The Impact of FDI on Bilateral Exports: The Case of the Automotive Industry in the Visegrad Countries

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Abstract

This analysis presents the effect of foreign direct investments in the automotive industry on the automotive exports of the Visegrad countries. The econometric analysis is based on the gravity model of trade. The author uses panel data to estimate variables that impact the automotive export. The data consists of the bilateral flows of trade and investments between the Visegrad countries and the other members of the OECD. The empirical analysis shows a positive correlation between the value of the FDI stock in the car industry and the automotive exports to the country of origin of investment. The results of the analysis prove that the Visegrad countries export a significant part of their automotive production to the home countries of the investing MNCs.

Keywords: Foreign Direct Investment, Visegrad countries, automotive industry, export, OECD, restructuring.

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1. Introduction

The car industry plays an important role in the economies of the Visegrad countries (Hungary, Slovakia, Czech Republic and Poland). Since the 1990s, the automotive industry has been restructured in the Visegrad Group. The reorganization and modernization of automobile production had been led by foreign direct investments (FDI) of multinational companies (MNCs). The former state-owned production facilities had been acquired by MNCs, which have invested in numerous green-field facilities as well. The investments in the region have resulted in the formation of an automotive cluster. The automotive industry of the Visegrad Group produces mainly for the European market. In Slovakia, 99% of the produced automobiles are exported (Jakubiak et al, 2008). The ratio of motor vehicles in total exports reaches 10% (Hungary) to 20% (Slovakia). These numbers show that motor car products play an important role in total exports.

The goal of this analysis is to verify whether there is a positive correlation between bilateral automotive FDI and exports in the Visegrad Group. I use an econometric model based on the gravity model of trade in order to verify this hypothesis. I analyze bilateral trade flows between the Visegrad countries and the other members of the OECD (Organization for Economic Co-operation and Development).

The research hypothesis is: *the value of the bilateral FDI stock in the automotive sector has positive impact on bilateral automotive exports from the host country to the country of origin of the investment.*

The hypothesis might seem to be evident, however, there is no clear empirical evidence for this relationship in the literature. A positive impact of bilateral investments on bilateral exports implies that a significant part of the produced motor vehicles should be exported to the home country of the motor car MNC. The automotive industry of the Visegrad Group not only supplies its domestic market, but also the home markets of the MNCs. This relationship should be observable for the markets of Germany, Italy and France, which are the countries of origin of major investors. This means that the MNCs exploit the potential of the internalization of production in the Visegrad Group. A high quality of the manufactured products enables the MNCs to sell these products in their home market under the same brand.

The automotive industry is used as a case study to analyze the relationship between foreign investments and exports in the Visegrad countries. The export oriented car industry is a suitable basis for the analysis of the impact of FDI on exports. The production of motor vehicles in the Visegrad countries is based on the investments of MNCs. Additionally, the availability of statistical data for the car industry enables the analysis of exports and investments. Finally, the industry is regarded as a successful sector of the region.

The paper has the following structure: Section 2. presents the review of the literature. Section 3. describes the changes in the main macroeconomic factors.

The data base is introduced in Section 4. The results of the empirical analysis are presented in Section 5. The paper ends with the conclusions in Section 6.

2. The review of the literature

Foreign direct investments are sometimes split into two groups: market seeking horizontal investments and cost seeking vertical investments (Reinbold et al, 2010). Horizontal investments are used to serve the demand of the host country, usually by establishing a production facility abroad. Vertical investments are necessary to establish production-chains, where specific stages of the production process are located in different countries in order to reach the most cost-efficient production.

The classification of the different forms of production networks is closely related to investments. Reinbold et al (2010) enumerate four types of production-strategies: centralized production, host-market production, regional product specialization and transnational vertical integration. Host market production is financed by horizontal investments, while transnational vertical integration is established by vertical investments. Centralized production occurs in a single location, in this case foreign markets are supplied by exports; thus it is not connected to FDI. Regional product specialization means that a whole region specializes on the production of a specific product.

John H. Dunning is one of the most influential experts of MNCs activity. He is the author of the Eclectic Theory of International Production, originating from the late 1970s. The eclectic paradigm, often referred to as the OLI-paradigm, is related to the internalization theory. The finding of the internalization theory is that "the greater the net benefits of internalizing cross-border intermediate product markets, the more likely a firm will prefer to engage in foreign production itself, rather than license the right to do so, e.g. by a technical service or franchise agreement, to a foreign firm" (Dunning, 2000, p.2).

Dunning identifies three different types of advantages that induce a firm to engage in FDI activity; they originate from Ownership (O), Location (L) and Internalization (I). The Ownership-advantages include competitive advantages owned by the firm seeking to produce abroad over local rivals. The Location-advantage encourages the MNC to make use of the immobile assets of a foreign country. Finally, the I-advantage leads the firm which owns O - and L-specific advantages to make use of them by itself on the foreign market, instead of licensing them to indigenous producers. A firm has the incentive to internalize its activity in order to decrease its transaction costs.

Dunning also notices that the form of entry to a foreign market determines the exploitation of the different types of advantages. While the engagement in FDI-activities makes use of O-, L- and I-advantages as well, export involves only O- and I-advantages, while by licensing the firm can make use of only O-advantages. This

means that FDI represents the highest level of foreign expansion, and promotes globalization.

Markusen (2000) develops the OLI-framework further, connecting Dunning's ideas to firm and country characteristics. His 'knowledge-capital' model (2000) examines the effects of trade and investment liberalization through the activity of MNCs.

In the centre of his theory is the concept of knowledge capital, which includes the human capital of the employees, patents, procedures etc. The production of the MNCs is knowledge capital intensive, as this type of capital is well suited for international production: it can be easily transported to foreign production facilities; furthermore it has a "public-good" property.

The author also notices that knowledge-capital intensive production requires skilled labor force, which explains why those countries attract the most FDI, that are abundant in qualified labor force. These features of the knowledge-capital belong to the O-advantages. Markusen differentiates the L-advantages according to the type of production: vertical or horizontal. For horizontal production, L-advantages include the elimination of transport costs and tariffs and the utilization of the scale of economics in the case of large markets. For vertical production, L-advantage originates from the exploitation of factor price differences. The I-advantage of knowledge capital is the preservation of its value, as licensing a company's valuable know-how is not risk-free (the partner might damage the firm's reputation, absorb the technology etc).

Markusen (2000) examined the relationship between investment liberalization and trade in goods with high-value added. His important conclusion is that the direction of trade between the host and the source country can be reversed when the relative endowments of the countries differ significantly. In Markusen's model, the source-country is relatively abundant in high-skilled workers, while the host-country in unskilled workers. With the liberalization of investments, enough production of the high-value added good is shifted to the host-country to change the direction of trade. Markusen's finding is in line with the implications of liberalization of investments in the Visegrad countries, which became exporters of motor vehicles to Western-Europe.

Markusen (2000) examined the differences between vertical and horizontal investments as well. When the source- and the host-countries are similar in size and endowments, investments tend to be horizontal, while when they are different in endowments, vertical investments are more typical. Trade liberalization has different effects on the two types of investments: horizontal investments will decrease, while vertical ones increase. Markusen's conclusions are in line with the findings of other empirical studies about the Visegrad region. The majority of automotive investments have vertical character in the Visegrad countries.

Helpman, Melitz and Yeaple (2003) examine the decision of firms to serve

a foreign market through exports, or through local subsidiary sales (FDI). They extend the 'proximity-concentration tradeoff' theory (firms invest, when the gains of maintaining foreign subsidiaries outweigh the costs) with intra-industry firm heterogeneity and firm-productivity. The authors carry out an econometric analysis using a multicountry, multisector general equilibrium model. They come to the conclusion that the productivity of a firm determines its level of engagement in international commerce: only the most productive firms of a sector engage in FDI activity. Productive firms serve the markets by export, and the less productive stick their activity only to the home market.

The authors examine the connection between the ratio of FDI to exports and intra-industry firm heterogeneity in the same analysis. There is positive correlation between these variables – in industries in which productivity levels differ highly across firms, the ratio of FDI to exports is higher.

2.1. The gravity model

The gravity model is one of the most popular tools used to analyze bilateral trade flows. It is widely used, because its results are easy to interpret, its results strongly fit the empiric data; furthermore it can be extended with additional variables. The traditional gravity model is in analogy with Newton's Law of Gravitation. The flow of goods or factors of production is attracted by the mass of demand and supply, however, the potential volume is reduced by distance (Anderson, 2011). The form of the traditional gravity model:

$$X_{ij} = \frac{Y_i Y_j}{d^2_{ij}} \ ,$$

where is the value of the flow of goods or factors between country i and j, Y_i and Y_j are the GDP values of the trading partners, d_{ij} is the distance between them. The gravity model had been firstly used by Tinbergen in 1962. It became quickly popular, although the model lacked theoretical backgrounds (Śledziewska, 2012). In the next decades several authors contributed to the development of the gravity model.

The theoretical foundation of the gravity model is that „trade between two regions is decreasing in their bilateral trade barrier relative to the average barrier of the two regions to trade with all their partners. Intuitively, the more resistant is to trade with all others a region is, the more it is pushed to trade with a given bilateral partner" (Anderson et al, 2001, p.1). Anderson provided theoretical explanations for the gravity model in 1979. The author allowed products to be differentiated by the place of origin, while maintaining homothetic preferences across regions. He specified the expenditure function to be a Constant Elasticity of Substitution

(CES) function (Anderson, 2011). Bergstand (1989) connected the gravity model with the Heckscher-Ohlin framework, examining factor-endowments of the trading partners and per capita income as well. Anderson and Wincoop (2011) solved the 'border-puzzle', presented by McCallum in 1995. McCallum compared the value of trade between Canadian provinces and the USA, with the trade among the Canadian provinces themselves. A very powerful border-effect took place, which decreased the reliability of the traditional gravity model. Anderson and Wincoop (2011) also found a reduction of trade by borders; however, they developed the model further, by allowing to study the effects of different institutions, e.g. currency unions.

The theoretical framework for connecting the gravity model with multinational companies is laid down by Helpman (1984). The author outlined a general equilibrium model of trade, which allowed to determine the circumstances, in which a corporation decides to engage in FDI. The authors showed that multinational companies shift production to those countries, where the input factor price is relatively cheap.

I will use the gravity model for the empirical analysis, like many other authors of empirical studies describing international trade.

2.2. The review of empirical studies on FDI and automotive MNCs in Visegrad countries

The empirical literature describing the effects of FDI and the activities of automotive MNCs in the Visegrad region is very rich, therefore only the main conclusions of a few selected analyses are presented in this paper.

Rădulescu and Şerbănescu (2012) describe the impact of FDI on exports and export competitiveness of Central and Eastern European (CEE) countries. Their finding is that FDI in the tradable sector tends to increase exports, while FDI in the non-tradable sector might fuel domestic demand, increasing imports. The authors come to the conclusion that export of the Visegrad countries had been supported by the FDI of MNCs in the car sector.

Alguacil et al (2008) presents an econometric analysis on the effects of FDI on economic growth. The authors compare the EU-15 with the member states that joined the EU in 2004. They prove that FDI significantly affects economic growth in a positive way. In the new member states, FDI has a positive effect on domestic investments, FDI and the domestic investments tend to be complementary, which means that FDI does not crowd out domestic investments.

Radosevic and Rozeik (2005) present the restructuring of the CEE automotive industry from an FDI perspective. Value chain desegregation (different components of a product are manufactured in different regions) and value chain reengineering (value chain steps are redesigned in the new location, to capture further

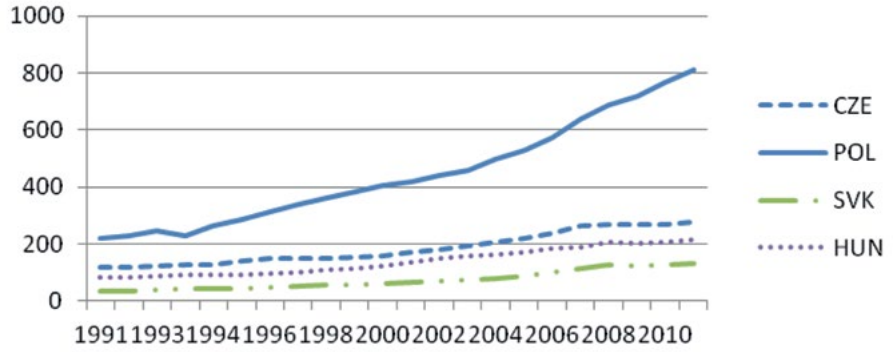
efficiencies) are the most typical forms of production in CEE. The restructuring of production has been entirely led by FDI. The integration of CEE into the European network of automotive MNCs has been carried out in vertical forms of production, which has created value-added for the MNCs. The authors conclude that those CEE countries that attracted large FDI benefited from larger export, preserved employment, increased productivity and a potential of development of the local supply chain.

Molnár (2012) discusses the role of Eastern Europe in the division of labour in the automotive industry. The author examined the motor vehicle industry in the Visegrad Countries, Romania and Slovenia (EEC-6). All countries have an increasingly positive trade balance in cars, the highest in the Czech Republic (40.5%), the lowest in Poland (18.9%) in the year 2010. Empirical data shows that the most important markets of the EEC-6 are the European source countries of investments – Germany, Italy and France. According to the author, the intra-EEC-6 trade has a potential to grow, as the MNCs outsource their production to the countries of the region, strengthening the trade between them. There is a tendency towards the increasing role of exports of parts and accessories in the intra-EEC-6 trade, which also shows the deepening fragmentation of production.

3. Changes in macroeconomic factors

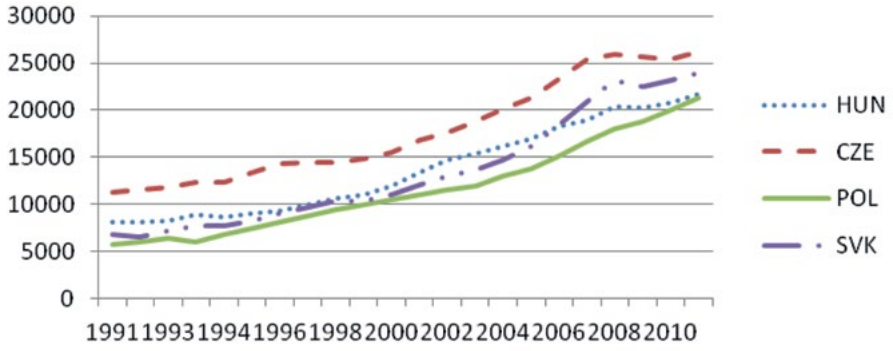
I begin the analysis by presenting the main changes in the economies of the Visegrad countries, having a potential impact on the results of the empirical analysis. The graphs below show the scope of the successful transition to market economy in Central Europe, which is marked by upward trends in the examined variables from the second half of the 1990s. The parallel growth of FDI stock and motor vehicle production, along with exports is easily observable. The effects of the global financial crisis are also visible in the Visegrad region since the crisis of 2008, when the economic prosperity became endangered by stagnation or recession.

Graph 1. GDP based on purchasing power parity in billion international dollars (1991-2011)



Source: World Bank (World Development Indicators Database)

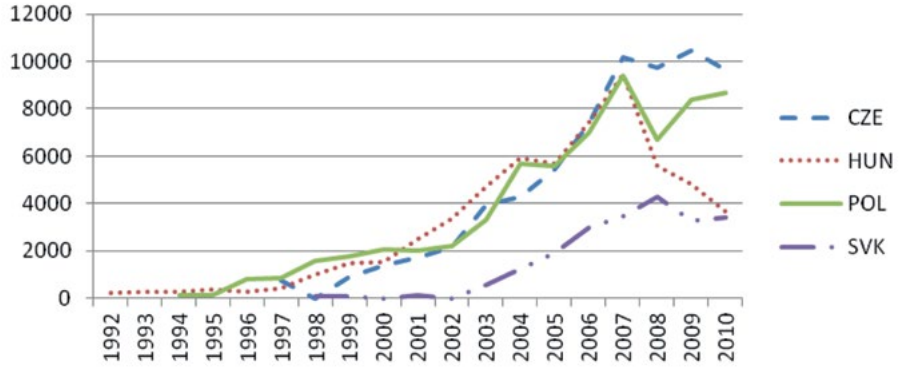
Graph 2. GDP per capita based on purchasing power parity in international dollars (1991-2011)



Source: World Bank (World Development Indicators Database)

The Visegrad countries experienced drastic macroeconomic changes in the early 1990s - the socialist, centrally-planned economic model was abolished in favor of market economy. After the change of regime a period of recession or economic stagnation took place in all four countries; however, from the second half of the decade the economies started to grow. The GDP per capita values increased dynamically until the financial crisis of 2008.

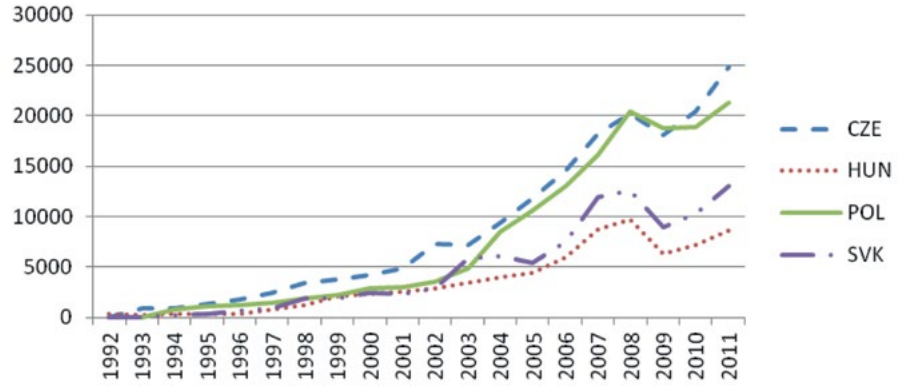
Graph 3. Foreign Direct Investment inward position in the motor vehicle industry in million USD (1992-2010)



Source: OECD Foreign Direct Investment Statistics

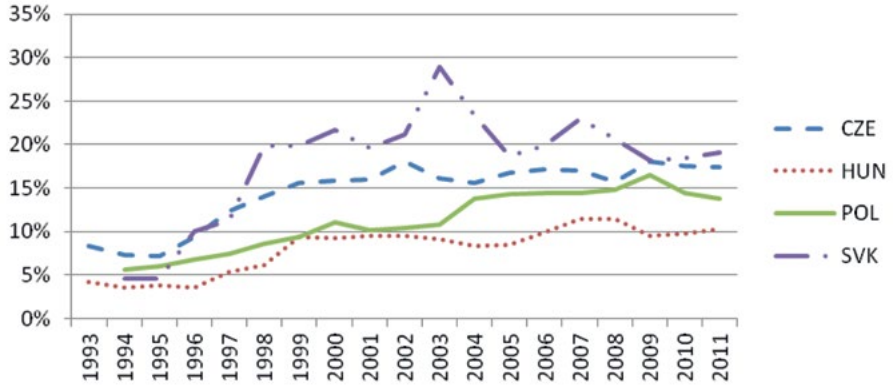
The value of FDI stock in the motor vehicle industry grew gradually since the second half of the 1990s. Until 2006 the Hungarian economy attracted the most FDI to her car industry. The FDI stock value declined in all four economies after 2007. The recent years are characterized by stagnation, in terms of FDI stock.

Graph 4. Export of motor vehicles in million USD (1992-2011)



Source: UN Comtrade

Graph 5. Share of motor vehicles in total exports (1993-2011



Source: own calculations, UN Comtrade

At the beginning of the 1990s the exports of motor vehicles were negligible in the Visegrad Group. As investments appeared in the automotive industry, exports began to expand quickly, especially in the Czech Republic. It is worth noticing the great dynamics of growth in the case of Poland, starting from 2002. The beginning of the economic crisis put an end to the fast expansion of motor vehicle export of the Visegrad region. By the year 2011 the value of export has reached the pre-crisis level, with the exception of Hungary, where it has remained at a slightly lower level. The ratio of motor vehicles in total exports reaches 10% in all countries, which shows, that the car industry plays an important role in the trade of the Visegrad countries.

4. The data base

I would like to verify the hypothesis that there is a positive correlation between the value of the FDI stock, and the value of exports in the motor vehicle industry of the Visegrad Group. The analysis is based on the gravity model. In this model the values of all variables are expressed in logarithmic form. The standard gravity model contains additional variables as well (nationality, language, colonial past etc), which are not directly included in this model. This analysis is restricted to the motor vehicle industry, where language will have no effect, since there are no other countries speaking the same language.

The FDI variables are presented with a one year lag. The lagged form is necessary to handle the problem of endogeneity. There is a problem of endogeneity, beacause FDI affects trade and vice versa. Including the lagged FDI, however, reduces the importance of this problem. Furthermore, once an investment takes place in the automotive sector, its effect on exports appears later in time - by adjusting FDI values a year forward, this time gap is decreased.

The data set contains data for the period 1992-2011, however, for each country and variable the covered years are different, as data is not completely available.

The basic form of the model is the following:

$$\ln Exp_{ijt} = \alpha_0 + \alpha_1 fdigeocar_{ijt\text{-}1} + \alpha_2 prodval_{it} + \alpha_3 gdpv4_{it} + \alpha_4 gdp_{jt} + \alpha_5 gdpcapdif_{ijt} + \alpha_6 distcap_{ijt} + \alpha_7 eu_{ijt} \quad ,$$

where:

Exp_{ijt}: the value of motor vehicle exports from Visegrad country i to the OECD member j in year t

$fdigeocar_{ijt\text{-}1}$: the value of FDI stock in the motor vehicle industry of Visegrad country i, originating from OECD member j in year $t\text{-}1$

$prodval_{it}$: the value of motor vehicle production in Visegrad country i in year t

$gdpv4_{it}$: the value of GDP in Visegrad country i in year t

gdp_{jt}: the value of GDP in OECD member j in year t

$gdpcapdif_{ijt}$: the absolute value of the difference between the GDP per capita of Visegrad country i and OECD country j in year t

$distcap_{ijt}$: the distance between the capital of the Visegrad county i and the OECD member state j in year t

eu_{ijt}: dummy variable, representing the EU membership of country i and j in year t

All values in the data base are in their current value, without deflation, therefore time dummies for all years are added to the model. Time dummies are necessary to handle the stationarity problem as well. This problem originates from the time trend that is clearly observable for both the dependent variable (exports) and the main independent variable (FDI).

The details of the data set are presented in the appendix.

5. The results of the analysis

The empirical analysis is based on different panel data regressions. Panel data regression is an econometric tool often used in the literature. The analytical framework for this econometric analysis is the gravity model, as my aim is to determine, which variables have a statistically significant impact on the value of export. The variables presenting foreign direct investment values are different in each regression – three different regressions are introduced altogether in this section. Data panels are defined by bilateral trade flows between the Visegrad countries and the other OECD members in all regressions.

I am using the fixed-effects estimation method in all regressions, like the other authors of the literature. This regression method is suitable to analyse the impact of variables that change over time. The results of the Breusch-Pagan Test and the Hausman Test, which are used to determine the statistically correct estimation method, suggest that the fixed-effects estimation method is the appropriate one.

The variable *disctap* (distance between the capital cities of the trading partners) is omitted in all fixed-effects estimations.

Table 1. The results of the regressions

	(1)	**(2)**	**(3)**
VARIABLES	**ln_exp**	**ln_exp**	**ln_exp**
ln_fdigeocar	0.147***		
	(0.0496)		
ln_fdicar		0.292***	
		(0.0929)	
ln_fdigeo			-0.0206
			(0.0284)
ln_gdpv4	1.840	-0.900*	-0.284
	(1.932)	(0.467)	(0.387)
ln_gdp	2.307***	1.141***	0.824***
	(0.740)	(0.251)	(0.238)
ln_gdpcapdif	-0.955***	0.0113	0.0694
	(0.348)	(0.0722)	(0.0760)
ln_prodval	-1.96e-05	0.182***	0.183***
	(0.220)	(0.0591)	(0.0227)
eu	-2.507***	-0.440***	-0.169*
	(0.341)	(0.106)	(0.102)
Constant	-31.11	3.592	2.250
	(22.98)	(6.340)	(5.548)
Observations	375	1,258	1,187
R-squared *within*	0.658	0.567	0.526
R-squared *between*	0.0709	0.0948	0.0922
R-squared *overall*	0.0374	0.1760	0.1732
Number of paired	71	115	115

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source: own calculations

5.1. Regression with FDI stock values with breakdown by country of origin and by automotive sector

The starting point in the econometric analysis is the regression with the most accurate FDI data, where investments are grouped according to the industry and the source-country as well.

Are bilateral motor vehicles exports correlated to bilateral investments in the car industry? This regression gives us the statistically significant answer, notably that exports are indeed positively affected by FDI stock values.

The number of observations is 375, which is low compared to other regressions included in this analysis, however, it is large enough to make statistically appropriate conclusions. The R-squared values show how well the model fits the data. The *R-squared within* value is related to the variation inside the panels. The *R-squared between* value is connected to the variation between the panels. In our analysis, this value is the most interesting. In this case, the value is 7,1%, which is an average value for a fixed-effects estimation explaining international trade. The *R-squared overall* is the weighted average of the other two R-squared values.

The number of country-pairs is 71. The regression includes data for the period 1997-2010.

The statistically significant variables are the following*: fdigeocar, gdp, gdpcapdif* and *eu.* The variable *fdigeocar* is the key variable, and the empirical estimation confirms my expectations, that the value of FDI stock significantly affects the value of exports to the host country. The null-hypothesis is dismissed about the lack of influence of FDI on exports (p-value=0.003<0.05). According to this regression, if the FDI stock from an OECD source country in a Visegrad country's motor vehicle industry increases by 1%, the exports of motor vehicle industry back to the source country increase by 0.15%.

The GDP of the partner country and the absolute value of the difference in the GDP per capita values of the trading partners are standard gravity model variables; their statistical significance and direction of correlation with exports are in line with the theory.

The dummy variable of the EU proved to be statistically significant, although with a negative coefficient. The strong position of Asian companies among the producers in the region might explain this result. This may suggest, that the OECD membership plays a more important role in vehicle production, than the membership of the EU.

The GDP of the Visegrad countries is not related to the value of export according to this regression. The reasons for this are unclear, it might be caused by the low number of observations, or some distinctive features of the dataset.

Surprisingly, the value of the automotive production proved to be statistically insignicant, with a negative coefficient.

5.2. Regression with FDI stock aggregated according to sector

The next regression involves FDI stock data in the motor vehicle industry in each Visegrad country, without geographical breakdown. The less detailed FDI data allows us to extend the number of observations from 375 to 1258. The number of country pairs is 115. The time period of regressions is 1992-2011.The *R-squared between* value is now 9,5%.

It is interesting to see whether the conclusions from the previous regression with less accurate FDI data are also valid for a wider sample. I examine with this regression the relationship between all automotive investments and bilateral exports. The results confirm our earlier findings - inward FDI stock is positively correlated to exports. The positive effect of investments in the motor vehicle industry on automotive exports is clearly visible: if FDI stock increases 1%, the value of bilateral exports increase 0,29%. The results of the two regressions are very similar. Two more independent variables are statistically significant in this regression: *gdpv4* and *prodval*. The negative effect of the Visegrad country's GDP on its automotive exports is not in line with the theory. However, Graph 1. and Graph 4. show that the ranking of countries according to their GDP is different from their ranking according to their automotive export. The statistically significant positive effect of the automotive production's value on the automotive exports is in line with my expectations.

5.3. Regression with FDI stock aggregated according to host country

The third regression contains bilateral FDI data, with no breakdown to sectors. This regression connects all bilateral foreign direct investments from specific OECD member states with bilateral automotive exports from the Visegrad countries. The time period and the number of coutry-pairs is the same, as in the previus regression.

The *R-squared between* value is 9,2%. The variable *fdigeo* is statistically insignificant. It means that the value of automotive exports from a certain Visegrad country to an OECD member state is independent from the value of all investments that come from the partner state. The geographical structure of investments does not match the geographical structure of exports. The literature about the connections between FDI and export performance discusses this relationship. Rădulescu and Șerbănescu (2012) find out that the composition of FDI does matter: investments in the tradable and non-tradable (e.g. the financial sector) sectors have different results. While FDI in the tradable sectors boosts exports, in the non-tradable sector it has a tendency to increase imports, instead of exports. As *fdigeo* contains all FDI from a certain partner, including not only reinvested profits, but also investments in the non-tradable sector, it does not have to affect the motor vehicle industry.

The first regression with *fdigeocar* showed a positive correlation between bilateral automotive exports and bilateral FDI stock. This regression reduces the possibility that exports are not connected to sector specific FDI, and cars are sold in larger volume in those countries, that tend to invest more in the region, independently from the goals of investments.

5.4. Conclusions from the empirical analysis

The results of regressions are in line with my expectations. The value of FDI stock in the motor vehicle industry is statistically significant in the regressions. These regressions directly prove that the Central-European motor vehicle industry is based on investments of MNCs from OECD members, and that a large share of manufactured motor vehicles and parts and accessories is sold in the home markets of the MNCs. This leads to the conclusion that automotive investments are enhancing trade between the host and the source countries in manufactured automobiles and automotive parts. The increased trade has two possible sources. The automobile industry of the Visegrad Group has been integrated into the European network of production, and produces for the whole EU market. For example, the models of German manufacturers, produced in the Visegrad countries - e.g. the VW Polo, the Audi Q7 or the Skoda models are very popular in the German market. The other explanation for the increased bilateral trade is the vertical character of production. The automobiles are not produced in a single location or country, parts and accessories are transported between countries, which creates intra-industry trade. The automotive MNCs outsourced parts of the production process to the Visegrad countries- e.g. the Audi and Opel facilities in Hungary, which produce engines for the German factories.

The fact that investments not connected to the automotive sector proved to be independent from motor vehicle exports, supports the thesis that the automotive industry in Central-Europe is based on sector-specific investments.

6. Conclusions

The aim of the analyis was the verification of the positive correlation between the inflow of automotive FDI to, and the automotive exports from the Visegrad countries. Using a simple econometric model based on the gravity model of trade, I analyzed bilateral trade flows between the Visegrad countries and the other members of the OECD.

The results of the analysis have shown a positive, robust impact of automotive FDI on exports. The automobiles produced in the Visegrad countries by the affiliates of car MNCs are sold in large volumes in the domestic markets of these MNCs. The analysis proves that there are significant automotive exports from the

Visegrad countries to the source countries of investments. These exports include automobiles and automotive parts as well. The results of the empirical analysis allow to make further statements on the activities of automotive MNCs in the Visegrad Group.

From the second half of the 1990s, the investments of car MNCs have been strongly increasing, which has been followed by the dynamic growth of exports. The restructuring of the automotive industry in the Visegrad Group had been based on FDI, which has led to the formation of a competitive, export-oriented industry. The quality of the manufactured automobiles enables the MNCs to sell them in their home markets. The results of the empirical analysis are in line with other empirical and theoretical studies on the subject. The automotive investments have vertical character, the MNCs invest in the region in order to serve their international markets with the produced cars. The positive correlation between FDI and exports suggests that the Visegrad countries are integrated into the transnational chains of production. The export of parts and accessories strengthens the positive correlation between bilateral exports and FDI, several facilities produce automotive parts, that are exported for assembly to the source country of investment.

The restructuring of the automotive industry in the Visegrad countries can be considered as a story of success. This analysis concludes that automotive FDI in the Visegrad countries is enhancing automotive exports to the source countries of investments. The increased export affects positively the Visegrad countries through economic growth, increased employment and improved balance of payments. Altough this analysis does not assess the spillover-effects of FDI, the results of other analyses suggest that the Visegrad countries have been benefiting from further positive effects of FDI. These advantages of investments include the usage of local content in production, transfer of technology and know-how.

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APPENDIX

Appendix 1. The data set

The dependent variable of the model is the bilateral export of motor vehicles from the Visegrad countries to the members of the OECD. The source of the data is the United Nations Commodity Trade Statistics Database (UN Comtrade). The exported products concern the 87th category of the HS 1988/1992 nomenclature (vehicles other than railway or tramway rolling stock, and parts and accessories thereof).

As the number of available observations for the FDI data is highly fluctuating, depending on the level of aggregation, three different methods of presenting FDI data are included in the dataset: FDI values with breakdown by country of origin and economic activity as well; breakdown by economic activity only; breakdown by country of origin only.

The first method is the most accurate one: the amount of inward foreign direct investment is grouped according to the country of origin and the economic activity. In our case it is the amount of inward FDI stock in a Visegrad country's motor vehicle industry, which originates from a particular OECD member. The source of the data is the Eurostat. The investments are divided according to the nomenclatures NACE rev1 (up to 2008) and NACE rev2 (from 2008). The chosen categories are 'motor vehicles' for NACE rev1, and 'manufacture of motor vehicles, trailers and semi-trailers' for NACE rev2. The variable is marked as *fdigeocar*.

As the first kind of FDI data has only limited number of observations, it is worth using more aggregated forms of FDI as well. The second variable is the inward FDI position in a Visegrad country's motor vehicle industry, without geographical breakdown. Theoretically, these investments can be originating from countries outside the OECD as well, however, statistics with geographical breakdown are clearly showing that there are very minor investments between the Visegrad Group and the countries outside the OECD.

The data has two sources, both provided by the OECD: the International Direct Investment Database (online) and the International Direct Investment Statistics Yearbook 1991-2001 (printed). The chosen nomenclatures are the same as previously. The variable is marked as *fdicar*.

The third variable concerning FDI is the inward FDI position in a Visegrad country in all sectors from a given OECD partner country. The sources are the same as for *fdicar*. The variable is marked as *fdigeo*.

The values of production are collected by Eurostat. In the nomenclature NACE rev2, the data is available in 6-digit level of aggregation.

The GDP values of the OECD members are collected from the database of the World Bank.

The difference in the per capita income between the trading partners is also

included in the gravity model. This variable is the absolute value of the difference in the GDP per capita between country *i* from the Visegrad Group and country *j* from the OECD.

The distance between the trading partners is measured as the distance between the capital cities of the Visegrad Group and the OECD members. The source of the values is the CEPII database, distance is measured in kilometers.

The EU membership is a dummy variable (the value is 1, when the trading partners are both members of the EU in the given year).

Appendix 2. Statistical tests

Table A1. The Breusch-Pagan Test

Breusch and Pagan Lagrangian multiplier test for random effects
ln_exp[pairid,t] = Xb + u[pairid] + e[pairid,t]
Estimated results:

	Var	**sd = sqrt(Var)**
ln_exp	6.357525	**2.521413**
e	1.900634	1.378635
u	1.928052	1.388543

Test:Var(u) = 0
chibar2(01) = 173.57
Prob > chibar2 = 0.0000

The Breusch-Pagan Test dismisses the null hypothesis that the variance between the data panels is zero. This means that OLS regressions would not be statistically correct. The appropriate estimation method is the random-effects or the fixed-effects regression.

Table A2. The Hausman Test

	(b) fixed	**(B) random**	**(b-B) Difference**	**sqrt(diag(V_b-V_B)) S.E.**
ln_fdigeocar	.1776551	.1673069	.0103482	.0162398
ln_gdpv4	.7816791	.5220713	.2596078	.3977155
ln_gdp	1.702542	.1889174	1.513625	.8861506
ln_gdpcapdif	-.8454929	-.3788931	-.4665998	.3920627
ln_prodval	.2219872	.2174782	.004509	.0033961
eu	-1.214198	.1036345	-1.317832	.1875945

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg
Test: Ho: difference in coefficients not systematic
chi2 (6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 58.27
Prob>chi2 = 0.0000
(V_b-V_B is not positive definite)

The Hausman Test is used to decide, whether the random effects or the fixed effects estimation method is statistically correct. The test dismisses the null hypothesis that the unique errors are not correlated with the independent variables, therefore fixed-effects estimation is the correct method.