THE ANALYSIS OF FLAT GLASS EXPORTS FOR ROMANIA USING THE GRAVITY MODEL

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Abstract: *The intense international competition and reduced rates of economics growth force the companies at dynamic and appropriate strategies to address internal and external market. The manufacturing industry from Romania has competitive advantages defined by tradition, qualified labour force, indigenous raw materials, and its products serve various industries – construction, automotive, food – that is expected to experience a future sustained development. With approximately 2,500 employees, the glassware sector from Romania is part of the manufacturing industry which has constantly decreased in the last 25 years. Romania has a long tradition in the glassware sector and remains a strategic player in the region being integrated in the global flows from the industry. Geographical orientation of Romanian trade of flat glass for export is analyzed using the gravity model. The purpose of this article is to determine the essential factors of flat glass export level from Romania to states with which has commercial partnerships using both a gravity static model, but also a gravity dynamic model – a common model in the literature, used to analyze the trade flows between world countries or polarization strength of cities and commercial centres. The empirical results of both models have shown that the gravity attraction of local and destination economies, transport costs – measured by the distances between capitals and lack of common border –, language interconnectivity, and also belonging to the BSEC (Organization of the Black Sea Economic Cooperation) are the most important factors affecting the Romanian exports of the flat glass.*

Keywords: gravity model; Romanian export; export drivers; flat glass.

JEL classification: C23; F23; R15

1. Introduction

International Chamber of Commerce considers that globalization rewards companies which are innovative and competitive. As international companies enter on the local markets, local companies enter on the global market, increasing competition, improving product quality, expanding the product range, and keeping the price at a low level (http://www.iccwbo.org/).

Due to the increasing globalization, the export is a way of foreign market entry and sales expansion for companies, thus it is an important field of research in marketing (Cavusgil and Kirpalani, 1993; Samie and Anckar, 1998). As an answer, the researchers have responded to this topic focusing on internal and external antecedents of company export performance (Aaby and Slater, 1989; Cavusgil and Zou, 1994; Szymansky, Bhradway, and Varajan, 1993). In spite of increased interest, the empirical research on exporting are

limited and provides few perspectives for those responsible with export performance and development (Czinkota, 2000; Katsikeas, Leonidou, and Morgan, 2000).
Previous research on export area has identified three categories of factors that influence on company export performance: the external environment factors (Garnier, 1982; Rao et al., 1989), the organizational factors (Wiedersheim-Paul et al., 1978; Cavusgil and Nevin, 1981), and decision maker factors (Simmonds and Smith, 1968; Cavusgil and Nevin, 1981).
Through this paper we attempt to identify the most important drivers of flat glass export from Romania to other countries applying the static and dynamic gravity models based on data that were annual collected during 2001-2013. Data regarding the annual GDP of analyzed countries and Romania were taken from the database of the World Development Indicators of World Bank. Data on exports and imports of flat glass (7005 code – float glass and surf ground or polished sheets) of the analyzed countries were taken from Trade Map.
In the study, the models were estimated using the methodology based on panel data with fixed effects models (FEM) or random effects models (REM). To determine the model type, Hausman test has been applied.

2. Literature review

2.1 Drivers of extern market strategy

Marketing as a discipline is universal, but its application differs from one country to another, for the simple reason that countries and people are different. These differences make that a successful marketing approach in a region may not be successful in another region or country. Consumers' preferences, competition, distribution channels, communication media may vary.
It is important for a successful manager to understand the degree to which extend the marketing plans and programs at the international level, also the level from where the adaptation is required. How the company is addressing to that is the reflection of the global marketing strategy.
The typology of strategies used in international marketing are structured according to the mission and vision of the company, market conditions, international experience, company resources, content and size of the products portfolio (Florescu, 1987).
The important factors from an industry are represented by the actions that create the conditions to achieve the performance (Căpățînă and Drăghescu, 2015). At the rigorous elaboration of an external market strategy is taking into account two groups of factors: endogenous – related to the company – and exogenous – related the environment in which it operates. In the category of exogenous factors are involve the characteristics of market segment targeted by the company, the ways of demand manifestation for products company, the components of demographic, technological, natural, social, political and cultural environment in which company conducted its activities. Given the interdependence between them, the knowledge, the utilization and the appropriate combination of this factors influence directly and indirectly the company activity, underpinning the establishment of strategic connections between firm and market, and the implementation of the most appropriate strategies (Balaure, et al. 2002).
The decision to export is based on several drivers: internal – the domestic market is saturated, the company has a specialized product, and the diversification of customers' portfolio – and external – the existence of a competitive advantage, on other markets can be achieved better profitability, a favourable external environment.
There are both advantages and disadvantages arising from the decision to export. The advantages of the export include: increasing competitiveness in the domestic market, sales growth, reducing dependence on initial customers' portfolio, reducing seasonal fluctuations, increasing productivity. The disadvantages facing the companies that undertake export activities are additional costs for personnel, administrative, financial,

promotion, longer payment terms and higher risk of default, the subordination of short-term profit through taking of long-term gains.
In elaboration of international strategy, the company is based on three essential steps: initial market penetration, expansion on penetrated markets, and global rationalization (Douglas and Craig, 1989).

2.2 The flat glass industry at global level and in Romania

We estimate the glass market with a production of 125 million tons per year, which represents a value of approximately 150 billion globally. Europe, China, and North America produce about 75% of global production (http://ec.europa.eu/, 2015; Is Investment Report, 2013; Pilkington Report, 2010; FEVE, 2015; Glass for Europe, 2014). The glass production from Romania is estimated at 150 million, of which €70 million flat glass, €40 million glass packaging, €20 million household glass, and €20 million fibres glass (estimation based on figures published by manufacturers on www.mfinance.com).
At international level the main players in the flat industry are Asahi Glass, Saint Gobain, Nippon Sheet, Trakya Cam, and PPG (Table 1).

Table 1. The main manufacturers of flat glass at global level

Manufacturer	**Country of origin**	**Production units**	**Capacity million Tons/annual**	**Overlay**
Asahi Glass	Japan	13	8.6	America, Europe and Asia
Saint Gobain	France	17	7.6	Europe, North America, Asia
Nippon Sheet	Japan	12	7.5	Europe, Japan, America and Russia
Trakya Cam	Turkey	7	1.7	Europe, Russia, Asia
PPG	USA	2	1.4	Europe

Source: Is Investment Report, 2013

The French from Saint Gobain represent the sole manufacturer of flat glass from Romania through production unit from Calarasi. The production value is €70 million, of which 60% is exported to foreign markets. The local market is estimated at approximately €55-60 million, and Saint Gobain has a market share of 40%. The rest of market share from Romania is divided by the AGC, Guardian and Sisecam.

Table 2. The Romanian export for flat glass – 7005 code – during the 2006 -2014

Export countries	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
At global level	10535	54814	49782	32612	41370	29791	35217	43709
Bulgaria	2178	5215	7813	4079	3600	1226	5519	7764
Hungary	129	754	798	557	660	989	1034	4408
Poland	295	9767	12395	1035	4443	2668	848	567
Italy	2268	3693	3578	3599	4994	4911	2791	2146
Ukraine	218	109	10	0	87	1606	2961	6765
Turkey	987	5792	8195	11243	17398	8751	11240	9937

Greece	635	4495	4734	3117	2580	330	1469	2131
Moldova	822	929	1331	1253	1822	2028	2445	2024
Mexico	0	0	0	0	0	0	414	1227
Croatia	0	158	232	424	118	40	80	267
Serbia	650	1461	2639	1562	1841	1470	902	923
Germany	49	10592	120	1045	145	673	302	364
Macedonia	238	440	462	522	298	438	655	893

Source: http://www.intracen.org/itc/market-info-tools/trade-statistics/, accessed on March 28, 2015

The proximity countries remain the main export countries of Romania, but our attention is drawn in a positive way on by the exports to Mexico and Germany.

3. The gravity model of flat glass export for Romania

3.1 Model overview

The gravity model in terms of bilateral trade between countries was used for the first time by Nobel laureate in economics J. Tinbergen (1962), who was interested to understand the trade flows in the absence of trade barriers, arguing that free trade is the solution to maximize the welfare in the world. He proposed the simplified version and basic gravity model that explains today to a large extent the bilateral trade.

$$\log E_{ij} = \beta_0 + \beta_1 \log Y_i + \beta_2 \log Y_j + \beta_3 \log D_{ij}$$

Where:

E_{ij} = the export from country i to country j

Y_i = GDP in country i

Y_j = GDP in country j

D_{ij} = the distance between country i and country j

The gravity model is extended by Linnemann (1966) which adds the population size as variable analyzing the correlation between the quantity of exported products by country i and the gross domestic product, the population size from destination country j, with the effect that the distance between this countries has on commercial volume (Kristjansdattir, 2005). The Gross Domestic Product is a measure of national income, while the distance approximate the transport costs. The population expresses the size of each economy, considering that a large country has generally an economy characterized by a high degree of self-sufficiency, compared to an economy of reduced scale (Zaman et al., 2010).

For a more exquisite approach, in addition to the basic variable of the gravity model, it is used additional variables that can stimulate or block the activity of international trade. In the model can be added dummy variable – binary variable 0 or 1 – as common border with the analyzed country, preferential trade agreements, language and religion compatibilities (Popa et al., 2009).

3.2 Data and methodology

The application of gravity model has considered the selection of countries based on the importance of commercial partnership with Romania in glassware area, assessing the impact of trade arrangements on flat glass exports of our country through several determined factors.

Given the availability of statistical data, the analysis includes 12 countries – Hungary, Germany, Bulgaria, Italy, Greece, Ukraine, Poland, Moldova, Turkey, Croatia, Serbia, and Macedonia – that import flat glass from Romania.
The timeframe for analysis is from 2001 to 2013, considering that from 1990 to 2000 Romania has been in a continuous process of transition and structural-economic repositioning, and then has experienced a significant economic growth, subsequently affected by the global economic crisis from 2008.
The article aims to determine the essential factors of flat glass export from Romania to the countries with which has commercial partnerships using both a static and a dynamic gravity model.
Information required to model elaboration during the analysis period includes annual data retrieved from:

- World Development Indicators of World Bank, the database including information on GDP, GDP per capita, implicitly of Romania;
- Trade Map, data on flat glass exports (7005 code) of analyzed countries.

In order to shape and implementation the gravity model for flat glass exports of Romania were involved in the model the following variables:

- The GDP of countries from analysis, which is expressed in US $ million at constant prices (base year: 2005 = 100);
- The GDP per capita in US $ at constant prices (base year: 2005 = 100/inhabitant);
- The distances (in kilometres) between Bucharest and other capitals of countries j are obtained using Google maps.

In the study the models will be estimated with the methodology based on panel-models data with fixed effects (FEM) or models with random effects (REM). In order to determine the model type, it will be applied the Hausman test.
Considering that classical gravity models has used data in section for more countries, for a single time period, the model design – that expresses the best possible flat glass export of Romania – has created the premise of applying a model based on panel data.
The version of gravity models started from the components that have become linear through logarithms.

Static gravity model has the following form:

$$\log\left(\exp_{ijt}\right) = \beta_0 + \beta_1 \log\left(Y_{it}\right) + \beta_2 \log\left(Y_{jt}\right) + \beta_3 \log\left(D_{ijt}\right) + \sum_h \delta_h P_{ijht} + u_{ijt}$$

Where:

exp_{ij} - the export of glass between Romania (country i) to country j;
Yi (Yj) – GDP of country i (j);
D_{ij} - the road distance between country i and country j;
u_{ij} - the residual variable;
β_i - the model parameters;
P_{ij} - the dummy variables included in the model in addition to the basic variables of the gravity model representing the facilities or barriers in international trade:

- Border – a binary variable, which established 1 as value for countries i and j that have common border and 0 as value in other countries that do not have a common border;
- BSEC – a binary variable with 1 as value for the members states of the Organization of the Black Sea Economic Cooperation in year t and 0 as value for countries that are not members of that organization;
- Language – a binary variable which can take the value 1 for linguistic interconnected economies and the value 0 for the other countries with economies that are not linguistic interconnected.

Considering the specific dummy variables, the statistical gravity model can be written as:

$$\log\left(\exp_{ijt}\right) = \beta_0 + \beta_1 \log\left(Y_{it}\right) + \beta_2 \log\left(Y_{jt}\right) + \beta_3 \log\left(D_{ijt}\right) + \delta_1 Border_{ijt} + \delta_2 Language_{ijt} + \delta_3 BSEC_{ijt} + u_{ijt}$$

Static gravity model is complemented with dynamic gravity model because the exports could be persistent. In fact, the initial investment or stranded costs incurred by exporters in order to establish new distribution and service networks often generate persistence in exported goods through consumption patterns and distribution channels recently established on foreign markets. Therefore, the exports performance of the previous year provides a basis for activities from the current year.

Dynamic gravity model has the following form:

$$\log\left(\exp_{ijt}\right) = \beta_0 + \beta_1 \log\left(Y_{it}\right) + \beta_2 \log\left(Y_{jt}\right) + \beta_3 \log\left(D_{ijt}\right) + \beta_4 \log\left(\exp_{ijt-1}\right) + \sum_h \delta_h P_{ijht} + u_{ijt}$$

In relation with detailed dummy variables, dynamic gravity model will be written as:

$$\log\left(\exp_{ijt}\right) = \beta_0 + \beta_1 \log\left(Y_{it}\right) + \beta_2 \log\left(Y_{jt}\right) + \beta_3 \log\left(D_{ijt}\right) + \beta_4 \log\left(\exp_{ijt-1}\right) + \delta_1 Border_{ijt} + \delta_2 Language_{ijt} + \delta_3 BSEC_{ijt} + u_{ijt}$$

This dynamic gravity model involves the same variables as in previous model, so appear the influences of the same factors to which is added $\log\left(exp_{ijt-1}\right)$ representing the flat glass exports of Romania to partners' countries (j) in previous year (t-1).
From a theoretical perspective, in terms of variables signs from both models, is expected a positive sign of regression coefficients for both exports from previous year – involved in equation to determine the trend of economic relationships and assess the impact of historical commercial relationships on exports – and also for GDP of partners countries – as a direct economic measure of the given countries.
Romania tends to trade more with a country where transport cost are low. In the model the proxy variable for transport cost is the geographical distance between the capital of two countries and their common border. Therefore, it is assumed a negative sign for regression coefficient corresponding to this variable. Also, it is expected a positive sign of regression coefficient representing the language influence, as well as the membership in the BSEC.
Using the panel model has the advantage of capturing the important relationships between variables over the time and to monitor the unobserved individual effects of countries pairs,

allowing a generalized gravity model of trade. The econometrics models estimates were made using Eviews 7.0.

3.3 The empirical results of gravity model

The results of Hausman test indicates that for both static and dynamic gravity model, it cannot reject the null hypothesis (Table 1 - Annex), therefore is recommended the utilisation of REM model for both gravity models using the PLS (Panel Least Squares) method.

As a result of data introduction and Eviews program application, the static gravity model of flat glass export of Romania (Table 2 - Annex) was estimated as:

$$\log\left(\exp_{ijt}\right) = -34{,}38 + 3{,}88\log\left(Y_{it}\right) + 0{,}74\log\left(Y_{jt}\right) - 2{,}90\log\left(D_{ijt}\right) - 1{,}01\, border_{ijt} + 1{,}72\, Language_{ijt} + 0{,}91\, BSEC_{ijt} + u_{ijt}$$

The coefficients signs of static model indicate that countries GDP – Romania, and also partners countries –, the language, and the BSEC belonging has a positive impact on exports, while the distance and common border as proxy variables for transports costs have a negative impact on transport.

The regression coefficient corresponding to the GDP influence of Romania is positive (+3.88), being statistically significant (prob=0.00 is lower than 0.05), and show that the glass export of Romania will increase by approximately 3.88% due to the increased economy by 1%, while maintaining constant the variation of other factors of influence.

The next regression coefficient corresponding to the GDP of country j is positive (+0.74) and statistically significant (prob=0.00 lower than 0.05), which presents that Romania tends to commercialize with greater savings. The more the country destination economy grows, the more larger will be the glass exports of Romania, this having as explanation the growth foreign revenues that will lead to higher demands from abroad for flat glass. The glass export of Romania with country j increases by approximately 0.74% due to the fact that GDP of country j increases by about 1%, in the context of constant variation of other influence factors.

Regarding the dummy variables influence, it coud be observed from static model that both the distance coefficient, and also the common border coefficient present the estimated sign – negative –, thus the transport costs have an negative effect on Romanian exports; on average, an increased of 1% in transport costs – distance and common border – leads to a descrease of 2.9%, and 1.01% in flat glass exports of Romania, keeping constant the other factors. This aspect of correlation between export and distance can be presented as elasticity of export at distance as being -2.9.

The language interconnectivity between countries leads to an increase in flat glass export of Romania, as well as the countries membreship to the Organization of the Black Sea Economic Cooperation (BSEC), fact notified by the positive results of the regression coefficients corresponding to two variables 1.72 and 0.91.

Simultaneous action of explanatory variable of static gravitymodel explains about 49% of flat glass variation of Romanian exports through the value of determination coefficient R Square.

Similar results are obtained also in case of elaboration a dynamic gravitymodel through the data introduction and Eviews program application (Table 3 - Annex).

$$\log\left(\exp_{ijt}\right) = -22{,}00 + 2{,}37\log\left(Y_{it}\right) + 0{,}30\log\left(Y_{jt}\right) - 1{,}36\log\left(D_{ijt}\right) + 0{,}458\log\left(\exp_{ijt-1}\right) - 0{,}6\, border_{ijt} + 0{,}81\, Language_{ijt} + 0{,}576\, BSEC_{ijt} + u_{ijt}$$

As in the case of static model, all coefficients of dynamic model are statistically significant at the 5% threshold and present the estimated signs, but with other values close to those presented above.
By adding the endogenous variable lag, with role of exogenous variables in the dynamic model has led to an increased of determination degree of the model to 59% (R Square), revealing that dynamic model adjusts better the data.
Positive coefficients of GDPs of Romania and partners countries indicate a positive effect on flat glass export, representing a measure of the saving size.
The distance coefficients and common border coefficients have expected negative signs. In other words, transport costs have a negative effect on Romanian export; on average, an increase of 1% of transport cost (distance and lack of common border) lead to a decrease of 1.36% and 0.6% in flat glass exports, keeping the other variables unchanged.
A positive sign in the flat glass exports from previous year indicates an positive impact on export performance from current year. This result seems to be acceptable in the real world because the achievements in the previous year, such as new business relationships with foreign importers provide a basis for Romanian companies to expand their export activities in the next year. Similarly, as economic growth leads to an increase in export supply, a positive sign seems reasonable.
Also, the language interconnectivity and belonging to BSEC has a positive effect on dynamics flat glass export of Romania with partner countries.

4. Conclusions

The various strategies and trade policies of the countries included in the analyses along with Romania, together with other factors established significantly for country export – distance, lack of common border, language interconnectivity, and belonging to BSEC – have favoured the drawing of a static gravity model previously completed with a dynamic model.
Establishing the two gravity models – static and dynamic – is due to the application of panel model. This type of model highlights the significant interdependencies between variables used in time – 2001-2013 – and monitors the unobservable individual effects of countries pairs.
The estimation process of econometrics models was done using Eviews 7.0. Result the significant positive impact of Romania and other countries GDP, and a positive impact of the flat glass export from previous year on increasing flat glass export of Romania. However, the results of the two models highlights the fact that between flat glass export of Romania and distance, existence or inexistence of common borders with Romania, language interconnectivity, and belonging or not belonging to the BSEC there is an indirect interdependence. This type of connection is natural and positive regarding the future perspectives of the export development, as main component of trade.
Competitive activity and oscillating rhythms of evolution in the process of economic growth require to the companies from manufacturing flat glass industry of Romania the application of dynamic and appropriate strategies to address internal and external market.
Context requires, on the one hand, adopting a rather aggressive attitude to maintain tradition in glassware sector, on the other hand a strategic action of integration into the global flows through improving the quality of glass at high quality standards, comparable to those from international level.

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Annex

Table 1. The results of Hausman test for gravity model of Romanian export

Correlated Random Effects - Hausman Test
Equation: MODEL GRAVITATIONAL
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random			
Static gravity model	1.52	3	0.6767
Dynamic Gravity Model	1.57	3	0.8127

Table 2. Static gravity model of Romania, 2001-2013

Dependent Variable: LN_EXP_IJ
Method: Panel EGLS (Cross-section random effects)
Date: 04/17/15 Time: 17:07
Sample: 2001 2013
Periods included: 13
Cross-sections included: 12
Total panel (unbalanced) observations: 145
Swamy and Arora estimator of component variances
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-34.38798	8.185484	-4.201094	0.0000
LN_GDP_J	0.744629	0.203894	3.652048	0.0004
LN_GDP_I	3.881603	0.604504	6.421137	0.0000
LN_DISTANCE	-2.908328	0.602912	-4.823805	0.0000
BORDER_IJ	-1.013269	0.615456	-1.646371	0.1020
OCEMN	0.919525	0.453013	2.029799	0.0443
LIMBA	1.727675	0.397681	4.344369	0.0000

R-squared	0.490020
Adjusted R-squared	0.470890

Table 3. Dynamic gravity model of Romania, 2001-2013

Dependent Variable: LN_EXP_IJ
Method: Panel EGLS (Cross-section random effects)
Date: 04/17/15 Time: 17:08
Sample (adjusted): 2002 2013
Periods included: 12
Cross-sections included: 12
Total panel (unbalanced) observations: 131
Swamy and Arora estimator of component variances
White cross-section standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-22.00957	8.981077	-2.450660	0.0157
LN_GDP_J	0.303574	0.133510	2.273795	0.0247
LN_GDP_I	2.375516	0.815205	2.914009	0.0042
LN_DISTANCE	-1.361796	0.479789	-2.838325	0.0053
BORDER_IJ	-0.600729	0.294009	-2.043234	0.0432
OCEMN	0.576198	0.170111	3.387194	0.0009
LIMBA	0.817657	0.217742	3.755167	0.0003
LN_EXP_IJ(-1)	0.458390	0.110535	4.146998	0.0001

R-squared	0.597774
Adjusted R-squared	0.574883