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## Article

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# Implications of the European integration: revisiting the hypothesis of ‘hub-and-spokes’ model

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## ABSTRACT

Already in 1994, Baldwin predicted the formation of the ‘hub-and-spokes’ model to describe the outcomes of economic integration across the European Union (EU) implying marginalization of the new EU member states. We examine the validity of this hypothesis by putting an emphasis on Visegrad group of countries (The Visegrad four (V-4): Poland, the Czech Republic, Slovakia and Hungary) and investigate the impact of the European integration scheme on their export performances. To conduct the analysis, we estimate the augmented gravity model for the panel data of the exports of V-4 with the rest of the world by employing pseudo-Poisson maximum likelihood estimator. Estimation results do not favour the creation of the ‘hub-and-spokes’ model, but rather demonstrate that integration within the EU was quite beneficial for V-4 without giving the origin neither to their peripherization nor to the loss of markets of the natural trade partners.

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## 1. Introduction

The European Union (EU) enlargement scheme based on the Association Agreements (AA or Europe Agreements), inspired Richard Baldwin to postulate the hypothesis predicting the formation of the ‘hub-and-spokes’ (Baldwin, 1994). Namely he stated that such bilateral agreements provided separate links between the EU and Central and Eastern European Countries (CEEC) without supporting intra CEEC economic integration that finally should form the ‘hub-and-spokes’ model, the EU being the hub and CEEC being spokes.

It is remarkable, that Baldwin discussed explicitly the case of Visegrad group of countries (The Visegrad four (V-4): Poland, the Czech Republic, Slovakia and Hungary) since among other CEEC this group of countries is mostly connected geographically to the Western Europe and to themselves. He suggested that to translate this physical geography into the favourable economic geography there would be the necessity of the trade liberalization not only between the hub and spokes but also among spokes. However, while referring to the growing number of FTAs among CEEC (for instance, Central European Free Trade Agreement (CEFTA), he considered them as an outcome of

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the political pressure of the EU and thus artificial enough to avoid formation of the ‘hub-and-spokes’ relations. He referred to the economies of scale and the market access to explain that EU FDIs would be located in the most efficient way to make firms production concentrated in the central market, that is, the EU.

One may reasonably state, that after the EU accession all CEEC would benefit of the free trade with all the other EU members, including themselves, and therefore, the ‘hub-and-spokes’ model would not impede their economic development. However, Baldwin stated that if the core EU countries had got a head-start due to the 5 or 10 years of ‘hub-and-spoke bilateralism’ preceding the EU enlargement, then it would have been far more difficult for the new EU member states (NMS) to catch up. So he argued that improper policies even being only temporarily might have very long-lived harmful consequences by emphasizing that EU membership in 10 years might not be enough to offset the initial head-start of core EU countries on CEEC. Additionally, Baldwin predicted the loss in trading between CEEC and the former Soviet republics. His intuition was that as these republics would start to develop they would raise barriers against the CEEC’s exports, which finally would result in harming CEEC exports in the long run due to the lost markets in these natural trading partner countries.

The issue at hand was explicitly examined by De Benedictis, De Santis, and Vicarelli (2005). Unlike to the Baldwin’s hypothesis, authors found that CEFTA as well as Baltic Free Trade Agreement (BFTA) were quite beneficial to avoid formation of ‘hub-and-spokes’ type relation. However, while this study covered the period before the EU accession, there is no study examining the topic after the EU accession. To fill the gap in the literature, we aim to examine this early hypothesis of Baldwin (1994) predicting the formation of the ‘hub-and-spokes’ model by covering pre as well as post-EU accession periods.

Namely, we construct the augmented gravity model for the panel data of the exports of V-4 with the rest of the world (234 countries) in 1999–2014. Instead of creating dummies, for CEFTA and BFTA, that was already done by De Benedictis et al. (2005), we rather divide trade partners into EU15, Visegard, NMS and post-Soviet country groups. This division allows us to figure out whether exports from V-4 increase with EU15 and decrease with V-4 and other NMS, or whether markets of natural trade partners, such as post-Soviet countries, are lost due to the EU enlargement. To test explicitly the effects of V-4 accession to the EU, we set the structural break in 2004 and derive estimations by employing pseudo-Poisson maximum likelihood (PPML) estimator. Estimation results do not favour the creation of the ‘hub-and-spokes’ model but rather demonstrate that integration within the EU was quite beneficial for V-4 without giving the origin to their peripherization predicted by Baldwin (1994).

The rest of the paper is organized as follows: Section 2 presents the literature review, Section 3 specifies model and describes the data followed by estimation results in Section 4 and finally the last section concludes the findings of the analysis.

## 2. Literature review

The most popular methodology to study the impacts of international trade on economies of countries involved in the process of regional integration is the theoretical framework of the Gravity model (Acharya, Crawford, Maliszewska, & Renard, 2011; Baier & Bergstrand, 2009; Carrere, 2006; Ghosh & Yamarik, 2004; Magee, 2008; Silva & Tenreyro, 2006;

Soloaga & Winters, 2001). The model was introduced by the crucial work of Tinbergen (1962) based on a law called the 'gravity equation' by analogy with the Newtonian theory of gravitation reflecting the relationship between the size of economies, the amount of their trade and the distance between the trade partners, in the following form:

$$X_{ij} = GS_i M_j \vartheta_{ij},$$

where  $X_{ij}$  is the monetary value of exports from country  $i$  to country  $j$ ,  $M_j$  controls for all importer-specific factors that make up the total importer's demand and  $S_i$  comprises exporter-specific factors that represent the total amount that the exporters are willing to supply.  $G$  is the set of regressors, whose values are not specific for each  $i$  and  $j$  pair, such as the level of world liberalization. Finally,  $\vartheta_{ij}$  represents the trade costs between  $i$  and  $j$  countries. The latter is mainly represented as the country-pair-specific information such as contiguity and distance, common language, ethnic groups or borders, common memberships in regional trade agreements and tariff rates between trade partners.

It is considerable that based on the theoretical framework of gravity model the literature shows quite opposite findings to Baldwin's predictions. Already in 2005 De Benedictis et al. (2005) examined the hypothesis about formation of 'hub-and-spokes' model by estimating dynamic gravity model for CEEC in 1994–2002. Authors found the evidence that signing CEFTA and BFTA were quite efficient to avoid 'hub-and-spokes' relations between CEEC and the EU15.

Other studies on CEEC after the EU accession demonstrate that surprisingly intra-Visegrad trade flows increased relatively more than the trade flows among the Visegrad and the other EU member states. In an attempt to explain this remarkable upward intra V-4 trade tendencies, the literature outlines the impact of improved economic performances reflected in higher GDP growth rates, increased FDI inflows from the EU15 and other advanced countries and the elimination of non-tariff barriers to trade.

Namely, Hunya and Richter (2011) analyse FDI flows to figure out the reasons for the increased intra trade between the four countries since the EU accession. Their statistical analysis indicates that while the overall FDI inflows have been playing a decisive role in the economic growth, both inward and outward bilateral FDI in most cases are negligible. Thus authors conclude that it is not bilateral FDI, but the FDI in general from the EU15 and other advanced countries that boosted the intra-Visegrad trade. Additionally, the paper indicates that the division of the period 2000–2007 into a pre-accession and a post-accession segment does not reveal outstanding changes in the composition of intra-V-4 trade by factor inputs since the integration process was started long before the official accession date in 2004.

The impact of improved economic performances on the enlarged trade flows is also outlined in the paper of Foster (2012). Namely, the author studies the gravity determinants in intra-Visegrad trade after these countries' accession to the EU. The analyses shows that this is higher GDP growth rates of V-4 after their EU accession coupled with an increased GDP growth differential relative to the EU15, which yields the significant positive impact on the bilateral trade. Therefore, the author concludes that the EU accession is associated with the improved economic performances reflected in the increased GDP, which in its turn causes the upward trend in bilateral trade flows between V-4 countries.

Additionally, Hornok (2010) highlights that the elimination of non-tariff barriers as a consequence of the EU accession might increase the trade flows among V-4 countries.

More precisely, the author outlines elimination of the following non-tariff barriers: customs procedures, border waiting times, technical barriers to trade through completion of harmonization, lower legal and information costs for exporters and reduced political risk. Moreover, the role of the government export promotion for all the Visegrad countries is analysed by Janda, Michalíková, and Psenakova (2013) and Janda (2014), who find significant positive impacts of export credit agencies on export performances of V-4. Furthermore, Akhvlediani and Sledziwska (2015, 2016) find the positive and statistically significant impacts of Common Commercial Policy of the EU on the V-4 exports.

To conclude, the reviewed empirical studies demonstrate that unlike to the hypothesis of Baldwin, the intra V-4 trade did not decrease but instead increased during their integration processes in the EU. Besides, while De Benedictis et al. (2005) explicitly examined the hypothesis of formation of 'hub-and-spokes' model before the EU accession, there is no recent study that would elaborate this hypothesis after the actual EU enlargement.

To fill the gap in the literature, this paper aims to test empirically the theoretical predictions of Baldwin (1994) implying the marginalization of Visegrad economies and the loss of markets of their natural trading partners due to the EU enlargement. According to the data availability our sample covers the years from 1999 to 2014 and thus, puts the focus on the consequences of the EU enlargement. Since De Benedictis et al. (2005) have already found the positive effects of CEFTA and BFTA, we do not create dummies for the regional trade agreements but rather we divide countries into several regional groups such as: EU15, Visegard, NMS and post-Soviet country groups. In case Baldwin's hypothesis holds, then we expect V-4 exports to increase with trade partners from the EU15 and to decrease with trade partners from all other country groups. Moreover, we set the structural break in 2004 to see actual consequences of the EU enlargement. More precisely, if before the EU accession, hub-and-spokes model was formed and thus distorted V-4 from trading with other CEEC, then after removing all the barriers since 2004, we expect exports to decrease with the trade partners from the EU15 and increase with NMS and V-4. As for the post-Soviet countries, if before the EU enlargement hub-and-spokes model was established then after 2004 removing all the barriers still might not increase V-4 exports to these countries. This is because of existence of tariffs and non-tariff barriers that V-4 exports (as all the EU countries) still face in post-Soviet countries. So, we expect the change in V-4 exports to post-Soviet countries to be negative and statistically significant.

Based on the above-stated reasoning, the formation of hub-and-spokes model will be supported if our analysis confirms the following research hypothesis:

- Over the whole period of analysis V-4 exports increase with trade partners from the EU15 and decrease with trade partners from NMS, V-4 and the Post-Soviet countries;
- After 2004, V-4 exports decrease with trade partners from the EU15 and increase with trade partners from NMS, V-4.

### 3. Model specification and data description

Although the gravity model is already a commonly accepted and a standard tool to study the trade flows, the specification of the equation for estimation purposes differs across studies. The most remarkably, Silva and Tenreyro (2006) in their seminal paper have

raised a problem that has been ignored so far by both the theoretical and empirical studies. In particular, they argued that the logarithmic transformation of the original model is not relevant approach to estimate elasticities. Namely, the multiplicative trade models with multiplicative error do not satisfy the assumption of the homoscedasticity of the error term since there is dependency between the error term of transformed log-linear model and the regressors, which finally causes inconsistency of the ordinary least squares estimator or the random and fixed effects estimator.

As an alternative, authors propose the estimation of the gravity model in levels using the PPML estimator. Besides tackling with the problem of heteroscedasticity of the error term, the estimator deals with the zero value observations in trade flows. Additionally, unlike to the standard Poisson approach, PPML does not require the data to be Poisson type, in other words, that it does not require the dependent variable to be an integer. Finally, PPML allows identifying effects of time invariant factors. The latter is very important feature for our analyses, since we aim to test the effects of several dummy variables denoting countries from the different regional groups. For instance, by employing Poisson estimator for fixed effects instead of PPML, we would not only result in dropping all the time invariant regressors but also all the pairs of never-trading countries from the sample. So together with omitting the variables of our most interest (regional dummies) we would also face a sample selection and one might doubt whether the conclusions drawn from the model based on the resulting skewed sample would still be representative for the whole intended population.

Apart from selecting relevant estimator, our paper takes into account other important issues for estimating gravity model properly. Namely, to account for the multilateral resistance term (MRT), following Head and Mayer (2015), Rose and van Wincoop (2001), Feenstra (2004) and Baldwin and Taglioni (2006) we include country and time fixed effects. Here time effects account for cyclicalities of economies involved. Moreover, we do not deflate trade flows improperly. Namely, being aware that Gravity is an expenditure function allocating nominal GDP into nominal trade flows (see for instance Head & Mayer, 2015) we take current GDPs without deflating it by US aggregate price index.

Finally, our estimation equation for exports of Visegard with the rest of the world in 1999–2014 is formed as follows:

$$EX_{ijt} = \exp [\beta_0 + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(GDP_{jt}) + \beta_3 \ln |GDP\_pc_{it} - GDP\_pc_{jt}| + \beta_4 \ln(Z_{ij}) + \beta_5 D_{jt} + \beta_6 D'_{ij} + \mu_i + \varphi_j + \lambda_t] + \varepsilon_{ijt}, \quad (1)$$

where  $EX_{ij}$  is the export flow from country  $i$  to country  $j$  at time  $t$ . As for the right-hand side of the equation, we include independent variables approximating the market size, the difference in factor endowments, geography, different regional groups and MRT. Namely, market-related variables are  $Y_i$  and  $Y_j$ , which represent the current GDPs of the trade partners at time  $t$ ,  $|GDP\_pc_{it} - GDP\_pc_{jt}|$  stands for the absolute value of the difference between real GDP per capita and proxies difference in factor endowments between trade partners at time  $t$ . Geographical variables are presented by  $Z_{ij}$ , which is the non-binary but time invariant information such as distance between the exporter and importer countries;  $D'_{ij}$  which stands for contiguity and equals one when the trade partners share the common border and zero otherwise and  $D_{jt}$  which presents a dummies for the

different country groups. Namely regional dummies control for the EU15, NMS,<sup>1</sup> V-4 and the former states of the Soviet-Union among trade partners. Finally,  $\mu_i$  and  $\varphi_j$  represent country effects,  $\lambda_t$  presents time dummies and  $\varepsilon_{ijt}$  is the error term that does not have to be homoscedastic (PPML allows errors to be heteroscedastic and by the default it runs regressions with the robust errors).

To test our research hypotheses explicitly, we allow for structural changes in 2004 due to the EU enlargement, which reflects the belief that the influence of particular independent variables on the level of exports might be altered since 2004. Technically this can be done in two ways: either by estimating Equation (1) separately for the periods 1999–2003 and 2004–2014 or by introducing a set of interaction terms of the independent variables with a dummy variable which distinguishes between two considered periods (1999–2003 and 2004–2014). The latter is better: we can get a single model with a higher number of degrees of freedom and additionally, by employing the Wald statistics we can easily test whether the parameter on each independent variable exhibited a statistically significant change in 2004. Finally, by allowing structural break in 2004 due to EU accession, Equation (1) converts into Equation (2), as follows:

$$\begin{aligned} EX_{ijt} = & \exp [\beta_0 + \beta_1 \ln (\text{GDP}_{it}) + \beta_2 \ln (\text{GDP}_{jt}) + \beta_3 \ln |\text{GDP}_{pcit} - \text{GDP}_{pcjt}| \\ & + \beta_4 \ln (Z_{ij}) + \beta_5 D_{jt} + \beta_6 D'_{ij} + I_{2004} \{ \beta_7 \ln (\text{GDP}_{it}) + \beta_8 \ln (\text{GDP}_{jt}) \\ & + \beta_9 \ln |\text{GDP}_{pcit} - \text{GDP}_{pcjt}| + \beta_{10} \ln (Z_{ij}) + \beta_{11} D_{jt} + \beta_{12} D'_{ij} \} + \mu_i + \varphi_j + \lambda_t] + \varepsilon_{ijt}, \end{aligned} \quad (2)$$

where  $I_{2004}$  is a dummy indicator variable, which equals 0 before 2004 and 1 from 2004 on.

By employing PPML, we first estimate Equation (2), then Equation (1) and finally we run regressions on the pooled sample. To decrease omitted variable bias and to provide further sensitivity tests, we also control for regional trade agreements (RTAs) in our estimations. RTAs contain information whether trade partners have any signed trade agreements at time  $t$ . In other words, our dummy for RTAs controls for active as well as inactive trade agreements. Thus, first we derive estimates with interaction terms, then we compare results with the estimates with no structural break to underline the effects of inclusion structural break. Finally, we provide estimations excluding all the proxies for MRT that further highlights that the coefficients of some variables could be drastically different once we do not control for MRT.

The data on the export flows in millions of Euros come from the Eurostat. The data of the current GDP levels in millions and real per capita GDPs are included from the World Development Indicators database compiled by the World Bank. The data for the other variables such as distance and contiguity are taken from the CEPII database. Information about RTAs is taken from the WTO database. According to the data availability, the sample covers the period from 1999 to 2014. The considered group of countries consists of Visegrad countries as reporters, and the rest of the world consisting of 234 countries as partners in our sample. The complete set of variables included in the model is given by [Table 1](#).

#### 4. Estimation results

As discussed in the previous section, we estimate the augmented gravity model for the export flows of V-4 in the period 1999–2014. To control for the effects of the EU accession



**Table 1.** Variables employed in the model.

Variable name	Description	Source	Expected sign
exports	Exports in millions of Euros (dependent variable)	Eurostat	
IGDP_rep	Natural logarithm of GDP in current US dollars of a reporter country	WDI	+
IGDP_par	Natural logarithm of GDP in current US dollars of a partner country	WDI	+
IGdpR_pc	Natural logarithm of the absolute value of difference of GDP per capita in purchasing power parity (PPP) of reporter and partner countries	WDI	–
ldistance	Natural logarithm of geographical distance between the capital of the trading partners	CEPII	–
contig	Dummy variable standing for the neighbouring countries	CEPII	+
RTAs	Dummy variable standing for any signed agreement between trade partners.	WTO	+
EU_15	Dummy variable denoting the EU15 countries among partners		+
NMS	Dummy variable denoting new member states of the EU among partners, excluding Visegrad countries		–
VS	Dummy variable denoting V-4 among partners		–
Post-Soviet	Dummy variable denoting the former Soviet states among trade partners, excluding Baltic countries	CEPII	–

Source: Own compilations.

we introduce structural break in 2004. All estimations are done by PPML. In each of the specifications, all the variables, except the dependent variable and dummies, are taken in logarithms, the latter two are taken in levels.

Table 2 reports estimation results. In column (1) we provide estimations for the whole time period, all independent variables are interacted with the time dummy for 2004 and estimations control for the country and time fixed effects. Column (2) presents estimated differences in the influence of a given variable compared to the pre-2004 period. In other words, statistical significance in column (2) reflects whether the difference of the estimated values of the coefficients in pre and post-EU accession periods is statistically significant. Column (3) and column (4) provide robustness checks of previously derived estimations by including dummies for RTAs. Here as well, together with country and time fixed effects we include the structural break. Column (5) and column (6) present estimations for the whole period without interaction terms with and without RTAs. Finally, column 7 and column 8 provide estimations with no country and time effects and neither structural break. For robustness checks, likewise in the previous case, we run regressions with and without RTAs.

First of all we should notice that estimates exhibit the expected signs and suggest statistical significance of most variables at the 1% significance level. The estimated post-accession change in parameters indicate that after the EU accession the impact of the reporter countries' GDP increases. This finding is in line with the literature, stating that after the EU accession, economic growth increased in Visegrad countries that eventually had positive impact on their export performances. Additionally, the magnitude of the absolute difference in real per capita GDP, that presents relative factor endowments of the trade partners, is decreased after the EU accession. This might imply that the difference in factor endowments loses its explaining power on the exports from V-4.

When it comes to the geographical variables, which proxy transportation and information costs, while the coefficient of the dummy for contiguity does not change drastically through all the estimations, coefficient of distance is reduced twice once we exclude time and country effects from the estimations. It is remarkable that inclusion of RTAs in the analysis does not change estimations and indicate robustness of our analysis.

**Table 2.** Estimation results.

Variables	Country and time effects				Country and time effects		No country and time effects	
	Structural break				No structural break		No structural break	
	(1) without RTAs	(2) (change)	(3) with RTAs	(4) (change)	(5) without RTAs	(6) with RTAs	(7) without RTAs	(8) with RTAs
IGDP_rep	0.638*** (0.153)	0.103*** (0.0334)	0.614*** (0.158)	0.0885*** (0.0333)	0.684*** (0.155)	0.629*** (0.161)	0.605*** (0.0185)	0.635*** (0.0179)
IGDP_par	0.710*** (0.0552)	0.0230 (0.0220)	0.734*** (0.0587)	0.0238 (0.0214)	0.786*** (0.0508)	0.788*** (0.0558)	0.861*** (0.0129)	0.875*** (0.0138)
IGdpR_pc	0.0252 (0.0387)	-0.189*** (0.0374)	0.0340 (0.0420)	-0.201*** (0.0407)	-0.148*** (0.0183)	-0.151*** (0.0188)	-0.0589** (0.0242)	-0.0657** (0.0256)
ldistance	-0.444*** (0.0485)	0.0426 (0.0433)	-0.481*** (0.0518)	0.0916* (0.0468)	-0.394*** (0.0365)	-0.388*** (0.0381)	-0.872*** (0.0376)	-0.872*** (0.0358)
contig	0.347*** (0.0831)	-0.0445 (0.0845)	0.310*** (0.0842)	0.000655 (0.0868)	0.310*** (0.0379)	0.312*** (0.0393)	0.282*** (0.0505)	0.273*** (0.0512)
RTAs			0.118* (0.113)	0.243*** (0.0937)		0.0490* (0.0364)		0.229*** (0.0429)
EU_15	2.882*** (0.449)	0.0165 (0.0672)	2.759*** (0.468)	0.0808 (0.101)	2.669*** (0.439)	2.664*** (0.449)	0.776*** (0.0569)	0.808*** (0.0539)
NMS	-0.432 (0.368)	-0.155 (0.0959)	-0.318 (0.378)	-0.217 (0.0918)	-0.416 (0.360)	-0.458 (0.361)	1.082*** (0.0893)	1.116*** (0.0926)
VS	4.958*** (0.454)	-0.155 (0.116)	4.883*** (0.480)	-0.209 (0.115)	4.652*** (0.432)	4.636*** (0.439)	1.586*** (0.0826)	1.642*** (0.0828)
Post-Soviet	3.949*** (0.398)	-0.186*** (0.0850)	4.364*** (0.433)	-0.218** (0.0943)	3.039*** (0.426)	4.058*** (0.435)	0.705*** (0.0576)	0.781*** (0.0637)
Constant	-17.44*** (1.889)		-17.27*** (1816)		-17.43*** (1.960)	-16.84*** (1.831)	-12.48*** (0.423)	-13.05*** (0.458)
Observations	11,123		10,587		11,123	10,587	11,123	10,587

Note: Robust Standard errors in parentheses. Significance at the 10%\*, 5%\*\* and 1%\*\*\* levels.

Source: Own calculations, Stata (2014).

The impact of RTAs, as well as the change in the impact is positive. However, likewise in case of distance, coefficient of RTAs is twice smaller in estimations which exclude time and country fixed effects. This indicates that the impact of distance and RTAs could be overestimated when estimations do not include the measures for MRT, which in this case are proxied by country and time effects.

As for the regional dummies, it is remarkable that regional dummies yield quite high magnitudes that might imply that these coefficients may contain all the effects of the links of V-4 with one another as well as with Post-Soviet and EU members via various channels, such as neighbourhood, historical, cultural ties or the other factors brought by the lengthy process of integration in the EU. The highest magnitude comes on the dummy standing for Visegrad countries among trade partners followed by the post-Soviet countries and then the EU15. This finding does not support formation of hub-and-spokes model as stated in our first research hypothesis. In other words, throughout the whole period of analysis, V-4 exports did not only increase with the EU15 but mostly among each other with no loss of markets in post-Soviet countries.

The change in the magnitudes of the regional dummies is not statistically significant with the only exception of the dummy for post-Soviet countries that decreases after the EU accession. This implies that the EU enlargement might have reduced the exports to the post-Soviet countries. This could be explained by the fact that while among the EU countries no tariffs exist any more, in post-Soviet countries tariffs as well as non-tariff barriers still remain obstacles for V-4 exports. Although, as it is demonstrated by all the estimations, post-Soviet countries remain important destinations for V-4 exports. Overall, our estimations do not find significant increase in magnitudes of coefficients standing for V-4 NMS, and post-Soviet countries on an expanse of decrease in the magnitude of coefficient standing for the EU15. This indicates that hub-and-spokes model was not formed before the actual EU enlargement.

As for the dummy standing for the NMS, it turns significant with quite high magnitude only in the estimations without country and time fixed effects. This finding demonstrates somehow less robust estimates for this particular variable. On the other hand, we may argue that it was CEFTA that contributed a lot in increase of trade flows among V-4. So that if there was a free trade agreement among all NMS before the EU accession then V-4 exports could also be drastically increased with all NMS not only among V-4.

Besides, it is considerable that while literature on V-4 economies demonstrates that trade flows within Visegrad have remarkably increased after the EU accession, the change in the magnitude of dummy standing for V-4 is not statistically significant. However, this finding goes back to the AA agreements and highlights their effectiveness to support V-4 integration in the EU. More precisely, integration processes has been started a decade ahead the EU accession and that is why the year of the accession itself (2004) might not have the statistically significant impact. Our finding is also in line with the recent findings of Hunya and Richter (2011), which illustrated that the dummy for 2004 does not have the statistically significant impact due to the long integration processes that had a place before the actual EU enlargement.

Overall, our estimations reveal that through the whole period of analysis V-4 exports do not increase only with the EU15 but also with V-4 and post-Soviet countries. Formation of hub-and-spokes model is neither supported before the actual EU enlargement. Namely, our estimations do not find significant increase in magnitudes of coefficients standing

for V-4 NMS, and post-Soviet countries on an expanse of decrease in the magnitude of coefficient standing for the EU15.

## 5. Conclusions

The paper aimed to examine the early hypothesis of Baldwin (1994) predicting the formation of the 'hub-and-spokes' model as a consequence of the EU enlargement. Based on the augmented gravity model we estimated the panel data of the export flows of V-4 over 1999–2014. Together with the standard gravity variables, we have included RTAs, as well as the set of dummy variables denoting different EU country groups such as EU15, V-4 and NMS. Besides, we controlled for post-Soviet countries as the natural trade partners of V-4. To illustrate the precise outcomes of the EU accession on the V-4 export performances, we introduced interactions of independent variables with the time dummy standing for 2004. The latter was employed to control for the possible structural changes due to the EU accession and besides, it allowed country effects to remain same for the whole period of analyses. We followed the advancement in the empirical trade literature and applied PPML estimator with country and time fixed effects.

Our results indicated that unlike to the Baldwin's hypothesis, Europe Agreements were quite efficient tools for easing the trade of V-4 with all the group of countries covered in the sample. More precisely, we found that for the whole period of analysis while being EU15 increases exports of V-4, Visegrad countries still present the most important partners for one another. Moreover, post-Soviet countries still remain essential destinations for V-4 exports. Our estimations neither supported formation of hub-and-spokes model before the actual EU enlargement. However, relatively to the pre-EU accession, in the post-EU accession the significant decrease was observed in V-4 exports to post-Soviet countries. The latter may imply that tariffs and non-tariff barriers that still exist at the post-Soviet countries could distort exports from V-4.

Therefore, we may state that the theory introduced by Baldwin (1994) to describe the European integration processes might not necessarily illustrate the real implications of the EU enlargement. Namely, while Baldwin predicted the dominance of the EU15 in determining directions of the trade of NMS, in fact our estimations showed that the trade of V-4 is not concentrated over the EU15 but among themselves and furthermore among their natural partners. Therefore, the hypothesis of Baldwin implying the marginalization of V-4 is not supported by our estimations. Thus, we may state that the model of 'hub and spokes' does not report the contemporary trade relations across the EU.

## Note

1. To avoid collinearity, NMS contain all the countries that became members of the EU by or after 2004, excluding V-4.

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