading regime of the hundreds of RTAs notified to the GATT/WTO as being in contravention of the MFN principle has been trivial compared to the establishment of multilateral trade law based on the nondiscrimination principle. The dissemination of regionalism can contract and distort non-discriminatory multilateralism. Countries are too diverse in their developments. Negotiations under the framework of WTO take too much time as well. Regionalism is then an alternative to consider, at least, for countries geographically close to each other, especially for countries with close economic exchanges and interests.

Recent studies suggest that regional trade agreements may complement rather than threaten the multilateral trade system. At a theoretical level, economists are divided over the desirability of regional trade agreement in a multilateral trade regime. There is still no consensus about this issue. However, regionalism, with its advantages and drawbacks, is a reality of the current global trade regime. The wave of regionalism is likely to intensify in near future. If a very high proportion of global trade gets diverted through the regional route, WTO is bound to lose some of its relevance in the global trading system. However, in the current state of distorted multilateralism, regionalism has turned out to be one of the more viable alternatives for developing countries to expand their market access.

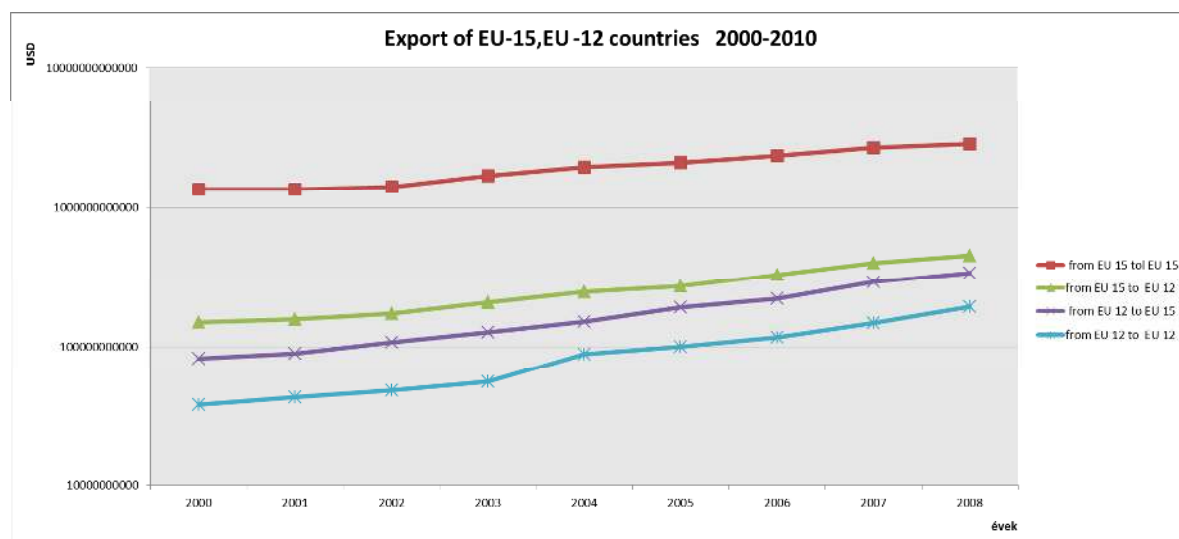
Since 1989, Europe has been the stage of an ongoing process of regional integration involving 15 European Union (EU) member states and ten Central and Eastern European Countries (CEECs). The EU admission of eight CEECs on 1 May 2004 represented a temporary peak in the integration process, but it was not the end of it. Bulgaria and Romania also joined the EU in January 2007 and Croatia in 2013.

The enlargement of the European Union (EU) from 15 to 27 members between 2004 and 2007 was one of the defining developments in its recent history. The Union had never before experienced such a major change in its structure and economic geography in such a short period of time. The economies involved in earlier enlargements had neither the heterogeneity between new members nor the divergence from the EU economic mean which this new enlargement involved (Huber, 2008 and Dupuch et al., 2004). Prior to enlargement there was much concern about the impact of the integration of economies with such different cost structures on industry in the existing EU and, in particular, industrial employment in the EU15 (Jacoby, 2010). This concern motivated several studies on the

likely economic impacts of enlargement which mainly concluded that the impacts would be far greater on the EU12 than on the EU15 (Buch and Piazzolo, 2001, Dupuch et al., 2004 and Bchir et al., 2003). These studies have explored several likely impacts from the EU's eastern enlargement including on wage rates and welfare (Bchir et al., 2003), foreign direct investment (FDI) (Dupuch et al., 2004 and Buch and Piazzolo, 2001), portfolio investment (Buch and Piazzolo, 2001) and trade (Bchir et al., 2003, Buch and Piazzolo, 2001 and Dupuch et al., 2004). We focus on the later the trade impacts of enlargement.

Enlargement not only resulted in free trade between the EU12 and the EU15, it also changed the EU12s trade policy in relation to the rest of the world. On accession to the EU the new member states were required to apply the common external tariff of the EU, including the preferential access to developing countries and other preferential trade partners which is part of the 'acquis communautaire'. In most cases this represented a liberalisation of trade policy (Avery and Cameron, 1998 and Buch and Piazzolo, 2001).<sup>3</sup> This trade opening would in any event be expected to foster trade as its costs fall (Bchir et al., 2003). What we seek to explore here is the extent to which it re-enforced the regionalisation of EU trade, especially in certain products.

**Figure 1** Export within the European Union



Source: Own calculation from gravity database

## OBJECTIVES AND METHODS

The gravity model has been used widely as a baseline model for estimating the impact of a variety of policy issues, including regional trading groups, currency unions, political

blocks, various trade distortions and agreements, border region activities and also historical linkages.

Owing to comparative advantages, habits, tastes, infrastructure and technology, regions with common border and similar historical background may be natural trade partners. Borders often tend to be formed around populations that are relatively homogenous, have similar tastes and habits, common historical background, and in which the regional economies are linked. The associated regions may create common rules to protect themselves from external shocks.

Growing empirical literature finds that historical linkages are important determinants of international trade flows (Frankel, Stein and Wei, 1995; Frankel, 1977; Eichengreen and Irwin, 1998).

The current EU members have already created a well-integrated market among themselves and they are maintaining stronger trade links with each other than with the countries that will join later. This fact must also be taken into consideration when analysing EU eastward enlargement processes.

The analysis now turns to reviewing and assessing actual approaches to measure the effect of membership of economic integration. The very purpose of this model is to further analyse the relations between the integration indicators.

### *Gravity Model*

The gravity model is an instrument which enables statistical analysis of flows and patterns with bilateral trade flow data. The model is convenient as an examination tool for many reasons such as simplicity, high explanatory ability and improved econometrics. Lately the model has been advanced to examine trade diversion and trade creation effects as well which has enhanced the models use. The model is frequently used in trade pattern researches.

Starting in the 1860s when H.Carey first applied Newtonian physics to the study of human behaviour, the gravity law based approach has been widely used in the social sciences. Thus, a gravity model is a mathematical model based on analogy with Newton's gravitational law which has been used to account for aggregate human behaviour related to spatial interaction (see Send and Smith, 1995). Gravity model based studies have achieved empirical success in explaining various types of inter-regional and international flows, including labour migration, commuting, customers and international trade.

Newton's law states that the attraction force between two bodies is directly related to their size and inversely related to the distance between them. Thus, interaction ( $F_{ij}$ ) between entities  $i$  and  $j$  is a function of repulsive forces at  $i$  and attractive forces at  $j$ , and an inverse function of distance (or friction) ( $d_{ij}$ ) between  $i$  and  $j$ . Analytically, the basic equation that is used to express the gravity hypothesis on trade flows between origin  $i$  and destination  $j$  is:

$$F_{ij} = f \frac{m_i m_j}{d_{ij}^b}$$

in which:  $F_{ij}$  represents exports from origin  $i$  to destination  $j$ ,  $f$  is a constant of proportionality,  $m_i$  and  $m_j$  express the sizes of origin  $i$  and destination  $j$ ,  $d_{ij}$  represents spatial separation between each origin  $i$  and each destination  $j$  and  $b$  is the so-called distance decay parameter, measuring the flow sensibility to spatial separation.

In the gravity equation used for exploring international trade flows the interaction volume ( $F_{ij}$ ) is represented by the trade flows from the country  $i$  to the country  $j$ .

The gravity model of international trade was developed independently by Jan Tinbergen (1962) and Pentti Pöyhönen (1963). In this basic form of the gravity model, the amount of trade between two countries is assumed to be increasing in their sizes, as measured by their national incomes, and decreasing in the cost of transport between them, as measured the distance between their economic centres. Following this work, Hans Linnemann (1966) included population as an additional measure of country's size. This model is sometimes called "the augmented gravity model" (Cheng and Howard, 2002). It is also common to specify the augmented gravity model using per capita income (or per capita GDP). The population expresses the size of a country as well as the size of its economy. Per capita income expresses the level of economic development. Thus, the size of economy and level of economic development are the main attractive forces or pull factors of bilateral trade flows.

The main push factor is the distance between the trading partner's countries.

The theoretical considerations for using gravity models to explore international trade flows have been widely discussed and developed (Tinbergen 1962; Linnemann, 1966; Anderson, 1979; Bergstrand, 1985, 1989 and 1990; Deardorff, 1984, 1995 and 1998; Evenett and Keller, 1998 and 2002; Anderson and Wincoop, 2001; Harrigan, 2001;

Hanson and Xiang, 2002; Cheng and Wall, 2002). Thanks to various modelling refinements and their application to debates about theoretical foundation of the gravity equation, this model has established itself as a serious empirical tool for exploring regional trade patterns. Evenett and Keller (2002), and Deardorff (1998), evaluate the usefulness of gravity models also in testing alternative theoretical models of trade. Despite the continuing discussions about the foundations of the gravity equation, we can summarize that the theoretical considerations which are mostly based on microeconomic foundations, trade theories and new economic geography are also applicable when analysing possible consequences of regional integration in the context of EU eastward enlargement.

The regional integration effects as the deviations from the volume of trade predicted by the baseline gravity model, which expresses the impact of traditional gravitational forces like size of economy, level of economic development and distance, are captured by dummy variables.

Gravity models have been used extensively for the empirical analysis of a wide range of international economics topics, including FTAs.

In this study, we will use a gravity model in the general form of:

$$FLOW_{ij} = A GDP_i^{\beta_1} GDP_j^{\beta_2} d_{ij}^{\beta_3} L_{ij} L_i L_j \varepsilon_{ij},$$

The traditional approach to estimating this equation consists in taking logs of both sides, leading to a log-log model of the form.

$$\ln FLOW_{ij} = \ln A + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln d_{ij} + \ln L_i + \ln L_j + \ln L_{ij}.$$

$FLOW_{ij}$  = Trade between economy i and j (as reported by economy i)

$GDP_i$  = GDP of economy i, as a proxy for the size of the reporting economy

$GDP_j$  = GDP of economy j, as a proxy for the size of the partner economy

$d_{ij}$  = Distance between i and j, as a proxy of travel cost of trade (data are extracted from <http://www.distancefromto.net/>)

$L_{ij}; L_i, L_j$  = Predictors, independent variables, stand for other variables such as common language and historical bonds, population, size of the economy

$\varepsilon_{ij}$  = residual of the regression; the term captures movements in the bilateral trade not explained by the factors listed earlier

Dummy variables are added to the gravity equation to capture abstract features and differences between country pairs that may play a determining role in trade relations. Common dummy variables that are included in the equation are language and borders which take consideration to cultural affinity and historical and economic ties between



countries. They indicate lower transaction costs and possibly a more open market between countries with similar cultures.

But borders can also reflect a hinder to trade because crossing borders involves formalities that take time and tariff costs which contribute to reduction of trade. In addition borders can indicate different languages and different currencies which impede trade as well (Krugman and Obstfeld, 2006). Dummy variables can also capture for RTA effects. Through a set of dummies one can analyze if the propensity to import and export in total with their propensity to import and export between specific partners has changed because of a RTA.

**Border** = Dummy variable takes the value of '1' if both economies  $i$  and  $j$  have connecting border or else the dummy variable takes the value of '0'

**Language** = Dummy variable takes the value of '1' if both economies  $i$  and  $j$  have common official language or else the dummy variable takes the value of '0'

**EU both $_{i,j}$**  = Dummy variable takes the value of '1' if both economies  $i$  and  $j$  belong to EU or else the dummy variable takes the value of '0'

**EU one $_{i,j}$**  = Dummy variable takes the value of '1' if either economy  $i$  or  $j$  but

#### *Data*

The data used cover a period of 11 years (2000-2010) whereas the country sample contains all of the 27 EU member countries. The bilateral trade data ( $EXP_{ij}$ ) are extracted from the United Nation ComTrade database (UN ComTrade). Population and GDP data come from the World Bank Database (World Trade indicators). In my gravity database there are **7723** observations, the matrix has altogether **642697 data cells**.

The GDP variables in the gravity equation are used as representing the importer demand and exporter supply potential, which also indicates that the size of an economy has direct relation to the volume of imports and exports as indicated by the equation. Larger economies produce more goods and services which means they have more to sell in the export market. Larger economies also generate a higher income enabling a higher import level.

It is expected that the coefficients associated to *GDP* and *POP*, have positive signs, because these are the traditional propulsion (for origins) and attraction (for destinations) variables in the gravity model. The sign and the statistical significance of these coefficients will indicate how these factors affect bilateral trade between a pair of countries/economies.

If a coefficient is statistically significant and it is positive, the factor it represents has a strong direct relationship with bilateral trade, i.e., the factor is deemed to promote bilateral trade. From the equation we would expect both GDP and POP to be positive since the size of reporting economy and partner economy will directly affect the size of bilateral trade between the two economies. Generally, we expect economies/countries with bigger economic sizes (as proxy by GDP) to have a larger capacity to trade.

On the contrary, it is expected that the distance parameter has a negative sign. If a statistically significant coefficient is negative, the factor it represents has a strong inverse relationship with the bilateral trade, i.e., the factor is deemed to impede trade. If a coefficient is statistically insignificant, it indicates that the factor it represents has a minimal impact on the bilateral trade. Distance measures transport costs between countries and indirectly also takes account to poor infrastructure as it is a component that impairs transport and increases costs as mountains, seas and sea harbors complicate trade and makes it difficult. Distance also affects personal contact and communication which affects trade as well.  $D_{ij}$  is likely to be negatively since distance presents a hindrance to trade.

## RESULTS

### Cross section analysis

The quantitative study is performed on panel data from 2000 to 2010. The results of the regressions are presented in Tab. 1.

Exporter GDP (0.705) exhibits a positive coefficient. The importer GDP coefficient (0.8633) has the same positive sign. These results indicate a great impact from the EU countries. The coefficient estimate indicates that an increase of 1% in the EU GDP will increase the EU export to EU by 0.7057%.

The distance coefficient which is negative in the OLS results has the most significant impact on bilateral trade flows and this impact is as expected negative. The impact of the trading partners' size and level of economic development is positive. The common border coefficient, while positive and significant in the OLS table,  $\exp(0.57)=1.768$ . The coefficient of the border dummy is statistically significant and it indicates that bilateral trade flows between the border countries are 76.8 % times larger than trade flows between other countries.

**Table 1** Cross section gravity estimation for export flows within EU members

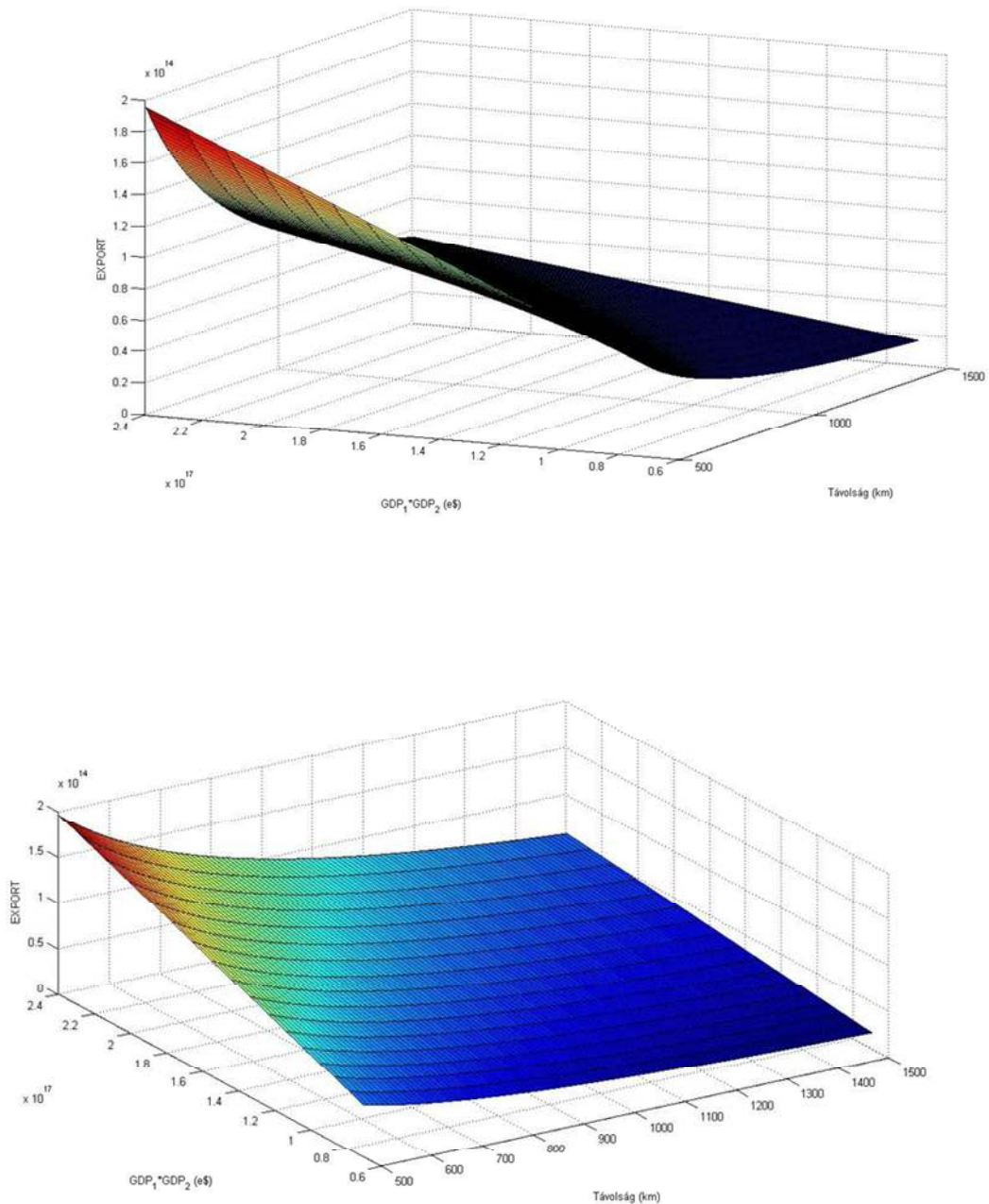
Variable	Dependent variable: $\ln \text{export}_{ij}$			
	<i>Linear regression</i>			
	2007	2008	2009	2010
$\ln \text{GDP}_1$	0.910 *** (0.145)	0.701 *** (0.188)	1.100 *** (0.033)	0.938 *** (0.097)
$\ln \text{GDP}_2$	0.966 *** (0.146)	0.863 *** (0.153)	0.872 *** (0.31)	0.746 *** (0.113)
$\ln \text{Distance}_{12}$	-1.066 *** (0.109)	-1.043 *** (0.1183)	-1.121 *** (0.091)	-1.208 *** (0.089)
$\ln \text{size1}$	0.0567 (0.066)	0.113 *** (0.058)	0.115 (0.059)	-0.074 (0.054)
$\ln \text{size2}$	0.046 (0.071)	0.094 *** (0.071)	0.005 (0.052)	0.119 *** (0.064)
$\ln \text{Population1}$	0.177 (0.178)	0.383 *** (0.216)	-0.058 (0.13)	0.111 (0.113)
$\ln \text{Population 2}$	-0.334 *** (0.18)	-0.275 (0.183)	0.212 (0.1523)	0.126 (0.141)
border	0.444 *** (0.251)	0.573 *** (0.232)	0.225 *** (0.176)	0.115 (0.17)
common language	-0.655 (0.533)	-0.294 (0.466)	0.753 *** (0.229)	0.563 (0.23)
$R^2$	0.702	0.642	0.802	0.801

Source: own calculation.

The equation based on cross section estimation from **2008** is the following:

$$\text{export}_{12} = g * \text{GDP}_1^{0.7057} * \text{GDP}_2^{0.8633} * \text{D}_{12}^{-1.0451} * \text{Border}^{0.5726} * \text{Language}^{-0.2941}$$

**Figure 2** Shape of linear regression (cross section model 2008)



Recently, it is criticised that the use of conventional cross-section estimation is misspecified since it is not able to deal with bilateral (exporter and/or importer) heterogeneity, which is extremely likely to be present in bilateral trade flows. In this regard a panel based approach will be desired because heterogeneity issues can be modelled by including country-pair “individual” effects.

## Panel data analysis

After discussing the recent econometric developments in gravity modeling, a correctly specified fixed effects gravity model is proposed in this section.

In [HYPERLINK "http://en.wikipedia.org/wiki/Statistics"](http://en.wikipedia.org/wiki/Statistics) \o "Statistics" statistics and [HYPERLINK "http://en.wikipedia.org/wiki/Econometrics"](http://en.wikipedia.org/wiki/Econometrics) \o "Econometrics" econometrics, the term **panel data** refers to multi-dimensional [HYPERLINK "http://en.wikipedia.org/wiki/Data\\_set"](http://en.wikipedia.org/wiki/Data_set) \o "Data set" data frequently involving measurements over time. Panel data contain observations of multiple phenomena obtained over multiple time periods for the same firms or individuals. [HYPERLINK "http://en.wikipedia.org/wiki/Time\\_series"](http://en.wikipedia.org/wiki/Time_series) \o "Time series" Time series and [HYPERLINK "http://en.wikipedia.org/wiki/Cross-sectional\\_data"](http://en.wikipedia.org/wiki/Cross-sectional_data) \o "Cross-sectional data" cross-sectional data are special cases of panel data that are in one dimension only (one panel member or individual for the former, one time point for the latter).

Longitudinal and panel databases and models have taken an important role in the literature. They are widely used in the social science literature, where panel data are also known as pooled cross-sectional time series and in the natural sciences, where panel data are referred to as longitudinal data.

To be able to answer the basic question in this paper an empirical research is performed with the frequently used gravity model. The gravity equation is estimated through the OLS procedure. In aim of receiving the best regression results from the OLS an alternative version of the standard gravity equation, a fixed effect equation is calculated and run as well. The quantitative study is performed on panel data from 2000 to 2010.

Although a number of panel estimation techniques such as the pooled OLS, the Fixed Effects Model, and the Random Effects Model have been applied in various contexts, the assumption that unobserved individual effects are uncorrelated with all the regressors is convincingly rejected in almost all studies. Therefore, the Fixed Effects estimation has been the most preferred estimation method in order to avoid the potentially biased estimation.

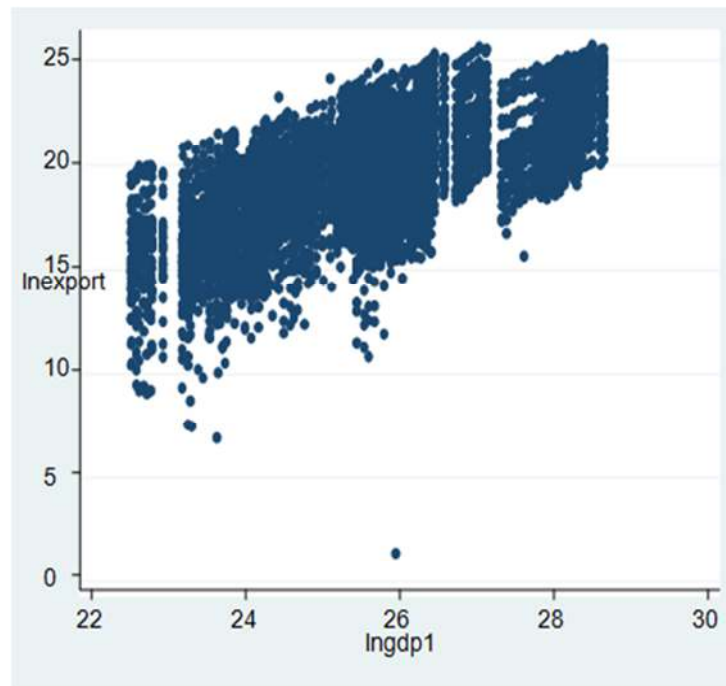
The FE (Fixed effects) model does not measure the actual between-country effects but rather controls and fixes them, because the individual country-specific variation which is stable over time, should not affect the conclusion of the research. Unfortunately this also means that constant factors like distance, common language and common borders cannot be estimated for which the model will drop. However, the reasons for a performance of a country-pair fixed effect regression overshadow this shortcoming. A FE regression is

therefore performed on the data simultaneous to the regular OLS. This is done through inclusion of individual country-pair dummies in the gravity model function. When examining panel data with a FE model, inclusion of time dummies is considered to provide better results where complete panel dimensions are taken account to.

**Table 2** Gravity panel data regression analysis

Variables	Dependent variable: $\ln \text{export}_{ij}$						
	<i>Linear regression</i>						
	<i>2000-2008 fixed effect (fe)(1)</i>	<i>2000-2009 pool (OLS)(2)</i>	<i>2000-2009 random effect (re)(3)</i>	<i>2000-2009 fixed effect (fe)(4)</i>	<i>2000-2010 pool (OLS)(5)</i>	<i>2000-2010 random effect(re)(6)</i>	<i>2000-2010 fixed effect(fe)(7)</i>
$\ln \text{GDP}_i$	1.535*** (0.459)	1.163*** (0.012)	1.125*** (0.033)	1.401*** (0.114)	1.049*** (0.050)	1.264*** (0.072)	1.424*** (0.033)
$\ln \text{GDP}_j$	1.187*** (0.276)	0.7623*** (0.015)	0.801*** (0.310)	0.806*** (0.110)	0.889*** (0.046)	0.866** (0.068)	0.664*** (0.310)
$\ln \text{DIST}_{ij}$	-1.091	-1.142*** (0.028)	-1.102*** (0.077)	-1.120	-1.049*** (0.033)	-1.097*** (0.079)	-0.675 (0.077)
EU ONE	0.239*** (0.010)	0.243	0.274*** (0.054)	0.280*** (0.049)	0.165*** (0.097)	0.293*** (0.049)	0.316*** (0.054)
EU BOTH	0.381*** (0.114)	0.432	0.574*** (0.052)	0.486*** (0.054)	0.623*** (0.105)	0.523*** (0.523)	0.545*** (0.052)
$R^2$	0.940	0.693	0.6208	0.615	0.705	0.702	0.670

Tab. 2 reports the results of estimates of different panel models, namely the OLS, the fixed effect (FE) and the random effect (RE) models. The estimated coefficient of total export is positive and significant at the 5% significance level. Exporter GDP and importer GDP are positive as expected and significant at 5%. (Any unit increase of a country's GDP raises, ceteris paribus, its exports to other EU countries by 1.535% more). The estimated coefficient EU membership is positive and has a very high estimated value of 0.38. The coefficient is also statistically significant at the 5% level.

**Figure 3** Correlation between GDP1 and export.

Source: Own calculation made by STATA program

Hausman test can be also used to differentiate between fixed effects model and random effects model in panel data. In this case, FE model is preferred.

**Figure 4** Hausman test

```
. xttest0
Breusch and Pagan Lagrangian multiplier test for random effects
lnexport[orszagpar_azon,t] = Xb + u[orszagpar_azon] + e[orszagpar_azon,t]
Estimated results:
```

	Var	sd = sqrt(Var)
lnexport	7.249338	2.69246
e	.6238804	.789861
u	1.527214	1.235805

```
Test: Var(u) = 0
      chi2(1) = 17829.12
      Prob > chi2 = 0.0000
```

## CONCLUSION

First, the impact of the GDP variables is always significantly positive, whereas the impact of population variables is found to be mostly insignificant. Second, the impacts of EU membership are all positively significant. In general, the intra-EU trade volumes were positively affected by the enlargement of the European Community, e.g. with the accession

of new member states. This clearly suggests that one of main factors behind the increasing importance of intra-EU trade within the total EU trade is clearly the stronger link among member states over the last decade.

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