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The contribution of the Visegrad four automotive industry to economic growth

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Abstract. In the countries of the Visegrad Four (V4) (Czech Republic, Poland, Hungary, Slovakia), significant and modern car production capacities were built due to foreign direct investment inflows. According to the results of mainstream research, the automotive industry can make a substantial contribution to the growth of the GDP of the affected national economy. In the V4 countries, the opposite has taken place in the automotive industry over the past decade. Automotive production increased in the Czech Republic, Hungary, and Slovakia but decreased in Poland. The study seeks to answer the question of the close relationship between automotive output and changes in GDP in the countries concerned. The correlation calculation results show that the automotive industry has a powerfully positive effect on GDP growth in countries where the sector's contribution is significant and growing dynamically.

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1. INTRODUCTION

In the V4 countries, the automotive industry shows a different structure. (PEI, 2019), most cars were produced in the Czech Republic, Slovakia, Hungary, and Poland, respectively. In contrast, if we look at the added value created by the automotive industry, we see that the order will be different. Based on this ranking, it amounts to 9.7 billion euros in the Czech Republic, 7.2 billion euros in Poland, 4.9 billion euros in Hungary, and 3.4 billion euros in Slovakia. The study examines the close relationship between car production volumes and GDP developments in the V4 countries as the two rankings differ significantly. The closeness of the relationship between the two indicators will be presented in the study by correlation calculation. The second chapter describes the literature review of the automotive industry in the V4 countries. The third shows the methodology and database of the analysis. The fourth chapter describes the results and the fifth the conclusions in the study.

1.1. Antecedents of the automotive industry in the region

In the second half of the last century, in socialist countries, car manufacturing was given a prominent role in economic policy. Initially, cars were manufactured under Western licenses, and these countries continued to produce internally by further developing the permit. Manufacturers sought to serve their market, selling cars infrequently and in small quantities outside the socialist bloc. As a result, production volumes remained low (Radosevic & Roziek, 2005).

Following the regime change in Eastern Europe, the automotive industry lost its internal recording market and declined. The inflow and reversal of the process required an influx of foreign capital. The former socialist countries, by building their production capacities, created an opportunity for the Western European assembly industry to settle in the region after privatization. Following the regime changes in the 1990s, investments in the automotive sector in the V4 area have been made to exploit local resources (Dicken, 1998). The automotive bloc of the V4 countries is emerging as a particular production center in global vehicle manufacturing. In this block, after the regime change, assembling subsidiaries of Western European car factories were established based on cheap labor and automotive traditions. Haiss et al. (2009) found that automotive FDI was indeed the driving force behind the economies of Central and Eastern Europe, albeit to varying degrees. Their study confirms the positive impact of FDI on host economies at the automotive sector level because they have positively supported economic development efforts.

Over the past 25 years, the automotive industry in the V4 countries has undergone significant changes. As a result of several factors, over the past 25 years, the region has become a significant automotive cluster where most of the leading brands are represented. With leading automotive companies, several supplier networks have been formed, covering the Czech Republic, Northwest Hungary, Western Slovakia, and Southwest Poland. While investor interest temporarily declined during the Great Depression, they announced further increases in production capacity in the V4 countries in 2015 and 2016 (Mytna, 2018).

The spatial structure of car manufacturing has changed significantly in the last quarter of a century. Vehicle emissions more than quadrupled between 1990 and 2015, while the supplier industry grew even faster. Today, the automotive sector of Central and Eastern European countries has integrated into the global automotive industry. In this integrated model, the periphery consists of attractive production sites close to developed economies' large and prosperous markets. Its attractiveness is due to significantly lower production costs, mainly lower wages (Pavlinek, 2017).

Germany has an unique role in the automotive industry in Central and Eastern Europe. This country is the primary buyer of imports of cars and car parts. It is the country from which a significant portion of the automotive companies established in the region is controlled. This confirms that Central and Eastern Europe can be considered the eastern part of an emerging Central European automotive district headquartered in Germany (Molnár et al., 2015). This finding is also relevant to the automotive industry of the V4 countries and characterizes the significant dependence of these countries on Germany.

In 2019, there were thirty vehicle factories in the V4 region, fifteen in Poland, eight in the Czech Republic, four in Hungary, and three in Slovakia. The impact of the volume of cars produced by these thirty car factories in the years 2010-2019 on the countries' GDP will be the focus of the study.

2. LITERATURE REVIEW

The car is not only a physical product of technology; it also has economic, environmental, social, cultural, and political implications (Featherstone, 2004). As the dominant means of transport, cars also refer to technological systems that also affect the production, use, recycling, and disposal of vehicles (Urry, 2004). The development of global production chains has also been facilitated by expanding liberalized trade and investment activities, institutionalizing economic integration, and the pro-FDI policy environment (Torlak,

2004). OEM (original equipment manufacturer) companies in developed countries have become multinational and global industry players looking to take advantage of the wide range of opportunities available in developing countries (Chanaron & MacNeill, 2005, Humphrey & Memedovic, 2003).

Florida & Sturgeon (2000) distinguish between the process of internationalization and globalization concerning that process. The former interprets the cross-border nature of economic activities, while the latter analyzes the creation of standardized, functionally integrated systems. Internationalization appears in this perspective as a quantitative change, while globalization appears as a qualitative development. In doing so, the activities of each economic operator become part of an internationally coordinated process system.

Western European (mainly German, French, Italian, and Swedish) car manufacturers appeared in the V4 countries after regime change. The German automotive industry built the most significant production bases, which began a gradual shift in strategy in the early 2000s, in line with the changing world market situation. The enlargement of the Union to the east and its positive effects can be seen as part of the global adaptation of German companies. The most important part of the strategy change was the relocation of labor-intensive segments of manufacturing work to the V4 countries. By this time, Western European companies had "outgrown" Europe's market protection system, and their strategic adaptation was much more focused on global perspectives (Krzywdzinski, 2014).

Also, during this period, the automotive value chain structure's transformation began, accompanied by a decrease in the depth of production and development at automotive companies. In the automotive industry today, relatively few internationally active OEM (original equipment manufacturer) companies design, manufacture and sell cars on their own as complete products.

The multi-level international supply system produces units/modules / most of the value-added of a modern car, about 65 percent. Experts estimate this ratio to reach 78 percent by 2020 (Fortwengel, 2011); (Sofka et al., 2008). It was accompanied by the outsourcing of manufacturing processes and the outsourcing of related development processes to suppliers. While in 2000, two-thirds of improvements were made by OEMs, in 2010, this proportion was only around 50 percent, and by 2020 it is projected to decline to one-third.

In the last few years, however, there have been dramatic changes in the automotive industry. Due to environmental and energy concerns, sales of fossil fuel vehicles are declining faster than expected. After more than a hundred years of selling fossil fuel vehicles, the global automotive industry must transform itself to respond to the electric car revolution. Over the past decade, the global automotive industry has grown by 30 percent. The automotive industry needs to keep pace with the changing consumer demands that are evolving towards electric cars. It seems that in the next decade, only manufacturers innovative in electric and autonomous vehicle technology can become global leaders in the automotive industry (Oktav, 2017).

3. METHODOLOGY

To perform the test, the sample is given by the data of the V4 countries. The study will examine the correlation between car manufacturing data and gross value added (GDP) data for these countries. The closeness of movement between the indicators is measured by correlation calculation (Guilford, 1953).

The relationship between dependent and independent variables can theoretically be functional, stochastic, or completely disconnected. Before analyzing the relationship between dependent and independent variables, I assume that this relationship will be stochastic since functional and complete independence can be ruled out. The appropriate procedure for examining the stochastic relationship is correlation calculation.

Correlation answers whether there is a relationship between two or more quantitative variables and how close it is if any. In the study, one quantitative variable will be the number of car production in the V4 countries, and the other quantitative variable will be the countries' GDP. Pearson's correlation coefficient characterizes the combined change of the variables. The sign of the correlation coefficient, retaining the character of the covariance, indicates the direction of the relationship. The role of the variables in the correlation study is interchangeable; none of them has a prominent role.

During the correlation calculation, I will calculate the movement of the V4 countries' indicators over the examined period (2010-2020) separately, which will be expressed by the Pearson coefficient of the relationship between them. The correlation will indicate the magnitude and direction of the linear relationship between the two values, their relationship to each other. The explanatory (independent) variable will be the car production data of the V4 countries included in the study, and the result (dependent) variable will be the GDP data of these countries.

Correlation calculation is often used to examine the relationship between macroeconomic variables. Kurecic & Kozina (2017) used foreign direct investment, net inflow (FDI), and gross domestic product (GDP) as independent and dependent variables in the calculation of Pearson's correlation coefficient (R). (To examine the relationship between macroeconomic indicators for correlation calculation, see also the following studies: Vinkler (2008), Jayadevan (2018), Anghelanche et al. (2019)).

The study was conducted at a significance level of 5 percent per country. The results of the correlation calculation are presented in Chapter 4.

The data required to perform the analysis are shown in Table 2. The data source is the database of the Automobile Manufacturers' Association (ACEA) and Eurostat.

3.1. The place of the V4 countries in European car production

Car manufacturing is one of the key industries in the E U. The automotive industry is the engine of growth, employment, exports, and innovation in advanced economies. Equally important are supplies and services related to the automotive-related market. The European Union produced 15,260,000 cars in 2010 and 15,837,000 in 2019. Germany produces 29.4 percent of the total E U volume (4,661,000), making the German economy the world's fourth-largest automotive producer after China, Japan, the United States, and Europe's largest.

The V4 states produced 21.9 percent of the European Union's production volume in 2019, which means 3,461 thousand pieces. As the most dynamically growing automotive emitter in the region, Slovakia achieved 1.1 million emissions by 2019. However, the Czech Republic continues to be the essential industry player in the V4 area, with 1,428,000 passenger cars. Poland's automotive capacity is gradually declining following the financial crisis of 2008-2009, as the country's production fell from 785,000 in 2010 to 435,000 in 2019. On the other hand, Hungary has taken the opposite path, increasing the sectoral output of the car industry thanks to continuous developments. The Hungarian national economy increased its production in 2019 from 203 thousand units produced in 2010 to 498 thousand units (ACEA, 2020).

The V4 countries increased their production from 2,620 thousand to 3,461 thousand in 2010, the difference being 841 thousand in absolute terms and an increase of 32.1 percent. These countries accounted for 17.17% of Union production in 2010 (15,260,000 units in total), increasing 21.85 percent by 2019 (15,837,000 units in total). The largest increases (excluding Finland, the Netherlands, Austria, and Portugal, which produce invaluable quantities) were achieved in percentage terms in Hungary (+145.32), Slovakia (+95.73), and the Czech Republic (+33.46). In Poland, however, car production fell by 44.59 percent during the period under review.

3.1.1. The automotive industry in Slovakia

The production volume of Slovaks is particularly outstanding. Slovak car factories assembled 1.1 million cars last year. This volume is slightly higher than the level reached in 2018, which means that Slovakia remains the world leader in per-capita car production. The share of car production in Slovakia's industrial production is 49.5 percent, and its share in exports is 46.6 percent. The car industry directly employs more than 177,000 people and provides 275,000 jobs, including the supplier network. The automotive sector is Slovakia's most important industrial sector, accounting for 8.5 percent of total employment. Its structure is characterized by a few large foreign-owned, export-oriented, high-productivity, and assembly-focused automakers, such as Volkswagen, Jaguar Land Rover, Kia Motors, and Groupe PSA. These are complemented by many small and large companies that supply auto parts to large automotive companies. They are also exported to Germany and neighboring countries to the Central and Eastern European automotive cluster. The sector (including supplier exports) accounted for 26.9 percent of total exports in 2018, compared to 7.5 percent (E. C., 2019). For a more detailed presentation of the Slovak automotive industry, see (E. C., 2020a).

3. 2. About the Hungarian car industry

The automotive industry plays a crucial role in the Hungarian economy. In the automotive industry, in 2018, it generated 16.5 percent of export revenue and 4.7 percent of gross value added. Domestically, employment accounted for 2.6 percent, and foreign direct investment (FDI) to the country accounted for 11.4 percent at the end of 2018. Compared to other Central and Eastern European countries, the automotive sector has a larger role in the Hungarian economy than other countries and the E U.

The industry has made a significant contribution to economic growth, increasing annual GDP growth by an average of 0.4 percentage points since 2010. For a more detailed presentation of the Hungarian car industry, see (E. C., 2020b).

3. 3. Czech automotive industry

The country's automotive industry is outstanding in export performance because 90-92 percent of the volume produced is exported. However, the industry is facing enormous challenges due to the expected changes in technology. The Czech Republic is one of the countries potentially more affected by technological change in the automotive industry than other countries. According to available research, 40 to 70 percent of current automotive jobs (depending on the method used) are at risk of being fully or partially automated in the coming decades. The automation share is markedly higher in the automotive industry, especially for jobs such as manufacturing or machine operation. The high-risk potential of automation is related to the large share of production in the Czech Republic. In the Czech Republic, the automotive industry accounted for 23.1 percent of GDP in 2018, a rate of 8.5 percentage points above the E. U. average. The automotive industry alone accounts for a significant share of GDP and total employment if all indirect suppliers are included in the sector's performance. For a more detailed presentation of the Czech automotive industry, see (E. C., 2020c).

3. 4. About the Polish car industry

Poland's automotive capacity has been gradually declining since the financial crisis, and the Polish car industry employed 1.1 percent of employees. In Poland, the automotive value-added to total economic value added increased by less than 0.5 percentage points between the early 2000s and 2014, lagging behind the regional average. In the cluster of large automotive companies, Poles are the least productive, which is

related to Poland's larger domestic market and more large domestic companies. In Poland, the automotive industry accounts for 3.8 percent of the national GDP and the sector for 15 percent of exports. In Poland, the low-carbon transition is also a challenge in sectors such as transport or energy-intensive sectors such as the car industry. Sectoral emissions and energy consumption in the transport sector have continued to increase in recent years. The car industry and the transport sector make the second-largest contribution to the problem of air pollution in Poland. For a more detailed presentation of the Polish car industry, see (E. C., 2020d).

3. 5. Challenges facing the automotive industry in the V4 countries

The world's automotive industry is facing a whole new era, which poses particular challenges for countries such as the V4 countries, where the automotive industry plays a vital role in the economy's performance. Listing all the factors and analyzing them would deserve a separate study, so I will only focus on two relevant factors here.

3. 5. 1. Transformation of the spatial structure of production

It will be essential for the V4 countries to develop R&D infrastructure and train the human resources involved in the developments soon, which will be a challenge for the governments and companies of the V4 countries in the future. The competitive position of the automotive market is determined by the structure of the sector over the last two decades. The two most important features of this are developing production networks, which are becoming a stable operating framework, and their international character. The production networks and production chains were established because the large car manufacturers (Original Equipment Manufacturers, OEMs) creating certain brands outsourced more and more of their activities abroad, mainly due to cost-saving reasons. Today, virtually only the design of the car and the planning of its production, the construction of the market brand, and some key activities (such as final assembly or the production of critical components) have been retained.

The future of the automotive industry has reached a fork in the V4 region and is pointing in two directions. As a first option, with the extensive development of the sector, the number and production volume of assembly plants installed so far can be expanded. However, this option is still associated with low value-added functions and a lack of development activities. However, even to achieve these, securing a low-wage workforce will pose increasing challenges for the V4 countries in the future. Alternatively, the intensive development of the industry could come to the fore, which would involve strengthening the supplier bases of the V4 countries and integrating development functions instead of assembly activities. The intensive direction directs the companies towards the employment of qualified labor and stimulates the actors in the sector to carry out development activities.

3. 5 2 Expected costs of complying with E. U. environmental standards

Another major challenge for car manufacturing in the V4 countries is the tightening of environmental regulations. The E U has introduced a regulatory system that focuses on cars' CO2 emissions per kilometer. Its EU-adopted target for CO2 emissions per kilometer was 130 g / km between 2015 and 2019, which corresponds to a consumption of about 5.6 liters per 100 kilometers in a petrol car. Value had to be met in terms of fleet average, i.e., the average of all vehicles sold by the manufacturer. From 2021, a discount of 95 g / km will have to be met in the fleet average, but manufacturers have received a little relief this year: only 95 percent of the cars sold need to be included in the standard.

To reduce CO2 emissions, a penalty will have to be paid in Europe from this year if a manufacturer fails to meet the required average CO2 emissions. Manufacturers affected by the expected penalty also operate in their V4 countries. Czech Republic: TPCA Group, Volkswagen, Hyundai. Hungary: Suzuki, Volkswagen, Daimler, Opel. Poland: Volkswagen, FCA Group, Toyota, Opel, Volvo. Slovakia: Volkswagen, PSA Group, Hyundai. The expected CO2 emissions vary from manufacturer to manufacturer, as the average weight of a manufacturer's vehicle is also considered when determining it.

The total fine to pay the most significant producers to the European Union in 2021 could reach € 14.5 billion. Most of this, € 4.5 billion, can be produced by the Volkswagen Group. However, taking into account the 2018 profit, Mazda and Jaguar-Land-Rover are in the worst position. For them, the amount of the penalty is higher than their pre-tax profit in 2018. Although Mazda's € 877 million penalty puts the manufacturer in the middle, it is 115 percent of its 2018 pre-tax profit. Jaguar-Land-Rover's expected fine of € 93 million is the second-lowest nominal amount among the 13 groups, but it's four times their 2018 result or 400 percent. These latter two producers do not have a production base in their V4 countries.

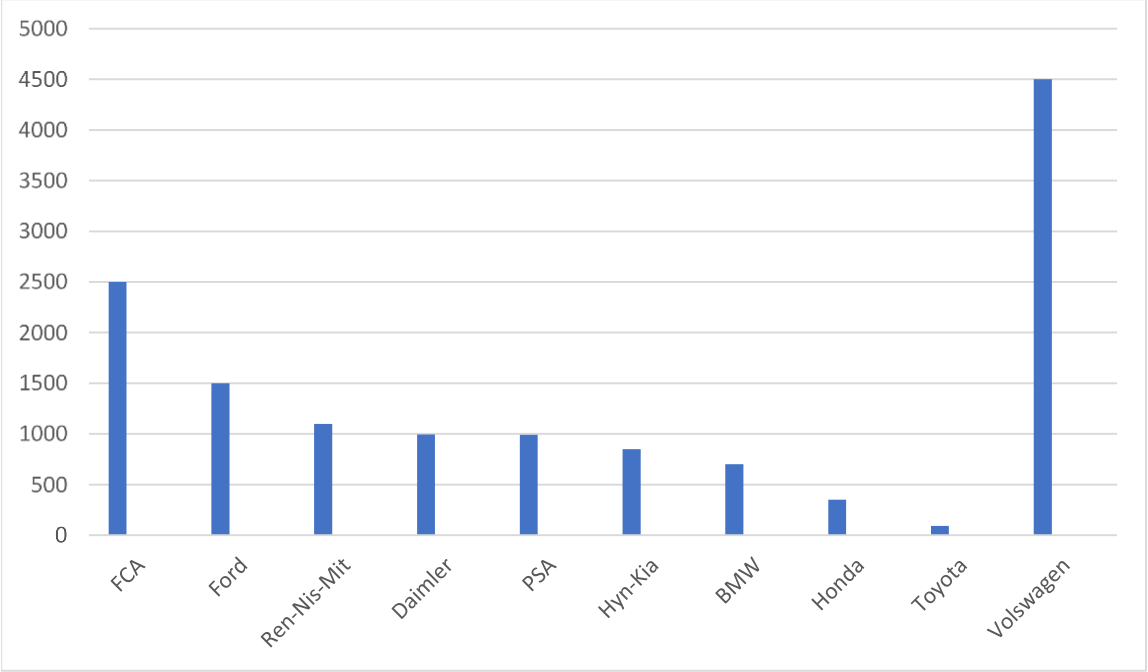

Figure 1. Expected automotive emissions penalty in the European Union in 2021 (million euros)
Source: P A Consulting (2020)

Toyota is clearly in the best position, as already in 2016, it had the lowest fleet average in terms of CO2 emissions. Besides, it is one of the few manufacturers that has reduced its value year after year. The company expects to increase its PHEV sales, so the report says the Japanese manufacturer will not avoid the penalty utterly next year. As a penalty, they will have to pay a significantly lower amount than other manufacturers. They are doing exceptionally well as a percentage of their pre-tax profit in 2018, at just 0.1 percent of the amount payable. In addition to Toyota, the Hyundai Group and the Renault-Nissan-Mitsubishi alliance have reduced CO2 emissions from their fleets in recent years. Still, the latter two started from a much higher base than Toyota. The Korean Hyundai Group could pay € 797 million, or nearly a third, or 28.9 percent, of its 2018 revenue into the E. U. coffers, despite expecting one of the most significant declines.

There is an increasing environmental burden on motor vehicles, and analysis of car emissions from environmental pollution is becoming more widespread among researchers. It examines emissions from the transport sector in the 27 member states of the European Union (Török, 2017). A critical finding of this study is that there are significant regional differences in pollutant emissions.

3.5.3 The development of the GDP of the member states of the European Union in the examined period

The chapter presents the GDP and changes in the countries with car production in the period under review. The data are shown in Table 1.

Table 1

European Union GDP, in a million euros, (at market price; 2010, 2015, 2019)

Country	2010	2015	2019	Ratio of 2019	2019/2010
Belgium	363140	416701	476203	3,11	131,13
Czech Rep.	157920	169558	223945	1,46	141,81
Germany	2564400	3026180	3449050	22,53	134,50
Spain	1072709	1077590	1244772	8,13	116,04
France	1995289	2198432	2425708	15,84	121,57
Italy	1611279	1655355	1789747	11,69	111,08
Hungary	99576	112701	146062	0,95	146,68
Netherland	639187	690008	810247	5,29	126,76
Austria	295897	344269	397575	2,60	134,36
Poland	362191	430466	532329	3,48	146,97
Portugal	179611	179713	213301	1,39	118,75
Romania	125472	160150	223322	1,46	177,99
Slovenia	36364	38853	48393	0,32	133,08
Slovakia	68189	79768	93865	0,61	137,65
Finland	188143	211385	240556	1,57	127,86
Sweden	374695	455495	474194	3,10	126,55
United King.	1872176	2644717	2522713	16,48	134,75
EU Total	12006238	13890801	15311982	100,00	127,53

Source: Eurostat (2020)

The aggregate GDP of the car-producing European Union member states in the examined period 2010-2019. they are increased by 27.53 percent at current prices in the years to come. However, due to the COVID-19 epidemic in 2020, GDP in the European Union fell by 4.7 percent (excluding the U.K.) (Statista, 2021). The larger economies achieved the lowest GDP growth among the surveyed member states. Italy's 11.08 percent and Spain's 16.04 percent growth is the weakest among member states. Germany's 34.5 percent and Britain's 34.75 percent growth also puts them only in the middle. However, the V4 countries are at the forefront of GDP growth. Poland's 46.97 percent, Hungary's 46.68 percent, the Czech Republic's 42.81 percent, and Slovakia's 37.65 percent GDP growth (excluding Romania) is the highest among E. U. car-producing member states.

It is not the purpose of this study to present the reasons for economic growth in the V4 countries. This topic has been extensively addressed in several dissertations, such as (Petr & Bal-Domanska, 2016); (Szent-Iványi, 2017). However, some relevant factors need to be highlighted among several explanatory variables. The first is that the dynamic GDP growth of the period under review is mainly explained by the

accession of the V4 countries to the European Union. Before the acquisition, there was no alternative to world economic integration and foreign-oriented development in the globalizing world economy for economies with a narrow domestic market and a small growth reserve. Before accession, the moderately developed V 4 countries could not transfer capital, state-of-the-art technologies, high-quality products, or state-of-the-art management methods. As a result, their economic modernization could only be driven by the close cooperation with a developed, capital-intensive region that the European Union provided them. Moderately or poorly developed Central and Eastern European countries (including the V4 countries) had never been natural partners for each other before accession.

The engine of the foreign and general economic development of Central and Eastern European countries in cooperation with the other member states of the European Union, as these countries are the region's main trading partners. According to the latest analyses assessing the first decade of E. U. membership, the E. U.'s enlargement to the east is successful. Moreover, they point out that the region can be an engine of European economic growth. Today, for example, the Visegrad Four (V4) represents the 15th largest economy globally in terms of their combined GDP (HLRG, 2014).

Another explanatory factor is that even its V4 countries became eligible for financial transfers from the Union's general budget contributed to the dynamic GDP growth. The new members became net beneficiaries of the E. U. budget. The new Member States have received significant external funding to invest in areas that affect their long-term development and competitiveness. The necessary conditions for economic growth in the new accession countries must be created: infrastructure must be developed, the workforce's level of skills must be improved, and research and development and innovation must be encouraged. In essence, these areas are covered by E. U. regional policy support. The V4 countries received the following amounts of support from the European Union between 2004 and 2020, in billions of euros: Poland 175, Hungary 55.2, the Czech Republic 53.5, and Slovakia 29.5 (E. C., 2019).

3.5.4. The relationship between the automotive industry and GDP

The dissertation further seeks to answer whether there is a correlation between the change in car production in the V4 countries and the GDP growth. If there is a relationship, it is also relevant to examine how close the relationship is. The reviewed period is 2010-2020, and the years between. The analysis will use the correlation calculation method. The relationship between GDP and car production can be interpreted as a non-stochastic relationship, where variables can be assumed to be linear. The independent variable in this study is the volume of new car production, and the dependent variable is GDP growth. The macroeconomic relationship between the two variables is trivial because if car production increases, it should also impact the GDP of the national economy concerned. With the data revealed during the research, I examine the closeness of the relationship between economic growth (GDP) and car production volumes.

Table 2

Car production in V4 countries (in thousands) and GDP (billion euros), 2010-2020

Country		**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Czech Rep.	Car	1070	1192	1172	1128	1247	1241	1344	1306	1437	1428	1129
	GDP	158	165	163	159	158	170	177	194	211	224	214
	Car	785	741	540	475	473	535	555	515	452	435	279
Poland	GDP	362	380	388	392	409	430	427	467	498	532	523
	Car	203	209	231	318	434	492	523	418	463	498	432
Hungary	GDP	100	102	100	102	106	113	116	127	136	146	137
	Car	562	640	927	975	971	1039	1040	1032	1093	1100	944
Slovakia	GDP	68	71	74	74	76	80	81	85	90	94	92

Source: ACEA (2020); Eurostat (2020); ACEA (2021)

Due to the COVID-19 epidemic, the volume of car production has decreased globally. The European Union produced 10.8 million cars in 2020, up from 14.1 million in 2019, down 23 percent. Car production in Sweden, Belgium, Romania, and Poland (-1.7 percent) proved to be the most epidemic-resistant, with lower production capacity and a minimal reduction in volume. Hungary (-13.3 percent) was in the middle group in a group with Slovakia (-14.2 percent), Italy (-13.2 percent), and the Czech Republic (-20.9 percent).

The relevant research data confirms that the COVID-19 epidemic caused panic in the new car market in 2020. The dissertation proves this by the fact that the median value calculated from the decrease in recent car sales in the European Union member states is more than three times the median value measuring the reduction in the member states (Török, 2020).

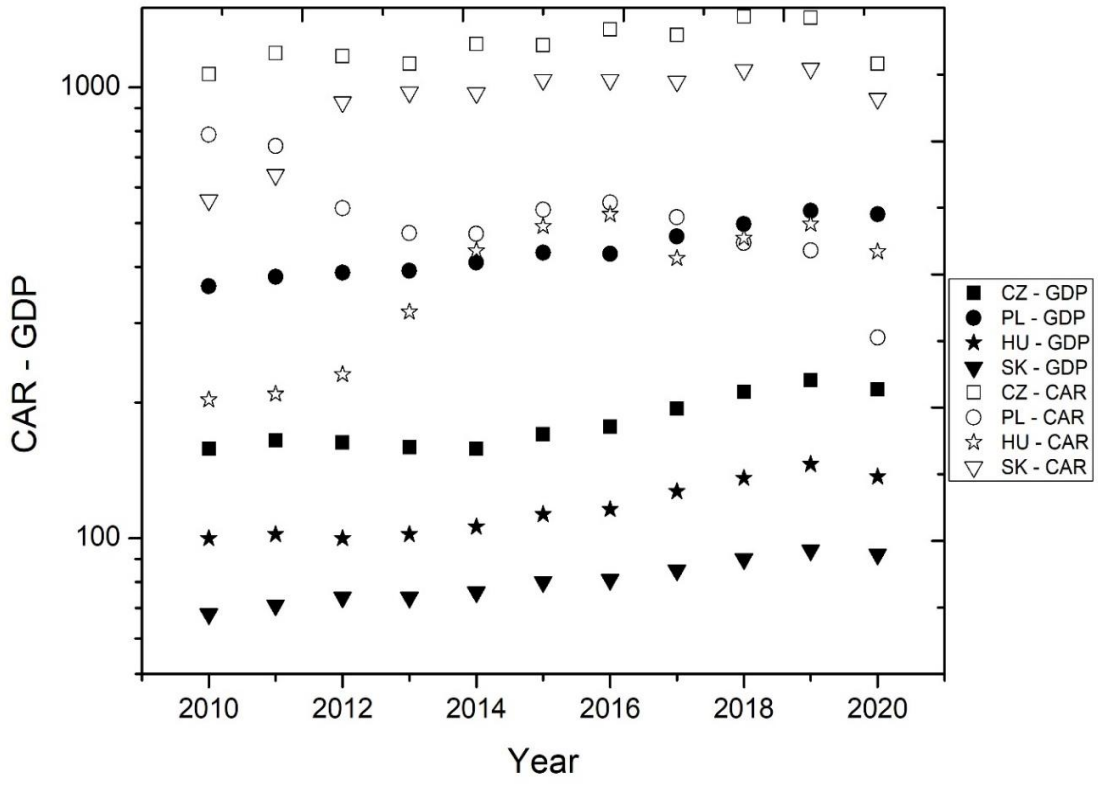

Figure 2. Car production in V4 countries (in thousands) and GDP (billion euros), 2010-2020
Source: ACEA (2020); Eurostat (2020); ACEA (2021)

The analysis was performed using the correlation calculation method, SPSS / Analyze / Correlate / Bivariate. There is a possibility of a stochastic relationship between GDP and car production, where variables can be assumed to be linear. The independent variable in this study was the volume of new cars produced annually in the V4 countries. The dependent variable was the value of the annual GDP of these countries.

The V4 countries' car production value and their Pearson coefficient calculated from their GDP values are positive for three countries and harmful for one country. A positive value indicates a relationship between the two indicators (volume of car production and GDP). The looser the correlation between two indicators, the closer the value of the correlation coefficient is to 0. The stronger the correlation between the indicators, the closer the value of the coefficient will be to 1. If, on the other hand, the value of the

Pearson coefficient is negative, it means that there is an inverse relationship between the indicators (volume of car production and GDP).

The study conducted Shapiro-Wilk testing of automotive and GDP data for the V4 countries. The results of testing relatively few data show that the data follow a normal distribution.

4. EMPIRICAL RESULTS AND DISCUSSION

Table 3

Descriptive statistics and correlations for V4 countries

Country	Car production				GDP			
	Mean	Std. D.	N	P. corr.*	Mean	Std. D.	N.	Sig.
Czech R.	1244,91	122,39	11	0,6190	181,18	25,03	11	0,042
Slovakia	938,45	176,78	11	0,7300	80,45	8,81	11	0,011
Hungary	383,73	121,38	11	0,6950	116,82	16,93	11	0,018
Poland	525,91	139,54	11	-0,7680	437,09	59,39	11	0.006

*Correlation is significant at the 0.05 level (2-tailed).

As a result of the correlation calculation, a very close relationship can be shown between the growth of car production and GDP growth in Slovakia (r = 0.730). This correlation value is the highest of the r values of the V4 country studied.

In order, the second-highest correlation value could be detected in the case of Hungary (r = 0.695). The third strongest correlation value was found in the Czech Republic (r = 0.619) between car production and GDP.

These values suggest that output from the automotive industry can positively affect the growth of gross value added (GDP) of the affected economies.

However, the high correlation coefficient measured in the cases of the Czech Republic, Slovakia, and Hungary also means that the economies of these countries are heavily dependent on the automotive industry. The correlation calculation shows a negative value for Poland (r = -0.768).

The explained that only Poland is one of the V4 countries where car production has decreased significantly. Production of the 785,000 cars produced in 2010 fell 44.59 percent to 435,000 by 2019, down from 279,000 in 2020. Another consequence of the decline in car production is that this sector accounts for a declining share of the annual value-added of the Polish national economy.

The role of the automotive industry in Poland is in line with the European average, so the country's dependence on the automotive industry is not high. Due to this fact, the Polish economy is expanding more stably, with a much more balanced economic structure than the other three countries.

Several studies have already confirmed the positive impact of car manufacturing on GDP. Haugh et al. (2010) state that the automotive industry is economically significant. Its cycle is intertwined with business cycles, with automotive production able to influence GDP positively and negatively. A similar relationship was found by Peters (2012). Saberi's (2018) study argues that automotive market experts say the global car market will grow at an annual rate of about 3.6 percent shortly, which is in line with the growth dynamics of world GDP.

5. CONCLUSION

Nearly one-fifth of global car production is produced in the European Union. The V4 countries now have a significant weight in the global automotive industry, and the increase in the output shown in Table 2 contributed to this.

The following data confirm the growing role of the global car industry: Hungary was ranked 19th among the exporters in the average period from 1997 to 2016. From the region, the Czech Republic (12th), Slovakia (14th), and Poland (16th) are ahead of Hungary. The upscale export location can be explained by the fact that Hungary has several large car factories, which mainly export the completed cars after assembling the vehicles (OICA, 2019). Despite declining production in Poland, the V4 countries are increasingly important players in the global automotive industry. For the region's automotive sector to contribute to the GDP growth of its V4 countries at a higher rate than at present, it would not be necessary primarily to increase the volume but to increase the share of higher value-added activities (R&D, innovation).

This sector plays a significant role in national product production, especially in the Czech Republic, Hungary, and Slovakia. For these three countries, the correlation coefficient between production and GDP showed a very close correlation. The correlation shown is confirmed by the data on the contribution of the V4 countries to GDP. The contribution of the automotive industry to GDP is 5.6 percent in the Czech Republic, 4.7 percent in Hungary, 5.9 percent in Slovakia, and only 1.8 percent in Poland (PEI, 2019). Thus, the sector is making less and less contribution to the added value of the Polish economy.

Authors are examining the data of the production of the V4 countries between 2010 and 2020 (Table 2). It can be seen that the dynamics of growth are the highest in the case of Hungary, followed by Slovakia, the Czech Republic. In the case of Poland, the values are decreasing. The dynamics of annual production growth was 9.57 percent for Slovakia and 3.35 percent for the Czechs. An analysis of the growth data shows that the growth reserves of the car industry in the Czech Republic and Slovakia are depleting.

The simple annual average growth of Hungarian production growth was 14.53 percent in the period under study. It follows from these growth dynamics that the automotive industry will still be the driving force in Hungary in the future. This growth in the automotive industry will be supported by the Hungarian national economic policy and the expected production growth in the automotive sector on the world market. The three factors described above have contributed to the fact that one of the largest German premium car manufacturers has recently started to build a significant production capacity in Eastern Hungary.

Both this study and the articles cited in Chapter 5 have demonstrated that growth in the automotive industry can positively support GDP growth. Three of the V4 countries (Czech Republic, Hungary, and Slovakia) are more dependent on the car industry than Poland. In a global economy, this is an advantage for these three countries over those in which the automotive industry contributes less to GDP. However, in times of crisis, such as the time of COVID-19 in 2020, strong dependence on the automotive industry had an opposite effect on GDP.

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