Journal of Sustainable Development of Transport and Logistics
journal home page: https://jsdtl.sciview.net

Kozicki, B., Skrabacz, A., Gałek, B., & Lorek, M. (2023). Multidimensional analysis of losses in the number of passengers transported by air in Poland and Germany caused by the COVID-19 pandemic in terms of the maintenance of economic security. *Journal of Sustainable Development of Transport and Logistics, 8*(2), 58-70. doi:10.14254/jsdtl.2023.8-2.4.

ISSN 2520-2979

Multidimensional analysis of losses in the number of passengers transported by air in Poland and Germany caused by the COVID-19 pandemic in terms of the maintenance of economic security

Bartosz Kozicki *, Aleksandra Skrabacz *, Beata Gałek **, Marlena Lorek ***

** Military University of Technology in Warsaw,*
Kaliskiego Street, 2, Warsaw 00-908, Poland
Tel: (+48) 261839175
bartosz.kozicki@wat.edu.pl; aleksandra.skrabacz@wat.edu.pl
*** University of Siedlce,*
Konarskiego Street, 2, Siedlce 08-110, Poland
Tel: (+48) 25 6431915
beata.galek@uph.edu.pl
***** Rzeszów University of Technology,*
Al. Powstańców Warszawy 12, Rzeszów 35-959, Poland
Tel: (+48) 178651100
mlorek@prz.edu.pl

Article history:

Received: May 28, 2023
1st Revision: September 22, 2023
Accepted: October 30, 2023

DOI:
10.14254/jsdtl.2023.8-2.4

Abstract: In the study, the authors conducted a multidimensional data analysis on the decrease in the number of passengers transported by air in Poland and Germany caused by the COVID-19 pandemic between 2020-2022. Forecasts of the number of passengers transported by air in Poland and Germany obtained after applying the Holt-Winters exponential smoothing method from January 2020 to December 2022 were compared with actual data. The research showed that in the case of Germany, in 2020 there was a decrease of 174 628 873 people, and in 2022, it was 90 620 354 people. In Poland, the decrease in 2020 amounted to 40 257 520 people; in 2022, it was already 21 083 066 passengers.

Keywords: air transport, oil price, COVID-19, multidimensional comparative analyzes, economic security

1. Introduction

The article is a continuation of B. Kozicki's study of 2021, which was extended with newly available data between 2021-2022 and a time series of data on the number of passengers transported by air in Poland (Kozicki, 2021). The following research problem was presented: to what extent did the impact of the COVID-19 pandemic affect the number of passengers transported by air in Germany and Poland between 2020 and 2022?

Corresponding author: *Bartosz Kozicki*
E-mail: bartosz.kozicki@wat.edu.pl

This open access article is distributed under a Creative Commons Attribution (CC-BY) 4.0 license.

The following research purpose was adopted for this research problem: to conduct forecasting based on retrospective data on the number of passengers transported by air in Germany and Poland for the period from January 2020 to December 2022 and to conduct a multidimensional comparative analysis of the obtained forecasts with actual data.

For the research problem and the purpose of the work, the following research thesis was put forward: between 2020-2022 there were decreases in the number of passengers transported by air in Germany and Poland compared to their forecasts for the period from January 2020 to December 2022 with a decreasing trend dynamically.

The research method used in the study was the analysis of literature on definitions concerning air passenger transport, as well as multidimensional data analysis and economic security.

2. Analysis of the literature of the research subject

The term "security" in the literature is widely understood. According to W. Kitler, it is inner trust, peace of mind, and certainty, properly or falsely justified in the circumstances giving rise to fears (Kitler, 2011, p. 22). It is also defined as the main need of man and social groups, a kind of strategic goal (Stańczyk, 1996, p. 18). Security is considered subjective and objective (Skrabacz, 2012, s. 24; Jurgilewicz, 2023, p. 25). Economic security is one type. It is defined as the certainty of survival and development of the economic system of the state and international economic organizations, along with tools guaranteeing the preservation of their appropriate international position in social relations and the assumed standard of living of citizens (Nurzyńska, 2016, p. 22, Kozicki et al., 2021). The importance and awareness of economic security have been particularly highlighted in the 21st century by the emergence of the COVID-19 pandemic. The World Health Organization announced it on March 11, 2020. The disease tended to spread rapidly and caused deaths (Wołosowski, 2022; Książkowski, 2022; Jabłonowski, Istel, 2023; Skrabacz, 2021). It led to the introduction of restrictions, for instance, on transportation.

First of all, as never before in history, it influenced the emergence of a crisis in air passenger transport and a decrease in the number of passengers. It should be emphasized that this type of transport is special; its strategic goal is to meet the needs of travellers. It is recognized as a stimulator that brings markets closer, i.e. places where purchase and sale transactions are made, thus enabling an increase in production and, thus, an increase in sales, revenues and profits. In addition, the increase in the number of passengers transported by air facilitates the development of infrastructure and causes the development of other branches of the economy. It also affects the level of globalization in terms of its growth and allows it to reach any place on Earth. Transport needs are an essential issue in the field of air passenger transport. They are considered as the desire/necessity of relocation within a specific time and space by the national economy and citizens of respective countries using appropriate means of transport. It is generally accepted that the classification of needs results from the purpose of the travel. The fundamental role in passenger air transport is played by the price, which is the value of the service provided in terms of movement dynamically (See Jurgilewicz et al., 2020 and 2022).

Air transport is primarily divided into three groups based on the transport object. These include passengers, goods and mail. The study focuses on passenger air transport. Until 2019, a strong growing trend in the number of people travelling by this type of transport was noticeable worldwide (Stajniak, Kozicki & Wenerska, 2022). In the first phase, the COVID-19 pandemic led to a decrease in the number of passengers transported by air, especially in April 2020 (Civil Aviation Authority, 2021) - reaching over 95% compared to the same period in 2019 (Ramotowski, 2022; Slomski, 2021; Szymanski, 2020). This led to a decrease in demand for crude oil, followed by long-term price drops until December 2020 (Kardaś, Łoskot-Strachota, Wiśniewska, 2020; Suder, 2021).

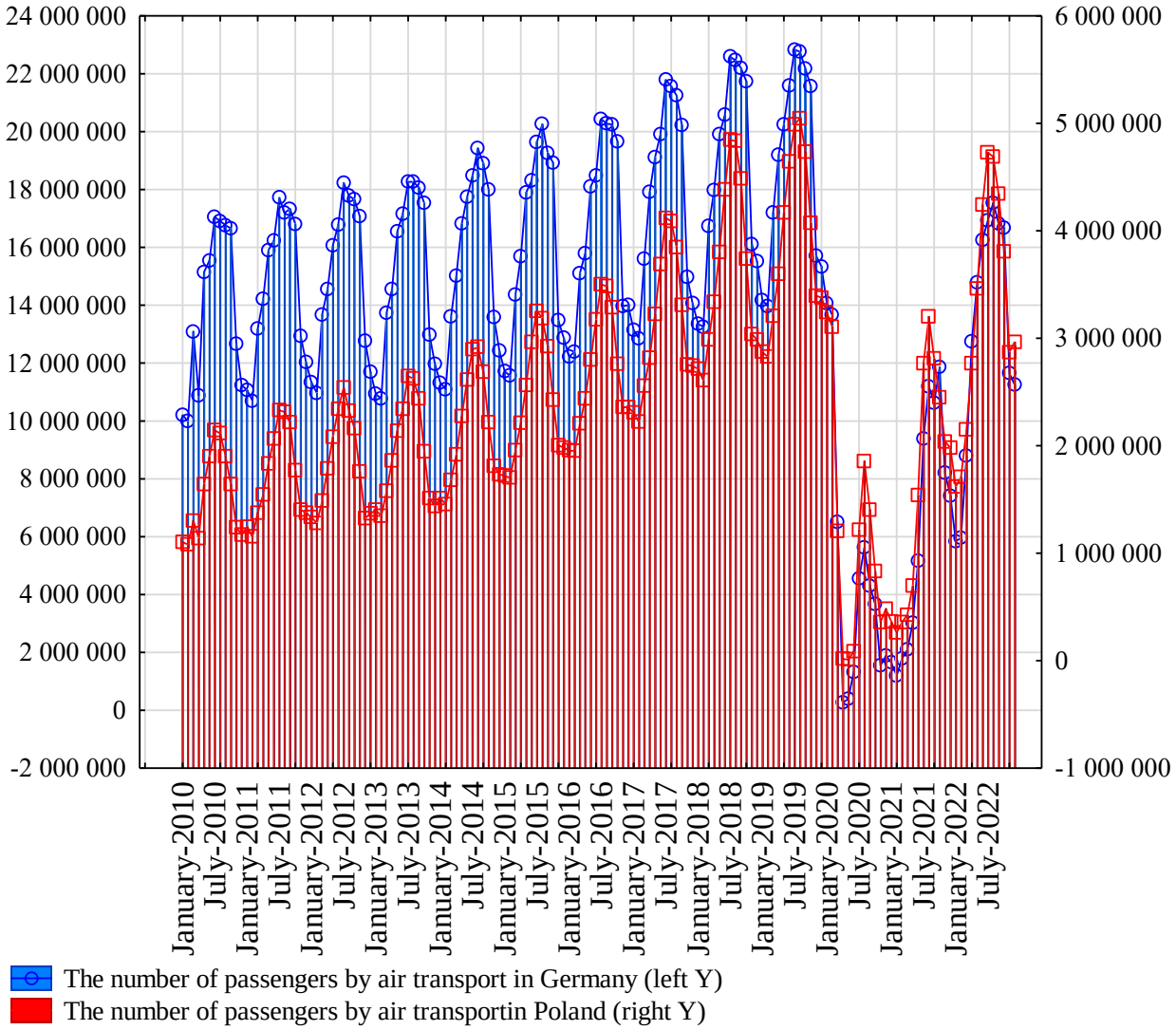
The abovementioned events, with the attack of Russia on Ukraine, contributed to the increase in inflation in Europe. In 2022, inflation in the European Union was 10,4%, while in December 2021, it was 5,3% (Błaszkiewicz, 2023; Knees, 2023).

The study used multidimensional comparative analyses, during which at least two dependent variables were analyzed and evaluated. The data was grouped and compiled on categorized line and bar charts, and, for research purposes, they were given separate scales to observe their trends dynamically.

3. Multidimensional comparative analyzes of the number of passengers transported by air in Germany and Poland

The research in Figure 1 began with the outline of data on the number of passengers transported by air in Germany and Poland from January 2010 to December 2022.

Figure 1: Categorized bar chart of the number of passengers transported by air in Germany and Poland from January 2010 to December 2022 (left scale of the Y axis - Germany; right scale of the Y axis - Poland)

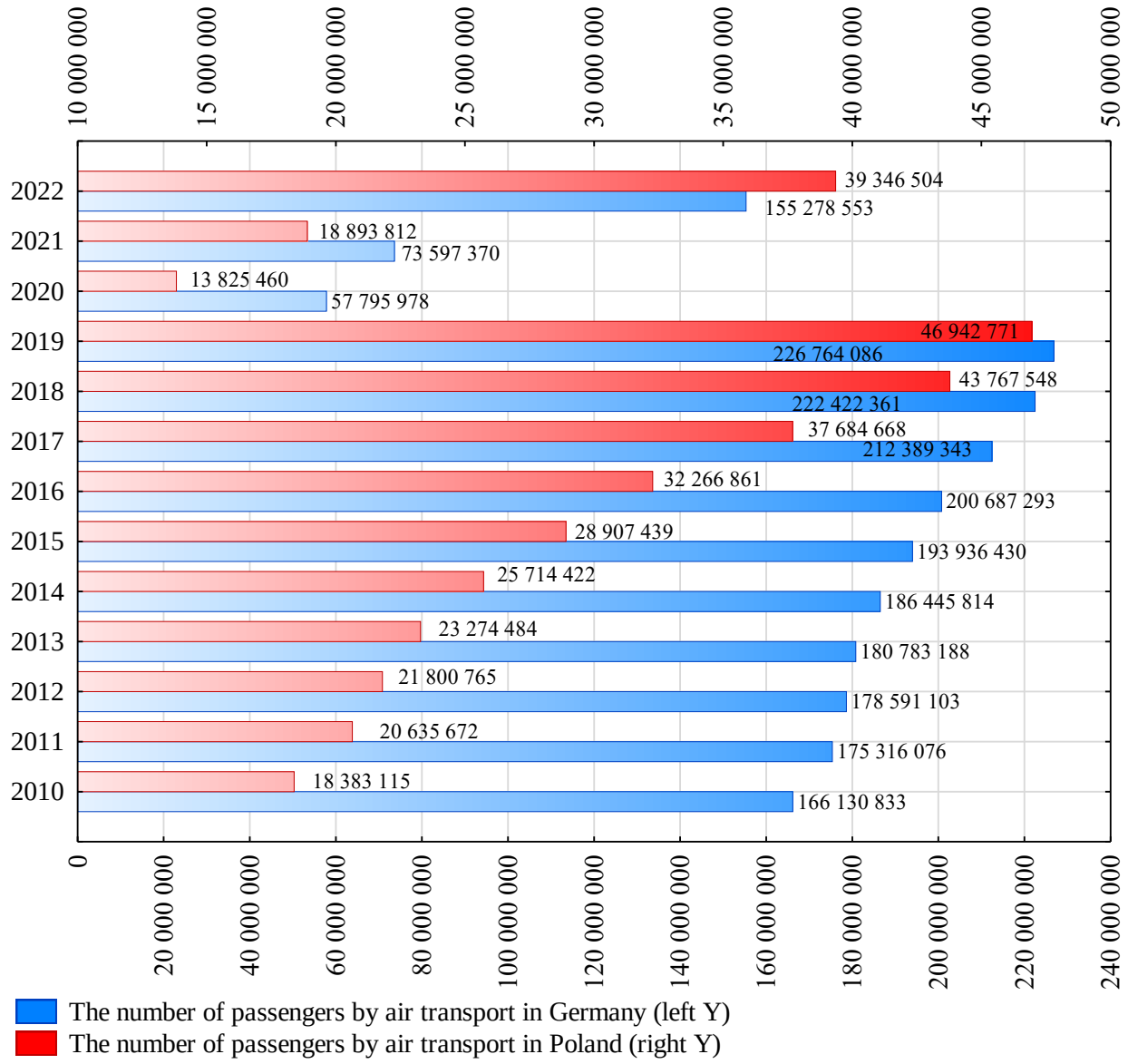


Source: own study based on data obtained from the website: https://ec.europa.eu/ (as of 31.03.2023)

Observation of the data presented in Figure 1 shows that from January 2010 to December 2019, there was an upward trend and seasonality monthly in the number of passengers transported by air passenger transport in Poland and Germany. Since the announcement of the COVID-19 pandemic by the WHO (March 11, 2020), a strong decrease in the number of passengers transported by air was observed in both analyzed countries, followed by a gradual increase between 2020-2022 while maintaining the phenomenon of seasonality. The two considered time series were given separate scales on the right and left Y axes for illustrative purposes. The abovementioned solution shows a stronger upward trend between 2010-2019 was observed in Poland. The arithmetic means of the number of passengers transported by air in Germany monthly between 2010-2019 was 16 195 554 and in Poland 2 494 815. The standard deviation from the arithmetic mean in Germany was 3 400 042 in the period under consideration and in Poland 974 798.

Then, for research purposes, the number of passengers transported by air in Germany and Poland was compiled in the group of dependent variables from 2010 to 2022 to observe the trend phenomenon.

Figure 2: Categorized bar chart of the amount of the number of passengers transported by air in Germany and Poland in the group of dependent variables from 2010 to 2022 (left scale of the Y axis - Germany; right scale of the Y axis - Poland)

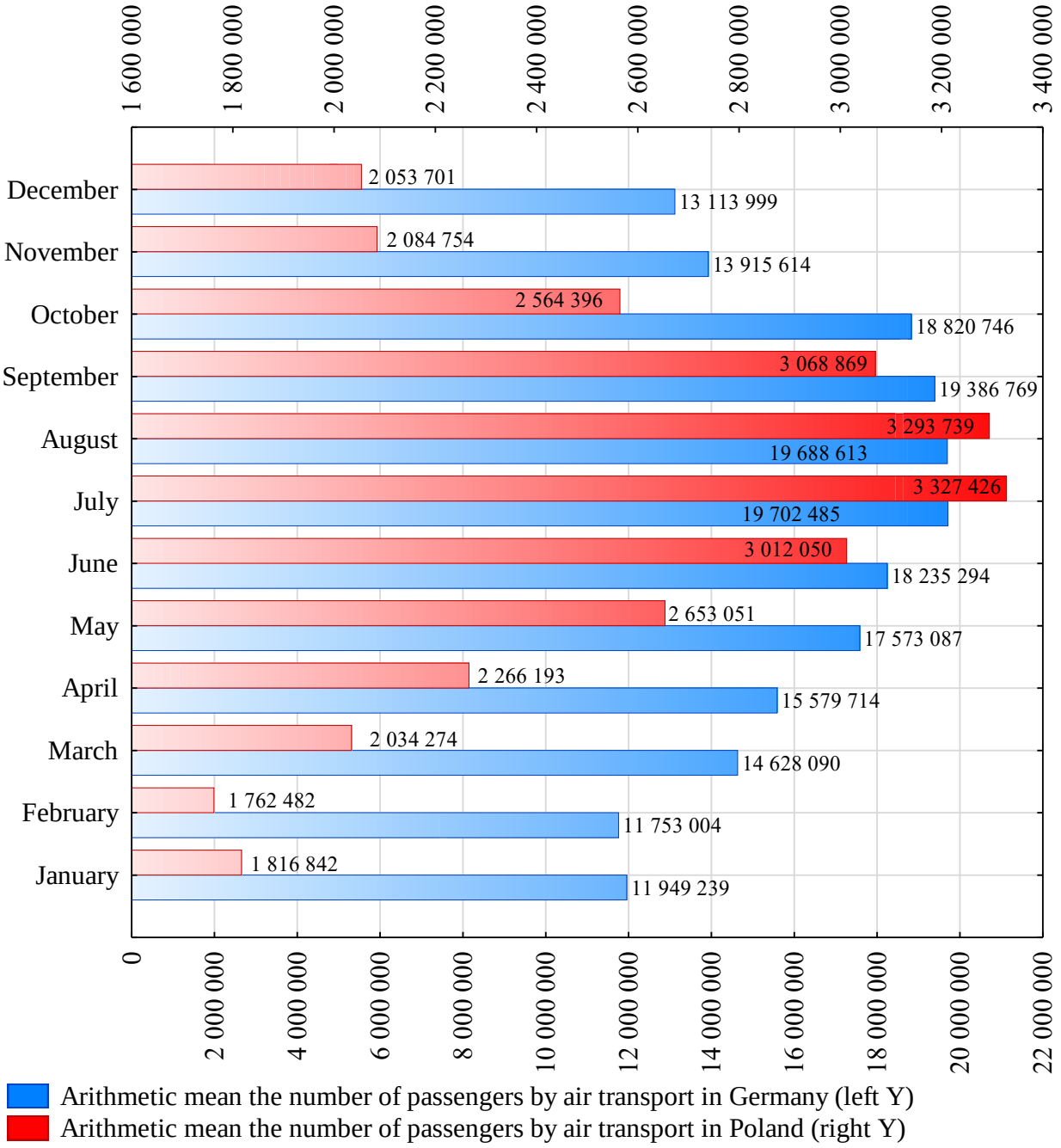


Source: own study based on data obtained from the website: https://ec.europa.eu/ (as of 31.03.2023)

In 2010, 166 130 833 passengers were transported by air in Germany and 18 383 115 in Poland. Until 2019, an upward trend had been visible in both countries. In Germany in 2019, compared to 2010, there was an increase of 36,5 p.p. - to 226 764 086 passengers. On the other hand, in Poland at that time, an increase of 155,36 p.p. was recorded - to the level of 46 943 771 passengers. In 2020, huge declines were visible in both countries. In Germany, the decrease compared to 2019 was by 74,51 p.p., i.e., by 168 968 108 passengers. In Poland, however, a decrease of 70,55 p.p. was recorded, i.e. by 33 117 311 passengers. In 2021, an increase in the number of passengers transported was observed in both analyzed countries compared to 2020, in the case of Germany by 15 801 392 passengers and in Poland by 5 068 352 passengers. The largest increase in the number of passengers transported by air was in 2022, but still, not as many people were transported in this period as in 2019. In Germany, between 2021 and 2022, an increase of 81 681 183 people was recorded, while in Poland, by 20 454 692 people.

The next stage of the research was to outline data on the arithmetic mean in Figure 3 of the number of passengers transported by air in Germany and Poland in the group of dependent variables of months from 2010 to 2019 in order to observe the phenomenon of seasonality monthly.

Figure 3: Categorized bar chart of the arithmetic mean of the number of passengers transported by air in Germany and Poland in the group of dependent variables of months from 2010 to 2019 (left scale of the Y axis - Germany; right scale of the Y axis - Poland)



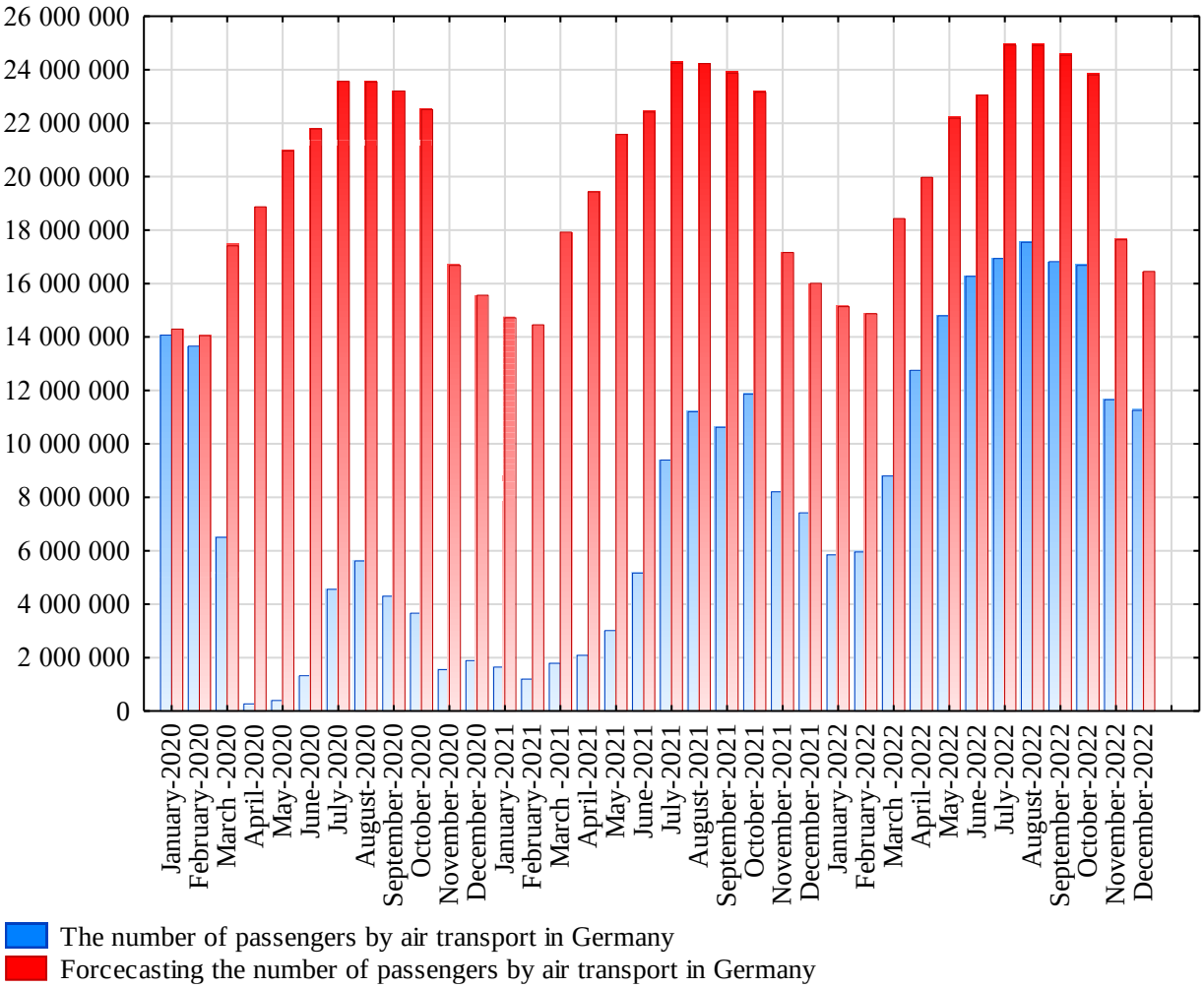
Source: own study based on data obtained from the website: https://ec.europa.eu/ (as of 31.03.2023)

The data in Figure 3 indicates the existence of seasonality monthly: from February to August, there is an increasing trend and, then, from August to February, a decreasing trend.

4. Forecasting and evaluation of the obtained forecasts

The existence of an upward trend and seasonality monthly in the time series of the number of passengers transported from January 2010 to December 2019 by air became the premise for their forecasting using the Holt-Winters exponential smoothing method from January 2020 to December 2022 in both considered European countries. The forecasting results in Germany with actual data are presented in Figure 4, and in Poland in Figure 5.

Figure 4: Categorized bar chart of data on the forecast of the number of passengers transported by air between 2020-2022 in Germany with the use of the Holt-Winters method with actual data



Source: own study based on data obtained from the website: https://ec.europa.eu/ (as of 31.03.2023)

The obtained forecast indicates the preservation of the upward trend between 2010-2019 and the phenomenon of seasonality monthly. The largest differences between the forecasted and actual data were observed in April-June 2020. Then, their slow downward trend could be seen.

For research purposes, Table 1 analyses the error indices of the forecast of the number of passengers transported by air in Germany between 2020-2022 after using the Holt-Winters method.

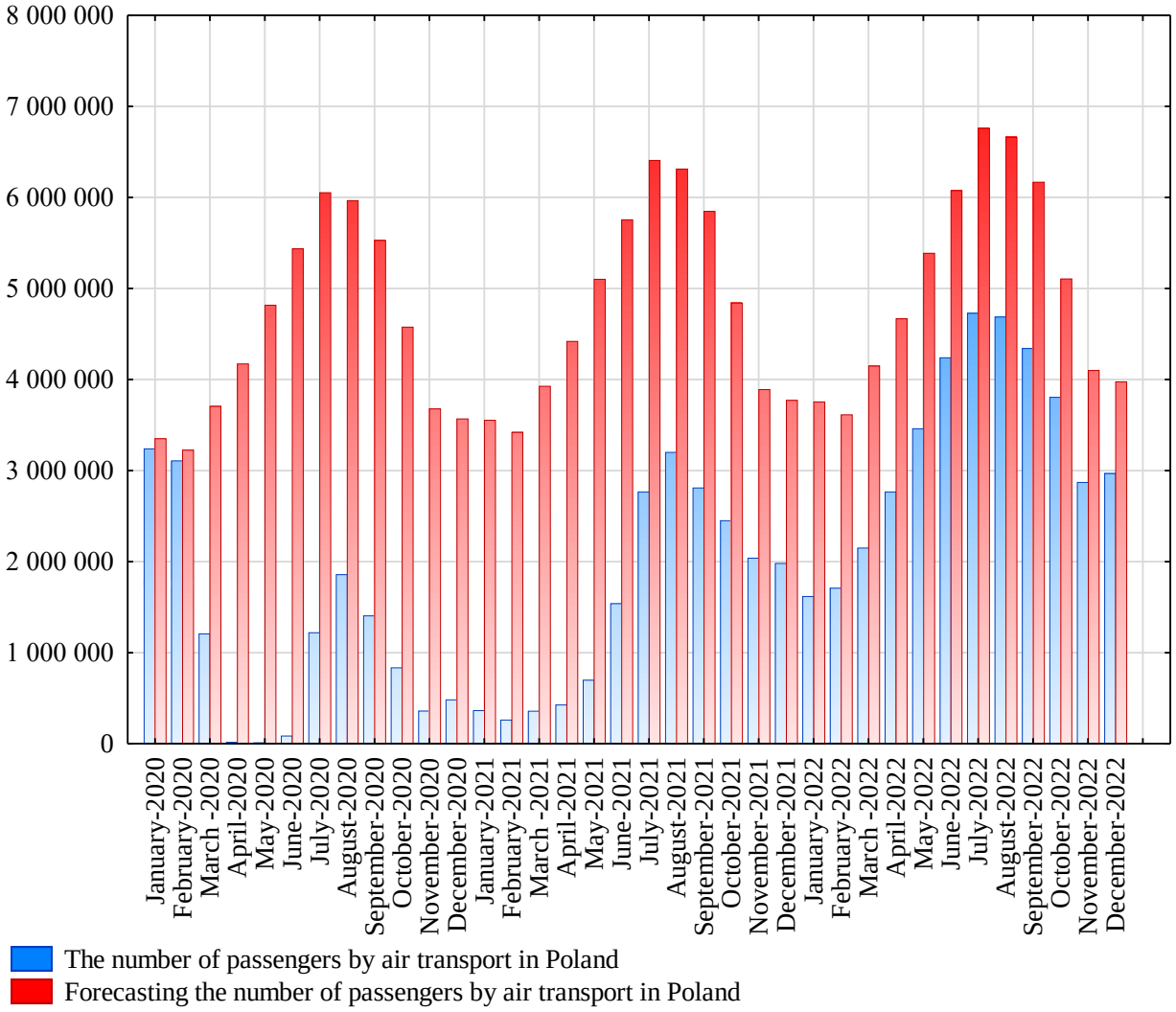
Table 1: Analysis of error indices of the forecast of the number of passengers transported by air in Germany between 2020-2022 after the use of the Holt-Winters method

Index	Result
Average error	−8 685,27
Average percentage error	−0,12
Average absolute percentage error	1,73

Source: own study based on data obtained from the website: https://ec.europa.eu/ (as of 31.03.2023).

The obtained indices show that the forecasting was excellent because the average absolute error of the forecast was 1,73%, and the average percentage error was 0,12%. On the other hand, the average error was at the level of -8 685,27.

Figure 5: Categorized bar chart of data on the forecast of passengers transported by air transport between 2020-2022 in Poland with the use of the Holt-Winters method with actual data



Source: own study based on data obtained from the website: https://ec.europa.eu/ (as of 31.03.2023)

As in the case of data on the number of passengers transported by air in Germany (Fig. 4) and Poland (Fig. 5), the forecast using the Holt-Winters method retained the regularities visible in their retrospective data as an upward trend and seasonality monthly. The largest deviations between the forecasted and actual values were in the period April-June 2020.

Then, a slow downward trend is observed as in the time series presented in Figure 4. It should be emphasized that the differences between the predicted and actual values were much higher in the German time series than in Poland.

Then, Table 2 analyses errors in the forecasting concerning the time series of the number of passengers transported by air in Poland.

Table 2: Analysis of error indices of the forecast of the number of passengers transported by air in Poland between 2020-2022 after the use of the Holt-Winters method

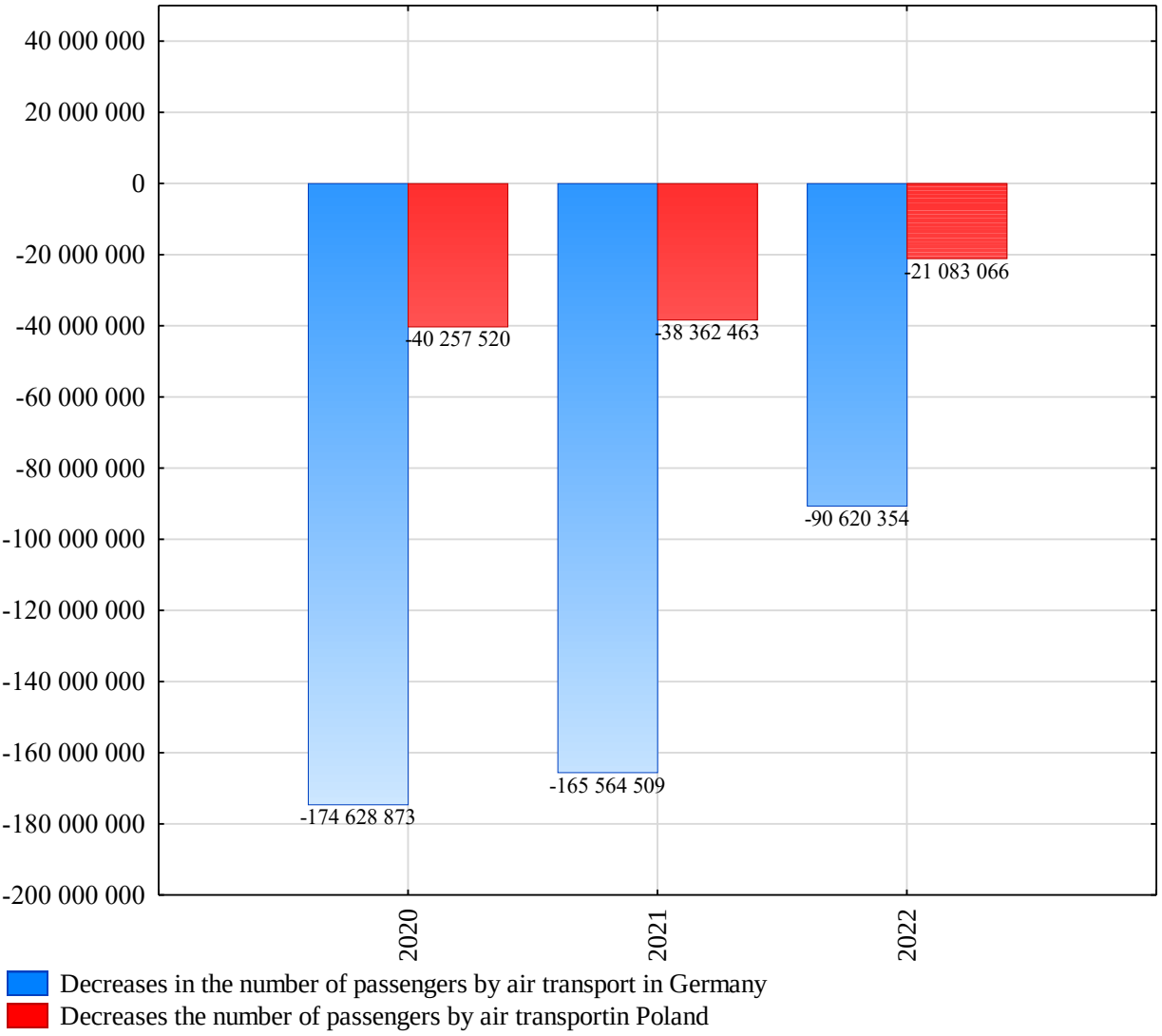
Index	Result
Average error	1582,59
Average percentage error	–0,12
Average absolute percentage error	2,30

Source: own study based on data obtained from the website: https://ec.europa.eu/ (as of 31.03.2023)

The forecasts obtained were very good as the average absolute percentage error was 2,3% and the average percentage error was 0,12%. The average error reached the level of 1582,59.

The next stage of the research was to compare the differences between the forecasts of the number of passengers transported by air transport and the actual data in both countries between 2020-2022.

Figure 6: Decreases in the number of passengers transported between the forecast with the use of the Holt-Winters method and actual data in particular years 2020-2022 in Poland and Germany



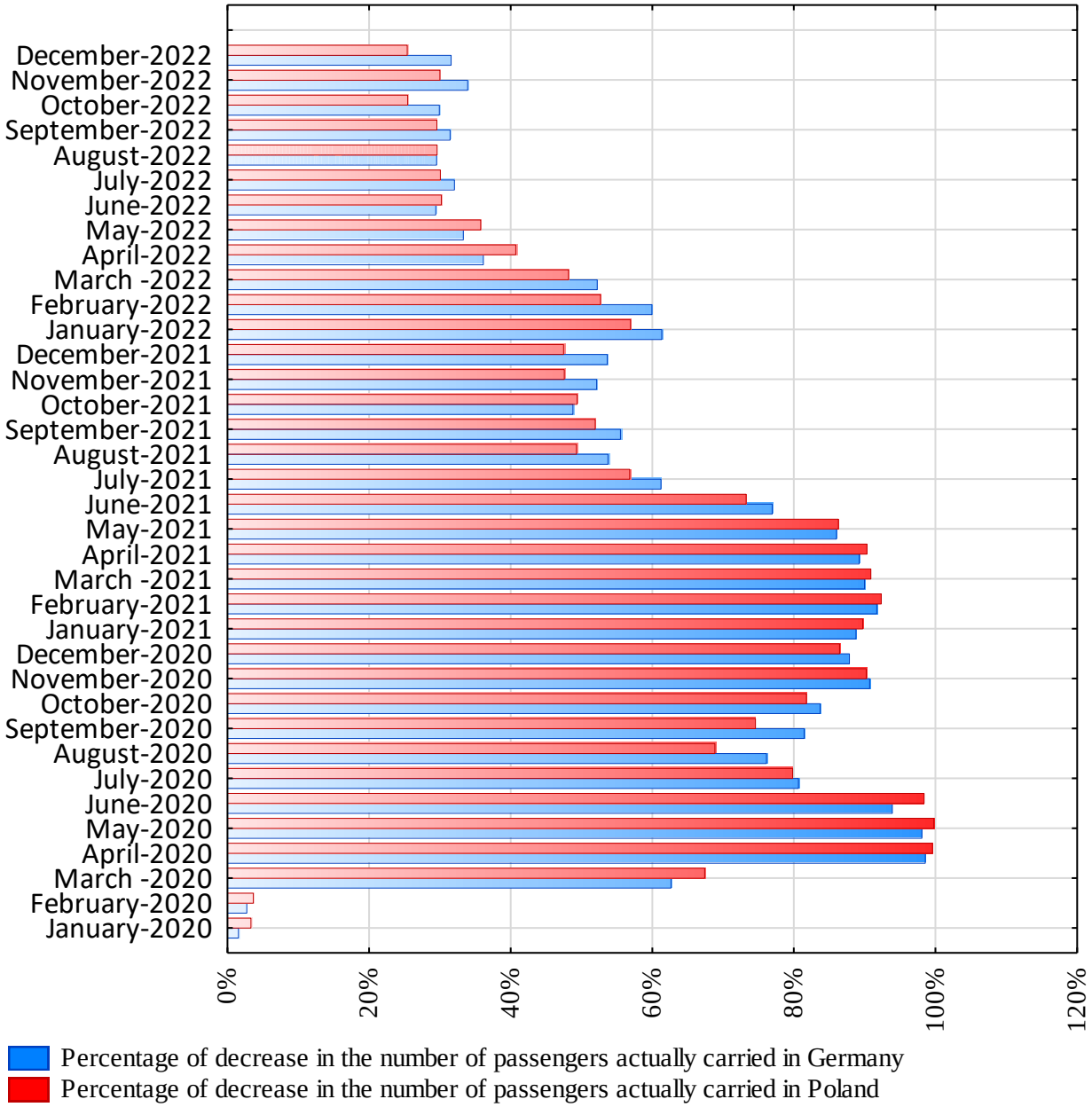
Source: own study based on data obtained from the website: https://ec.europa.eu/(as of 31.03.2023)

The largest differences between the forecasted and actual values were in Germany. The ranking of differences in the number of passengers transported by air between 2020-2022 in Germany is as

follows - 2020: - 174 628 783; 2021: -165 564 509; 2022: -90 620 354, while in Poland - 2020: -40 257 520; 2021: – 38 362 463; 2022: – 21 083 066.

Then, for research purposes, data on the percentage decrease in the number of passengers transported by air transport in Poland and Germany was compiled and compared to the forecasts made by the Holt-Winters exponential smoothing method from January 2020 to December 2022.

Figure 7: Percentage decrease in the number of passengers transported by air in Poland and Germany compared to the forecasts with the use of the Holt-Winters exponential smoothing method for the period from January 2020 to December 2022



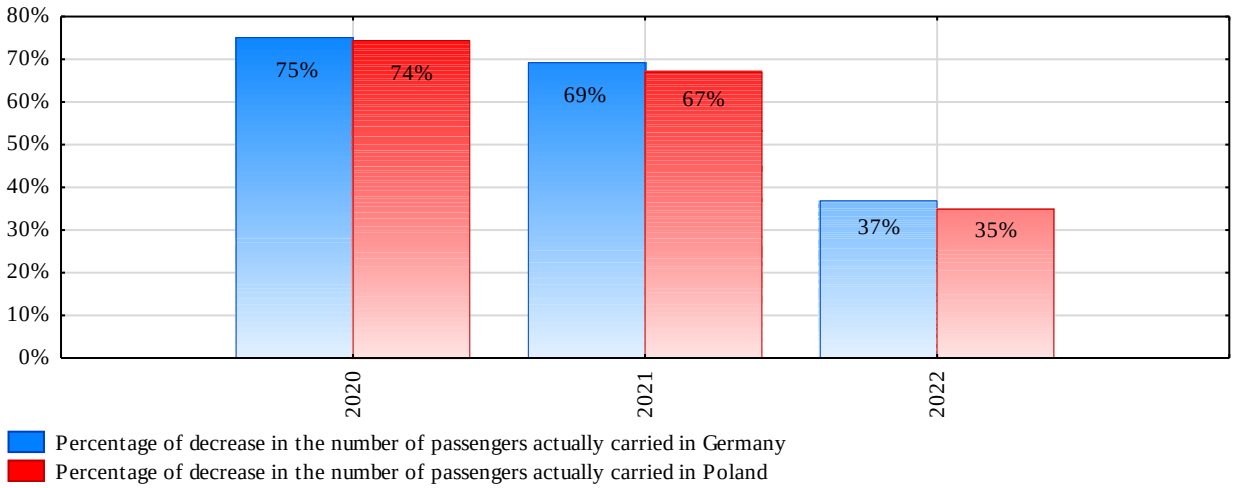
Source: own study based on data obtained from the website: https://ec.europa.eu/(as of 31.03.2023)

The largest decreases in the number of passengers transported were recorded in Poland - they reached 100% in April and May 2020. In the case of Germany, the largest decreases were in April 2020 and amounted to 99%, then in May and June - 98% each.

From the emergence of the COVID-19 pandemic to December 2022, the number of passengers transported by air was not as high as that resulting from the forecasts obtained using the Holt-Winters

method. Decreases in the number of passengers in Germany and Poland between 2020-2022 are presented in Figure 8.

Figure 8: Percentage of decrease in the number of passengers transported by air in Poland and Germany compared to the forecasts with the use of the Holt-Winters exponential smoothing method between 2020-2022



Source: own study based on data obtained from the website: https://ec.europa.eu/(as of 31.03.2023)

In 2020, the percentage decrease in the number of passengers transported by air in Germany was 75% and in Poland 74%. In 2021, a reduction in the decline was observed in both countries - in the case of Germany, 69% and Poland, 67%. 2022 is the year of another decrease in the number of passengers transported by air. In the case of Germany to the level of 37% and in Poland to 35%. It should be emphasized that from 2020 to 2022, due to the COVID-19 pandemic, both in Germany and Poland, the number of passengers transported by air has still not been reached as observed in 2019.

5. Summary and conclusions

The conducted research shows that from January 2010 to December 2019, there was a visible growing trend and monthly seasonality of the number of passengers transported by air in Germany and Poland. From 2020 to 2022, there are visible decreases in the number of passengers transported in both analyzed European countries caused by the COVID-19 pandemic. In Germany in 2020, the decrease compared to 2019 was 74,51 p.p., i.e., by 168 968 108 passengers, while in Poland, there was a decrease by 70,55 p.p., i.e., by 33 117 311 passengers. In 2021, compared to 2020, increases were observed in both countries. In Germany by 15 801 392 passengers and in Poland by 5 068 352 passengers. The largest increase in the number of passengers transported by air took place in 2022, but still, not as many people were transported in this period as in 2019. In Germany, between 2021 and 2022, an increase of 81 681 183 people was recorded, while in Poland, by 20 454 692 people. The seasonality of the analyzed data between 2010-2019 is highlighted in Figure 3. It shows that from February to August, there is an upward trend and a downward trend from August to February.

The detection of two regularities, a trend and seasonality, allowed the selection of the Holt-Winters exponential smoothing method for the forecasting of the data in both analyzed European countries from January 2020 to December 2022. A comparison of forecasts with actual data shows that they do not coincide. There is also a tendency for their differences to be decreased dynamically. In the case of Germany, the difference from 2020 of -174 628 873 decreased in 2022 to -90 620 354. In Poland, the difference from 2020 from -40 257 520 decreased in 2022 to -21 083 066 passengers.

Considering the decline percentage, in Germany, it was 75% in 2020 and 74% in Poland. In 2022, decreases in Germany were visible at 37% and in Poland at 35%. The development of air transport affects the economic growth of countries. Since the emergence of the COVID-19 pandemic in 2020 until the end of 2022, there has been a decrease in the number of passengers transported by air, resulting in a lower level of economic growth and a decrease in budget revenues dynamically. An optimistic

observation is the growing tendency to reduce the level of decline and revival of the air passenger transport sector. According to the authors, in 2023, the number of passengers transported by air in Poland and Germany will be similar to 2019.

Acknowledgement

Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

Data availability

Some or all data and models that support the findings of this study are available from the corresponding author upon reasonable request.

Citation information

Kozicki, B., Skrabacz, A., Gałek, B., & Lorek, M. (2023). Multidimensional analysis of losses in the number of passengers transported by air in Poland and Germany caused by the COVID-19 pandemic in terms of the maintenance of economic security. *Journal of Sustainable Development of Transport and Logistics, 8*(2), 58-70. doi:10.14254/jsdtl.2023.8-2.4

References

Eurostat. (n.d.). https://ec.europa.eu/.

Bankier.pl. (17.11.2022). Kolany K. Record inflation in the Euro zone (*Rekordowa inflacja w strefie euro)*. Retrieved 31.03.2023 from https://www.bankier.pl/wiadomosc/Inflacja-w-strefie-euro-pazdziernik-2022-finalne-dane-8441346.html.

Businessinsider.com.pl. (9.04.2020). Szymański D. *Another crash in the US economy. The number of unemployed is frightening* (*Kolejne uderzenie w gospodarkę USA. Liczba bezrobotnych zastrasza).* Retrieved 31.03.2023 from https://businessinsider.com.pl/twoje-pieniadze/praca/liczba-bezrobotnych-w-usa-w-i-tygodniu-kwietnia-2020-r-koronawirus-a-rynek-pracy-w/g1dh1m9.

Cowzdrowiu.pl. (14.10.2022). Wołosowski J. *Excess deaths in Europe, still increasing, but less* (*Nadmiarowe zgony w Europie, wciąż wzrost, ale już mniejszy)*, Co w zdrowiu. Retrieved 31.03.2023 from https://www.cowzdrowiu.pl/aktualnosci/post/nadmiarowe-zgony-w-europie-wciaz-wzrost-ale-juz-mniejszy.

DW. (13.02.2023). *Poland is still among the EU's inflation leaders* (*Polska nadal w inflacyjnej czołówce UE)*, Bielecki T. Retrieved 31.03.2023 from https://www.dw.com/pl/polska-nadal-w-inflacyjnej-czo%C5%82%C3%B3wce-ue/a-64684005

INTERIA.PL. (13.08.2022). Ramotowski J. *The fight against inflation must lead to an increase in unemployment* (*Walka z inflacją musi spowodować wzrost bezrobocia)*. Retrieved 31.03.2023 from https://biznes.interia.pl/gospodarka/news-walka-z-inflacja-musi-spowodowac-wzrost-bezrobocia,nId,6211730.

Jurgilewicz, M. (2023). *Rola terenowych organów administracji publicznej w zapewnianiu bezpieczeństwa i porządku publicznego w Polsce.* DIFIN, Warszawa.

Kardaś, S., Łoskot-Strachota, A., & Wiśniewska, I. (2020). *The crash and its consequences. The oil market in the era of a pandemic* (Krach i jego konsekwencje. Rynek ropy w dobie pandemii). *Komantarze*

OSW, *337*, 1-9. Retrieved 31.03.2023 from https://www.osw.waw.pl/pl/publikacje/komentarze-osw/2020-06-02/krach-i-jego-konsekwencje-rynek-ropy-w-dobie-pandemii.

Kitler, W. (2011). Bezpieczeństwo narodowe RP: podstawowe kategorie, uwarunkowania, system [National security of the Republic of Poland: basic categories, conditions, system]. *Varshava, Wydawnictwo Akademii Obrony Narodowej [in Poland]*.

konkret24. (19.01.2023). Jabłonowski K., Istel M. *Most excess deaths were in Poland? We check the chart circulating on the internet* (*Najwięcej nadmiarowych zgonów było w Polsce? Sprawdzamy wykres krążący w Internecie)*. Retrieved 31.03.2023 from https://konkret24.tvn24.pl/najnowsze/covid-19-nadmiarowe-zgony-w-europie-sprawdzamy-wykres-krazacy-w-internecie-6639478.

Kozicki, B. (2021). A multidimensional comparative analysis of the decline in the number of passengers transported by air in Germany in 2020. *Nowoczesne Systemy Zarządzania. Modern Management Systems*, (1), 87-96. https://doi.org/10.37055/nsz/134810.

Michalski, K., Jurgilewicz, M., Kubiak, M., & Grądzka, A. (2020). The implementation of selective passenger screening systems based on data analysis and behavioral profiling in the smart aviation security management–conditions, consequences and controversies. *Journal of Security & Sustainability Issues*, *9*(4). https://doi.org/10.9770/jssi.2020.9.4(2)

Misiuk, A., Jurgilewicz, M., & Drotárová, J. (2022). Management of restrictions during the SARS-Cov-2 pandemic in Central European countries. In *The Pandemic in Central Europe* (pp. 62-82). Routledge India.

Money.pl. (8.10.2021). Słomski D. *Unemployment in the US. Surprising data from the labour market. What about the dollar and printing?* (*Bezrobocie w USA. Zaskakujące dane z rynku pracy. Co z dolarem i drukowaniem?)*. Retrieved 31.03.2023 from https://www.money.pl/pieniadze/zaskakujace-dane-z-rynku-pracy-w-usa-co-z-dolarem-i-drukowaniem-6691617402972800a.html.

Nurzyńska, A. (2016). *Bezpieczeństwo usług w międzynarodowym transporcie lotniczym przewozów pasażerskich*. Wydawnictwo Naukowe Sophia.

Obserwator finansowy. (11.02.2021). Suder, J. *The pandemic continues to affect the oil market* (*Pandemia nadal wpływa na rynek ropy naftowej)*. Retrieved 31.03.2023 from https://www.obserwatorfinansowy.pl/bez-kategorii/rotator/pandemia-nadal-wplywa-na-rynek-ropy-naftowej/.

Obserwator Gospodarczy. (15.02.2023). Błaszkiewicz D. *Inflation in Europe in 2022* (*Inflacja w Europie w 2022 roku). Polska poza podium*, Retrieved 31.03.2023 from https://obserwatorgospodarczy.pl/2023/02/15/inflacja-w-europie-w-2022-roku-polska-poza-podium/.

Piwowarski, J., Kozicki, B., Jurgilewicz, M., & Malec, N. (2021). Managing the financial security of organizations during the covid-19 pandemic--multivariate analysis. *Journal of Security & Sustainability Issues*, *11*(1). https://doi.org/10.47459/jssi.2021.11.49.

Puls Medycyny. (4.01.2022). Książkowski M. Centr*al Statistical Office: the death rate in 2020 was the highest in nearly 50 years* (*GUS: współczynnik zgonów w 2020 r. był najwyższy od blisko 50 lat)*, Puls Medycyny. Retrieved 31.03.2023 from https://pulsmedycyny.pl/gus-wspolczynnik-zgonow-w-2020-r-byl-najwyzszy-od-blisko-50-lat-1137871.

Skrabacz, A. (2012). *Social security. Legal and organizational foundations (Bezpieczeństwo społeczne. Podstawy prawne i organizacyjne).* Elipsa, Warszawa.

Skrabacz, A. (2021). Wpływ pandemii koronawirusa na stan bezpieczeństwa społeczno-ekonomicznego Polaków. *Bezpieczeństwo. Teoria i Praktyka*, *43*(2), 17-33. https://doi.org/10.48269/2451-0718-btip-2021-2-001.

Stajniak, M., Kozicki, B., & Wenerska, B. (2022). The number of passengers transported by air in the world and the impact of the COVID-19 pandemic on air passenger transport in the USA in terms of economic security. *European Research Studies Journal, XXV*(2B), 173-183.

Stańczyk, J. (1996). *Współczesne pojmowanie bezpieczeństwa*. Instytut Studiów Politycznych Polskiej Akademii Nauk.

Urząd Lotnictwa Cywilnego. (2021). *Passenger air transport in 2020* (*Przewozy pasażerskie w transporcie lotniczym w 2020 roku)*. Retrieved 31.03.2023 from https://ulc.gov.pl/pl/aktualnosci/5632-przewozy-pasazerskie-w-transporcie-lotniczym-w-2020-roku.

Journal of Sustainable Development of Transport and Logistics
Scientific Platform - SciView.Net

© 2016-2023, Journal of Sustainable Development of Transport and Logistics. All rights reserved.
This open access article is distributed under a Creative Commons Attribution (CC-BY) 4.0 license.
You are free to:
Share – copy and redistribute the material in any medium or format Adapt – remix, transform, and build upon the material for any purpose, even commercially.
The licensor cannot revoke these freedoms as long as you follow the license terms.
Under the following terms:
Attribution – You must give appropriate credit, provide a link to the license, and indicate if changes were made.
You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.
No additional restrictions
You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits.

Journal of Sustainable Development of Transport and Logistics (ISSN: 2520-2979) is published by **Scientific Publishing House "CSR", Poland, EU** and **Scientific Publishing House "SciView", Poland, EU**
Publishing with JSDTL ensures:
• Immediate, universal access to your article on publication
• High visibility and discoverability via the JSDTL website
• Rapid publication
• Guaranteed legacy preservation of your article
• Discounts and waivers for authors in developing regions
Submit your manuscript to a JSDTL at https://jsdtl.sciview.net/ or submit.jsdtl@sciview.net