ISSN: 2277-5528
Impact Factor: 2.745 (SIJF)

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & MANAGEMENT

APPLICATION OF GRAVITY MODEL FOR IDENTIFICATION OF DETERMINES FOR EXCHANGE BETWEEN SERBIA AND PARTNERS

Ivana Nikolic*
Doctoral Studies, Megatrend University of Belgrade, Serbia, Faculty of Business Studies, City College, University of Sheffield, Management Department

ABSTRACT

This article will try to present the theoretical knowledge and research on the gravity model. It will explain the application of gravity models and try to identify factors that affect bilateral trade. The gravity model is frequently used to analyze the bilateral trade with the mathematic formula. As the factors, will be considered the variables, such as borders, EU affiliation, GDP and distance. And also will estimate the efficiency of the Serbian international trade with the partners.

Key words: Econometric Trade Mode, Gravity model, External trade efficiency, Determines for exchange-variables, Serbia.

INTRODUCTION

International trade in the industry and is the exchange of capital, goods and services across international borders and territories. In most countries, a significant part is the gross domestic product (GDP). Based on the principles and ways of working, international trade is not significantly different from domestic trade. The main difference is that international trade is much more costly than domestic trade. The reason for this is the additional costs, such as tariffs (at the borders). Based on the differences between individual countries, such as language, the legal system of the country and the culture, are the costs that influence economy. According to some authors, there are other kinds of differences between domestic and international trade, such as a factor of production, which includes labor and capital. Sometimes goods and services can be a substitute for trade in factors of production. Some countries are working on the following principle: instead of imported factors of production, those how imported a goods which already contains the factors of production (Lansbury et al, 1996 ; Uzagalieva et al . 2012). The aim of the research is to identify the determinants that affect the import and export of Serbian products , goods and services between partners .

The subject of the econometric modeling of bilateral trade flows based on the gravity model. The model is based on the trade of industrial goods between the two countries that have similar interests in the market.

***Corresponding Author**
Email: ivankinikolic@gmail.com

The aim is to investigate and predict the importance of having geographic distance between the partners and Serbia. The importance of the distance will be viewed only through the manner and means of transport as well as other physical costs of trade , but also the recognition of the fact that the geographical distance , may contain transaction costs that are related to information on the quality of the goods / products and the reliability of potential trade partners , including the costs of negotiation and other forms of personal action (Guiso et al . , 2009; Krugman 1995 ; Linnemann 1966, Portes and Rey , 2005; Grossman 1998) . Empirical confirmation gravity model of international trade is very strong .

According to the research, the main limiting factor in the sale is a " distance " . Distance can have a major impact on trade and cause resistance to that activity. The emergence of resistance will affect the time of transport, the cost of delivery of products or goods, a longer period between order and delivery time etc. There are additional factors of resistance to trade, who to a large extent also affect international trade , such as import tariffs , border controls and quantitative restrictions / quotas . According Greenaway and Milner - in - the (2002) , they represent artificial costs of trade

GRAVITY MODEL

“Gravity model " was first adopted at international trade by Tinbergen 's (1962) and Pöyhönen (1963) in order to explain the foreign trade flows . Independently of each other , they came up with the idea to bilaterarne trade flows shaped by the principles of Newton's law of gravity. According to

ISSN: 2277-5528
Impact Factor: 2.745 (SIJF)

them , the trade flow between two countries is proportional to the " economic " weight of each country and inversely proportional to the distance between the economic centers. They are usually measured by the distance in kilometers between the capitals and economic centers of the two countries .

In the past 40 years , the gravity model is extensively used in studies of international trade. The reason for this , is the empirical hardness and strength of the evidence that provides a particular model (Kepaptosoglou et al , 2010) . The gravitational equations is one of the solid empirical analysis in economics , which explains that the bilateral trade between two countries is proportional to size , measured by GDP , and inversely proportional to the geographical distance of these countries (Linne - mann , 1966).

MATERIAL & METHODS

In its simplest form the model predicts that the volume of trade between two countries is proportional to the product of their "economic mass" (Hakanson and Dow , 2011) . "Economic masses " are usually measured by GDP or population, and are inversely proportional to the geographical distance between them . Gravity model explains the volume of trade , the cost of capital and migration between the countries in the world . The key idea comes from the gravity theory in physics , where it is named. The theory begins with Newton's law of gravitational force (GFij) between two objects i and j. Gravity model will be presented with the following equation :

$$GFij = \frac{a(Mi\ Mj)}{Dij} \quad , \qquad i \neq j$$

where are:

- GFij - turnover from country to country and j ,
- Mi / Mj - economic size of each country (as GFij)
- Dij - the distance between them .

In order to apply the formula to the econometric method , it is necessary to present the model in logarithmic form with other parameters , which are supposed to influence the " friction " of international trade (eg, neighborhood , common language , colonial ties , membership in free trade zones) :

$$\ln GFij = \ln(Mi) + \ln(Mj) - \ln(Dij) \quad , \quad i \neq j$$

$$\ln GFij = \beta 0 + \beta 1 \ln(Mi) + \beta 2 \ln(Mj) + \beta 3 \ln(Dij) + \lambda\, Lij + \ln(\eta\, ij)$$

where are :

- λLij - vector bilateral " relationship "
- ηij - a term for error.

In recent decades, the gravity model is often adapted for the analysis of trade flows over time and has provided successful results in various studies (Porojan , 2001) . The role of the gravity model in this research is to investigate and discover the elasticity of distance , the effect of independent variables (such as geographical distance , " natural " distance , free trade zones , embargoes , tariffs) . The problem with the factor " distance " is the fact that none of these models can't explain what is its real function (Anderson 1979 ; Harrigan2003 ; Feenstra et al . 2001a, Leamer and Levinson 1995) . According to most authors , in all these models , the distance is closely related to trade costs, and they are , in their opinion , increased linearly (Konstantinos et al . 2010)

$$\ln BFTi = \beta + \beta_1 \ln(GDPi) + \beta_2 \ln(DISTi) + \beta_3 BORD_{dummy} + \beta_4 EU_{dummy} + \varepsilon \quad , \quad i \neq j$$

- $BFTi$ represents the bilateral trade flows between Serbia and country *i*
- $GDPi$ – is the gross domestic product of the partner country *i*, expressed in dollars
- $(DISTi)$ – is the distance in kilometars between Capital city Belgrade and the capital of the partner country *j*
- $BORD_{dummy}$ – is a independable variable and shows if the country has theoretical borders or not. The variable has value 0 if countries as a common border and 0 if countries doesn't have common borders
- EU_{dummy} - is independable ad has a value 1 if the partner is in EU and 0 if is not.

Data has for this research will be collected by the OECD, Eurostat databases, World Bank and World Trade Organization (Main Economic Indicators , Monthly Statistics of International Trade , Economic, etc.). Data based contains 43 countries with which the Serbia has bilateral trade in the period of 2004-20011.

Estimation of the Econometric Trade Model

Parameters are estimated with using Ordinary Least Squares method, and for the method is used regression analysis with the stepwise method.

The parameters are of the econometric model are estimated with the SPSS 21.0 software.

Tables 1 (Appendixes 1) shows the square of the correlation values (R Square) that are resented from the all regression factors for the 2004 and 2011. It could be noticed that from 5 variables entered to the model, the best model that has four significant influences factors, that are named $lnGDP_i$, lnDIST, BORD_dummy and EU_dummy. The chosen model explains 56.5% (2004) and 65.5% (2011) from the variation of the dependable variable that is the bilateral trade between Serbia and partner country. As it could be see the variable EU_dummy didn't have contribute significantly to explain the bilateral trade, neither now 2004, neither 2011.

The analysis of the data presented in Table 2 (Appendixes 2) ANOVA results, shows that the models explained significant variation in bilateral trade flows, based on the factors that are included in the model. But observing the model with the lowest residual error is the fourth model, which has the highest R Square value.

Analysing the results in Table 3, it will present the results of positive and negative correlation between BFT and GDP.

RESULTS AND CONCLUSION

The results show that the bilateral trade flows (BFT) are explained with GDP, the distance between two countries, and the the existence of the borders between Serbia and the partner country.

The positive correlation between:

- BFT and GDP shows that Serbia has more intense to external trade with the countries that have a higher GDP that with the countries with the lower GDP
- BFT and BORD_dummy present that Serbia has a bigger trade volume with the countries that has a common border (because of decreasing the costs of the transport)

The negative correlation:

- EU_dummy didn't have a big influence on the model.
- Between BFT and distance shows that the greater distance between Serbia and partner country, the lower is volume between these two.

According to research, there are factors that positively influence the growth of bilateral trade in goods, example- the effects of a large population.

In this paper, it is presented the gravity model in order to identify the significant variables for the bilateral trade between Serbia and the partner countries. That data are presented for 2004 and 2011, even that the all analysis is made for each year. According to the results that are presented there are big differences between the data for the each year.

The data explains that the BFT are explained from one part by the GDP, borders, EU affiliation and distance, which as it's mentioned have the positive and negative correlations.

The analysis is focused only on the total trade flow , but some reach are showed that the results could have bigger significant to the BFT if for the data are taken trade models of good, tabaco, low / medium/ high technology, pharmacy, waste and ICT manufacturing. So for the further study it could be made as such model.

ACKNOWLEDGEMENT

This study was supported by the PhD Business Department, Megatrend University, Belgrade, Serbia.

REFERENCES

1. *Andersson, R., Eriksson, H. and Torstensson, H. (2006) Similarities and differences between TQM, Six Sigma and Lean. The TQM Magazine, 18 (3), p. 282-296.*
2. *Arghyrou, G. M. (2000) EU participation and the external trade of Greece: an appraisal of the evidence. Application Economy, 32(2), p.151-159.*
3. *Augier, P., Gasiorek, M., and Lai Tong, C. (2005) The impact of rules of origin on trade flows". Economy Policy, 20(43), p.567-624.*
4. *Baier, L.S. and Bergastrand, H., (2007) Do free trade agreements actually increase memberes of international trade? International Journal of Economeis, 71(1), p.72-95.*
5. *Buch, C.M, and Piazolo D. (2001) Capital and trade flows in Europe and the impact of enlargement. Economy System, 25(3), p.183-214.*
6. *Bun, M.J.G, and Klaassen F.J.G.M. (2007) The Euro effect on trade is not as large as commonly thought. Oxford Business Economy Status, 69(4), p.473-96.*
7. *Burgess, D. (2010) Lean Six Sigma: Red hot relevance. Quality, 49(6), p. 42-45.*
8. *Chaney, T. (2013) The Gravity Equation in International Trade: An explanation. National bureau of Economics Research, Working Paper 19285; p. 1-49.*
9. *Christensen, M.C. (2011) The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business. Harper Business; Reprint edition*

ISSN: 2277-5528
Impact Factor: 2.745 (SIJF)

10. *Collier, A.D. and Evans, R.J. (2007) Operations management : goods, service and value chains. South-Western, Division of Thomson Learning.*
11. *Costinot, A. and Rodríguez-Clare, A. (2013) Trade Theory with Numbers: Quantifying the Consequences of Globalization. International Economics; 4(0), p. 1-66.*
12. *Egger P. (2008) On the role of distance for bilateral trade. World Economy, 31(5), p.653-662.*
13. *Ehigie, B. & McAndrew, E. (2005) Innovations, diffusion and adoption of total quality management (TQM). Management Decisions, 43(6), p. 925-940.*
14. *Elliott, D.R. (2007) Caribbean regionalism and the expectation of increased trade: insights from a time-series gravity model. Journal of International Trade Economy Development 16(1), p.117-36.*
15. *Ferragina, A., Giovannetti, G. And Pastore, F. (2005) A Tale of Parallel Integration Process. A Gravity Analysis of EU Trade with Mediterranean and Central and Eastern European Countries. IZA Discussion paper, no.1829, p.1-30.*
16. *Fillipini, C. and Molini, V. (2003) The determinants of East Asian trade flows: a gravity equation approach. Journal of Asian Economis, 14(5), p. 695-711.*
17. *Gopinath, M., Echeverria, R. (2004) Does economic development impact the foreign direct investment-trade relationship? A gravity-model approach. Am J Agric Econ, 86(3), p. 782-787.*
18. *Håkanson, L. and· Douglas, D. (2012), Markets and Networks in International Trade: On the Role of Distances in Globalization, Management International Review, (52), p.761–789.*
19. *Humels, D. (2007) Transportation Costs and International Trade in the Second Era of Globalization. Journal of Ecomonic Perspectives, 27(3), p.131-154.*
20. *Jenica, P.A., Mihai, D. and Sorin, A. (2010) Using lean Six Sigma as a motivational tool for processes improvement. Annals of the University of Ordea, Economics Science Series, 19(2), p. 438-422.*
21. *Kangas, K. and Niskanen, A. (2003) Trade in forest products between European Union and the Central and Eastern European access candidates. Forest Policy Economy, 5(3), p.297-304.*
22. *Kepaptsoglou, K., Karlaftis, G.M. and Tsamboulas, D. (2010) The gravitz Model Specification for Modeling International Trade Flows and Free Trade Agreement Effects: A 10-Year Review of Empirical Studies. The Open Economies Journals. 3(0), p.1-13.*
23. *Lampe, M. Bilateral trade flows in Europe, 1857-1875: a new dataset. Research Economy Hist, 26(1), p.81–155.*
24. *Linneman, H. (1966) An econometric study of world trade flows. Amsterdam: North-Holland Publishing Co.*
25. *Martinez-Zarzoso I, Suarez-Burguet C. (2005) Transport costs and trade: empirical evidence for latin american imports from the European union. Journal International Trade Economy Development, 14(3), p. 353-371.*
26. *McDaniel, C., Reinert, K. and Hughes, K. (2004) Tools of the Trade: Models for Trade Policy Analysis. Science, Technology, America, and the Global Economy, Woodrow Wilson International Center for Scholars. One Woodrow Wilson Plaza. Available also on: www.wilsoncenter.org*
27. *Mitrovic – Dragutinovic, M. (2005) Ogranicenje Gravitacionog Modela u Ekonometriskoj analizi spoljnotrgovinske razmene. Economic Annals; 167(0), p. 77-105.*
28. *Nitsch, V. (2000) National borders and international trade: evidence from the European Union. Can Journal of Economy, 33(4), p.1091-105.*
29. *Organization for Economic Cooperation and Development (OECD).*
1997a. National Innovation Systems. Paris. 1997b. Revision of High Technology Sector and Product Classification. Paris.
2008a. "Foreign Direct Investment Statistics." Database, Paris (available at http://stats.
oecd.org). 2008b. "Science, Technology and Patents." Database, Paris (available at http://stats.
oecd.org).
30. *Papazoglou, C. (2007) Greece's potential trade flows: a gravity model approach. International Advance Econ Res, 13(4), p.403-414.*
31. *Pinior et al. (2012) The trade network in the dairy industry and its implication*
for the spread of contamination, © American Dairy Science Association®, 0(95), p:6351-6361.
32. *Pelletiere, D. and Reinert, K.A. (2004) Used automobile protection and trade: Gravity and ordered probity analysis. Empirical Economy, 29(4), p.737-751.*
33. *Porojan, A. (2001) Trade flows and spatial effects: the gravity model revisited. Open Economy Review, 12(0), p.265-280.*
34. *Rault, C., Sova, R. Sova, A.M. (2008) Modeling International Trade Flows between CEEC and OECD Countries. CESIFO working paper no. 2282, Category 7: Trade Policy.*

ISSN: 2277-5528
Impact Factor: 2.745 (SIJF)

35. *R&D Guide (2007) FP7 Cooperation: Food, Agriculture and Fisheries, and Biotechnology. EURESEARCH, your Swiss guide to European research, Available on www.euresearch.ch*
36. *Rodrigue, J.P., Comtois,C. and Slack B. (2006) The geography of transport systems. by Routledge, 2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN*
37. *Saunders, M. (2003) Research Methods for Business Students. 3rd edition. Harlow, Prentice Hall, ch 8.*
38. *Sapir, A. (2001) Domino effects in Western European regional trade, 1960-1992. European Journal of Politic Economy, 17(2), p. 377-88.*
39. *Shepherd, B. (2012) The Gravity Model of International Trade: A User Guide. United Nations publication, Copyright © United Nations.*
40. *Stevenson, W. (2009) Operations Management. NY: McGraw-Hill/Irwin.*
41. *Sohn, C. H. Does the gravity model explain South Korea's trade flows? Japanese Economy Review, 56(4), p.417-430.*
42. *Timbergen, J. (1962) Sharping the world economy. New York, NY: 20th Century Fund.*
43. *Thompson, A.A., Strickland III, A.J. and Gamble, E.J. (2005) Crafting and Executing Strategy: The Quest for Competitive Advantage: Concepts and Cases, 14/e. NY: McGraw-Hill/Irwin.*
44. *Uzagalieva, A. et al (2012),Technological Innovation in New EU Market, Emerging Markets Finance & Trade, 48 (5), pp. 48–65*

APPENDIXES 1

Tables 1

R Square Statistics for the Selected Models Using Stepwise Method

Model Summary[e] 2004

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.222[a]	.049	.020	1.962196862583039
2	.222[b]	.049	-.010	1.992593562448201
3	.433[c]	.188	.109	1.871294008811375
4	.752[d]	.566	.508	1.390793847308257

a. Predictors: (Constant), EU_dummy
b. Predictors: (Constant), EU_dummy, lnDIST
c. Predictors: (Constant), EU_dummy, lnDIST, lnGDP2004
d. Dependent Variable: lnBFT2004

Model Summary[e] 2011

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.346[a]	.120	.094	1.758927451414462
2	.348[b]	.121	.068	1.784589536872847
3	.558[c]	.312	.247	1.603345592130666
4	.810[d]	.655	.611	1.152849823794334

a. Predictors: (Constant), BORD_dummy
b. Predictors: (Constant), BORD_dummy, EU_dummy
c. Predictors: (Constant), BORD_dummy, EU_dummy, lnDIST
d. Predictors: (Constant), BORD_dummy, EU_dummy, lnDIST, lnGDP2011
e. Dependent Variable: lnBFT2011

ISSN: 2277-5528
Impact Factor: 2.745 (SIJF)

APPENDIXES 2

Tables 2

ANOVA Results for the Selected Models

ANOVA[a] 2004

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.588	1	6.588	1.711	.020[b]
	Residual	127.057	33	3.850		
	Total	133.645	34			
2	Regression	6.591	2	3.295	.830	.045[c]
	Residual	127.054	32	3.970		
	Total	133.645	34			
3	Regression	25.091	3	8.364	2.388	.008[d]
	Residual	108.554	31	3.502		
	Total	133.645	34			
4	Regression	75.615	4	18.904	9.773	.000[e]
	Residual	58.029	30	1.934		
	Total	133.645	34			

a. Dependent Variable: lnBFT2004
b. Predictors: (Constant), EU_dummy
c. Predictors: (Constant), EU_dummy, lnDIST
d. Predictors: (Constant), EU_dummy, lnDIST, lnGDP2004

ANOVA[a] 2011

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	14.349	1	14.349	4.638	.038[b]
	Residual	105.190	34	3.094		
	Total	119.539	35			
2	Regression	14.442	2	7.221	2.267	.019[c]
	Residual	105.097	33	3.185		
	Total	119.539	35			
3	Regression	37.276	3	12.425	4.833	.007[d]
	Residual	82.263	32	2.571		
	Total	119.539	35			
4	Regression	78.338	4	19.584	14.736	.000[e]
	Residual	41.201	31	1.329		
	Total	119.539	35			

a. Dependent Variable: lnBFT2011
b. Predictors: (Constant), BORD_dummy
c. Predictors: (Constant), BORD_dummy, EU_dummy
d. Predictors: (Constant), BORD_dummy, EU_dummy, lnDIST
e. Predictors: (Constant), BORD_dummy, EU_dummy, lnDIST, lnGDP2011

ISSN: 2277-5528
Impact Factor: 2.745 (SIJF)

APPENDIXES 3

Tables 3

Parameter Estimated of the Model

Coefficients[a] 2004

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	11.374	.376		30.242	.000
	BORD_dummy	1.044	.798	.222	1.308	.200
2	(Constant)	11.376	.386		29.499	.000
	BORD_dummy	1.048	.821	.223	1.276	.211
	EU_dummy	-.044	1.491	-.005	-.029	.977
3	(Constant)	23.210	5.162		4.497	.000
	BORD_dummy	-1.047	1.194	-.223	-.877	.387
	EU_dummy	.346	1.410	.040	.245	.008
	lnDIST	-1.606	.699	-.576	-2.298	.028
4	(Constant)	4.277	5.333		.802	.029
	BORD_dummy	.697	.951	.148	.733	.069
	EU_dummy	-.094	1.052	-.011	-.089	.000
	lnDIST	-1.480	.520	-.531	-2.847	.008
	lnGDP2004	.700	.137	.699	5.111	.000

Coefficients[a] 2011

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	12.185	.332		36.656	.000
	BORD_dummy	1.519	.705	.346	2.154	.038
2	(Constant)	12.193	.341		35.806	.000
	BORD_dummy	1.539	.725	.351	2.122	.041
	EU_dummy	-.225	1.316	-.028	-.171	.065
3	(Constant)	25.151	4.359		5.770	.000
	BORD_dummy	-.755	1.008	-.172	-.749	.060
	EU_dummy	.201	1.191	.025	.169	.007
	lnDIST	-1.758	.590	-.677	-2.980	.005
4	(Constant)	7.593	4.450		1.706	.098
	BORD_dummy	.707	.771	.161	.916	.066
	EU_dummy	-.034	.857	-.004	-.040	.068
	lnDIST	-1.656	.425	-.638	-3.900	.000
	lnGDP2011	.641	.115	.659	5.558	.000