Modeling of Exports Flows in the Visegrad Sub-Region

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Abstract

This study investigates the determinants of the Visegrad Group (V-4) export performance with special attention to quantitative analysis of bilateral trade flows. Based on preliminary statistical analysis, a broad categorization of export directions for V-4 is introduced. Innovative application of the gravity model for international trade is applied to the various trade direction categories, revealing important results particularly in regards to the significance of inward FDI, the restrictive forces associated with the distance between markets, and the relative importance of estimates for aggregate supply and demand potentials. A new variable is introduced in this study to account for the fact that there is a new political border between Czech Republic and Slovakia. Evidence from this study suggests that the fact that these two now independent nations were unified until about 15 years ago remains a strong positive factor for the size of trade flows between them.

Keywords*: gravity model, trade flows, FDI, Central Europe, Visegrad Group*

JEL Classifications: C23, F12

1. Introduction

The countries of the Visegrad Group (V-4), Czech Republic, Hungary, Poland, and Slovakia, have undergone a dramatic economic transformation since the early 1990s. One aspect of this transformation has been the sub-region's emergence in world trade and, in particular, in terms of exports to the European Union. This study analyzes the export structure of V-4 countries by utilizing quantitative methods, in particular panel data regressions of V-4 exports.

The objective of this study is to quantify the determinants that influence the structure and trends of V-4 exports. The econometric modeling offers quantitative

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evidence for arguments that are often mainly qualitative in nature. Results from testing potential factors for V-4 exports determination can contribute to the discussion of further export promotion and facilitation efforts in the V-4 sub-region, and supplement other research efforts in related areas.

2. Research Methodology

This study follows a sequence of approaches for investigating V-4 exports patterns and trends. First, statistical analysis of trade flows and other macroeconomic indicators were utilized to determine the significance of exports to the economic performance of the V-4 countries over time, and to analyze the geographical allocation of the sub-region's exports. Throughout the study, the paper distinguishes between three broad categories of exports:

a) *Intra-sub-regional V-4 exports* (Intra-V-4): exports of V-4 countries with a final destination in another V-4 country;

b) *Exports to EU-15*: exports of the V-4 countries with a final destination in any of the EU-15 countries;[1]

c) *Exports to extra-regional Non-EU-15 countries* (Other destination): exports of the V-4 countries to a final destination outside of EU-15 or V-4 markets.

Second, we use results from the statistical analysis mentioned above and contemporary trade structure theories to determine the potential economic factors that explain the structure and trends of V-4 exports.

Third, we use a modified gravity model of international trade to test these derived assumptions about the factors of V-4 exports structures. Results from gravity model regressions can provide important implications related to the importance of specific factors of export performance in V-4 countries.[2]

3. Significance and Structure of V-4 Exports

Since the early 1990s the share of exports in the gross domestic product (GDP) of V-4 countries has grown substantially (Table 1). In Hungary and Czech Republic, exports account for around 60% of GDP and in Slovakia the figure is nearly 70%. V-4 country producers are increasingly depending more on external demand for exports relative to potential demand in the domestic economies.

[1] EU-15 countries are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom.

[2] Regressions for each category use panel data covering the period 1995 – 2004. The number of all observations totaled 560 bilateral trade flows.

The higher is the share of welfare directly affected by exports, the higher is the necessity for these countries to analyze the structure of their exports and developments in world trade and global financial flows. The exports to GDP ratio of the V-4 group as a whole increased from roughly 27% in the early 1990s to 45% in 2005.

T a b l e 1

Exports Shares of GDP (in %)

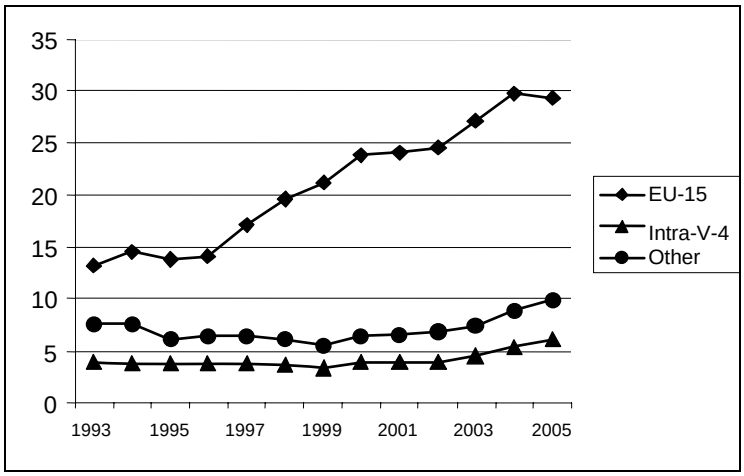
	1995 – 1999	2000 – 2004	2005
Czech Republic	39	55	64
Hungary	40	55	57
Poland	16	22	30
Slovakia	46	60	69
V-4 Total	27	37	45

Source: Own Calculations; World Bank (2006); IMF (2006).

The rising importance of exports for the V-4 economies is only part of the story though. Another important development is the changing geographical structure of V-4 exports as depicted in Figure 1. Since the early 1990s, exports performance of V-4 countries has been dominated by an increased integration with the EU-15 markets. The intra-sub-regional V-4 exports and exports to other non-EU-15 markets have been, generally speaking, keeping track with the growth of the member states' GDPs. The exports to EU-15 markets have increased more rapidly, doubling its share of V-4 GDP in less than a decade. Figure 1 gives a crude picture of effects from V-4 countries' increasing trade openness with the EU-15 market from the early 1990s to 2005.

F i g u r e 1

V-4 Exports Growth by Destination as a Percentage of Total V-4 GDP



Source: Own calculations; World Bank (2006); IMF (2006).

4. Determinants of V-4 Exports

4.1. Gravity Model Framework

The backbone of quantitative analysis for this research is the gravity model of international trade. In this study, the traditional model specification is augmented to accommodate special characteristics of V-4 exports. The gravity model has been used in numerous trade studies covering a wide variety of concepts, in particular regional trade analyses, and indeed represents the "standard empirical framework used to predict how countries match up in international trade" (Rauch, 1999, p. 10).

The gravity model has been applied, for this study, based largely on the innovative theoretical work by Linnemann (1966), who provided an intuitive framework for the level of trade by postulating that aggregated bilateral trade flows are universally determined mainly by three essential factors:

a) The total potential trade supply of the exporter, for which economic "mass" variable(s) (such as the exporter's GDP, population etc.) may serve as a proxy.

b) The total potential trade demand of the importer, for which economic "mass" variable(s) (such as the importer's GDP, population etc.) may serve as a proxy.

c) Any and all "resistances" to trade, which in its simplest form may be interpreted as geographic distance (as a proxy for transport costs), but for which other factors may also be included (such as information costs, tariffs, and other extra costs associated with international trade).

Linnemann's framework complements well with the national expenditure function mathematical derivations of the model by Anderson (1979), Bergstrand (1989), and others.

The basic formula of the gravity model is demonstrated below:

$$T_{ijt} = \beta_0 M_{it}^{\beta 1} M_{jt}^{\beta 2} R_{ij}^{\beta 3} \quad (1)$$

where

T_{ijt} – the volume of trade from country i to j at time t,
M_{it} and M_{jt} – the size or "mass" of countries i and j at time t,
R_{ij} – the relative "resistance" between i and j.

It is worth noting that although export data are used in regressions in this study for the dependent variable (T_{ijt}), the gravity model is not an export function in the traditional sense. The variables in the gravity equation are not meant to substitute as determinants for a country's exports volumes, but rather represent the essential and general forces predicting the size of total transactions, or trade flows, between two countries. Total trade or imports data between the country-pairs have also been used in regressions for the dependent variable in other studies,

although using total trade is not preferred for a number of reasons (see Kandogan, 2004). One additional argument for using exports is the fact that, given inclusion of a distance variable proxy for transport costs, using free-on-board (f.o.b.) trade figures make more sense for the model, while imports are more commonly reported in international databases in c.i.f terms, that is with costs of freight and insurance (costs associated with transport) already included.

4.2. Applying the Gravity Model of International Trade

"Mass" Variables

Various economic indicators can be used to represent the "mass" variables, which determine the potential trade supply of the exporter and potential trade demand of the importer. The most commonly used "mass" variables are GDP and/or population. In this study, two mass variables are applied:

a) Per capita GDP, which represents the proxy of the demand and supply potentials of a country; Higher per capita GDP indicates (ceteris paribus) higher potential export supply and import demand.

b) Total population, which further represents a proxy of the economic size of a country; higher population indicates (ceteris paribus) higher potential export supply and import demand as defined in this study.

"Resistance" Variables

The most common "resistance" variable is the geographical distance between the exporter and the importer. Following the precedence set by previous studies, geographical distance is a decent proxy for the variance of costs connected with trade flows. It is assumed that information costs and transport costs of trade between two economic centers are positively correlated with their geographical distance. The greater the geographic distance (ceteris paribus), the higher the costs (or greater "resistance") for trade between two countries.

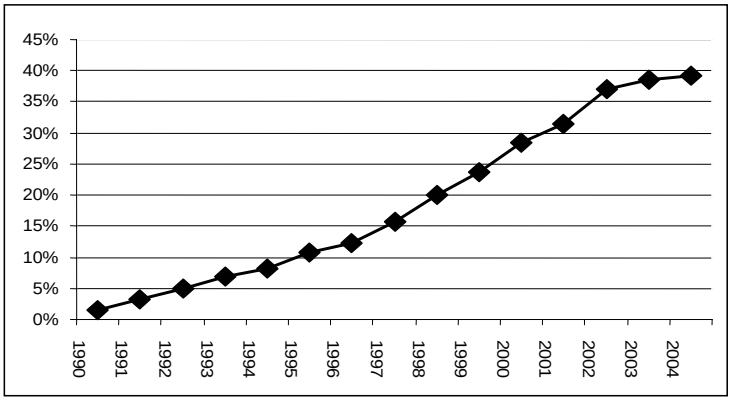
4.3. Special Applications for V-4 Trade

Importance of FDI for the Structure of V-4 Trade

Foreign direct investment (FDI) has grown in importance for V-4 economies since their transition into market economies in the early 1990s. The overwhelming share of growth in total inward FDI stock for V-4 is sourced from EU-15. By 1997, over 80% of total V-4 inward FDI came from EU-15 countries and the share has grown even more since. In 2000, nearly 95% of total inward FDI stock in Poland was EU-15-sourced; in 2004, EU-15 accounted for more than three-quarters of total inward FDI for Slovak Republic (UNCTAD, 2005).

Figure 2 shows how overall inward FDI stock has grown in importance to V-4 economies. It is also worth noting that the majority of total inward-V-4 FDI has been primarily directed to secondary and tertiary industries that also represent the major export sectors for V-4.

F i g u r e 2
V-4 Inward FDI/GDP



Source: Calculations by authors; UNCTAD (2004); World Bank (2006).

We have included total inward FDI stock of the exporter as an explanatory variable under the assumption that total inward FDI in V-4 countries increases the export supply potential, rather than stimulates production for the domestic market only. A common assumption is that new investors are using V-4 as a production base to supply the EU-15 market. The results from this research show that total inward FDI stock is, in fact, a particularly significant factor for V-4 trade with EU-15, while less significant in cases of intra-regional V-4 trade and extra-regional, non-EU-15 trade.

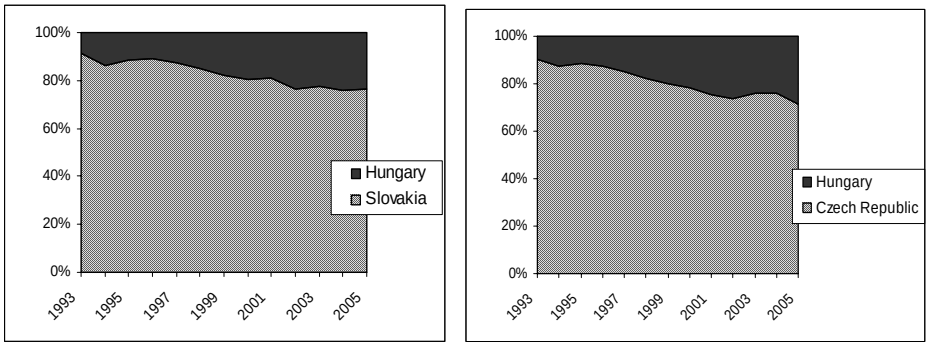
New Border Dummy Variable

A review of the V-4 intra-sub-regional trade statistics reveals a rather stark contrast of the intensities in direction of trade within the sub-region. There is an exceptionally high level of bilateral trade flows between Slovakia and Czech Republic relative to other V-4 partners. For example, while the economic size of Czech Republic and Hungary (in terms of GDP and population) are comparably similar, Slovak exports to Czech Republic are roughly three times higher than Slovak exports to Hungary. From figure 3, the dominance of Slovak and Czech exports to each other over exports to Hungary is considerable, although slowly diminishing. The fact that Slovakia and Czech Republic share a common political, socio-economical and cultural past apparently remains significant for determining the trade intensities within V-4.

Figure 3

Proportion of Czech and Slovak Exports to Hungary

(a) Exports of Czech Republic ***(b) Exports of Slovakia***



Source: IMF (2006); own calculations.

To account for the disproportionately high trade intensity between Slovakia and Czech Republic relative to other V-4 members, a dummy variable was introduced. This dummy variable, conceptually, represents the effects of the two nations' common past prior to their separation in 1993. We will refer to this unique and unprecedented variable as the "new border" dummy variable, since it accounts for the relative newness of the border between Czech Republic and Slovakia. The "new border" dummy variable will hold the value of 1 for trade between Slovakia and Czech Republic only, and a value of 0 for all other trade flows in the sample.

4.4. Summary of the Proposed Determinants for V-4 Exports

The potential supply and potential demand of the exporting and importing countries respectively is represented by the per capita GDP ($GDPPC_{ij}$) and the total population of the exporter (POP_{ij}). These "mass" variables are expected to be positively related to the volume of bilateral trade. A proxy for "resistances" to trade between two countries is the geographic distance ($DIST_{ij}$, measured in kilometers) between capitals or economic centers.

An additional supply potential factor expected to have significant impacts specifically for V-4 exports is the level of total inward FDI stock of the exporting country (FDI_i). FDI in V-4 countries is expected to have positive effects on the volume of exports especially to the EU-15 market, while the significance for total intra-V-4 exports and exports to other non-EU-15 destinations may be less prominent.

To account for the situation of the separation of Czech Republic and Slovakia in 1993, a "new border" dummy variable ($NBDV_{ij}$) was invented for this research. The "new border" dummy variable accounts for the assumed positive impacts on the volume of exports between these countries due to their formerly unified status.

Finally, a V-4 dummy variable ($V\text{-}4_{ij}$) is included in the economic modeling of V-4 exports. This dummy can be positively or negatively related to V-4 exports. Its significance will depend on whether the close historical and cultural circumstances in V-4 are also relevant for determination of trade volumes within V-4, relative to exports outside the sub-region.

5. Econometric Analysis of V-4 Export Structure

5.1. Econometric Analysis and Modeling of V-4 Exports

As mentioned above, for econometric analysis we distinguish three different categories of exports: V-4 exports to EU-15 markets, intra-sub-regional exports (within V-4), and V-4 exports to other destinations. The reason behind such categorization is the assumption that these three samples differ in the relative significance of factors that affect bilateral export volumes. Some initial support for this hypothesis was presented earlier in the stark differences in the trends of growth for trade in these individual directions, especially exports to EU-15 as compared to intra-V-4 and other destinations (see Figure 1).

This section presents the econometric specifications for testing the factors believed to influence the volume of V-4 exports with the specific destination groups over time. Following equation (1), we incorporate the determinants proposed in section 4.2 into the log-linear form:

$$\ln(T_{ijt}) = \alpha_0 + \alpha_1\ln(GDPPC_{it}) + \alpha_2\ln(GDPPC_{jt}) + \alpha_3\ln(POP_{it}) + \alpha_4\ln(POP_{jt}) + \\ + \alpha_5\ln(DIST_{ij}) + \varepsilon_{ijt} \quad (2)$$

Where all the abbreviations of the variables are as introduced in section 4.4, and (ln) stands for natural logarithm, ε_{ijt} is the error term, α_0 is an unknown constant and $\alpha_1 - \alpha_5$ are the coefficients to be estimated.

An additional variable is added to equation (2) representing inward foreign direct investment of the exporter (FDI_i), to test our hypothesis that inward FDI has a significant impact on the export volumes of the V-4 countries. A one year lag for FDI data ($FDI_{it\text{-}1}$) is used in regressions because there is likely a time-lag for FDI to affect an economy's supply potential for exports.

$$\ln(T_{ijt}) = \alpha_0 + \alpha_1\ln(GDPPC_{it}) + \alpha_2\ln(GDPPC_{jt}) + \alpha_3\ln(POP_{it}) + \alpha_4\ln(POP_{jt}) + \\ + \alpha_3\ln(DIST_{ij}) + \alpha_4\ln(FDI_{it\text{-}1}) + \varepsilon_{ijt} \quad (3)$$

The basic gravity equation (3) is further modified to include our new proposed augmenting variable: "new border" dummy variable ($NBDV_{ij}$), and also testing of a V-4 dummy variable ($V\text{-}4_{ij}$). The V-4 dummy variable is applied to a combined sample, where the three categories for directions of V-4 exports are stacked in one regression sample. The relevant outputs from the model for each directional category follow.

5.2. Analysis and Modeling of V-4 Exports to EU-15

The first sample represents all V-4 exports with final destination in EU-15 markets. The basic gravity equation (3) is applied to this restricted sample, with the regression results presented below (regression output 1).

From regression output 1, all the explanatory variables of V-4 exports have the expected signs. Furthermore, all the variables are highly significant, with the notable exception of GDP per capita of the exporter. The per capita GDP of a V-4 country (which may serve as a proxy for a series of factors such as overall productivity, technological advancement, and economic development) does not appear to have significant influence on the export performance of the particular V-4 country when EU-15 markets are concerned.

T a b l e 2

Regression Output 1: Equation 3 – Sample: V-4 Exports to EU-15 Markets

Independent Variables	Sign and Coefficient	Significance
GDP pre capita of the exporter ($GDPPC_i$)	(+) 0.026	Insignificant
GDP per capita of the importer ($GDPPC_j$)	(+) 0.764	High Significance
Population of the exporter (POP_i)	(+) 0.361	High Significance
Population of the importer (POP_j)	(+) 0.971	High Significance
Geographical Distance ($DIST_{ij}$)	(–) 1.109	High Significance
Inward Foreign Direct Investment (FDI_i)	(+) 0.521	High Significance
Adjusted R^2 = 0.898; **F – Statistics** = 824.8		

Note: High significance is significance at the 1% level; medium significance is significance at the 5% level; low significance is significance at the 10% level; less than 10% confidence level is considered insignificant.

Source: Own calculations.

The explanatory power of this model appears to be relatively high (adjusted R^2 at nearly 0.9) and is highly significant (as measured by the F-statistic); the model explains nearly 90% of V-4 exports to EU-15.

5.3. Analysis and Modeling of Intra-Sub-Regional V-4 Trade

Next, the gravity model analysis is conducted on intra-V-4 exports. In this case, the results are quite different. There are three instances where signs of the coefficients are opposite to expectations; also, population of importer and exporter and

the distance variables are insignificant. The explanatory power of the model, as measured by adjusted R^2 is relatively low. Overall, the model's fit is far less convincing for this group of trade flows as compared to the previous V-4-to-EU-15 case described in section 5.2.

T a b l e 3

Regression Output 2: Equation 3 – Sample: Intra-Sub-Regional V-4 Exports

Independent Variables	Sign and Coefficient	Significance
GDP pre capita of the exporter ($GDPPC_i$)	(+) 1.719	High Significance
GDP per capita of the importer ($GDPPC_j$)	(+) 0.745	High Significance
Population of the exporter (POP_i)	(+) 0.009	Insignificant
Population of the importer (POP_j)	(–) 0.090	Insignificant
Geographical Distance ($DIST_{ij}$)	(+) 0.248	Insignificant
Inward Foreign Direct Investment (FDIi)	(–) 0.280	Medium Significance
Adjusted R^2 = 0.313**, F – Statistics** = 9.114		

Note: High significance is significance at the 1% level; medium significance is significance at the 5% level; low significance is significance at the 10% level; less than 10% confidence level is considered insignificant.

Source: Own calculations.

As mentioned in section 4.4, the fact that Czech Republic and Slovakia were united until 1993 may be an important factor positively affecting their bilateral trade volumes. To test this assumption, a "new border" dummy variable ($NBDV_{ij}$) has been introduced as follows:

$$\ln(T_{ijt}) = \alpha_0 + \alpha_1\ln(GDPPC_{it}) + \alpha_2\ln(GDPPC_{jt}) + \alpha_3\ln(POP_{it}) + \alpha_4\ln(POP_{jt}) + \\ + \alpha_3\ln(DIST_{ij}) + \alpha_4\ln(FDI_{it}) + \alpha_5 NBDV_{ij} + \varepsilon_{ijt} \quad (4)$$

T a b l e 4

Regression Output 3: Equation 4 – Sample: Intra-Sub-Regional V-4 Exports

Independent Variables	Sign and Coefficient	Significance
GDP pre capita of the exporter ($GDPPC_i$)	(+) 1.124	High Significance
GDP per capita of the importer ($GDPPC_j$)	(+) 0.781	High Significance
Population of the exporter (POP_i)	(+) 0.644	High Significance
Population of the importer (POP_j)	(+) 0.708	High Significance
Geographical Distance ($DIST_{ij}$)	(–) 0.562	High Significance
Inward Foreign Direct Investment (FDI_i)	(–) 0.073	Insignificant
New Border Dummy Variable ($NBDV_{ij}$)	(+) 1.834	High Significance
Adjusted R^2 = 0.850**, F – Statistics** = 87.45		

Note: High significance is significance at the 1% level; medium significance is significance at the 5% level; low significance is significance at the 10% level; less than 10% confidence level is considered insignificant.

Source: Own calculations.

From regression output 3, the "new border" dummy variable ($NBDV_{ij}$), which accounts for the sustained integration between Czech Republic and Slovakia, "normalized" the output (according to expectations) as compared to the regression

of equation (3). The adjusted R^2 increased from 31% to 85%, the coefficients now have the expected signs, and the variables are highly significant, with the exception of inward FDI stock.

On average, inward FDI stock does not have an impact on intra-V-4 trade, even after controlling for the "new border effects" between Czech Republic and Slovakia. This result supports the hypothesis that inward FDI is significant in stimulating production for exports especially directed to EU-15 markets, but not for exports within the sub-region.

5.4. Analysis and Modeling of V-4 Exports to Other Destinations

The category of V-4 exports to "other" destinations accounts for all exports from V-4 countries outside V-4 and EU-15 markets. The results of the regression for equation (3) are presented in regression output 4 below. All the variables have the expected signs, and are highly significant, except for FDI_i. The explanatory power of this model is approximately 82% (according to adjusted-R^2). Compared to the previous samples, the coefficient estimate for geographical distance suggests a very significant impact on the size of exports. Exports flows scattered across the globe, away from the intra-V-4 or V-4-to-EU-15 directions of trade flows, apparently holds some extra transaction costs.

T a b l e 5

Regression Output 4: Equation 3 – Sample: V-4 exports to Other Destinations

Independent Variables	Sign and Coefficient	Significance
GDP pre capita of the exporter ($GDPPC_i$)	(+) 1.192	High Significance
GDP per capita of the importer ($GDPPC_j$)	(+) 0.507	High Significance
Population of the exporter (POP_i)	(+) 0.443	High Significance
Population of the importer (POP_j)	(+) 0.467	High Significance
Geographical Distance ($DIST_{ij}$)	(–) 1.860	High Significance
Inward Foreign Direct Investment (FDI_i)	(+) 0.178	Medium Significance
Adjusted R^2 = 0.823**, F – Statistics** = 200.8		

Note: High significance is significance at the 1% level; medium significance is significance at the 5% level; low significance is significance at the 10% level; less than 10% confidence level is considered insignificant.

Source: Own calculations.

Inward foreign direct investment is less significant, compared to the EU-15 sample, again supporting the assumption that FDI into V-4 stimulates exports mainly to EU-15 markets, and to a lesser extent for the rest of the world. A gravity model regression analysis of V-4 trade that had not used multiple trade samples to account for the differences in determination for V-4 exports by destination would have missed this important distinction for V-4 to EU-15 trade, and hence perhaps undervalued its significance.

5.5. Analysis and Modeling of Combined V-4 Trade

The combined sample represents all destination categories of exports of V-4 countries combined for a single regression. The results for equation (3) are shown in regression output 5 below.

T a b l e 6

Regression Output 5: Equation 3 – Sample: V-4 Exports to All Destinations Combined

Independent Variables	Sign and Coefficient	Significance
GDP pre capita of the exporter ($GDPPC_i$)	(+) 0.589	High Significance
GDP per capita of the importer ($GDPPC_j$)	(+) 0.450	High Significance
Population of the exporter (POP_i)	(+) 0.446	High Significance
Population of the importer (POP_j)	(+) 0.804	High Significance
Geographical Distance ($DIST_{ij}$)	(–) 1.340	High Significance
Inward Foreign Direct Investment (FDI_i)	(+) 0.362	High Significance
Adjusted R^2 = 0.824 **F – Statistics** = 707.0		

Note: High significance is significance at the 1% level; medium significance is significance at the 5% level; low significance is significance at the 10% level; less than 10% confidence level is considered insignificant.

Source: Own calculations.

By introducing the new border dummy variable ($NBDV_{ij}$) into the combined sample, we can review the concept under this broader context to further evaluate its relevance. In addition, a V-4 dummy variable ($V\text{-}4_{ij}$) was utilized to obtain a crude test of the relative effects of the group's sub-regional integration. The following equation (5) summarizes the model specification for an additional regression of the combined sample (results are presented in regression output 6).

$$\ln(T_{ijt}) = \alpha_0 + \alpha_1\ln(GDPPC_{it}) + \alpha_2\ln(GDPPC_{jt}) + \alpha_3\ln(POP_{it}) + \alpha_4\ln(POP_{jt}) + \\ + \alpha_3\ln(DIST_{ij}) + \alpha_4\ln(FDI_{it}) + \alpha_5 NBDV_{ij} + \alpha_6 V\text{-}4_{ij} + \varepsilon_{ijt} \qquad (5)$$

T a b l e 7

Regression Output 6: Equation 5 – Sample: V-4 Exports to All Destinations Combined

Independent Variables	Sign and Coefficient	Significance
GDP pre capita of the exporter ($GDPPC_i$)	(+) 0.472	High Significance
GDP per capita of the importer ($GDPPC_j$)	(+) 0.567	High Significance
Population of the exporter (POP_i)	(+) 0.457	High Significance
Population of the importer (POP_j)	(+) 0.857	High Significance
Geographical Distance ($DIST_{ij}$)	(–) 1.284	High Significance
Inward Foreign Direct Investment (FDI_i)	(+) 0.382	High Significance
New Border Dummy Variable ($NBDV_{ij}$)	(+) 1.848	High Significance
V-4 Dummy Variable ($V\text{-}4_{ij}$)	(+) 0.319	High Significance
Adjusted R^2 = 0.852 **F – Statistics** = 655.4		

Note: High significance is significance at the 1% level; medium significance is significance at the 5% level; low significance is significance at the 10% level; less than 10% confidence level is considered insignificant.

Source: Own calculations.

From regression outputs 5 and 6, all coefficients have the expected signs and are significant at the 99% confidence level. The explanatory power of the model for the combined sample is 85%. As expected, while inward foreign direct investment (FDI_i) is significant in the combined sample, the coefficient has a smaller value than in the case of exports to EU-15 only. For the combined sample, the coefficients were 0.362 and 0.382, in comparison, in the EU-15 sample the coefficient was 0.521.

6. Conclusions

6.1. Economic Implications for Modeling of Export Flows

Besides the important implications for V-4 international trade summarized in 6.2, this study has also introduced some important conclusions on application of the gravity model.

The study has shown that purposely selecting different samples of direction of trade flows (i.e. exports to EU-15, intra-sub-regional V-4 Exports, and exports to other destinations) is essential in order to examine the contrasting determinants of export flows. Whereas in most other studies the gravity model is applied generally to all export destinations, distinguishing different categories of destinations of V-4 exports (based on initial statistics analysis) allowed for additional findings on how those categories differ from each other. Factors that have a certain impact on the general country's exports can have contrasting impacts or very different levels of significance for exports to different destinations.

This study has also introduced an innovative application of the gravity model particular for V-4 circumstances, but which could also be applicable in other regions. The model, proposed by the authors (as specified in equation 5), is restated below and can be utilized as a general gravity model of V-4 exports in further studies:

$$\ln(T_{ijt}) = \alpha_0 + \alpha_1\ln(GDPPC_{it}) + \alpha_2\ln(GDPPC_{jt}) + \alpha_3\ln(POP_{it}) + \alpha_4\ln(POP_{jt}) + \\ + \alpha_3\ln(DIST_{ij}) + \alpha_4\ln(FDI_{it}) + \alpha_5 NBDV_{ij} + \alpha_6 V\text{-}4_{ij} + \varepsilon_{ijt}$$

Notably, the New Border Dummy Variable ($NBDV_{ij}$) invented for this research, accommodates the impacts on export flows of the common political and economic past of Czech Republic and Slovakia, prior to their separation in 1993. The study has successfully shown that omitting this variable would lead to distorted regression results and wrong economic interpretations for intra-V-4 trade. The analysis of the combined sample has further confirmed the relevance of this variable with a confidence level of 99%.

The fact that the end of the 20th century has witnessed an emergence of more than 20 new countries split from former unified states gives further relevance to the New Border Dummy Variable ($NBDV_{ij}$) for analysis of international trade. This model can be applied for analysis of trade in other regions, particularly studies that include the former Yugoslavia and the countries of the Commonwealth of Independent states.

6.2. Economic Implications for V-4 International Trade

The analysis of the combined sample shows that all the proposed factors (independent variables) for V-4 trade are highly significant (at a 99% confidence level). The most important determinant of V-4 exports, overall, is the demand potential, represented by the GDP per capita and population of the importers. However, according to the model, the productive capacity of the exporters is similarly relevant; higher population of the exporter and higher GDP per capita of the exporter are positively correlated with export performance. It is nevertheless important to note that GDP per capita of the exporting country has contrasting impacts on exports to different destinations.

GDP per capita is usually highly related to a series of factors such as overall productivity, technological advancement, and economic development. The application of the model has shown that V-4 countries with higher GDP per capita are more successful in intra-sub-regional exports. While, on the other hand, the level of GDP per capita is insignificant in determining exports to EU-15. In other words, exports of V-4 countries with higher GDP per capita are more competitive in the intra-sub-regional V-4 market, but not when the EU-15 market is concerned. This result has the economic implication that the level of development (in terms of the GDP per capita) does not affect the countries' potential to export to the EU-15 market. In addition, the restricted sample regression of V-4 exports to other destinations reveals that more economically developed V-4 countries (in terms of GDP per capita) find it easier to sell their products in global markets (outside of EU-15 or V-4 markets).

Another important determinant of the V-4 export performance is the level of total inward FDI stock in the particular economy. It has been shown that while inward FDI stock has a positive impact on the total exports, its impacts on exports groups restricted to different destinations are in contrast. The application of the model has revealed that the total stock of inward FDI has a positive impact on exports to EU-15 markets with a 99% level of confidence. On the other hand, the level of inward FDI stock has been shown to be insignificant in relation to intra-sub-regional V-4 exports (i.e. export among the V-4 countries) and less significant for V-4 exports to other destinations.

The distance to the export market is another significant factor affecting the volume of V-4 exports. The transportation and information costs connected with the distance between markets pose relatively high restrictions for V-4 exporters. This analysis showed that the regression coefficient related to distance is especially high for V-4 exports to markets outside V-4 and EU-15. The authors consider this to be, in large part, the result of high information costs between V-4 countries and markets outside Europe, as V-4 products and producers are mostly unknown outside of Europe, and global business ties of V-4 enterprises are still being developed. The relatively high coefficients related to distance is one possible explanation for why the export growth of V-4 has tended to be somewhat regional in scope, rather than global. It is also worth noting that high information costs between V-4 countries and countries outside Europe likely do not only negatively affect export performance, but also performance in terms of attracting oversees foreign direct investment.

Finally, the positive sign of the coefficient corresponding to the V-4 dummy variable (in the combined sample) implies that V-4 countries are integrated not only historically, socially or culturally, but also economically. It is important to note, at this stage, that the value of the coefficient has been adjusted through introduction of the New Border Dummy Variable for the special case of trade between Czech Republic and Slovakia. Thus the V-4 dummy variable implies the real overall integration between the V-4 countries exclusive of the special effects of the close economic and historical ties between the two formerly unified member states.

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