Original Research Article

Emerging Automotive Sector in Hungary: A Comparative Study

Fitty Valdi Arie[1]*, Adrian Szilard Nagy[2]
[1]PhD Student, Károly Ihrig Doctoral School of Management and Business, University of Debrecen, Hungary
[2]Associated Professor, Department of Economics Applied Sciences, University of Debrecen, Hungary

*Corresponding Author
Fitty Valdi Arie
PhD Student, Károly Ihrig Doctoral School of Management and Business, University of Debrecen, Hungary

Abstract: One of the pillars of the economy in Hungary is the automotive industry; despite going through ups and downs due to the pandemic in 2020, the new car market in Hungary shrank by almost a fifth, with a total of 128,000 vehicles purchased at various brand levels. The study focused on a comparative analysis of revenue towards four car brands with a relatively large market share in Hungary both in the provision of production units and spare part units regarding OEMs, namely Audi Hungary, Opel Szentgotthárd, Magyar Suzuki, and Mercedes-Benz. Using the ANOVA model, this research deployed a quantitative approach by analyzing panel revenue data for the four-car brands from 2017-2021. The results of this study place Audy as the car brand that generates the most revenue and Mercedes-Benz the least. Based on Post Host Tests analysis with the Tukey method, it shows that the nominal value of the income relationship between Opel Szentgotthárd and Magyar Suzuki is not significant with a Tukey HSD value greater than 0.05, which means placed second and third in revenue over five years. The increase in revenue growth from the four car brands is undoubtedly the main driving force for the Hungarian economy, which has been growing and developing amidst the current European economic crisis. Therefore, the government can certainly further develop the automotive industry in a more sustainable direction which is also a challenge for the government in overcoming the energy crisis. Even though foreign companies still dominate Hungary's automotive sector, this positively impacts employment.
Keywords: Automotive Industry, Competitiveness, Comparative Study.

RESEARCH BACKGROUND

Within the framework of the last three years, the European economy has faced significant problems and challenges due to the pandemic and the role of Ukraine and Russia, so it has had an extraordinary impact on rising energy prices which stimulated increases in the prices of other commodities; this was not spared from what was experienced by the Hungarian economy. More than 2 million workers in Europa were accommodated and immediately worked, and more than 6 million people were directly involved in this industrial chain in 2014 (Fana & Villani, 2021). Regardless of these circumstances, from an economic aspect, the Hungarian government is still looking for a way to continue to survive this crisis while remaining productive in various industrial sectors, one of which is the automotive sector. The automotive industry is one of the essential industries in the world, not only at the economic level but also at the research and development aspect (Sanguesa *et al.*, 2021).

The automotive industry in Hungary has an important role; according to EMIS, this sector contributes around 30% of the entire manufacturing industry; despite the decline due to the pandemic, many factories have closed in Europe, including Hungary itself, thereby disrupting the supply chain resulting in a reduction of around 20% in 2020-2021.EU cut actual GDP growth estimates to 3.8% in 2022 and 4.3% beforehand; of course, this still opens up opportunities for players in the Automotive Industry in Hungary to increase business expansion further. However, these opportunities certainly increase the number of companies competing collectively across the market (Yu & Cannella, 2013). The four leading players, Audi, Mercedes-Benz, Opel, and Suzuki, should have used the opportunity to compete in the automotive industry sector to maximize revenue in the Hungarian automotive market.

Competing globally in the automotive industry is certainly not easy; technological change can undoubtedly increase the competitive intensity in the automotive market (Cabanelas *et al.*, 2019). The company needs to improve its competitiveness (Lee & Seo, 2017). According to EMIS data, based on ACEA, in January-September 2021, new car sales in Hungary increased by 4.9% y/y to 94,506 units, and for LCVs increased by 14% y/y to 17,411 units in that period. CV sales jumped 52% y/y to 7,171 over the same period. This is even more interesting because it places Audi as the most significant player in the automotive industry in Hungary with HUF 2.7tn revenue, followed by Mercedes-Benz with HUF 1.2tn, Magyar Suzuki with HUF 670 billion, and Opel with HUF 604 billion. Data reflects, as an area of competitive dynamics, what happened during competitive action and countermeasures shared by different competitors in the market (Gómez *et al.*, 2017), and also shown in figure 1.
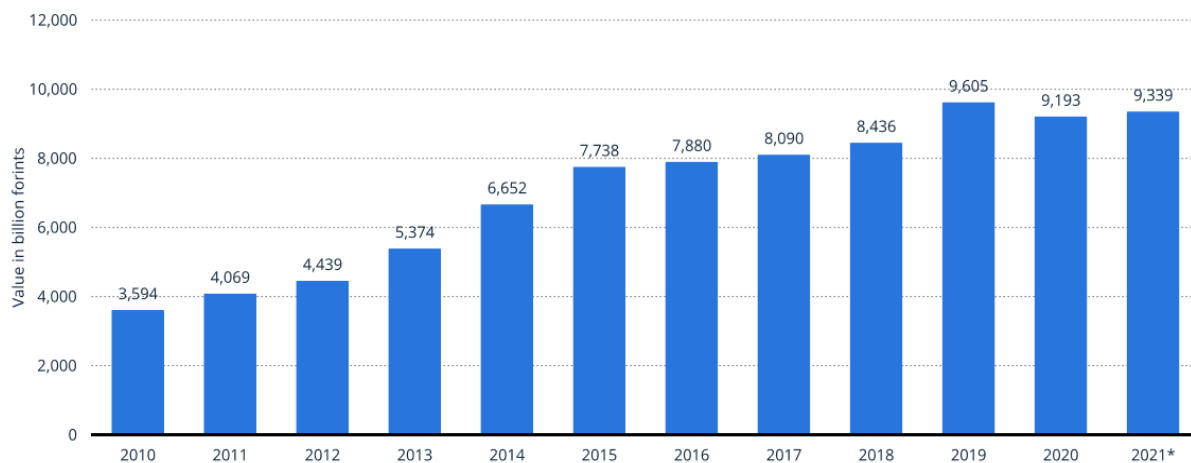

Figure 1: Total industrial sales of transport equipment in Hungary 2010-2021
Source: STATISTA

Figure 1 shows that the total sales of the transportation equipment industry in Hungary increased overall during the observation period, with a slight decrease in the last two years. By 2021, the total sales value of the transportation equipment industry will reach 9.3 trillion forints. This situation is used by automotive industry players Audi Hungary, Opel Szentgotthárd, Magyar Suzuki, and Mercedes-Benz to continue to exist to maintain the market to survive and even achieve competitive advantage (Lascu *et al.*, 2021). The purpose of this study is (1) to compare the revenues of four car brands, the largest automotive industry in Hungary, using panel data for the 2017-2021 periods. This paper is not only to compare in terms of income or panel data on car sales for five years but also as (2) a reference to be able further to increase the competitiveness and strategy of each brand so that it continues to make a positive contribution to the

Hungarian economy in the automotive industry. Several research results conducting (Kula & Naktiyok, 2021; Liu, 2018; Lee & Tan, 2019).

LITERATURE REVIEW

In recent years interdisciplinary research on the automotive industry has been expanded (Lascu et al., 2021). However, the automotive industry has yet to be explored systematically, especially those focusing on revenue and competitiveness. Based on finding (Zhurova & Krakovskaya, 2021), a comparative study makes it possible to identify and characterize the dynamics of the main trends in the development of the automotive industry in Russia, which were affected by the global crisis using panel data for 2008-2009 and 2020, as well as identify the urgency of problems and risks for the development of the automotive industry. To deepen further the

objectives of the issues raised in this study, the authors use the Systematic Literature Network Analysis (SLNA) approach briefly by using the VOSviewer to describe the scope of the literature review from this research. The SLNA process is based on manual filtering to minimize bias from reviewing the literature from a broad perspective. It also allows the identification, assessment, and synthesis of relevant studies with transparency and replicability, which can be applied to quantitative and qualitative issues (Ejsmont *et al.*, 2020).

The Web of Science Core Collection (WoSCC) and Scopus were used in this study's literature analysis because these two are the most common databases. To start the analysis stage of the literature review, the researcher must manually know the filters provided using the TAA approach (Title and Abstract Alignment) to get the .ris format, .bib format, etc., only to carry out text or bibliographic analysis using computer software such as VOSviewer (Tumiwa *et al.*, 2022). Researchers identified the most frequently cited literature reviews on WoSCC and Scopus to identify practical terms, synonyms, and abbreviations. In this case, to avoid duplication, query expressions reflecting the keywords "automotive industry" AND "competitiveness" AND "comparative study" AND "Hungary" It aims to explain the scale of the sustainability of research activities to understand

how a comparative study of the starving automotive industry can make a positive contribution to economic sustainability. The focus is on the automotive industry and its competitiveness. Based on the above keyword considerations, the search query is formulated as follows : "automotive Industry" AND "comparative study" AND (LIMIT-TO (PUBYEAR , 2023) OR LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017)) AND (LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "ECON") AND (LIMIT-TO (EXACTKEYWORD , "Automotive Industry") OR LIMIT-TO (EXACTKEYWORD, "Innovation") OR LIMIT-TO (EXACTKEYWORD, "Design/methodology/approach") OR LIMIT-TO (EXACTKEYWORD , "Automobile Industry") OR LIMIT-TO (EXACTKEYWORD , "Comparative Study") OR LIMIT-TO (EXACTKEYWORD , "Competitive Advantage") OR LIMIT-TO (EXACTKEYWORD, "Financial Performance") OR LIMIT-TO (EXACTKEYWORD , "Competitiveness") OR LIMIT-TO (EXACTKEYWORD , "Case Study")) AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SRCTYPE , "j")). After the query search stage is complete, the next step is to tabulate the document results into VOSviewer, as shown in figure 2.
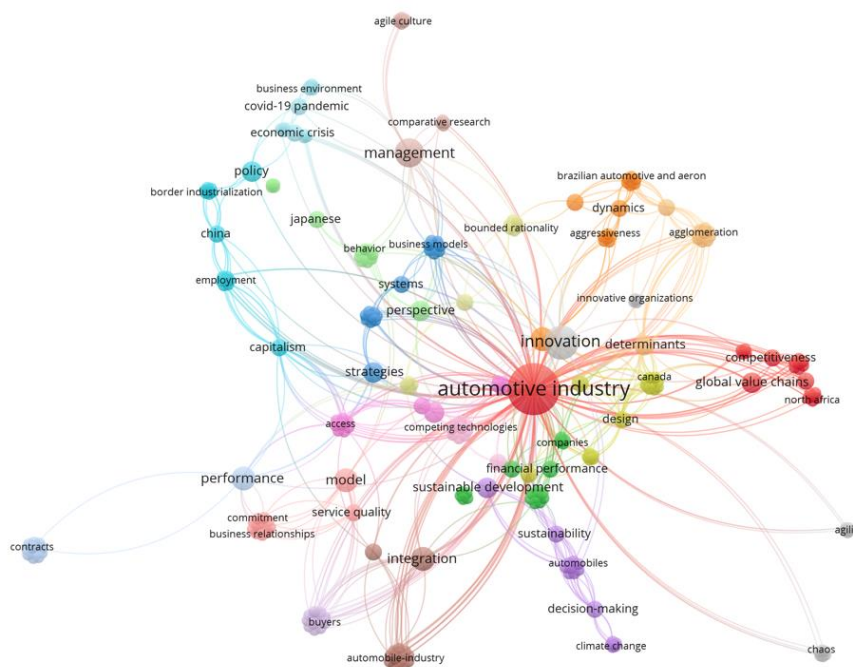

Figure 2: VOS viewer Mapping Based On The co-occurrence analysis
Source: VOSviewer

From figure 2, it can be seen that the clustering from the results of the VOSviewer analysis shows nude red (Automotive Industry), nude blue (Strategy), nude purple (sustainability), nude orange (innovation), naked blue easy (policy) and brown (management-comparative study). Filtering criteria are based on 48 documents from Scopus and WoS, which are included in journals/articles with year limitations from 2015-2023. Certain areas include economics, business, and management, including supply chain, to answer the second hypothesis of this study.

METHODOLOGY

Although the role of the automotive industry is crucial and can be studied further from the management aspect, interrelationships and strategic thinking are needed in competition by considering the influence of technological innovation. As a result, after conducting a literature review study to test the following research model, the hypothesis developed in this study is to compare the 5-years revenue of the four car brands that dominate the automotive industry market in Hungary. The stages carried out are shown in table 1, starting with setting topics, identifying research problems, setting research objectives then elaborating questions related to the hypotheses made.

Table 1: Steps of Research

Topic	Comparative Study of the Automotive Industry in Hungary
Research Problem	Compare the revenues of four car brands, the largest automotive industry in Hungary.
	The competitiveness and strategy of each brand toward economy
Research Objective	Highlighting comparative result
	Insight into internal and external strategies of car brands
Research Questions	Is there any significant differentiation between those car revenues during five years of revenue
	What are the aspects that are more crucial strategies in the Automotive industry?
Research Hypothesis	H1:There is a significant difference in average revenue between car brands.
	H2: Internal and external factors play essential roles in Automotive Industry
Research Objective	Audi Hungary, Opel Szentgotthárd, Magyar Suzuki, and Mercedes-Benz
Data Analysis Technique	One-way ANOVA, panel data 2017-2021
Software	SPSS 27

Source: author's

Data collection and sampling use panel revenue data for each car brand which is a significant player in the automotive industry in Hungary. A descriptive statistical approach was used in this study. According to (Kim, 2017), descriptive statistical analysis is a technique of collecting, managing, presenting data, and analyzing it in a quantitative illustrative manner to provide an organized description of an event in the form of a table or graph. The data management technique used to answer research questions uses analysis of variance (one-way ANOVA), which focuses on the results

RESULTS AND DISCUSSION

In conducting a one-way ANOVA analysis, several conditions must be met, including samples from independent groups, non-metric factor variables, customarily distributed data variables, and homogeneous data to test whether there is an average difference between two or more groups used as research objects. Table 2 shows the panel revenue data for each car brand to be analyzed.

Table 2: Revenue Brand of Car 2017-2021

Year	Brand			
	Audi Hungary	Opel Szentgotthárd	Magyar Suzuki	Mercedes-Benz
2017	7.55	1.50	2.10	3.55
2018	7.38	1.19	1.95	3.56
2019	8.56	1.05	2.41	3.69
2020	7.51	1.90	1.66	3.41
2021	7.72	1.80	1.75	3.09

Source: Statista 2022

Homogeneity test

The first step in the one-way ANOVA test process is to carry out a data homogeneity test, a guideline for making decisions on homogeneity tests; if the sig value is > 0.05, then the variant of the data group is homogeneous and vice versa. The homogeneity test results can be seen in table 3 below.

Table 3: Homogeneity Test

Tests of Homogeneity of Variances		Levene Statistic	df1	df2	Sig.
Revenue Brand	Based on Mean	.625	3	16	.609
	Based on Median	.313	3	16	.816
	Based on Median and with adjusted df	.313	3	8.673	.816
	Based on trimmed mean	.511	3	16	.681

Source: SPSS 27

From the results shown in table 3, it can be concluded that the significance value of the four automotive brands is homogeneity (from the SPSS results obtained a sig. value of 0.609 > 0.05).

Descriptive Analysis Result

The results of the descriptive statistical test, results refer to the average value of each brand which shows Audi Hungary is in first place with a revenue value of 7,447 (in mn HUF), and in second place is Mercedes-Benz with revenue with a value of 3,460 (in mn HUF), followed by Suzuki Magyar in third place with a revenue value of 1,974 (in mn HUF) and the last position is the Opel Opel Szentgotthárd with an income value of 1,488 (in mn HUF). as shown in table 4 below.

Table 4: Descriptive Analysis Result

Descriptives		
Revenue Brand		
	Minimum	Maximum
Audi Hungary	7.38	8.56
Opel Szentgotthárd	1.05	1.90
Magyar Suzuki	1.66	2.41
Mercedes-Benz	3.09	3.69
Total	1.05	8.56

Source: SPSS 27

One-Way ANOVA Result

To answer the research hypothesis (*H1: There are significant differences in average revenue between car brands*), a one-way ANOVA table is used (see table 5). Based on the results of the one-way ANOVA test, a significance value of < 0.001 is obtained (where the requirement to fulfill the ANOVA criteria is sig value is less than 0.05), it can be concluded that there is a significant difference in revenue between Audi Hungary, Opel Szentgotthárd, Magyar Suzuki, and Mercedes-Benz in the 2017-2021 time period.

Table 5: One-Way ANOVA Result

ANOVA					
Revenue Brand					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	121.395	3	40.465	322.926	.000
Within Groups	2.005	16	.125		
Total	123.400	19			

Source: SPSS 27

The results of the Anova test showed significant differences between car brands; the next step was to see which groups were different by doing a Post Hoc (see table 6). The LSD Post Hoc Test was used to find out whether one group had a significant difference from the other group. The results of the LSD Post Hoc test analysis in this study indicate an asterisk (*). The Tukey test results found that the relationship between the test scores and the average difference in revenue between the Opel

Szentgotthárd and Magyar Suzuki car brands was not significant (0.174 > 0.05).

Table 6: Post Hoc Test Result

Multiple Comparisons					
Dependent Variable: Revenue Brand					
Tukey HSD					
(I) Brand Name	(J) Brand Name	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound
Audi Hungary	Opel Szentgotthárd	6.25600*	.22388	.000	5.6155
	Magyar Suzuki	5.77000*	.22388	.000	5.1295
	Mercedes-Benz	4.28400*	.22388	.000	3.6435
Opel Szentgotthárd	Audi Hungary	-6.25600*	.22388	.000	-6.8965
	Magyar Suzuki	-.48600	.22388	.174	-1.1265
	Mercedes-Benz	-1.97200*	.22388	.000	-2.6125
Magyar Suzuki	Audi Hungary	-5.77000*	.22388	.000	-6.4105
	Opel Szentgotthárd	.48600	.22388	.174	-.1545
	Mercedes-Benz	-1.48600*	.22388	.000	-2.1265
Mercedes-Benz	Audi Hungary	-4.28400*	.22388	.000	-4.9245
	Opel Szentgotthárd	1.97200*	.22388	.000	1.3315
	Magyar Suzuki	1.48600*	.22388	.000	.8455

Source: SPSS 27

CONCLUSION AND RECOMMENDATION

Thus, it is believed that from the results of the comparison of the revenue of the four car brands, of course, the Hungarian government believes that the automotive industry in Hungary will remain one of the capable producers even though it will be disturbed by the issue of a global semiconductor shortage which has caused a decrease in Hungary's total PV output down 18% year-on-year (y-o-y) of 406,497 units, according to information from OICA. Although, from EMIS data, car production in Hungary is currently dominated by Magyar Suzuki, the results of this research prove Audi to be a car brand with the highest income level in the Hungarian market in the past in the last five years. However, Mercedes-Benz started producing the first electric car (SUV EQB) in October 2021 in Hungary. Opel Szentgotthárd still innovates in this sector, despite the suspension of production in previous years. To answer the second hypothesis (H2: Internal and external factors play an essential role in the Automotive Industry), the researcher used qualitative analysis based on qualitative data in EMIS.

From an internal perspective, Hungary's Automotive industry continues to produce stably. It has support from the government, especially the production sector, with an estimated GDP of 3.7% by the end of 2022 and significant demand from customers, especially the luxury cars segment. With the arrival of several new players in Hungary's automotive industry, technological exchanges and increased competition are possible. In addition, the government is still anticipating global challenges, such as the issue of the Covid pandemic, to continue to maintain the contribution of the automotive sector compared to early 2020 when the automotive market was hit hard. From the external side, the opportunity for the development of the automotive industry in Hungary is comprehensive due to the positive signals of making electric cars a form of Hungary's contribution as an EU member to reduce carbon use. Another positive thing is that export demand from outside Hungary is quite significant. Thus, the production supply chain is running well, and local auto parts producers are expanding exports to non-European markets. Of course, the threat still exists due to the semiconductor chip crisis. The issue of a shortage of skilled workforce and technology is also a threat to the auto industry in Hungary.

REFERENCES

- Azmeh, S., Nguyen, H., & Kuhn, M. (2022). Automation and industrialisation through global value chains: North Africa in the German automotive wiring harness industry. *Structural Change and Economic Dynamics*, *63*, 125-138.
- Barnes, T. (2017). Industry policy in Asia's demographic giants: China, India and Indonesia compared. *The Economic and Labour Relations Review*, *28*(2), 218-233.
- Cabanelas, P., Manfredi, L. C., González-Sánchez, J. M., & Lampón, J. F. (2020). Multimarket competition and innovation in industrial markets: Spain and Colombia in comparative perspective. *Journal of Business & Industrial Marketing*, *35*(3), 457-469.

- de Lara, F. F., & Marx, R. (2018). Comparative positioning between Brazilian subsidiaries and European matrices on Electromobility and carsharing technologies. *Research in Transportation Business & Management*, *27*, 67-74.
- Ejsmont, K., Gladysz, B., & Kluczek, A. (2020). Impact of industry 4.0 on sustainability—bibliometric literature review. *Sustainability*, *12*(14), 5650.
- Gómez, J., Orcos, R., & Palomas, S. (2017). Do strategic groups explain differences in multimarket competition spillovers?. *Strategic Organization*, *15*(3), 367-389.
- Karabag, S. F., Borah, D. J., & Berggren, C. (2018). Separation or integration for successful acquisition? A comparative study of established and emerging economies' firms. *Journal of Applied Economics and Business Research*, *8*(1), 1-23.
- Kim, T. K. (2017). Understanding one-way ANOVA using conceptual figures. *Korean journal of anesthesiology*, *70*(1), 22-26.
- Kula, M. E., & Naktiyok, A. (2021). Strategic thinking and competitive intelligence: Comparative research in the automotive and communication industries. *Journal of Intelligence Studies in Business*, *11*(2).
- Lascu, E., Severin, I., Lascu, F. D., Gudana, R. A., Nalbitoru, G., & Ignat, N. D. (2021). Framework on performance management in automotive industry: a case study. *Journal of Risk and Financial Management*, *14*(10), 480.
- Lee, J. W. (2019). Global corporate citizenship: Cross-cultural comparison of best practices in the global automotive industry. *Lee, Jung Wan*, 261-271.
- Lee, P., & Seo, Y. W. (2017). Directions for social enterprise from an efficiency perspective. *Sustainability*, *9*(10), 1914.
- Liu, Y., Blome, C., Sanderson, J., & Paulraj, A. (2018). Supply chain integration capabilities, green design strategy and performance: a comparative study in the auto industry. *Supply Chain Management: An International Journal*, *23*(5), 431-443.
- Llopis-Albert, C., Rubio, F., & Valero, F. (2021). Impact of digital transformation on the automotive industry. *Technological forecasting and social change*, *162*, 120343.
- Nam, K. M. (2015). Compact organizational space and technological catch-up: Comparison of China's three leading automotive groups. *Research Policy*, *44*(1), 258-272.
- Sanguesa, J. A., Torres-Sanz, V., Garrido, P., Martinez, F. J., & Marquez-Barja, J. M. (2021). A review on electric vehicles: Technologies and challenges. *Smart Cities*, *4*(1), 372-404.
- Tumiwa, J. R., Tuegeh, O., Bittner, B., & Nagy, A. (2022). The challenges to developing smart agricultural village in the industrial revolution 4.0.: The case of indonesia. *Torun International Studies*, *1*(15), 25-45.
- Villani, D., & Fana, M. (2021). Productive integration, economic recession and employment in Europe: an assessment based on vertically integrated sectors. *Journal of Industrial and Business Economics*, *48*, 137-157.
- Wu, S., Wee, H. M., & Lee, S. B. (2016). Technical innovation vs. sustainability–A case study from the Taiwanese automobile industry. *Transportation Research Part D: Transport and Environment*, *48*, 20-30.
- Yamashita, N. (2016). A comparative study of global production sharing in the automotive industry in China and India. In *Managing Globalization in the Asian Century: Essays in Honour of Prema-Chandra Athukorala* (No. 7, pp. 163-192). ISEAS Publishing.
- Yu, T., & Cannella Jr, A. A. (2013). A comprehensive review of multimarket competition research. *Journal of Management*, *39*(1), 76-109.
- Zhurova, L. I., & Krakovskaya, I. N. (2021). The Impact of Global Economic Crises on the Development of the Automotive Industry in Russia. *Regionologiya-Regionology-Russ. J. Reg. Stud.*, 541-561.