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MULTIDIMENSIONAL COMPARATIVE ANALYSIS OF PASSENGER RAIL TRANSPORT IN SELECTED EUROPEAN COUNTRIES IN TERMS OF ECONOMIC SECURITY

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Abstract. The study comprises a multidimensional comparative analysis of the number of passengers transported by rail in twelve European countries between 2019-2021; the considered data were grouped and analyzed. The dynamics indices with a constant base were used in the study. The aim of the article was a comparative analysis of the number of passengers transported by rail in the European countries under consideration between 2019-2021. The result of the research is the observation of an increase in the number of passengers transported by rail in twelve European countries in 2021 compared to 2020 by 374 965 people. It was visible in nine out of the twelve countries considered. The largest one was observed in France, with around 170 544 passengers. Considering the percentage increase between 2020 and 2021 in respective countries in rail passenger transport, it was observed that the most significant increase was in Italy, which amounted to 25,61%.

Keywords: transport; rail transport; Covid-19; security; economic security

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JEL Classifications: R4

Additional disciplines: security

1. Introduction

The study presented the following problem: in which out of the twelve European countries under consideration are there visible decreases in the number of passengers transported in 2021 compared to 2019-2020? The research aims to juxtapose the number of passengers transported by rail in the European countries under consideration between 2019-2021.

As a research method, the study applied an analysis of the literature on terms related to transport, economic security and the COVID-19 pandemic.

2. Analysis of the literature on the research subject

Economically, the transport sector is an integral part of supply chain management in terms of the paid provision of transport services for people, goods, their storage, reloading, packaging and other logistic activities in this matter (Hołowiński, 1961, p. 28; Jurgilewicz et al. 2022; Rakauskienė, Petkevičiūtė-Stručko, 2022).

On the other hand, Stajniak, Hajduk, Foltyński and Krupa believe that it is an activity covering the distance by people, things resulting from specific needs (Stajniak et al., 2008, p. 7). According to Tarski, transport is a technological process related to transferring people, goods or energy over a certain distance (Tarski, 1973, p. 48). According to the authors, in terms of the subject of the work, the best definition of this term remains a classic one that of J. Hołowiński (1961) who states that transport is a kind of paid service in terms of the entire supply chain management with respect to transport of people and goods, including their storage and other related logistic activities.

One of the specific modes of transport that the study focuses on is rail. It enables the transport of people and goods with rail vehicles within the rail network. It takes place only on rails arranged on respective railway tracks. The railway infrastructure consists of trains (locomotives and carriages), railway lines, and railway stations.

Rail transport gains in importance when we transport goods over long distances - it is more profitable than other modes of transportation. It is commonly used in countries with the well-developed mining industry, making it necessary to transport heavy raw materials over long distances (*Transport kolejowy – cechy charakterystyczne*, 2022).

In 2020, COVID-19 had an enormous impact on global transport. On March 11, 2020, this disease was declared a pandemic by the World Health Organization (Satomi et al., 2020). It has caused numerous human deaths worldwide (Kozicki, Sowa, Grabowska, Ovsepyan, 2022). It also influenced the introduction by respective countries of the world of many bans for citizens, including restrictions on transportation. In the first phase, the pandemic weakened the passenger air transport sector (Stajniak, Kozicki, Wenerska, 2022; Kozicki, 2022) and then the rail sector in Europe and the world (Magniszewski, Kozicki, 2021).

Tools aimed at protecting this industry were implemented to counteract the situation in the railway sector in terms of the limitation of financial losses caused by a decrease in the number of passengers transported. In Poland, at the beginning of the epidemic, PKP PLK, the national rail infrastructure manager, suspended the collection of reservation fees for resigning from the allocated capacity and penalties for launching trains by rail carriers with a traction vehicle other than the planned one or with an increased gross weight of the train. In May 2020, the so-called 'Tarcza 3.0', i.e. amendments to the Act of March 2, 2020, on unique solutions related to preventing, counteracting and combating COVID-19. The support from the state budget consisted in paying carriers amounts of money from the subsidy limit to compensate for revenues lost due to honouring statutory ticket discounts, as in the corresponding month of 2019. The European Parliament and the Council of the European Union adopted a regulation establishing measures for a sustainable railway market during the COVID-19 pandemic. Rules were created that stated the exemption from specific fees for the use of infrastructure while maintaining the deadlines for reimbursement of costs to entities providing access to the infrastructure (UTK, Dane Kolejowe, 2021).

The abovementioned observations allow the authors to conclude that the COVID-19 pandemic impacted the economic security of respective countries worldwide (Besenyő, Kármán; 2020; Adeniran et al., 2021). In the literature, the understanding of security has undergone many changes (Mitkow, Tomaszewski, Kozicki, 2021, p. 11; Grega, Nečas, 2022), and is identified with inner trust, peace of mind, certainty, correct or false, justified in circumstances giving rise to fear (Kitler, 2011, p. 22). One of the types of security considered in this study is economic security. It is understood as the certainty of survival and development of the state's economic system "guaranteeing that these entities will maintain an appropriate position in international economic relations and an adequate standard of living of the population" (Nurzyńska, 2016, p. 22). Economic security is associated with the economically efficient functioning of the state, maintaining prosperity and development of society, as well as the evaluation and counteracting of the related threats, such as stockpiling, and stashing funds crucial for the functioning of the economy and its organization (Kitler, 2018, p.101; Periokaitė, P., Dobrovolskienė, 2021).

3. Multidimensional comparative analysis of the number of passengers transported by rail in Europe between 2019-2021

The research began with Figure 1 outlining the data on the number of passengers transported by rail in twelve European countries between 2019-2021.

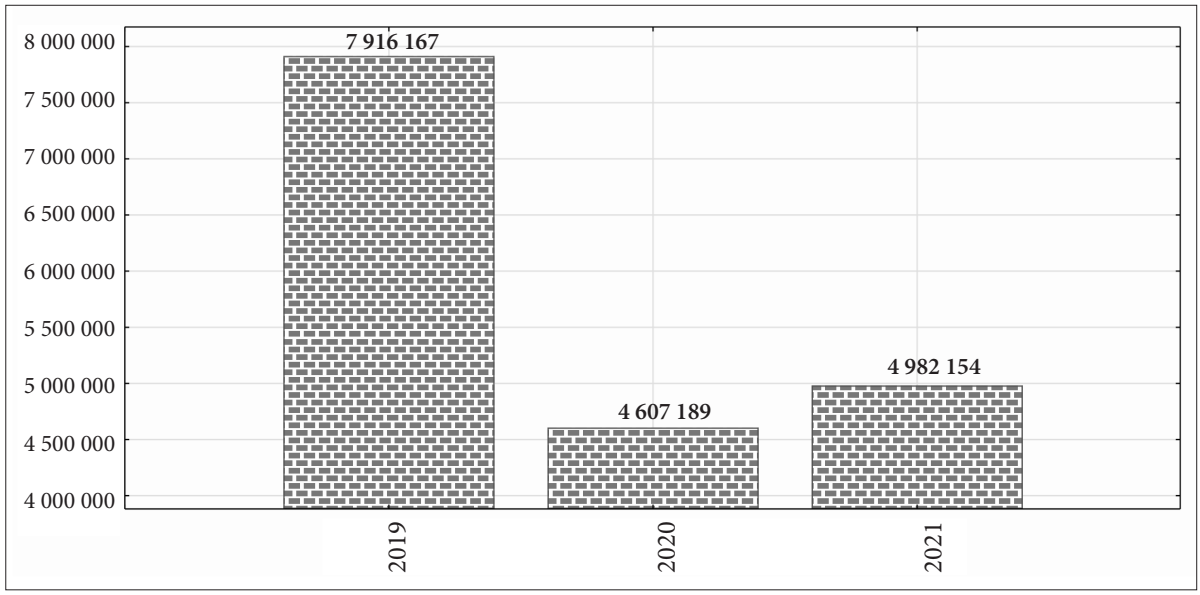

Figure 1. Number of passengers transported by rail in twelve European countries in total between 2019-2021 (data collected on a quarterly basis)

Source: own study based on data obtained from the website: https://ec.europa.eu/ (as of 27.11.2022).

The research presented in Figure 1 shows that between 2019-2021, in the twelve analyzed European countries, 17 505 510 passengers were transported by rail. Approximately 45,22% of all passengers were transported in 2019, i.e. 7 916 167 people. In 2020, however, only 26,32% of the total – 4 607 189 passengers. In 2021, an increase in the number of passengers carried in the twelve European countries under consideration was observed to 4 982 154 passengers, accounting for 28,46% of the total recorded between 2019-2021. It should be emphasized that the impact of the COVID-19 pandemic in 2020 resulted in a decrease in the number of passengers transported by rail in the twelve European countries under consideration compared to 2019 by 41,8% and in 2021 compared to 2019 by 37,06%. To sum up: in 2021, compared to 2020, an increase in the number of passengers transported by 374 965 people was observed.

The next stage of the research was the compilation of the number of passengers transported by rail in twelve respective European countries between 2019-2021 to observe trends in the countries under consideration (Figure 2).

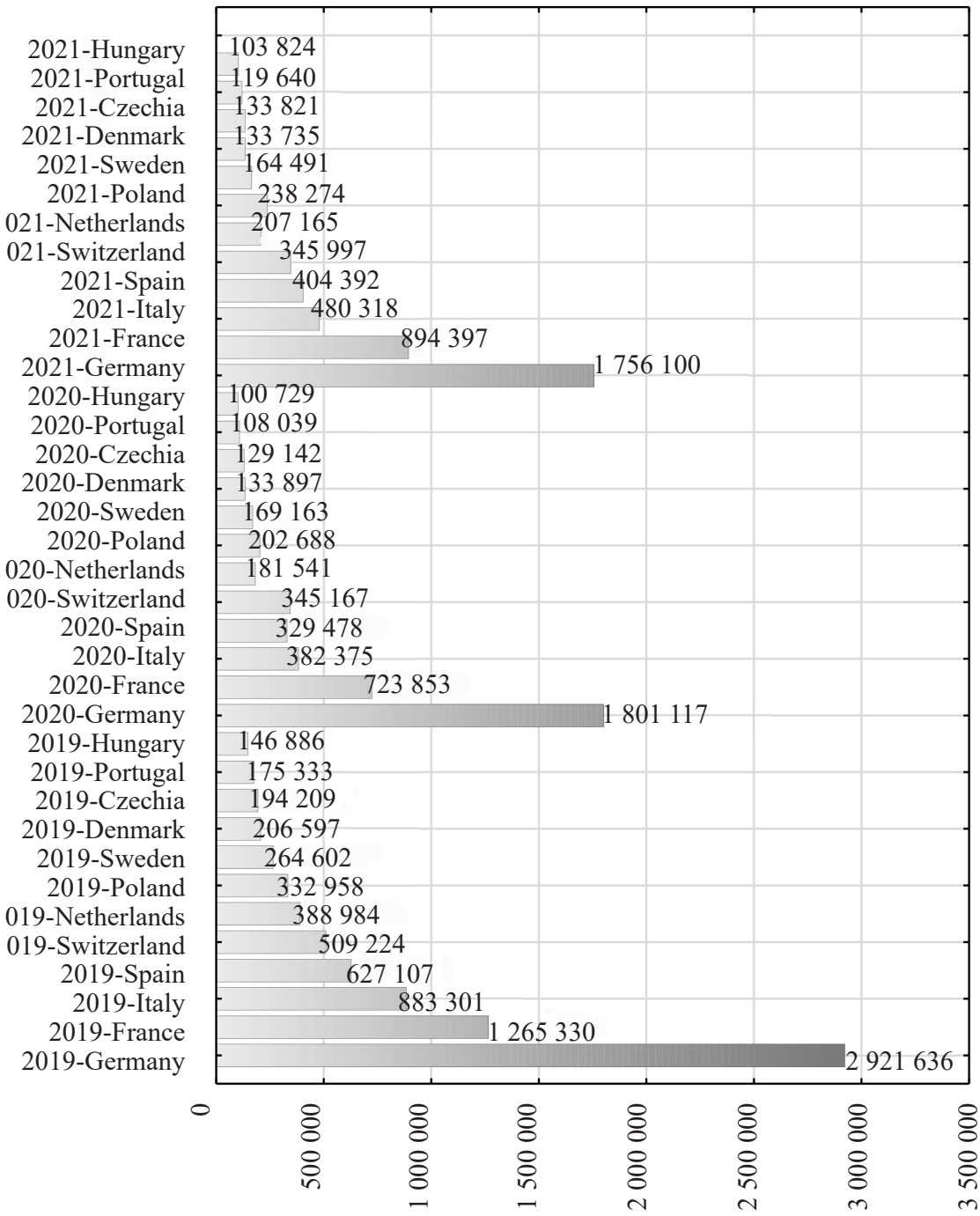

Figure 2. Number of passengers transported by rail in twelve European countries between 2019-2021

Source: own study based on data obtained from the website: https://ec.europa.eu/ (as of 27.11.2022).

The data presented in Figure 2 shows that Germany is the leader in rail passenger transport between 2019-2021. In 2019, approximately 2 921 636 passengers were transported there. In 2020, due to the COVID-19 pandemic, there was a decrease to the level of 1 801 117 passengers and in 2021 to 1 1 756 100 people. France was the second country in the ranking of the most significant number of passengers transported by rail. In 2019, 1 265 330 passengers were transported. In 2020 there was a decrease to 723 853 passengers, and in 2021 an increase to 894,397 passengers. The third country in the ranking was Italy. In 2019, 883 301 passengers were transported there by rail. As in previous countries, in 2020, the number of passengers decreased to 329 478, and in 2021 it increased to 480 318. Poland was ranked seventh in the ranking. In 2019, 332 958 passengers were transported in Poland. In 2020, a decrease to 202 668 passengers was recorded,

and in 2021 an increase to 238 274 passengers. Hungary was the lowest one in the considered passenger rail transport ranking. In 2019, approximately 146 886 passengers were transported there by rail. In 2020, due to the COVID-19 pandemic, there was a decrease to 100 729 passengers, and in 2021 an increase to 103 824 passengers.

The following research stage is a comparative analysis of changes in the number of passengers transported by rail in the European countries under consideration between 2019 and 2021. The results of the research and the ranking are presented in Figure 3.

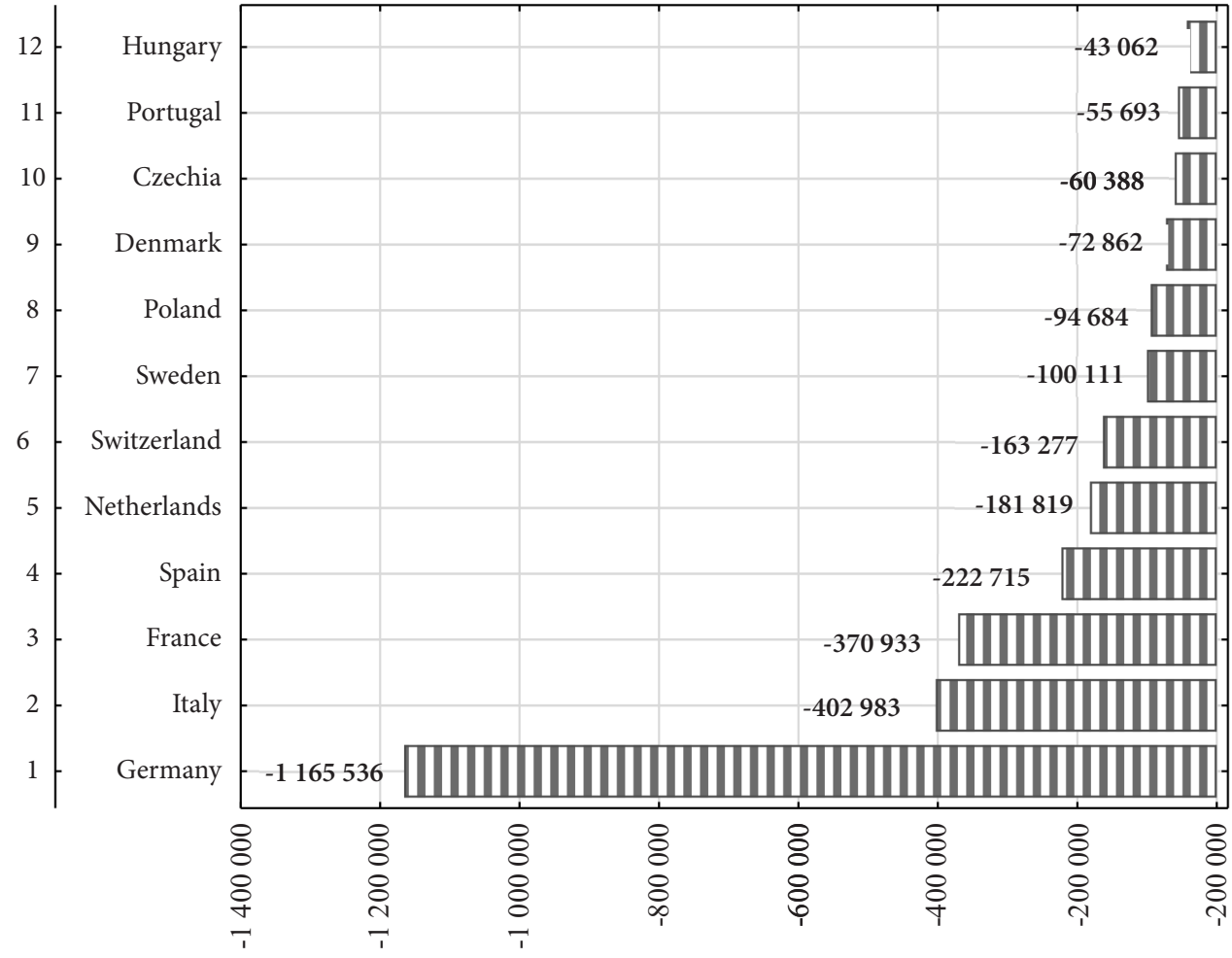

Figure 3. Decreases in the number of passengers transported by rail in the respective analyzed European countries in 2021 compared to 2019

Source: own study based on data obtained from the website: https://ec.europa.eu/ (as of 27.11.2022)

The research summarized in Figure 3 shows that decreases were observed in each of the European countries under consideration in 2021, compared to 2019. The largest ones were visible in Germany and amounted to 1 165 536 passengers in 2021. The second place was Italy with 402 983 passengers. France was ranked third with a decrease of 370 933 passengers. Poland took eighth place in the ranking of declines in 2021 with 94 864 passengers. The lowest decreases were recorded in Hungary – 43 062 passengers.

The median of the analyzed decreases in the twelve European countries under consideration amounted to 131 669, while the standard deviation from the arithmetic mean was 313 817 passengers. The next part of the research analyzes the percentage decrease in the number of passengers transported by rail in the respective surveyed European countries in 2021 compared to 2019. The research results are presented in Figure 4.

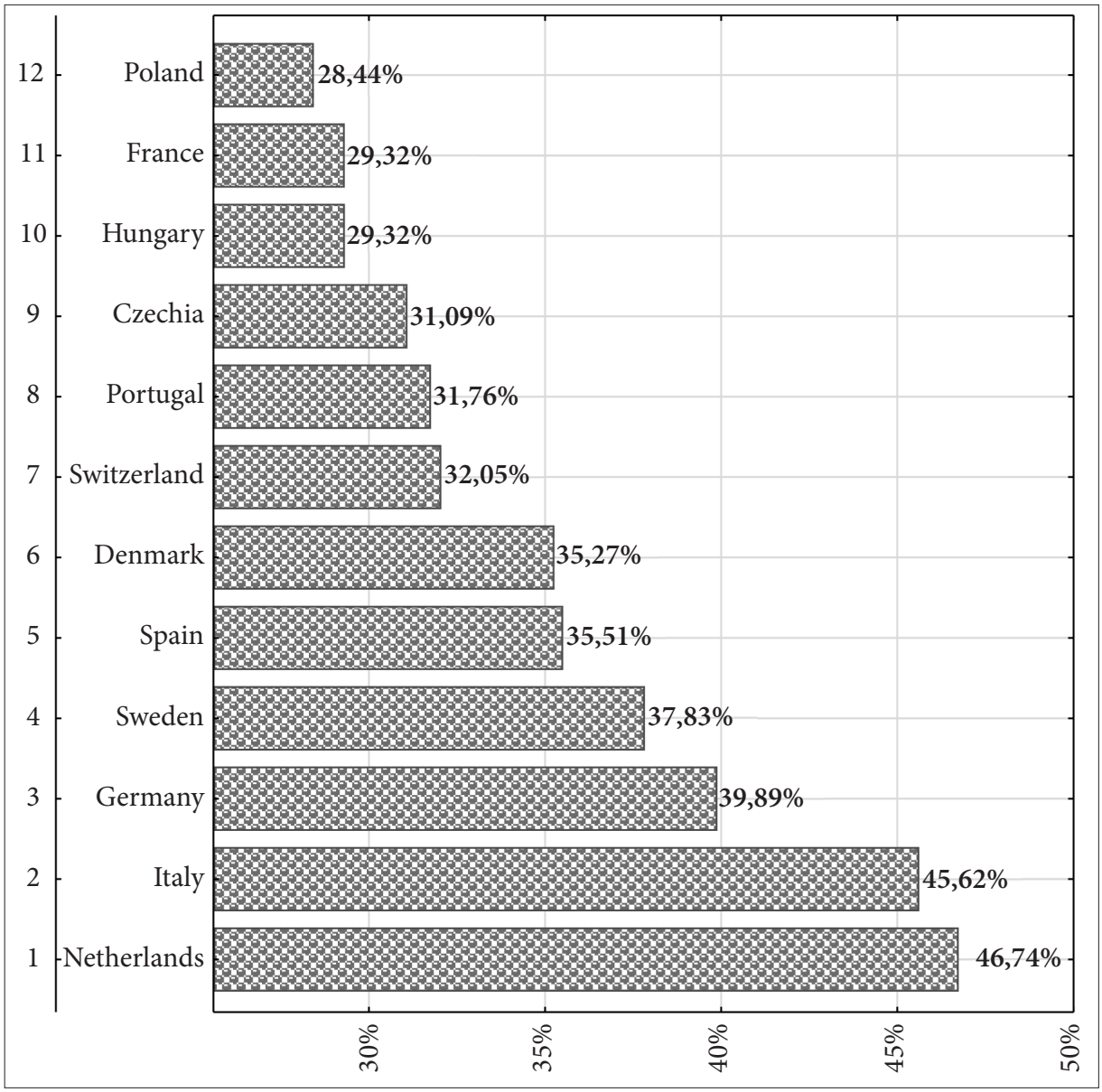

Figure 4. Percentage decrease in the number of passengers transported by rail in the respective analyzed European countries in 2021 compared to 2019.

Source: own study based on data obtained from the website: https://ec.europa.eu/ (as of 27.11.2022)

Research shows that the most significant percentage decrease in the number of passengers transported by rail in the twelve European countries under consideration between 2019 and 2021 was observed in the Netherlands: 46,74%. The second place was Italy, with a percentage decrease of 45,62%, and Germany took third place with a reduction of 39,89%. Minor percentage decreases were observed in Poland. They amounted to 28,44%. The median of the analyzed cutbacks between 2019 and 2021 in the twelve European countries under consideration was 33,66%, while the standard deviation from the arithmetic mean was 6,21%. The next stage of the research was analyzing the difference in the number of passengers transported by rail in the twelve European countries under consideration between 2020 and 2021. The results of the research are summarized in Figure 5.

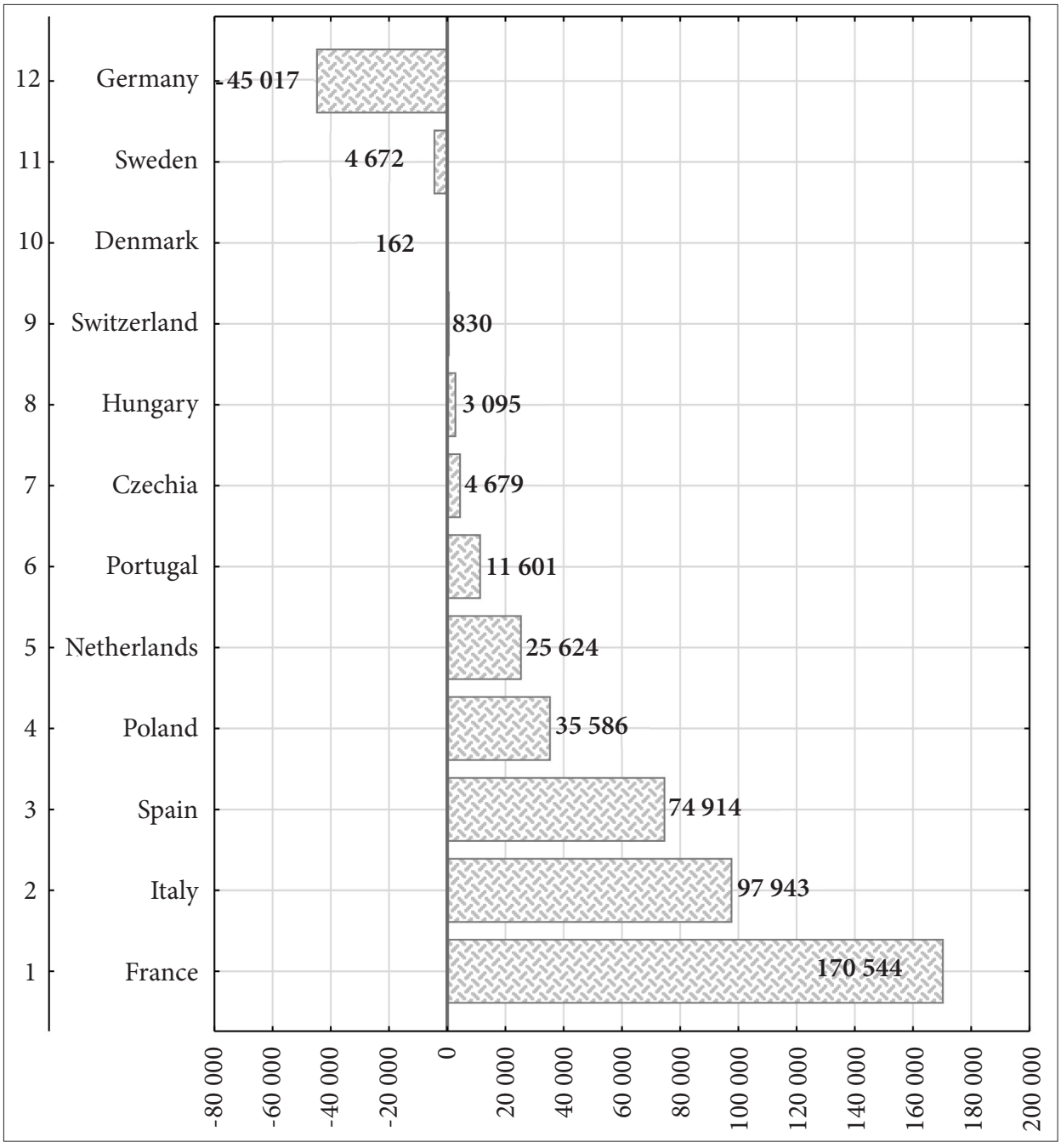

Figure 5. The difference in the number of passengers transported by rail in the twelve European countries under consideration between 2020 and 2021

Source: own study based on data obtained from the website: https://ec.europa.eu/ (as of 27.11.2022)

The analysis shows that in nine out of twelve European countries, an increase in the number of passengers transported by rail was observed in 2021 compared to 2020. The ranking leader is France, with an increase of 170 544 passengers. Italy is the second one, with an increase of 97 943 passengers. Spain was ranked third with an increase of 74 914 passengers. Poland was ranked fourth, with an increase of 35 856 passengers. The largest decreases in 2021 compared to 2020 were observed in Germany: 45 017 passengers. Reductions in the number of passengers transported by rail were also recorded in Sweden (4 672) and Denmark (162 passengers).

The median in the difference in the number of passengers transported by rail in the twelve European countries under consideration between 2020 and 2021 was 8 140 , and the standard deviation from the arithmetic mean was 57 770,48 passengers.

The last stage of the research is the analysis of dynamics indices with a constant base of the number of passengers transported by rail in twelve respective European countries under consideration in 2021. The research results are outlined in Figure 6.

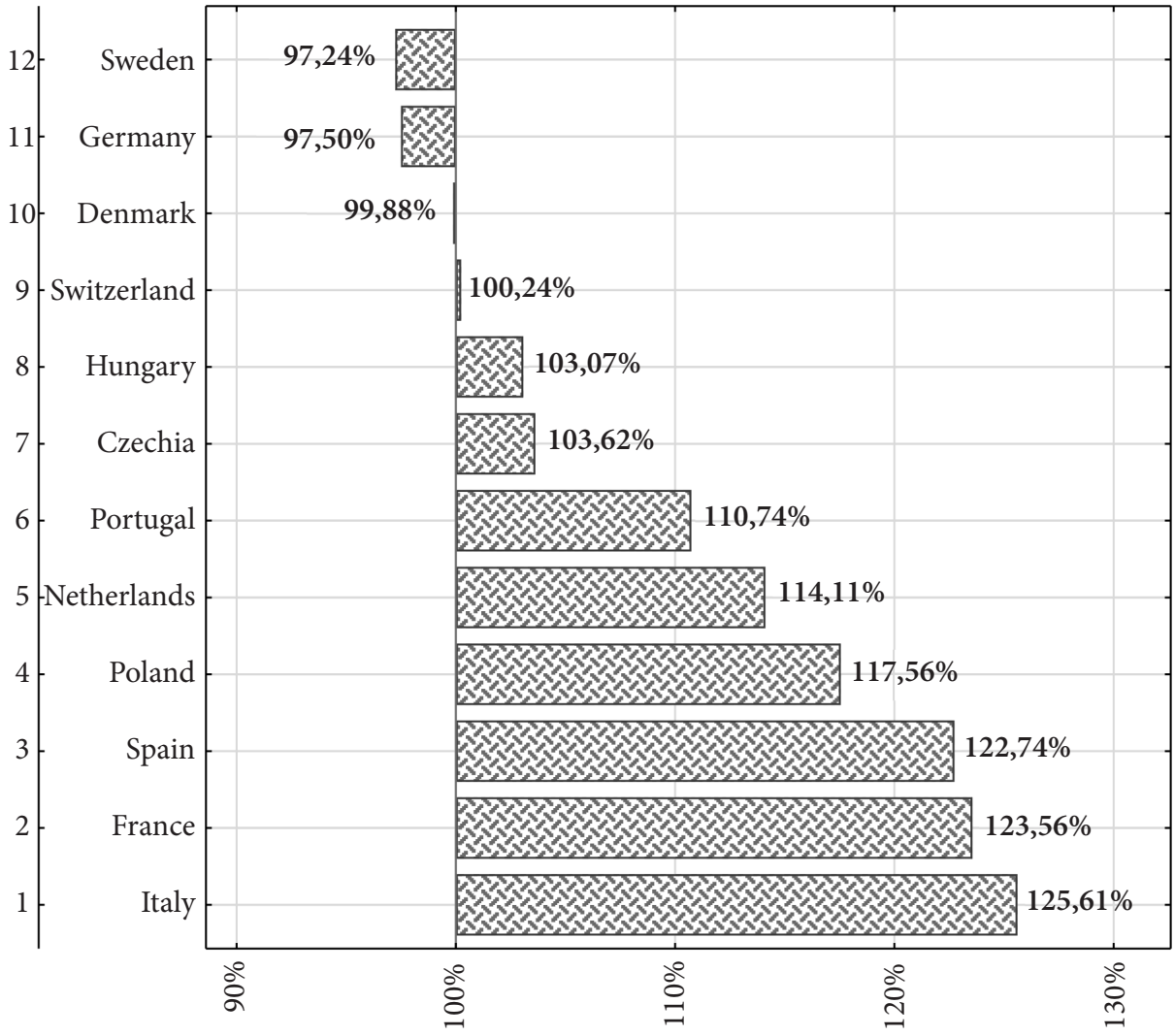

Figure 6. Dynamics indices with a constant base of the number of passengers transported by rail in twelve respective European countries under consideration in 2021 (the constant base is the number of passengers transported by rail in the twelve analyzed European countries in 2020)

Source: own study based on data obtained from the website: https://ec.europa.eu/ (as of 27.11.2022)

The conducted research shows that the largest percentage increases in the number of passengers transported in the twelve European countries under consideration between 2020 and 2021 were in Italy. The increase was recorded here at the level of 25,61%. The second place was France with an increase of 23,56%. Spain took third place with a rise of 22,74%. Poland was ranked fourth in the classification, with an increase of 17,56%. Three out of twelve European countries recorded declines. The lowest percentage decreases were observed in Sweden: 2,76%, Germany: 2,5% and Denmark: 0,22%. The median of dynamics indices with a stable base of the number of passengers transported by rail in the twelve European countries under consideration in 2021 was 107,18%, the arithmetic mean was 109,66%, and the standard deviation from the arithmetic mean was 10,74%.

4. Summary and conclusions

The COVID-19 pandemic weakened the rail passenger transport sector in Europe between 2020-2021. The goal of the research has been achieved. The study shows that in 2019, 7 916 167 passengers were transported by rail in the twelve European countries under consideration. In 2020, the number of passengers decreased to 4 607 189, and in 2021 it increased to 4 982 154 passengers.

The leader among the countries considered in the study in terms of passenger transport by rail between 2019-2021was Germany. In 2019, approximately 2 921 636 passengers were transported there. In 2020, due to the COVID-19 pandemic, there was a decrease to the level of 1 801 117 passengers and, in 2021, to 1 1756 100 people. The next place in the ranking was taken by France where, in 2019, 1 265 330 passengers were transported, in 2020 there was a decrease to 723 853 and in 2021 an increase to 894 397 passengers. The third place in the ranking belongs to Italy. In 2019, 883 301 passengers were transported here, while in 2020, 329 478 and an increase to 480 318 was observed in 2021.

In 2020, decreases in the number of passengers transported by rail were observed in all twelve European countries under consideration. In each of these countries, decreases were observed in 2021 compared to 2019. The largest ones were visible in Germany and amounted to 1 165 536 passengers in 2021. The second place was Italy, with 402 983 passengers. France was ranked third with a decrease of 370 933 passengers. Poland took eighth place in the ranking of declines in 2021 with 94 864 passengers.

When analyzing the percentage decreases in the number of passengers transported by rail in twelve European countries between 2019 and 2021, it was observed that the highest one was recorded in the Netherlands: 46,74%. Italy was ranked second with a percentage decrease of 45,62%, and Germany third with a reduction of 39,89%.

Nine of twelve European countries experienced an increase in the number of passengers transported by rail between 2020 and 2021. The ranking leader was France, with an increase of 170 544 passengers. The second place is Italy, with an increase of 97 943 passengers. Spain was ranked third with an increase of 74 914 passengers. Poland was ranked fourth with an increase of 35 856 passengers. Decreases in 2021 compared to 2020 were observed in three countries: in Germany - they amounted to 45 017 passengers, in Sweden: 4 672 and Denmark: 162 passengers.

Nine out of twelve countries recorded percentage increases in the number of passengers transported by rail in 2021 compared to 2020. Thus, the research thesis put forward at the beginning of the study has been confirmed. The highest percentage increases were recorded in Italy – at the level of 25,61%. France was second with an increase of 23,56%. Spain took the third place with an increase of 22,74%. Declines were recorded in Sweden 2,76%, Germany 2,5% and Denmark 0,22%.

The research clearly shows that the number of passengers transported before the COVID-19 pandemic in 2019 was much higher than in 2020 and 2021. Such significant decreases result in much lower revenues related to the sale of tickets and other groups of goods as part of the transport services provided. Lower revenues with basically the same costs generate lower profits. This, in turn, results in lower funds related to investments aimed at the modernization of this branch of transport.

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