EKONOMIHÖGSKOLAN
Lunds universitet

Department of Economics
University of Lund

East-West Trade Before the EU-expansion
- A Gravity Model Analysis

Supervisor: Carl-Johan Belfrage

Author: Victor Snellman. 800614-0118

Abstract

When the EU expanded to include ten new countries, the popular opinion was that this would inevitably lead to large increases in trade flows between eastern and western Europe. However, economists have studies the potential for increased trade between the two regions since the fall of the Berlin wall, and much of the evidence indicates that the EU already had a very good bilateral trade relationship with all of the new EU- members as early as the mid-nineties. This, coupled with the fact that the EU already is such an open market, and that the accession agreements had granted the future members even better access, indicates that the popular opinions might not be plausible.

This paper investigates the question by using the gravity model of trade, and concludes that the evidence is somewhat unclear, which in itself attests to the success of pre-accession trade integration efforts.

Keywords: European Union, East-West Trade, Gravity Model, Regional Integration

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List of Abbreviations

CEEC	Central and Eastern European Country
CMEA	Council for Mutual Economic Assistance
EA	Europe Agreement
EC	European Community
EU	European Union
FDI	Foreign Direct Investment
NAFTA	North American Free Trade Agreement
OECD	Organisation for Economic Cooperation and Development
RTA	Regional Trade Agreement

1. Introduction

Ever since a normal economic relationship between eastern and western Europe began to seem plausible after the fall of the soviet union, economists have studied the potential trade benefits of closer integration. These studies have been dominated by a certain type of estimates based on the gravity model of trade, and have concluded that the eastern and western European countries already had very successful bilateral trade relationships by the mid-nineties. This evidence coupled with the constantly increasing share of exports going from eastern to western Europe raises the possibility of there not being any large increases in trade after the expansion of the EU in 2004. This study is also based on the gravity model of trade, but takes a new approach. Instead of, as is standard in gravity model based studies, comparing east-west trade to trade in the rest of the the world, this paper compares east west trade to intra-eastern and intra-western trade, and uses a methodology that is more akin to what is usually found in gravity model studies of regional trade agreements.

The paper proposes that one cannot expect that any dramatic changes in trade volumes will be taking place in the future, if the trade relations between eastern and western Europe can be considered equivalent to the relationships between countries within the same region. The relationship will be considered equivalent if a western country trades just as much with an East European country as with another West European country, given certain values of underlying economic variables. This situation also implies that the CEECs included in the sample no longer trade far below their potential, as was estimated by several economists during the early 90's.

1.1 Purpose

This paper is an attempt to analyse trade between the new eastern European EU-members and the old EU in a gravity model framework. I will try to answer two questions through the use of this model. The first question is whether or not the gravity model can be used to describe east-west trade. The second question to be answered is whether or not we can expect any significant increase in trade after the accession of the new members in 2004.

1.2 Method

The methodology will consist of an econometric analysis based on the gravity model of trade, and will use a sample consisting of the old fifteen and eight new eastern EU member countries. The analysis is based on bilateral trade data, with 450 bilateral trade relations spanning the years 1995 to 2002. The methodology is inspired by several other studies on east-west trade and uses of the gravity model, but I have found no other study with on east-west trade with quite the same approach. Instead, the use of the gravity model in this paper is more similar to the studies that attempt to assess the success of different regional trade arrangements. This paper is however, not an explicit attempt to assess the EU's pre-accession trade agreements.

1.3 Delimitation

The paper limits itself to solely studying the EU and the new eastern members. While it would have been desirable to include Romania, Bulgaria and other central and east European members in the study, the lack of access to the required bilateral trade data made this impossible. Furthermore, no country is studied at an individual level.

1.4 Outline of the paper

The outline of the paper is as follows. Section 2 gives a short description of the historical setting, a description of the conditions for trade in the recent years and some facts about trade between the EU and their newly admitted members. Section 3 details some of the research on east-west trade. Section 4 describes the gravity model of trade, how it can be derived from the well known H-O model and how it is used in research. Section 5 contains the reasoning behind the model specification, and what conclusions we can draw from different outcomes. The sources for the data is found in section 6, and the results of the estimation can be found in section 7. Section 8 concludes, and references are in section 9.

2. Background

"*... sound international trade relations are likely to offer a far greater stimulus to the Eastern European economies than could any conceivable aid flow.*"
(Hamilton and Winters, 1992)

On the 1st of May 2004, the European Union admitted ten new members, and expanded from fifteen countries to twenty-five. The largest expansion of the EU to date, it will also be the most challenging. All of the new member countries are transition economies, some with large populations and a gross national production per capita far below the EU average. This is not the first time the EU has expanded to include its poorer neighbours, with Greece in 1981 and then Spain and Portugal in 1986. This time around however, the differences are much larger. This can be seen as a part of larger trend, where countries with widely varying levels of development are integrating (Fernandez 1997), with the second well known example being NAFTA. However, the EU enlargement dwarfs all other regional integration project in scale and potential.

Integration into the EU has been a foreign policy objective for Central- and East European countries since the end of socialism, and in 1997 the Luxembourg European Council decided to launch negotiations with all prospective members. Of the eastern European countries The Czech Republic, Estonia, Hungary, Poland, Slovenia, Latvia, Lithuania and the Slovak Republic officially became members of the EU on the 1st of May 2004.

2.1 Integration before accession – The Europe Agreements

"The Europe Agreements cover trade-related issues, political dialogue, legal approximation and other areas of co-operation, including industry, environment, transport and customs. They aim progressively to establish a free-trade area between the EU and the associated countries over a given period."
(Taken from the official EU web page at europa.eu.int/)

As a first step in joining the EU, all of the future members signed individual Europe Agreements. The official aim of the EAs is to ease the process of transition into EU-membership. A list of all East European countries that have signed a EA is given in table 1.

Table 1.

List of all Countries that have signed Europe Agreements				
Country	**Europe Agreement signed**	**Europe Agreement came into force**	**Official application for EU Membership**	Current EU-member?
Bulgaria	March 1993	February 1995	December 1995	No
Czech Republic	October 1993	February 1995	January 1996	Yes
Estonia	June 1995	February 1998	November 1995	Yes
Hungary	December 1991	February 1994	March 1994	Yes
Latvia	June 1995	February 1998	October 1995	Yes
Lithuania	June 1995	February 1998	December 1995	Yes
Poland	December 1991	February 1994	April 1994	Yes
Romania	February 1993	February 1995	June 1995	No
Slovakia	October 1993	February 1995	June 1995	Yes
Slovenia	June 1996	February 1999	June 1996	Yes

One of the main arguments for joining the EU was the increased access to the EU-markets. However, aside from certain "special" or "sensitive" goods like agricultural, steel, chemical and textile products (Cadot, Faini and Melo, 1995), the European market is already very open to foreign imports. The agreements first of all guarantee free access for all industrial goods. The EAs do however retain the restrictions on agricultural and textile goods. The official reason that free trade was not established immediately was that the future members would not be able to cope with the European market forces and competition[1]. This has lead to some observers stating that these agreements were simply keeping the status quo, and were unlikely to ever lead to much increase in trade (Fernandez 1997).

While the Europe Agreements might not have been as generous with respect to trade as some were hoping, they still contained many features that would lead one to expect an increase in trade flows. While the trade barriers on many sensitive goods were (and are, in the case of

[1] *Commission of the European Communities (1997)* (COM (97) 2001–2010, final) in Nilsson (2000)

Bulgaria and Romania) still in place, the free access for manufacturing goods was a boon to the future EU-members, as many studies have concluded that their revealed comparative advantages are in that area (one example being Landesmann, 1995).

In addition to liberalising trade, the EAs contain provisions regarding the free movement of services, payments and capital in respect to trade. Companies operating in a foreign market are also guaranteed treatment that is no less favourable than that given to native firms.
The Europe Agreements have a much stronger domestic economic policy implication than most regional trade arrangements. The EAs contain many provisions that effectively bind the domestic policies of the countries that sign them. Each of the participants promised to align their legislation on subjects including state aid and intellectual property with EU-standards.

Above all, the agreements require that the new members implement EU competition law to all trade between the EU and the CEECs. Questionable practices are to be judged with reference to EU law, and due to the highly incomplete nature of competition law in the CEECs, this basically amounted to exporting the EU's competition law to the CEECs (Fernandez, 1997). Together with the politically stabilising effects of EU membership, the EAs should improve the business environment in eastern Europe, which in itself is positive for trade relations, as institutional frameworks can be highly significant in determining trade volumes (Koukhartchouk and Maurel, 2003).

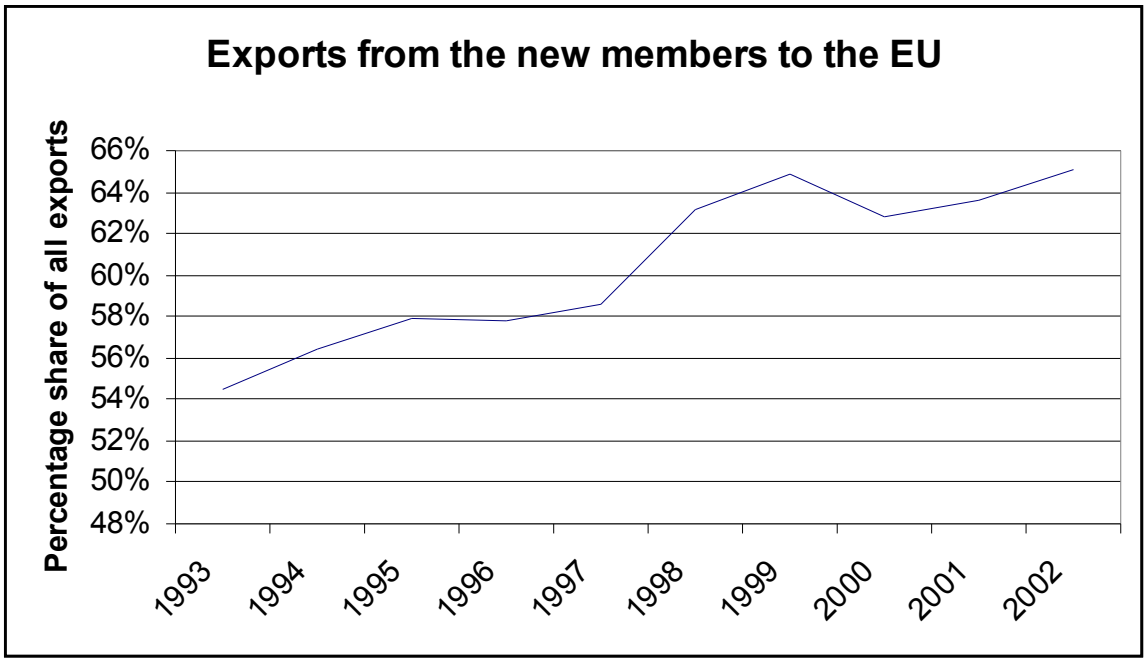
2.2 Facts about EU-CEEC trade

Between 1993 and 2002, the trade volumes between the EU and their future eastern European members grew at a rapid rate. The total volume of exports, from the the newly admitted EU countries to the rest of the EU rose by 245%, in current US dollars. At the same time, the western European EU-member countries saw their exports to Eastern Europe increase by 233%.

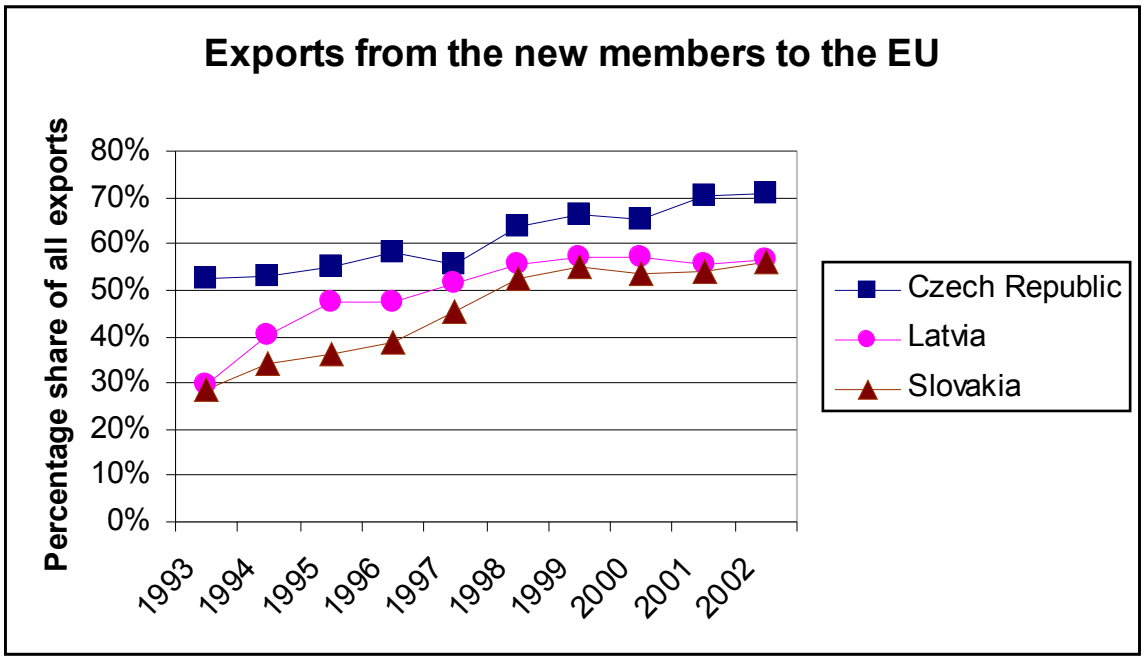
The EU is, by far, the most important trading partner of the new member countries, being the partner in 65% of their trade flows, as defined by the sum of exports and imports in current dollars in 2002. This figure is up from 54% in 1993. However, the 11 percentage point increase in share of trade flows was not across the board. The only countries that became

significantly more tied to the EU-market were The Czech Republic, Slovenia and Latvia. The rest of the group saw only very small increases, with a small decrease in the case of Lithuania. These points are illustrated in the diagrams presented below. All diagrams are based on figures taken from the OECD STAN database.

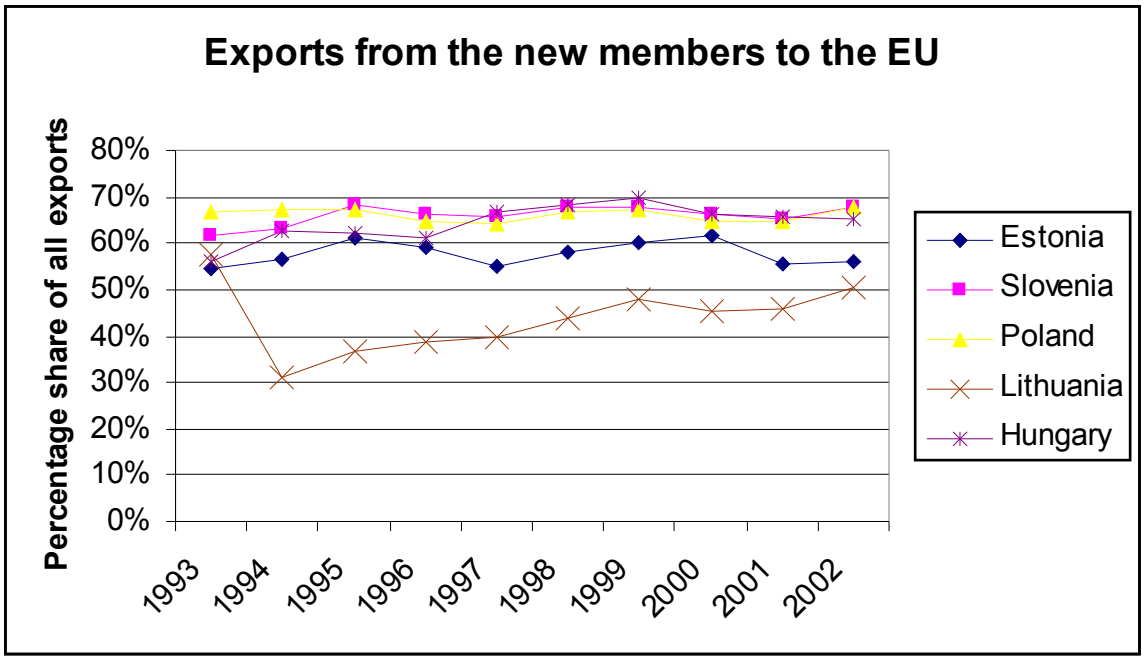
Graph 1.



Graph 2.



Graph 3.



3. Previous research on east-west trade

During the later half of 1989, the eastern and central European communist regimes started tumbling down, with the fall of the Berlin wall being the most dramatic symbol of the new era. Two years later in 1991, the eastern European trading and economic co-operation block Comecon officially broke up. Normal trade relations between east and west finally became plausible. As political tensions started to ease, economists went to work on assessing the potential gains.

Several papers were published in the early 90's, with Hamilton and Winters (1992), Wang and Winters (1992) and Baldwin (1994) perhaps being the most influential. Using econometric methods based on the gravity model of trade, all of these studies concluded that trade between eastern and western Europe was far below its potential level, making a strong case for increasing east-west integration.

The low trade volumes are generally thought to have been caused by two factors. First, and most importantly, government policies on both sides of the curtain explicitly suppressed commerce between the two regions. Before 1989, the governments of the CEECs were part of

the Council for Mutual Economic Assistance (CMEA) and restricted trade with the west by explicit interventions[1]. The consequence was greater trade friction for trade between the two blocs than for trade within them. Secondly, inferior technologies and many other factors caused the CEECs to grow at a slower pace than their western neighbours. This naturally had adverse supply and demand side effects on trade, further decreasing trade flows.

Between 1989 and 1992, trade flows expanded by 50%. The expansion was mostly fuelled by manufactures, where tariffs had never been very high in the first place. This suggests that EC trade policy was not the actual driving force (Portes 1993). This does not mean that trade policy had no effect, but it suggests that other factors probably were more important. The realignment of trade along paths determined by economic factors instead of politics, is the most likely the explanation.

As the date for EU accession got closer, several authors updated the analysis from the early nineties. Nilsson (2000), for example, compares his own findings to those of Baldwin (1994) and Gros and Gonciarz (1996). These three papers compare the trade volumes predicted by the gravity model ("potential trade") to actual trade. The potential trade volumes were predicted by using the coefficients from the gravity model, which in turn were based on a crossection with a wide variety of trade relations. This type of analysis therefore compares east-west trade to trade going on in the rest of the world. An index is then constructed:

$$\frac{\text{Potential trade}}{\text{Actual trade}} = \textit{Trade potential index}$$

A number lower than 1 indicates that actual trade is higher than predicted by the gravity model. A number higher than 1 indicates lower trade than predicted by the gravity model. If potential trade is estimated to be higher than actual trade, it was concluded that trade could be significantly increased through closer integration.

Together, these reports indicated that the eastern European countries were steadily catching up to the rest of Europe in EU trade. In many cases, countries were even trading far above the levels predicted by the gravity model. The findings of different papers with regards to the

[1] *See Schrenk (1992) for a description of the CMEA system*

potential trade of different countries are summarised in the following table (taken from Nilsson, 2002):

Table 2.

	Baldwin (1994)	***Gros and Gonciarz (1996)***	***Nilsson (2002)***
Year used	1989	1992	Average of 1995/1996
Bulgaria	5,2	-	-
Czech Republic	-	-	1,6
Estonia	-	-	0,4
Hungary	1,7	0,4	0,5
Latvia	-	-	0,4
Lithuania	-	-	0,5
Poland	2,1	0,4	0,7
Romania	1,2	-	0,5
Slovak Republic	-	-	0,8
Slovenia	-	-	0.9
CEEC(10)	-	-	0.9

The most relevant comparison to this study that can be found in this table, is the CEEC(10) figure, which includes all of the countries in the table, and concludes that the candidate countries exceeded their trade potentials around 1995 and 1996.

A paper by Breuss and Egger (1999) criticized the above methodology, and cast doubt over the actual possibility of utilising crossection modelling in order to make predictions about potential trade, as their own predictions were found to have confidence intervals of +/- 350%. The authors claim that this makes accurate forecasts of future EU-CEEC trade a questionable practice.

A few papers on more country specific effects have also been published. For example, Jakab, Kovacs and Ozlay (2001), uses a gravity model that has been specified in way that takes the criticism found in Breuss and Egger (1999) into account to investigate the trade between Poland, Hungary and the Czech Republic and the EU. They come to the conclusion that rapid integration has been taking place, and that trade levels are quickly approaching the levels predicted by the gravity model. Trade between Poland, the Czech Republic and the EU were concluded to not have reached their potential level in 1997.

Gros and Gonciarz (1997) finds that the general consensus that can be drawn from all of the studies on east-west trade, is that East European trade has rapidly been catching up to, and in some estimates exceeded, calculated trade potentials.

The idea for this paper came from the previously listed research. If so many papers were concluding that east-west trade was already dramatically exceeding what could be considered normal levels of trade in the mid nineties; could we really expect any large increases in trade volumes between the old and new EU members following the official expansion? The figures in Nilsson (2000), for example, indicate that Estonia was already in 1995 trading 2.5 times more with western Europe than was predicted by the gravity model. A paper by Cheng & Wall (2004) also found the the effects of joining the EU for Austria, Finland and Sweden were insignificant.

Furthermore, the EU was already, by international standards, a very open market, and the EAs gave virtually free access to industrial goods, the sector in which the new members have their strongest comparative advantage compared to the EU. Against this background, it seems reasonable to question the idea that we can expect significant increases in trade volumes after the official EU-expansion in 2004.

4. The Gravity Model

The empirical investigation in this paper is based on the gravity model of trade. There are several different versions of the gravity equation, but what they all have in common is that they explain bilateral trade flows as a function of the gross domestic product of the trading partners. The classical specification of the gravity model also includes a distance parameter as a proxy for trade costs. They all state that

$$\text{Trade volume} = f(GDP^{exporter}, GDP^{importer}, \text{distance})$$

The gravity model first appeared in papers by Tinbergen (1962) and Pöyhönen (1963), which used it to econometrically analyse trade flows. Their justification was only intuitive, and lacked any formal theory. However, the intuition for the gravity model is simple, and comes

from basic macroeconomics. As incomes rise in the importing country, so does demand. Unless we assume that demand for foreign goods actually falls or is constant as consumers get richer, there will be a positive statistical correlation between GDP and imports. Furthermore, since trade needs to balance in the long run, increases in imports should also increase exports. The exporting country's GDP can also be seen as a proxy for its supply and variety of goods. Lastly, distance between countries implies larger transport costs which decreases trade. In econometric applications, the distance variable probably captures other things as well, as countries that are closer together are more likely to have, for example, historical business ties, more similar cultures and greater ease of communication. Despite the models intuitive qualities, the use of the gravity model was often criticised for lacking more formal theoretical foundations.

The explanatory success of the gravity model prompted several researchers to direct their efforts towards a formal underlying theory. First out was Linneman (1966) who derived the gravity equation from a partial equilibrium model of export supply and import demand. During the 1980's a more solid case was made for the gravity model by Bergstrand (1985, 1989) and Krugman and Helpman (1985). Several authors have since then proven that many trade models, including the very different H-O models, Ricardian models and IRS-models, can be generalised into the gravity equation. Following these theoretical advancements, researchers started using the gravity model to empirically test different trade models. This led to the conclusion that the gravity model did not actually measure any single type of trade, but, as noted by Deardorff (1995) "because the gravity equation characterises many models, its use to test any of them is suspect."

4.1 How the Gravity Model can be derived from the H-O model

In order to show that a standard theory of trade can be generalised into the gravity model, this part of the paper will give a brief description of how the gravity model can be derived from the Heckscher-Ohlin model.

One example of a gravity equation, termed "the standard gravity equation" is taken from Deardorff (1995):

$$(1) \quad EX^{ij} = A\frac{(Y^j Y^i)}{D^{ij}}$$

EX represents exports from country i to country j. A is a multilateral resistance term, while Y is the GDP of each respective country. D is the distance between country *i* and country *j*.

Deardorff (1995) shows that the gravity equation can be derived from a modified version of the Heckscher-Ohlin; one of the most fundamental trade models. While the standard version of the H-O model assumes that there are no impediments to trade, Deardorff adds them. Trade costs are assumed to be positive for all goods traded between nations, and are of Samuelson's iceberg form, which means that the fraction (t^{ij} - 1) of each exported is destroyed during transport to a foreign country. Each country also produces different goods, and each good is only produced in a single country. Factor costs are also assumed to be different in each country. Competition is assumed to be perfect, and sellers therefore receive the same price for all exports in all countries. The transport costs are paid by the buyers, who therefore must pay the price $t^{ij} p^i$, where country *j* is the importer and country *i* is the exporter. Demand is of the Cobb-Douglas type, and identical across all countries. Consumers will spend a fixed share of their income on each good. From these assumptions, Deardorff shows that he can derive two versions of the gravity equation. If we choose to include transport costs in the value of trade, the value of trade between country i and j will be:

$$(2) \quad EX^{ij} = \frac{(Y^i Y^j)}{Y^w}$$

where Y^w is world GDP. This is called the frictionless gravity equation. If trade is valued apart from transport costs, the equation turns into:

$$(3) \quad EX^{ij} = \frac{(Y^i Y^j)}{(t^{ij} Y^w)}$$

Here we can clearly see that increased trade costs will lower trade between two countries, and in both equations trade is a positive function of both countries' GDP. If we assume that t^{ij} rises with distance, we get something that is very similar to the standard gravity equation.

Like in any economic model, several of the assumptions are violated in reality. Preferences are and are certainly neither identical across countries nor homothetic, but demand for imports is more likely to rise as consumers get richer and can afford a larger variety of goods. Still, the gravity equation has proven to be one of the most successful theories in empirical economic research.

4.2 Applications of the Gravity Model

Due to its simplicity, empirical success and use of readily available data, the gravity model has become immensely popular, even being referred to as "workhorse for empirical studies of [regional integration] to the virtual exclusion of other approaches." (Eichengreen and Irwin, 1998). It is most often used to analyse the effects of regional trade arrangements, by letting the gravity model explain trade volumes. Dummy variables for various RTAs are then inserted into the regression, and are tested for significance. Thus, the main function of the gravity model is that of providing a set of variables that control for factors other than those we wish to test for. A good example of this procedure can be found in Nilsson (2002). This approach is very close to the method used in this paper and has, to the best of this author's knowledge, not been used to examine east-west trade.

Gravity modelling has also been found useful when studying FDI-flows (Bos and Laar, 2004), measuring home market effects (Feenstra, Markusen and Rose, 1998) and the role of institutions in trade facilitation (Koukhartchouk and Maurel, 2003). There are also more unorthodox uses of the gravity model. Grether and Melo (2003), for example, uses the framework to study the impact of pollution havens. All in all, the gravity model has undoubtedly become a very popular and well established instrument in international economic research.

5. Specifying the model

5.1 Variables

This paper uses the basic version of the gravity model, which is based on the equation

$$EX^{ij} = A\frac{(Y^j Y^i)}{D^{ij}}$$

By taking logs, the model turns into

$$\ln EX^{ij} = \ln A + \ln Y^j + \ln Y^i + - \ln D^{ij}$$

which gives the econometric model

$$\ln EX^{ij} = c + \beta_1 \ln GDP^i + \beta_2 \ln GDP^j + \beta_3 \ln DIST^{ij} + \varepsilon_{it}$$

where GDP^i and GDP^j are the exporter's and importer's respective gross domestic production, and DIST is the distance between their capitals in miles. ε is the error term. This is a standards gravity model specification. Also note that, because all variables are in logs, the slope of the regression lines will be non-linear. However, the elasticity will be constant, which allows us to interpret the coefficients as elasticities.

Due to the popularity of the gravity model, there has been quite a bit of discussion about its correct specification. Intuitively, one would add the restriction $\alpha = 0$, since there cannot conceivably be any trade between countries with a GDP of zero. This was also standard practice in many early gravity model papers. However, it was later found that this provided biased estimates, and therefore the intercept is calculated normally in all regressions.

In this paper, we are first and foremost interested in estimating the multilateral resistance term A. The model asks the question if this multilateral resistance term is significantly different for trade between the two sets of countries and for trade between them. Two dummy variables are therefore inserted into the model:

$$\ln EX^{ij} = c + \beta_1 \ln GDP^{i} + \beta_2 \ln GDP^{j} + \beta_3 \ln DIST^{ij} + \beta_4 EE^{dummy} + \beta_5 WW^{dummy} + \varepsilon_{it}$$

Where WW stands for west-west and EE for east-east. WW^{dummy} and EE^{dummy} equal one if the bilateral relationship is between two countries in the same group. For example, EE^{dummy} equals 1 if the bilateral relation is between Poland and Estonia, but equals zero if the relationship is between Poland and Sweden. These two dummies will capture any differences in trade volumes that are not explained by GDP or distance.

The purpose of this paper is to find out whether or not trade between eastern and western Europe has reached a point where the trade relationship between eastern and western Europe can be considered equivalent to the relationships between the countries in the two regions. The relationship is defined as when a West European country does not trade significantly less with an East European one, given a certain level of GDP and distance. Provided that our model is correctly specified, we can make inferences about this by looking at the intercept dummies. They show the effect of binary qualities, and capture effects that are not explained by other variables in the regression. If the quality of being an East European country means that trade with a West European country is significantly less than with another East European country, given certain levels of whatever variables we choose to include in our model, we can draw the conclusion that trade is lower than what one would expect from looking at the explanatory variables in our gravity model. Therefore, the equivalency of trading relationships in this model is defined by statistically insignificant coefficients of the intercept dummy variables, i.e. that $\beta_4 = \beta_5 = 0$ cannot be refuted by the model.

5.2 Pooled data

The sample consists of several crossections over time, which makes it pooled data. Pooled regressions can be expressed in the general form

$$Y_{it} = \alpha_{it} + \beta_i X_{it}' + \varepsilon_{it}$$

for $i = 1, 2, 3,...,N$ cross sections and $t = 1, 2, 3,...,T$ periods. Y is the dependant variable, α the intercept, β_i is the coefficient for explanatory variable X, and ε_{it} is the error term. From here, there are several different methods for treating the data.

Pooled OLS

The pooled OLS calculates the coefficients in an ordinary manner, with $\alpha_{it} = \alpha$. The intercept will be the same for all crossections. This type of regression specifically ignores any type of unexplained heterogeneity in the data. This heterogeneity can lead to inefficient parameter estimates with large standard errors. One way to correct for this is to insert dummy variables into the model, in order to let coefficients vary across time and crossections. This is the approach taken in this paper, since it is the heterogeneity itself that interests us.

Fixed effects

There has been some debate on the use of fixed effects in gravity modeling, as it is one way to rid a model from unwanted heterogeneity, which would improve the model. However, it will not be used in this paper. The reasons are explained below.

When using fixed effects, we first take the general model

$$Y_{it} = \alpha_{it} + \beta_i X_{it}' + \delta_i + \varepsilon_{it}$$

where δ is an unobserved effect which is constant across time for each individual. Now, take the average of each observation of each variable:

$$\underline{Y}_{it} = \underline{\alpha}_{it} + \beta_i \underline{X}_{it}' + \delta_i + \underline{\varepsilon}_{it}$$

The unobserved term δ_i is unaffected, since it's assumed to be constant over time. Now subtract the second equation from the first:

$$Y_{it} - \underline{Y}_{it} = \alpha_{it} - \underline{\alpha}_{it} + \beta_i(X_{it}' - \underline{X}) + \varepsilon_{it} - \underline{\varepsilon}_{it}$$

This makes the unobserved effect disappear, and controls for any constant heterogeneity in the model. Fixed effects modeling has several attractive properties. First of all, any unobserved and constant heterogeneity is removed, making for better estimators. The problem with fixed effects however, is that any time invariant explanatory variable has to be dropped. Relating to the empirical project in this paper, this means that all distance variables, and any dummies

that stretch from the beginning to the end of the sample cannot be used. The gravity equation can therefore not be specified under fixed effects modeling. Furthermore, a clear consensus on how to best specify the gravity model under fixed effects has yet to emerge (Cheng & Wall, 2004). For the above cited reasons, this paper stays in line with tradition and will utilize the conventional gravity model specification.

5.3 Heteroskedasticity

One of the five Gauss-Markov assumptions is that the variance of the random error is constant across the sample. This is formally defined as

(1) $var(e_t) = \sigma^2 = var(y_t)$

If this assumption is violated, we have heteroskedasticity, and the variance of the error term varies across our sample:

(2) $var(e_{tj}) = \sigma_{tj}^2 = var(y_{tj})$

where t and j denote year and cross section respectively. While heteroscedasticity is most often encountered in cross section data, it also occasionally pops up in time series. In this analysis, it is highly probable that we have heteroskedasticity in our cross sections, due to the high heterogeneity of the sample. If there is heteroskedasticity in the sample, it will cause the least squares estimators to no longer be the best linear unbiased estimators, and their standard errors will be incorrect, and hypothesis testing could give misleading results. Unfortunately, Eviews 4.0 does not provide any means to test for heteroskedasticity in pooled regressions. Eviews 4.0, does however provide White's heteroskedasticity-consistent standard errors and variance, which allows us to treat each pool as if it were homoskedastic. Therefore, all regressions have been performed with White's heteroskedasticity-consistent standard errors and variance. Variances can also potentially be different across pools. Eviews 4.0 eliminates this problem by calculating a GLS using estimated cross section variance.

5.4 Autocorrelation

Another one of the Gauss-Markov conditions for obtaining the best linear unbiased estimator is that

(3) $\text{cov}(e_t, e_s) = 0$ for $t \neq s$

If this assumption does not hold, we have autocorrelation in our random error term. If we have autocorrelation, the variance of the random error can be modeled as

(4) $e_t = \rho e_{t-1} + \nu_t$ and $-1 < \rho < 1$

where ρ is the share of e_{t-1} that carries over to the next period in time, and ν_t is a random error term with distribution $N(0,\sigma_v^2)$. This is called an AR(1) error term. If they are present in the model, the estimators will still be unbiased, but no longer best, and just like with heteroskedasticity, the standard errors and thus hypothesis testing can be misleading.

In Eviews 4.0, the only test for autocorrelation is the Durbin-Watson. If we have a regression, and errors that behave like in equation (4), we can test if $\rho = 0$, which would mean that $e_t = \nu_t$. We begin by stating the null hypothesis H_0: $\rho = 0$ against H_0: $\rho \neq 0$. The p-value is then calculated by Eviews, and we can draw conclusions about autocorrelation.

If we find any autocorrelation in our models, Eviews can calculate a feasible Generalized Least Square(GLS)-estimator to remove the autocorrelation from the model.

6. Data

The sample consists of all current EU countries, including the new eastern European members, and runs between 1995 and 2002. Since Belgium and Luxembourg are treated as a single country, this makes for a sample with 22 countries across eight years. Due to the fact that bilateral trade data between Slovenia and the three Baltic states is missing, twelve crossections had to be excluded. Also, bilateral trade data between Slovenia and eleven

countries is missing for 1995 and 1996. This makes for 450 cross sections over eight years, with a total of 3578 data points for each variable.

All export and import data is taken from the OECD STAN bilateral trade data set, and has been converted to millions of current dollars. Where data on how much country *j* imports from country *i* has not been available, data on exports from country *i* to country *j* has been used to fill in the gap. While these should be the same in a perfect world, a quick analysis reveals that these are rarely exactly the same. Indeed, it is well known that the world is running a trade surplus (Blanchard, 2001). Luckily the difference is so small that one can safely assume that it will not affect the results significantly. All GDP data is taken from the IMF, and has been converted from billions to millions of current dollars.

The distances between capitals have been calculated in miles using the greater circle method with the help of Meridian World Data, a business intelligence provider.

7. Results

The results of the first gravity equation are in tune with what one would expect.

Econometric Results			
Variable	***Coefficient***	***Std. Error***	***P-value***
Intercept	-5.50316	0.790451	0.00000
Exporter GDP	0.70357	0.039310	0.00000
Importer GDP	0.79436	0.030831	0.00000
Distance	-0.93170	0.059908	0.00000

R^2: 0.667725

Adj. R^2: 0.667446

The trading countries' GDP is positively correlated with trade volumes, and a larger distance decreases trade. The explanatory power of the model is good, and there is no significant auto correlation.

In order to test the hypothesis about east-west trade, we insert the dummy variables into the regression, and get these results:

Econometric Results			
Variable	***Coefficient***	***Std. Error***	***P-value***
Intercept	-1.60570	1.710735	0.34800
Exporter GDP	0.54605	0.070263	0.00000
Importer GDP	0.63336	0.062334	0.00000
Distance	-1.01576	0.076821	0.00000
WW-dummy	1.16990	0.208743	0.00000
EE-dummy	-0.21545	0.178548	0.22760

R^2: 0.697069

Adj. R^2: 0.696645

The results are interesting. The safe conclusion that we can draw from these results is that, after controlling for GDP and distance, the data rejects the null hypothesis that the WW-dummy is not significantly different from zero. This in turn implies that, given GDP and distance, the old EU countries were still trading significantly more among themselves than with the future EU members. In the context of the gravity model, this is interpreted as the multilateral resistance term A is larger for exports from the old EU to eastern Europe. However, note that the data cannot reject that the east-east dummy is significantly different from zero, which implies that the eastern European countries were not trading significantly more or less among themselves than with the western countries in our sample.

The natural follow up question is if this situation is constant across time. Since economic integration is a dynamic process, it is very possible that there have been changes to the bilateral trade relations, interpreted as a change in the multilateral resistance term A, that we are trying to measure, inside the sample's time span. For example, the Europe Agreements were not in effect for many countries during 1995. Furthermore, we could hardly expect trade integration to be achieved over night. Instead, it is likely that reaching a new trading equilibrium would take many years. The trade data represented in graph 1 also shows that there has been a continual redirection of trade from eastern Europe to the EU.

Therefore, the sample is divided up into four parts for the periods ´95-´96, ´97-´98, ´99-´00 and ´01-´02. This method is a variation on the repeated crossections approach which can be found in many gravity model papers (one already cited example being Nilsson, 2000). The results are given in the tables below.

Econometric Results			
1995-1996			
Variable	***Coefficient***	***Std. Error***	***P-value***
Intercept	-1.498877	3.317287	0.6515
Exporter GDP	0.548871	0.134692	0.0001
Importer GDP	0.624504	0.119139	0.0000
Distance	-1.060684	0.156814	0.0000
WW-dummy	1.232121	0.422296	0.0036
EE-dummy	-0.394890	0.353239	0.2639

1997-1998			
Variable	***Coefficient***	***Std. Error***	***P-value***
Intercept	-1.552943	3.430227	0.6509
Exporter GDP	0.529507	0.140365	0.0002
Importer GDP	0.659338	0.124562	0.0000
Distance	-1.050551	0.154726	0.0000
WW-dummy	1.099085	0.418252	0.0087
EE-dummy	-0.259611	0.366739	0.4792

1999-2000			
Variable	***Coefficient***	***Std. Error***	***P-value***
Intercept	-1.607535	3.513939	0.6474
Exporter GDP	0.554149	0.144955	0.0001
Importer GDP	0.625526	0.128731	0.0000
Distance	-1.004416	0.154668	0.0000
WW-dummy	1.030487	0.425479	0.0156
EE-dummy	-0.153322	0.369956	0.6787

2001-2002			
Variable	***Coefficient***	***Std. Error***	***P-value***
Intercept	-1.292874	3.463418	0.7090
Exporter GDP	0.534886	0.143176	0.0002
Importer GDP	0.605393	0.127127	0.0000
Distance	-0.957264	0.151124	0.0000
WW-dummy	0.906908	0.405399	0.0255
EE-dummy	-0.198042	0.345710	0.5669

All regressions contain 900 observations, except 1995-1996, which only covers 878.

The dummy for intra-western trade ceases to be significant at the 1% level in the 1999-2000 sample, and has an even higher p-value in the following two years.

Choosing the level of significance of a hypothesis test is somewhat arbitrary. For example, if we set the level of significance α of our test to 0.01, we cannot reject the null hypothesis in the years 99-00 or 01-02. If we set $\alpha = 0.025$, we cannot reject the null hypothesis in the years 01-02. At the 5%-level, $\alpha = 0.05$, we can reject the null in all samples.

Unfortunately, the literature on gravity modeling does not offer much guidance on how to select the level of significance for hypothesis tests. If the null hypothesis that the WW-dummy is insignificantly different from zero is rejected, despite the fact that it is significantly different from zero, we have committed a type-1 error. The probability of making such an error is directly proportional to the chosen level of significance, and the chosen level of significance is often in practice set according to how costly a type 1 error would be to make (Hill, Griffiths & Judge, 2001).

The p-value of the WW-dummy increases as time goes by in our sample, from being clearly positive and significant, to being positive and of questionable significance. The process of economic integration is dynamic. In a gravity model context, differences in trade volumes between countries that are not explained by GDP is explained by the multilateral resistance term. If we assume that this multilateral resistance term changed together with the signing of the EAs, there would be a new long term equilibrium trade level. Reaching this new equilibrium trade level would take time, and the fact that the gravity model fails to show that

we can, at least with any great certainty, reject that there is significantly more trade within the western sample is evidence that the eastern European countries were close to reaching an equilibrium trade level that was equivalent to that of a full member of the EU in 2001 and 2002.

Therefore, what we can conclude is that it is more uncertain if the model states that there is significantly more trade within the western European countries than one would expect, in the later years of our sample, by looking at the gravity model variables. While this might at first seem like an unsatisfactory conclusion, note that the data cannot either very convincingly show that the WW-dummy is significantly positive, which in itself says something about the success of pre-accession east-west integration.

Note that there are some weaknesses in this study. First, the model only explains 70% of all trade. While an R^2 of 70% is a good explanatory power for an econometric model, it should be highlighted that a substantial part of the trade volume is left unexplained. Second, there is no data for the year before the official accession, nor much data for trade before the signing of the EAs, which would have been preferable. It is tempting to use this model to draw the conclusion that the EAs were responsible for the increased EU-CEEC integration. We should however be cautious when evaluating the EAs through this model. Ideally, to test a RTA, one should have a large part of the sample outside of the arrangement. That could be a group of similar countries, or several years of trade that was not under the RTA. By looking at table 1, we can see that very few of the observations are outside of the EAs. However, it is difficult to come up with any other reasonable explanation for the success of east-west integration.

8. Conclusion and summary

In the early 1990s, Carl Hamilton, Alan Winters and Zhen-Kun Wang prominently made the case for an eastern enlargement of the European Union. They provided a strong economic rationale based on the findings that east-west trade was much lower than what would have been expected by looking at the countries' economic size and geographical proximity to each other.

Later studies of east-west trade concluded that trade volumes had outperformed all estimates of potential trade. This research, coupled with the favourable trade conditions between eastern and western Europe raised the possibility that we perhaps should not expect any dramatic increases in trade after the official expansion of the EU. This paper has, by using a traditional gravity model, shown that, while the old EU15 countries trade significantly more within themselves than with eastern Europe during the first half of the period covered by the sample, it is uncertain if they were still doing so in the years 1999 to 2002. Therefore, we can conclude that the integration of eastern Europe into western Europe has been an a success. Due to the uncertainty of the econometric results in this paper, I will refrain from making any predictions about any future post-accession trade expansion.

The results in this paper are roughly consistent with previous research, at least in the sense that it concludes that the trade integration between eastern and western Europe has been a success. Further comparisons prove difficult, since I do not know of any other paper that has applied this type of methodology to east-west trade, which has traditionally been dominated by trade potential analysis.

While this paper is not an explicit attempt to asses the effectiveness of the EAs, it is difficult to find any other reasonable explanation for the success of east-west integration. While the EAs were not overly generous in terms of trade integration, it is possible that the other effects, like improvements on institutional quality and increased certainty about the economic future of eastern Europe had positive effects on the trade relations between eastern and western Europe.

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