JOURNAL OF SECURITY AND SUSTAINABILITY ISSUES
ISSN 2029-7017 print/ISSN 2029-7025 online
2023 Volume 13
https://doi.org/10.47459/jssi.2023.13.1

THE COVID-19 PANDEMIC AND THE IMPACT OF PASSENGER AIR TRANSPORT IN EUROPE ON CRUDE OIL PRICES IN TERMS OF ECONOMIC SECURITY

Szymon Mitkow[1], Bartosz Kozicki[2], Patrycja Bryczek-Wróbel[3], Robert Socha[4], Anna Ostrowska-Dankiewicz[5]

[1,2,3]Military University of Technology, Poland
[4]WSB University in Dąbrowa Górnicza, Poland
[5]Rzeszów University of Technology, Poland

E-mails: [1]szymon.mitkow@wat.edu.pl; [2]bartosz.kozicki@wat.edu.pl; [3]patrycja.bryczek-wrobel@wat.edu.pl; [4]rsocha@wsb.edu.pl; [5]adankiew@prz.edu.pl

Received 15 September 2022; accepted 17 November 2022; published 10 January 2023

Abstract. The study presents a multidimensional comparative analysis of two dependent variables: the number of passengers transported by air in 28 European countries and the price of one barrel of crude oil in dollars. The conducted analysis shows that in the historical data concerning the identical periods (months) in both tested series, dependencies can be found. This allowed for the construction of a zero-one multiple regression model in order to confirm the impact of the number of passengers travelling by air on the price of one barrel of crude oil and describe this phenomenon with an analytical function.

Keywords: Price; multiple regression; COVID-19; multidimensional comparative analysis; economic security

Reference to this paper should be made as follows: Mitkow, S., Kozicki, B., Bryczek-Wróbel, P., Socha, R., Ostrowska-Dankiewicz, A. 2023. *Journal of Security and Sustainability Issues*, 12, 5-16. https://doi.org/10.47459/jssi.2023.13.1

JEL Classifications: R4

1. Introduction

The COVID-19 pandemic still affects the economic security of European countries. Since March 2020, it has led to a decrease in the number of air transport passengers which in turn influenced the price of one barrel of oil in dollars. In the literature, prices are considered a complex economic and social category. They express the value of goods, services, different money or production factors in money (Owsiak, 2015, 64; Jurgilewicz et al., 2021; Piwowarski et al., 2021). On the other hand, transport is understood as a production process aimed at covering the distance (Jacyna, Lewczuk, 2016, 88; Periokaitė, Dobrovolskienė, 2021; Rakauskienė, Petkevičiūtė-Stručko, 2022).

There are recent many studies devoted to the peculiarities of transport development and factors impacting its sustainable performance (Ivankova et al., 2021; Kostiuk et al., 2021; Koman et al., 2022)

This article presents the following research problem: how to compare the dependent variables such as the price of one barrel of crude oil and the number of passengers transported by air in order to study their relationship in dynamic terms during the impact of the COVID-19 pandemic?

The aim of the study is to examine the impact of the number of passengers transported by air in Europe on the

prices of one barrel of crude oil in terms of the impact of the COVID-19 pandemic.

For the adopted research problem and the purpose of the work, a research hypothesis was outlined: it is assumed that the analysis and evaluation of two dependent variables, which are time series of the number of passengers transported by air in 28 countries in Europe and the prices of one barrel of crude oil in dollars, will allow the detection of the regularities to make it possible to build a model of zero-one multiple regression in order to investigate the influence of the two variables on each other and to describe their relationships with an analytical function.

The research method used in the article was the analysis of the literature on issues related to price, multiple regression, multidimensional comparative analysis and economic security.

The study consists of an introduction, four substantive points, a summary and conclusions.

2. Analysis of the literature on the research subject

To conduct the research in the study, multidimensional comparative analyzes were used. According to Łuniewska, this is a group of statistical methods that simultaneously analyze at least two variables describing each examined object (Łuniewska, 2006, 9). On the other hand, Panek and Zwierzchowski believe that multidimensional comparative analyzes allow for the comparison of dependent variables in order to discover their essential properties (Panek, Zwierzchowski, 2013, 15). The multidimensional analyzes used in the article showed the relationship between the two time series under consideration in the group of the same identical dependent variables - “months”.

This, as a result, allowed for the construction of a multiple regression model (Mitkow, Tomaszewski, Kozicki, 2021, 171-175; Czyżycki, Klóska, 2019, 25-69; Rabiej, 2018, 234-249, Kozicki, 2022, 179-186). Multiple regression consists in calculating the interdependence of variables, testing their significance and interpreting the results (Kot, Jakubowski, Sokołowski, 2011, pp. 317-323). To build the model, it was necessary to add binary variables reflecting the impact of the COVID-19 pandemic on two groups of the analyzed variables: dependent and independent.

The literature indicates that the first case of the COVID-19 infectious disease was detected in China in December 2019 (Zhu et al., 2020; Jurgilewicz et al., 2021; Przybylski et al., 2022). Since the very beginning of its observation, this disease has become a phenomenon closely monitored by the governments of many countries around the world. Its rapid spread and the threat to human life led to the situation that on March 11, 2020, the World Health Organization recognized COVID-19 as a global pandemic (Satomi et al., 2020). With the introduction of the pandemic, the number of passengers decreased, unprecedented in the history of aviation (Stajniak, Kozicki, Wenerska, 2022). This led to a decline in the world demand for crude oil which resulted in large fluctuations in its prices in dynamic terms (Luisetto, Fiazza, Latiyshev, 2020; Gurkow, 2020; Suder, 2021; Kardaś, Łoskot-Strachota, Wiśniewska, 2020) and, thus, in the shift of the level of security in respective European countries. It should be emphasized that from March 9 to July 1, 2020, the price of crude oil was lower than the cost of its extraction, i.e. below $ 40 per barrel. By the end of November 2020, it was oscillating around $ 40 per barrel. Then, especially since the end of 2021, its strong growth was observed (Słomski, 2022), and then declines (Suder, 2022). Strong fluctuations in oil prices may indicate an uncertain situation in the global economy and threats related to the maintenance of an appropriate level of economic security by respective European countries, caused by the COVID-19 pandemic and attack of Russia on Ukraine.

In the Dictionary of the Polish Language, security is defined as a state of non-threat, peace and certainty (Szymczak, 1981, 147). This is broad category, which embraces multiple facets, e.g. security of critical infrastructures (Sikimić, 2022); cybersecurity (Kovács, 2022; Tvaronavičienė et al., 2022); financial security (Khalatur et al., 2022); national security (Nte, Oluka, Feartherstone, 2022); security engineering (Ivanka, Osadská, 2022), etc. One type of security is the economic security. Scientist point out that the economic security is attributable to

the certainty of survival and development of the economic system of the country and international economic organizations, along with instruments guaranteeing them the maintenance of an appropriate international position in social relations and the assumed living standard for citizens (Nurzyńska, 2016, 22; Wysokińska-Senkus, Górna, 2021).

Particular importance should be paid to safety regulations (Ostrowska-Dankiewicz, 2019) and instruments of crisis in management (Dankiewicz, 2016; Rak et al., 2022).

3. Multidimensional comparative analysis of the number of passengers transported by air in Europe

The research began with the outline of a line chart of data on passengers transported by air monthly in respective 28 European countries from January 2017 to July 2021 with their arithmetic mean.

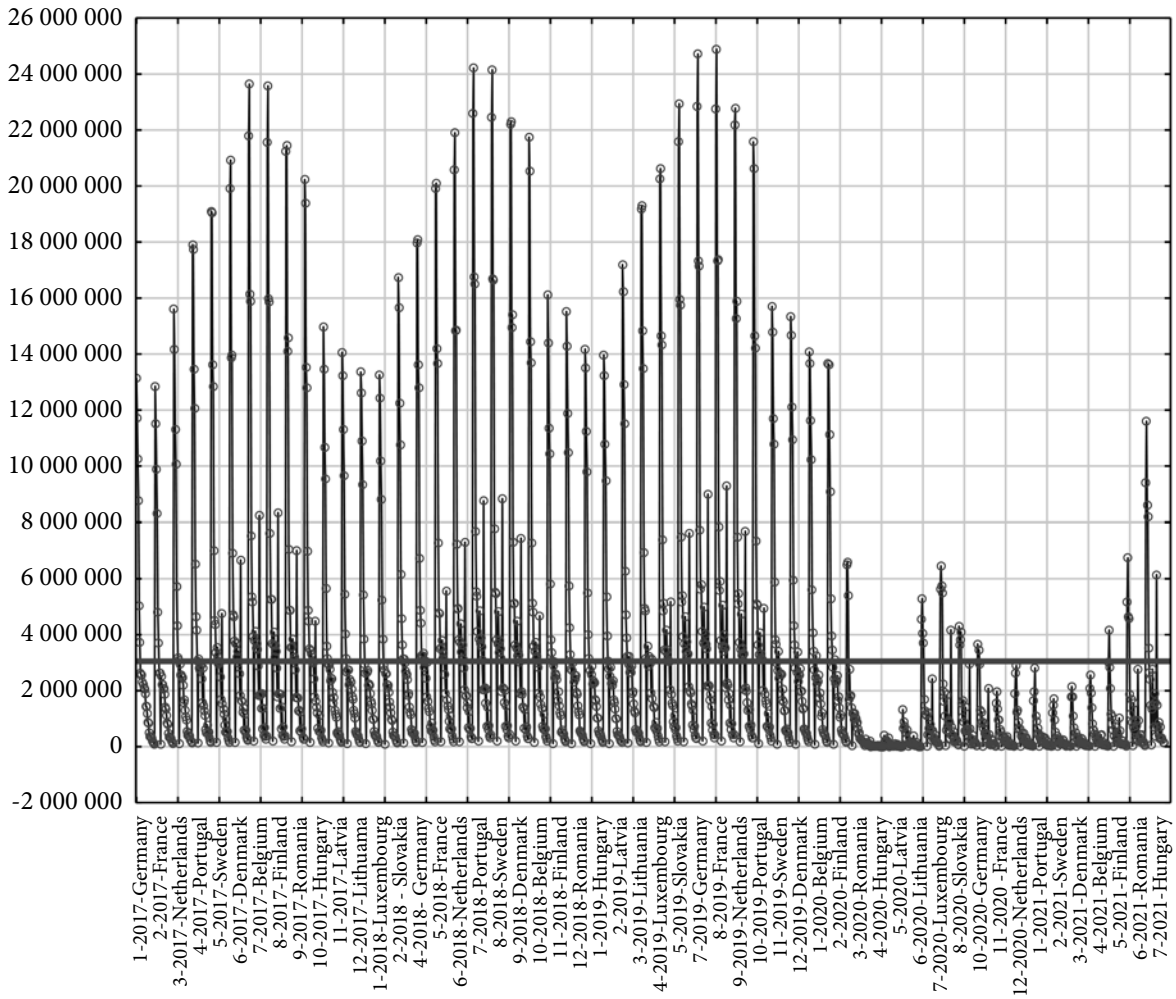

Figure 1. Categorized line chart of data on the number of passengers transported by air monthly in respective 28 European countries from January 2017 to July 2021 with their arithmetic mean

Source: own study based on data obtained from the website: https://ec.europa.eu/ (as of 18.10.2022)

The data in Figure 1 concerning the number of passengers transported by air in 28 respective European countries shows that their arithmetic mean was 3 051 418. The standard deviation from the arithmetic mean was 4 662 830 passengers. On one hand, such a high level of standard deviation was due to the large variety of the number of air travellers in the 28 respective European countries. In the period under consideration, most passengers were transported in Spain: 747 125 062. The second place was taken by Germany with a result of 743 665 203 and the third place by France where 559 838 460 passengers were transported by air during that period.

Poland was ranked 11th with 127 690 407 passengers. Since March 2020, a significant decrease in the number of transported passengers has been visible in all 28 analyzed European countries caused by the impact of the COVID-19 pandemic.

The study attempts to analyze the volume of the decrease in the number of transported passengers before the pandemic (January 2017 to December 2019) and during the COVID-19 pandemic (January 2020 to July 2021), considering the arithmetic means of the identical months in 28 European countries in total and comparing them to the arithmetic mean of the entire analyzed period from January 2017 to July 2021. The impact of the decrease in passenger transport on world oil prices in dollars per barrel was also examined.

The first study was the time series of data on passenger transport by air in 28 European countries from January 2017 to December 2019 in the group of identical months, with the calculation of indices such as arithmetic means and the results are summarized in Figure 2.

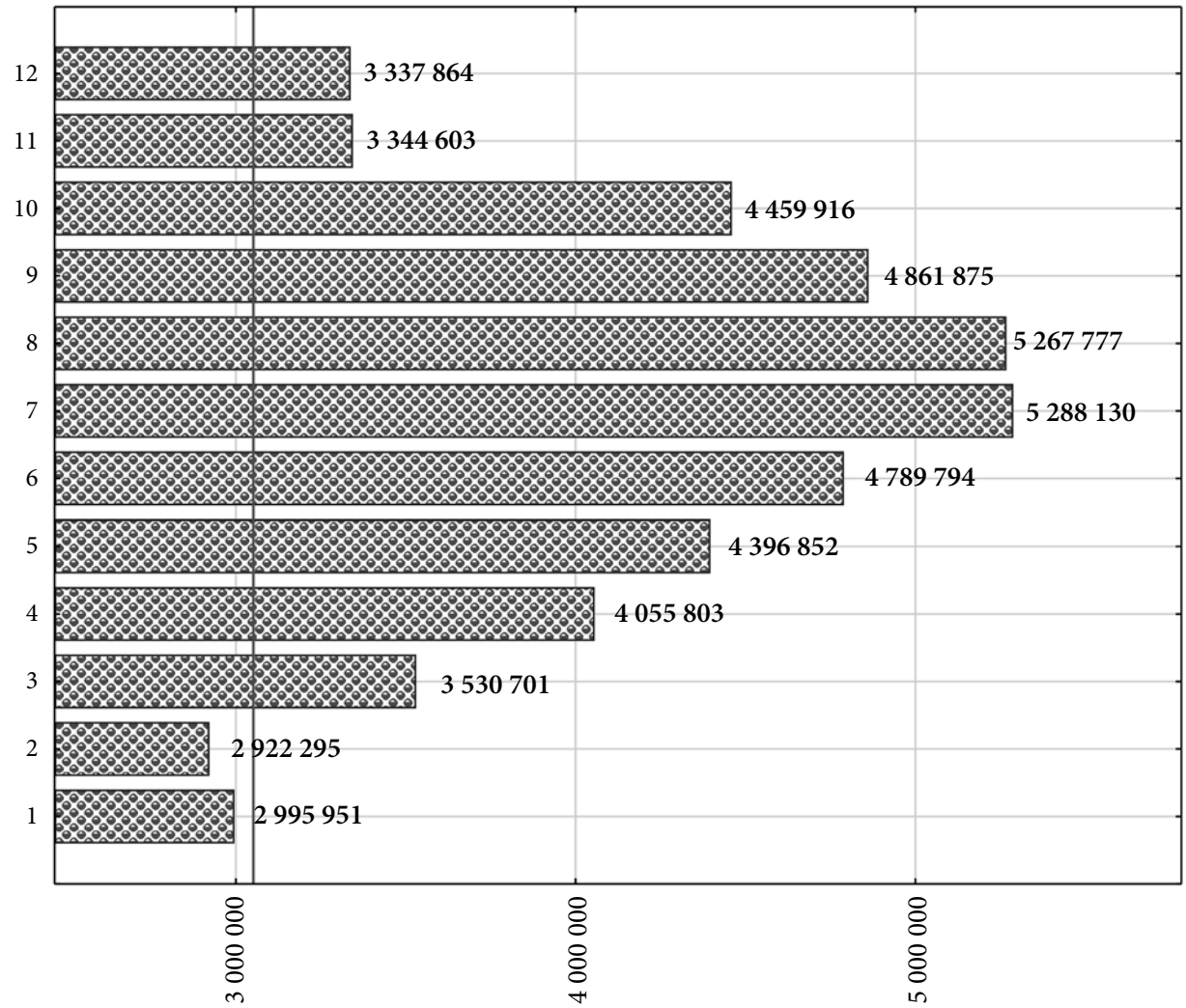

Figure 2. Bar chart of arithmetic means in the group of identical dependent variables of months with data on the number of passengers transported by air monthly in total in 28 European countries from January 2017 to December 2019 with the arithmetic mean of the analyzed data from January 2017 to July 2021

Source: own study based on data obtained from the website: https://ec.europa.eu/ (as of 18.10.2022)

The data presented in Figure 2 shows that the arithmetic mean of the total number of passengers in 28 European

countries in the identical months from January 2017 to December 2019 showed a seasonal phenomenon. The lowest arithmetic means in identical months were visible in February – 2 922 295 passengers transported - and in January (2 995 951 passengers transported). The highest arithmetic means were in July (5 288 130 passengers) and August with the arithmetic mean result 5 267 777 passengers. The observed pattern is an increase in the number of passengers from February to July and then a decrease until December. Another important observation is the fact that only in two cases the arithmetic mean of the number of passengers transported in 28 European countries from January 2017 to July 2021 is higher than the arithmetic mean of the analyzed data in the identical months from January 2017 to December 2019: months February and January.

Then, the time series of data on passenger transport by air in 28 European countries from January 2020 to July 2021 in the group of identical months was analyzed with the calculation of indices such as arithmetic means and the results are summarized in Figure 3.

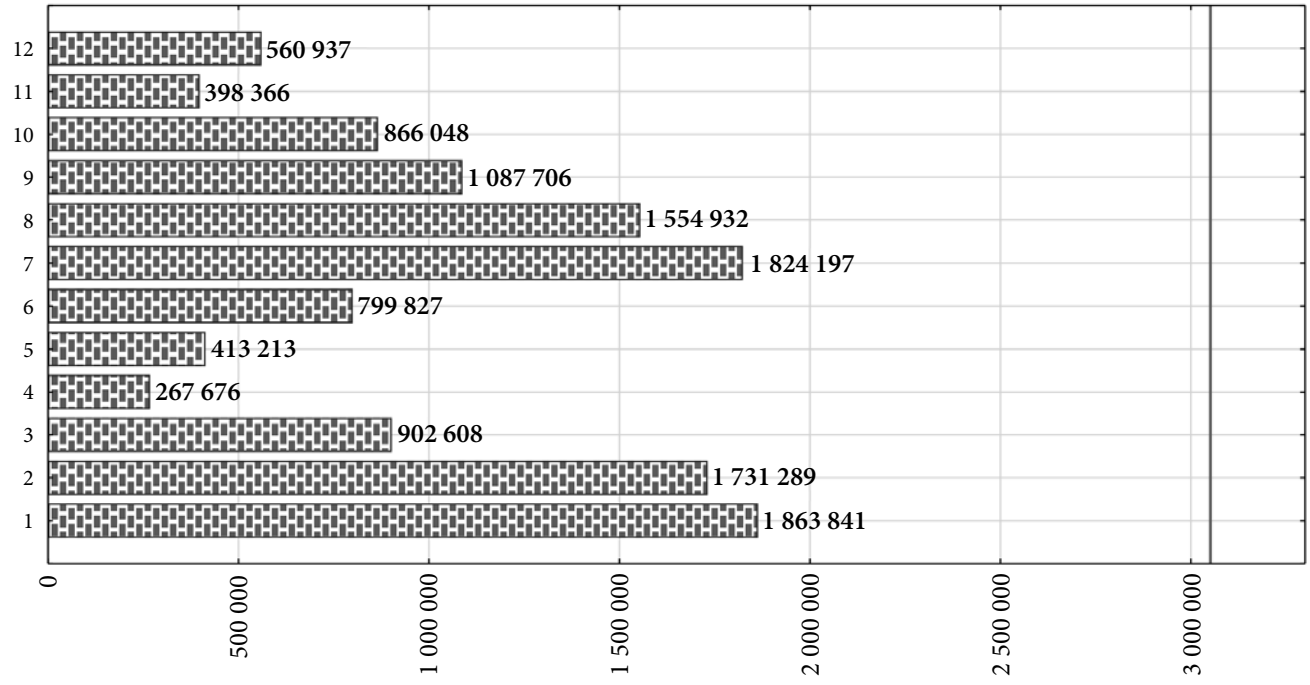

Figure 3. Bar chart of arithmetic means in the group of identical dependent variables on months with data on the number of passengers transported by air monthly in total in 28 European countries from January 2020 to July 2021 with the arithmetic mean of the analyzed data from January 2017 to July 2021

Source: own study based on data obtained from the website: https://ec.europa.eu/ (as of 18.10.2022)

The COVID-19 pandemic led to large decreases in the number of passengers transported by air in 28 European countries considered. Each of the 12 arithmetic means of the identical months (bars in Figure 3) from January 2020 to July 2021 is lower than the total arithmetic mean from January 2017 to July 2021 of 3 051 418 passengers (red line in Figure 3). The arithmetic mean of passengers transported by air from January 2020 to July 2021 in 28 European countries in total was 1 056 489 and the standard deviation was 2 001 554 passengers. The data on the number of passengers transported by air from January 2020 to July 2021 lack regularities visible before the COVID-19 pandemic such as the monthly seasonality (Fig. 2).

4. Comparative multidimensional analysis of crude oil price

Then, the time series of data on oil prices in dollars per barrel from January 3, 2017 to October 11, 2022 was examined, along with their arithmetic mean (Fig. 4).

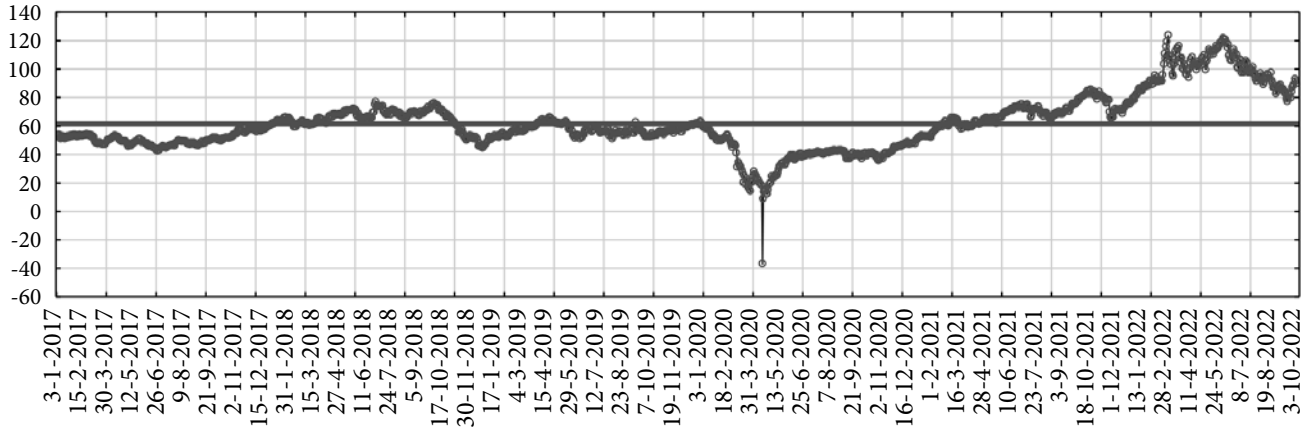

Figure 4. Categorized line chart of crude oil price data in dollars per barrel from January 3, 2017 to October 11, 2022 with their arithmetic mean

Source: own study based on data obtained from the website: https://fred.stlouisfed.org/ (as of 18.10.2022)

The data compiled in Figure 4 shows that the price of one barrel of crude oil before the COVID-19 pandemic fluctuated around the arithmetic mean of $ 57,66. On the other hand, the arithmetic mean of the prices of one barrel of crude oil for the entire period under consideration from January 3, 2017 to October 11, 2022 was $ 61,77. What is more, after the WHO announced the COVID-19 pandemic on March 11, 2020, the price of oil began to decrease to minus $ 36,98 on April 24, 2020. The decrease in crude oil prices was triggered by the stoppage of the passenger aviation sector due to the impact of the COVID-19 pandemic. From March to December 2020, the price of crude oil was below $ 50 a barrel. Moreover, since January 2021, strong increases in the price of a barrel of crude oil have been observed, mainly due to its long-term low prices in the initial period of the COVID-19 pandemic and the weakening of the passenger air transport sector. It should be emphasized that the attack of Russia on Ukraine on February 24, 2022 contributed to sharp increases in oil prices caused by large sanctions imposed on Russia by the United States, the European Union and other countries. Tensions in relations between Ukraine and Russia and the uncertain situation on the border meant that on March 24, 2022 the price per barrel was $ 115,3. For illustrative purposes, data on the arithmetic mean of prices per one barrel of crude oil in the group of identical dependent variables on months in dollars before the COVID-19 pandemic from January 3, 2017 to December 31, 2019, along with their arithmetic mean from January 3, 2017 until October 11, 2022.

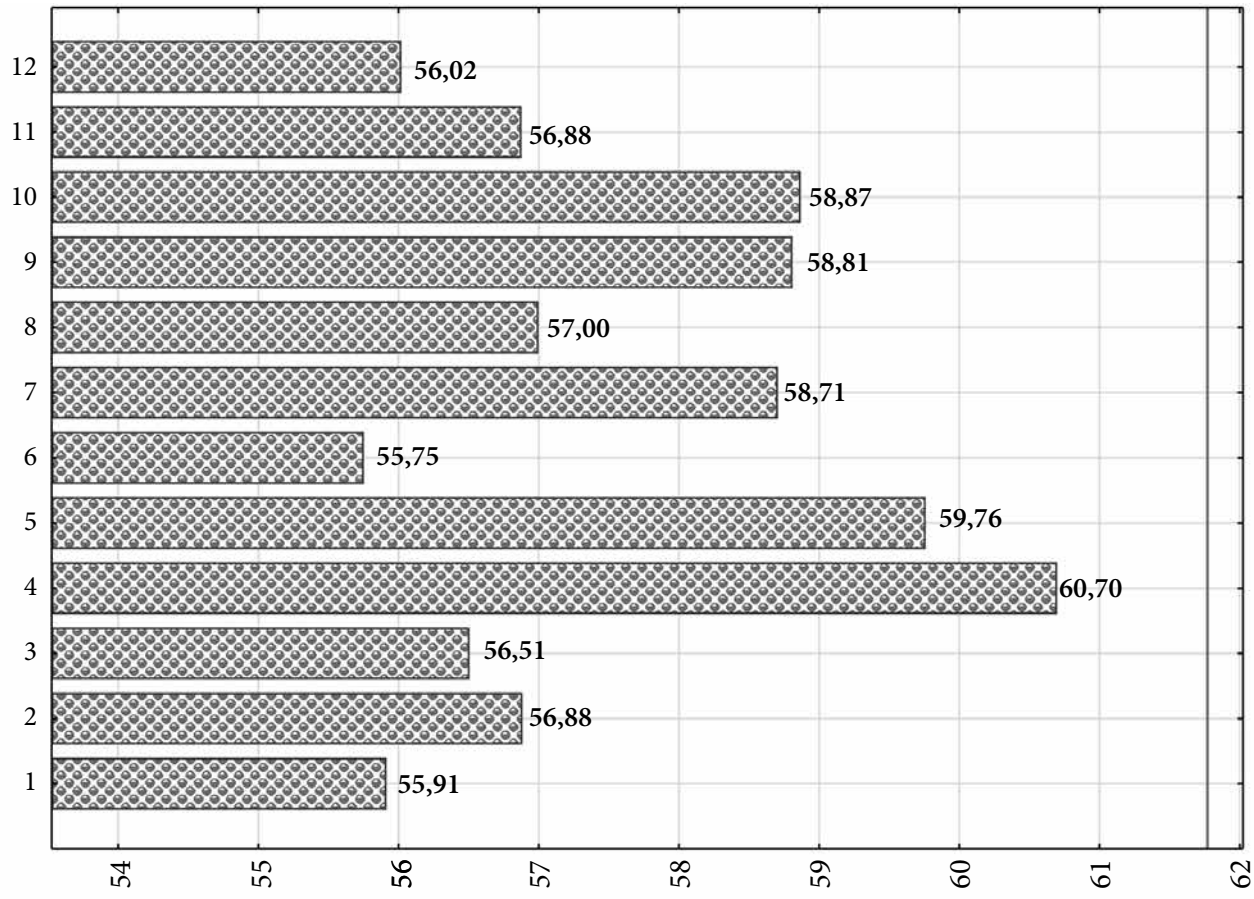

Figure 5. Bar chart of arithmetic mean of crude oil prices in dollars per barrel in the group of identical dependent variables on months from January 3, 2017 to December 31, 2019 with their arithmetic mean from January 3, 2017 *to October 11, 2022*

Source: own study based on data obtained from the website: https://fred.stlouisfed.org/ (as of 18.10.2022)

The data presented in Figure 5 show that the respective arithmetic means of prices per barrel of crude oil for the identical months from January 3, 2017 to December 31, 2019 were below the price of $ 61,77, i.e. the arithmetic mean of prices per barrel of crude oil from 3 January 2017 to October 11, 2022. Before the COVID-19 pandemic from January 3, 2017 to December 31, 2019, the price of one barrel of crude oil oscillated around $ 57,66 while on average in respective months it deviated from the arithmetic mean by $ 7,67.

Then, the price per barrel of crude oil was analyzed from January 3, 2020 to October 11, 2022 considering arithmetic means in the group of identical dependent variables on months. The test results are presented in Figure 6.

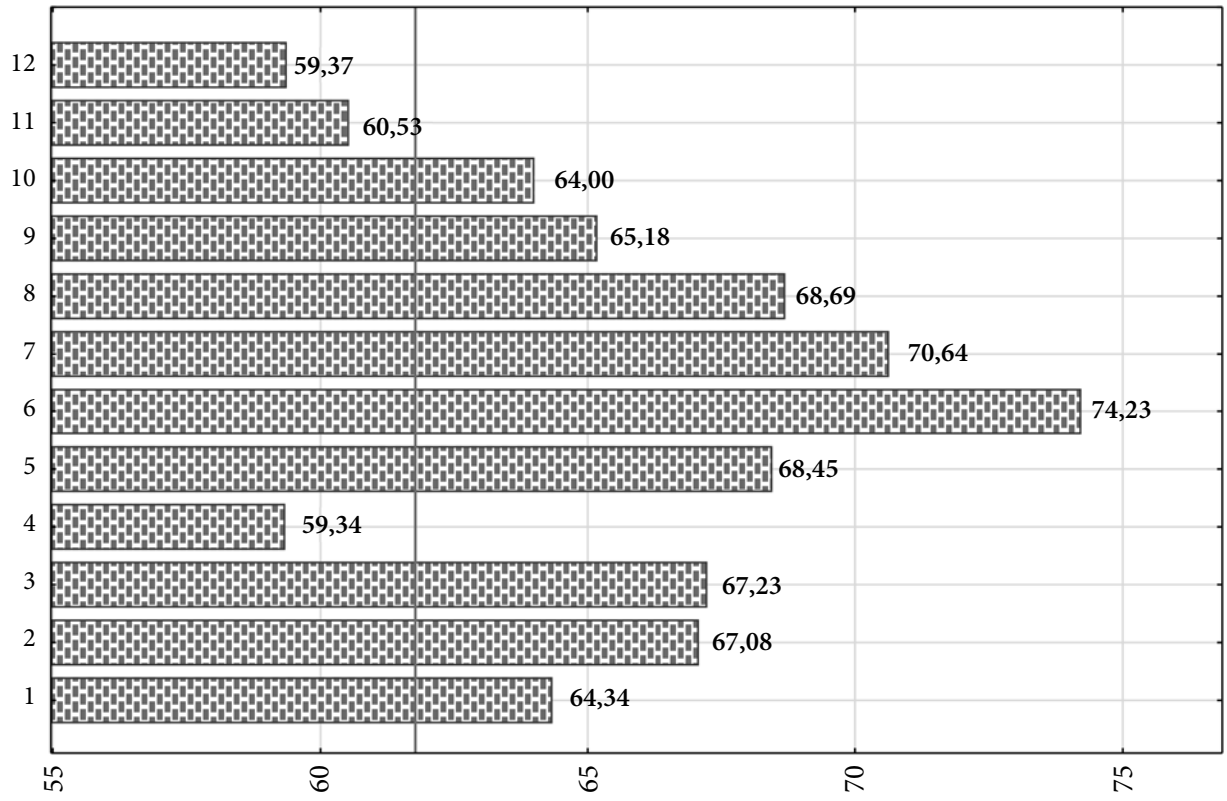

Figure 6. Bar chart of arithmetic means of crude oil prices in dollars per barrel in the group of identical dependent variables on months from January 3, 2020 to October 11, 2022 with their arithmetic mean from January 3, 2017 to October 11, 2022

Source: own study based on data obtained from the website: https://fred.stlouisfed.org/ (as of 18.10.2022)

The information presented in Figure 6 shows that the arithmetic mean of crude oil prices, considering the group of dependent variables on identical months, increased compared to the prices before the COVID-19 pandemic (Fig. 5) - by comparing them to the arithmetic mean for the entire period under consideration from January 3, 2017 to October 11, 2022. The increase in crude oil prices has taken place since 2021, i.e. after long-term low prices from March to December 2020. The highest arithmetic means of crude oil prices in dollars per barrel were seen in the identical months - June ($ 74,23 from January 3, 2020 to October 11, 2022). The lowest, however, in identical months - April: $ 59,34 dollars for one barrel.

In conclusion, the decrease in air passenger numbers caused by the COVID-19 pandemic led in the first phase to a long-lasting decline in oil prices (7 months from March to December 2020), and then to strong increases to above $ 120 per barrel (Fig. 4).

5. Zero-one multiple regression model

The abovementioned studies and their evaluation became the premise for the introduction of a zero-one multiple regression model to investigate the dependence of two variables (the price of one barrel of crude oil and the number of passengers travelling by air in Europe). To achieve this goal, indices were calculated for two time series such as arithmetic means of identical months from January 2017 to July 2021, on the basis of which two time series were built and named in the study as: ON and passengers. In total, five predictors as variables were used to build the model: passengers, t, t2, lnt and zero-one COVID-19 variables.

Table 1. Zero-one multiple regression model

N = 55	R = 0,70368193 R^2 = 0,49516826 Correctness R2 = 0,44365482 Estimation standard error: 8,6196					
	b*	Standard error	b	Standard error	t(49)	p
Free term			13,33108	7,881945	1,69134	0,097123
passengers	0,4475931	0,2055994	0,0000030	0,0000014	2,1770151	0,0343257
t	-2,9935441	1,0877504	-2,1593061	0,7846172	-2,7520505	0,0082799
t^2	3,1550518	0,7906490	0,0393941	0,0098721	3,9904585	0,0002201
lnt	0,9409883	0,4446777	12,1447945	5,7391997	2,1161129	0,0394401
COVID-19	0,9040749	0,2765165	21,7704726	6,6586236	3,2695154	0,0019745

Source: own study based on data obtained from the website: https://ec.europa.eu/ https://fred.stlouisfed.org (as of 18.10.2022)

We can see that all test probabilities are less than 0,1. The model obtained can therefore be considered as final. The analytical form of the model was identified as:

Y=13,3310844103227+0,000003026354699545 54*v1-2,15930612266267*v2+0,0393940763015648*v3+12,1447945049053*v4+ 21,770472636227*v5

The estimation standard error indicates that the actual price of one barrel of crude oil could have deviated from the predicted value by an average of $ 8,6196 per barrel. The match of the model was at the level of 0,495. The constructed model, including the analytical function outlined, allows for the forecasting of the dollar price per barrel of crude oil for the future and confirms the relationship between passenger air transport and the dollar price of one barrel of crude oil.

6. Summary and conclusions

The conducted research shows that in 2020 and 2021, previously unprecedented decreases in the number of passengers transported by air were observed. In 2020, 1 053 114 269 fewer passengers were transported in the 28 analyzed European countries than in 2019 (Fig. 1). In 2021, an increase in the number of transported passengers was observed compared to 2020 but these values are much lower than those of 2019.

From 2017 to 2019, the phenomenon of seasonality can be found in passenger air transport in the 28 analyzed European countries. The highest number of transported passengers is in July and August - the arithmetic mean is 5 288 130 and 5 267 777 (Fig. 2).

The appearance of the COVID-19 pandemic has led to a large decrease in the number of passengers transported by air, and the monthly seasonal pattern has also ceased to be visible (Fig. 3).

The emergence of the COVID-19 pandemic has led to a large decrease in the number of passengers transported by air and the seasonal pattern on a monthly basis has also ceased to be visible (Fig. 3).

The price of one barrel of crude oil from 2017 to 2019 oscillated around the arithmetic mean of $ 57,66 (Fig. 4). At that time, the lowest prices can be observed in June, January and December (Fig. 5). However, during the COVID-19 pandemic, in its first phase from March to December 2020, there were decreases to below $ 50 per barrel and at the end of 2021 and in 2022 it increased to a level above $100 per barrel.

The article introduces a zero-one multiple regression model to investigate the relationship between two time series (the price of one barrel of crude oil and the number of passengers travelling by passenger air transport in Europe). For the construction of the model, the abovementioned data was compiled as arithmetic means of the identical months from January 2017 to July 2021 and named: ON and passengers. In total, five predictors as variables were used to build the model: passengers, t, t2, lnt and zero-one COVID-19 variables.

The multiple R of the constructed model was 0,7 while the standard error of the estimation was 8,62. The five predictors used to build the model turned out to be significant because they did not exceed the significance level of 0,1. Therefore, a relationship was observed between the time series of the number of passengers transported by air in 28 European countries and the price of one barrel of crude oil. The analytical form of the model was also defined:
Y = 13,3310844103227+0,00000302635469954554*v1-2,15930612266267*v2+0,0393940763015648*v3+ 12,1447945049053*v4+ 21,770472636227*v5

This allows for the conclusion that the research hypothesis adopted at the beginning has been verified.

The COVID-19 pandemic has led to the collapse of the passenger aviation sector. The huge decreases observed resulted in large and long-lasting fluctuations in oil prices and affected other sectors of the economy, as well as the high inflation visible in Europe in 2022.

It is therefore extremely important to monitor emerging crises, including the analysis and evaluation of dependent variables, the impact of which causes strong and long-term fluctuations resulting in the so-called cascades. The obtained evaluation may be a way to overcome emerging crises in dynamic terms in the future.

References

Czyżycki R., Klóska R.. 2019. *Wybrane zagadnienia z prognozowania*, Wydawnictwo Naukowe Uniwersytetu Szczecińskiego, Szczecin.

Dankiewicz, R. (2016) Ubezpieczenia kredytów eksportowych jako narzędzia wspierające handel międzynarodowy. *ANNALES*, Universitatis Mariae Curie-Skłodowska, Sectio H Oeconomia, 4, p. 50.

Gurkow A., 2020, *Rosja. Niskie ceny ropy rujnują gospodarkę* https://www.dw.com/pl/rosja-niskie-ceny-ropy-rujnuj%C4%85-gospodark%C4%99/a-52974249, 19.10.2022.

Jacyna M., Lewczuk K. 2016. *Projektowanie systemów logistycznych*, Wydawnictwo Naukowe PWN, Warszawa.

Jurgilewicz, M. Malec, N., Piwowarski, J., Kozicki. B. 2021. Forecasting the reservemoney of the central bank of Poland in the aspects of economy security. *Journal of Security and Sustainability Issues*, 11, 525-536. https://doi.org/10.47459/jssi.2021.11.48

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 and Sustainability Issues*, 11, 537-546. https://doi.org/10.47459/jssi.2021.11.49

Kardaś, Sz., Łoskot-Strachota, A., Wiśniewska, I., 2020, *Krach i jego konsekwencje. Rynek ropy w dobie pandemii*, https://www.osw.waw.pl/pl/publikacje/komentarze-osw/2020-06-02/krach-i-jego-konsekwencje-rynek-ropy-w-dobie-pandemii, 19.10.2022.

Kot, S.M., Jakubowski, J., Sokołowski, A. 2011, *Statystyka*, Difin SA, Warszawa.

Kozicki, B. 2022. *Model planowania potrzeb Sił Zbrojnych RP wobec aktualnych wyzwań bezpieczeństwa narodowego w XXI wieku*, Wojskowa Akademia Techniczna, Warszawa.

Luisetto M., Fiazza C., Latyshev O.Y., 2020. *Short Communication COVID-19 Pandemic and the Management Strategy for Business and Economy Indexed by #Harvard University Library, #Washington State University Library*, IMA Academy Research Centre.

Łuniewska M., Tarczyński, W. 2006. *Metody wielowymiarowej analizy porównawczej na rynku kapitałowym*, Wydawnictwo Naukowe PWN, Warszawa.

Mitkow Sz., Tomaszewski, J., Kozicki, B. 2021, *Bezpieczeństwo militarne a potencjał osobowy Sił Zbrojnych RP*, Wojskowa Akademia Techniczna, Warszawa.

Nurzyńska, A. 2016. *Bezpieczeństwo usług w międzynarodowym transporcie lotniczym przewozów pasażerskich*, Wydawnictwo Naukowe SOPHIA, Katowice.

Ostrowska-Dankiewicz, A. 2019. Consumer protection policy in the Polish life insurance market in the aspect of current legal regulations. *Investment Management and Financial Innovations*, 16(4), 168-180.

Owsiak, S. 2015. *Finanse*, Polskie Wydawnictwo Ekonomiczne, Warszawa, 2015.

Panek, T., Zwierzchowski, J. 2013. *Statystyczne metody wielowymiarowej analizy porównawczej. Teoria i zastosowanie*, Oficyna Wydawnicza Szkoły Głównej Handlowej w Warszawie, Warszawa.

Periokaitė, P., Dobrovolskienė, N. 2021. The impact of COVID-19 on the financial performance: a case study of the Lithuanian transport sector. *Insights into Regional Development*, 3(4), 34-50. https://doi.org/10.9770/IRD.2021.3.4(3)

Przybylski P., 2022, *Edukacja i wychowanie na rzecz bezpieczeństwa i obronności – wybrane aspekty*, Polityka i Społeczeństwo, 20(3)

Rabiej M. 2018. *Analizy statystyczne z programami Statistica i Excel*, Helion, Gliwice.

Rakauskienė, O. G., Petkevičiūtė-Stručko, M. 2022. Determinants of logistics' performance: a new approach towards analysis of economic corridors and institutional quality impact. *Insights into Regional Development*, 4(3), 11-33. https://doi.org/10.9770/IRD.2022.4.3(1)

Koman, G., Bubelíny O., Tumová, D., Jankal, R. 2022. Sustainable transport within the context of smart cities in the Slovak republic. *Entrepreneurship and Sustainability Issues,* 10(1), 175-199. http://doi.org/10.9770/jesi.2022.10.1(9)

Kostiuk, Y., Kohútová, V., Straková, J., Koleda, N. 2021. Added value in the transport sector during COVID-19 pandemic: a comparison of the EU countries. *Entrepreneurship and Sustainability Issues*, 9(2), 303-315. http://doi.org/10.9770/jesi.2021.9.2(20)

Ivankova, V., Gavurova, B., Bacik, R., Rigelsky, M. 2021. Relationships between road transport infrastructure and tourism spending: A development approach in European OECD countries. *Entrepreneurship and Sustainability Issues*, 9(2), 535-551. http://doi.org/10.9770/jesi.2021.9.2(35)

Sikimić, M. 2022. Security of European critical infrastructures outside the European Union: a review of the Western Balkans national laws, *Insights into Regional Development,* 4(2), 63-72. https://doi.org/10.9770/IRD.2022.4.2(5)

Kovács, A. M. 2022. Ransomware: a comprehensive study of the exponentially increasing cybersecurity threat. *Insights into Regional Development,* 4(2), 96-104. https://doi.org/10.9770/IRD.2022.4.2(8)

Khalatur, S., Pavlova, H., Vasilieva, L., Karamushka, Danileviča, A. 2022. Innovation management as basis of digitalization trends and security of financial sector. *Entrepreneurship and Sustainability Issues*, 9(4), 56-76. http://doi.org/10.9770/jesi.2022.9.4(3)

Tvaronavičienė, M., Plėta, T., Beretas, Ch.P., Lelešienė, L. 2022. Analysis of the critical infrastructure cyber security policy. *Insights into Regional Development*, 4(1), 26-39. http://doi.org/10.9770/IRD.2021.4.1(2)

Nte, N.D., Oluka, N.L, Feartherstone, C.R. 2022. Small states, statescraft and the challenges of national security: the case of Guyana. *Insights into Regional Development*, 9(3), 89-104. http://doi.org/10.9770/IRD.2022.4.1(6)

Ivanka, J., Osadská. V. 2022. Security engineering problems: determination of tolerance intervals for azimuthal positional errors. *Insights into Regional Development*, 9(3), 105-115. http://doi.org/10.9770/IRD.2022.4.1(7)

Wysokińska-Senkus, A., Górna, J. 2021. Towards sustainable development: risk managemet for organizational security. *Entrepreneurship and Sustainability Issues*, 8(3), 527-544. http://doi.org/10.9770/jesi.2021.8.3(33)

Rak, R., Kopencova, D., Sulc, F., Vlach, F., Hudecova, V. 2022. Crisis Development and its management. *Entrepreneurship and Sustainability Issues*, 9(3), 414-428. http://doi.org/10.9770/jesi.2022.9.3(25)

Satomi E. et al. 2020, Alocação justa de recuros de saúde escassos diante da pandemia de COVID-19 Considerações éticas, *Einstein*, 18(2),1-5. http://doi.org/10.31744/einstein_journal/2020AE5775

Słomski S., 2022, *Prezes firmy handlującej ropą wysłał złowieszczy sygnał. Idziemy na rekord*, https://www.money.pl/gielda/prezes-firmy-handlujacej-ropa-wyslal-zlowieszczy-sygnal-idziemy-na-rekord-6777571491613248a.html, 19.10.2022.

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.

Suder J. 2021. *Pandemia nadal wpływa na rynek ropy naftowej*, https://www.obserwatorfinansowy.pl/bez-kategorii/rotator/pandemia-nadal-wplywa-na-rynek-ropy-naftowej/, 19.10.2022.

Suder J., 2022. *Silne spadki cen surowców energetycznych*, https://www.obserwatorfinansowy.pl/tematyka/makroekonomia/trendy-gospodarcze/silne-spadki-cen-surowcow-energetycznych/, 19.10.2022.

Szymczak M. (red.). 1981. *Słownik języka polskiego*, t. 1, Państwowe Wydawnictwo Naukowe, Warszawa.

Zhu N., Zhang D., Wang W., Li X., Yang B., Song J. et al. 2020. A Novel Coronavirus from Patients with Pneumonia in China, *New England Journal of Medicine*, 382(8), 727-733.

Szymon MITKOW is a professor at the Military University of Technology, PL. Research interests: national security, internal security.
ORCID ID: 0000-0003-2845-2589

Bartosz KOZICKI is an assistant professor at the Military University of Technology, PL. Research interests: national security, internal security.
ORCID ID: 0000-0001-6089-952x

Patrycja BRYCZEK-WRÓBEL is an assistant professor at the Military University of Technology, PL. Research interests: national security, internal security.
ORCID ID: 0000-0001-7154-7335

Robert SOCHA is a professor at the WSB University in Dąbrowa Górnicza, PL. Research interests: internal security.
ORCID ID: 0000-0003-2388-1819

Anna OSTROWSKA-DANKIEWICZ is an assistant professor at Rzeszów University of Technology, PL. Research interests: insurance, life insurance, risk management.
ORCID ID: 0000-0002-2131-452