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## The Impact of Covid-19 Pandemic on Energy Security by Demand Analysis for Oil and Air Passengers in European Countries

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**Abstract:**

*The rationale for undertaking the research was to observe the lack, in the literature, of multidimensional comparative analyses concerning the number of passengers transported by air before and during the COVID-19 pandemic in twenty-two European countries.*

*The study aims to carry out a multidimensional comparative analysis of the number of passengers transported by air before and during the COVID-19 pandemic in dynamic terms in the context of security. Twenty-two European countries are the subject of the study, and the number of passengers transported by air will be the object of the study. The study uses research methods in the form of a literature analysis, which deals with the multidimensional analysis and the disease called COVID-19. The following research tools were used: categorized frame-and-hinge charts with arithmetic averages/means and line charts.*

*Fixed and chain-based dynamics indicators have been calculated. The calculated indicators have been compiled on categorized line charts. This has allowed us to observe a dynamic trend. The study concludes with a summary and conclusions.*

*The multidimensional comparative analysis and evaluation of data concerning the number of passengers transported by airlines before and during the COVID-19 pandemic in selected twenty-two European countries was carried out in the study.*

**Keywords:** Coronavirus, multidimensional analyses, air transport.

**JEL codes:** C51, E31, E37, E64.

**Paper Type:** Research in Security Studies.

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## **1. Introduction**

The rationale for undertaking the research was to observe the lack, in the literature, of multidimensional comparative analyses concerning the number of passengers transported by air before and during the COVID-19 pandemic in twenty-two European countries.

The study aims to carry out a multidimensional comparative analysis of the number of passengers transported by air before and during the COVID-19 pandemic in dynamic terms in the context of security. Twenty-two European countries are the subject of the study, and the number of passengers transported by air will be the object of the study.

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## **2. Literature Review**

At the end of 2019, an unusual variant of the disease called coronavirus (2019-nCoV) was observed in China (Tian, *et al.*, 2020) is published by the American Science (2020), which had a tendency to spread rapidly and posed a threat to people. The pandemic's first links were observed in Wuhan, China (Grochot, 2020). There are currently 11.6 million people in different parts of the world infected with the new variety of the virus (Medonet, 2020). Since March 11, 2020, it has been considered a pandemic (Satomi, *et al.*, 2020).

One of Coronavirus's effects in March 2020 is the drop in the sale price of natural resources in the form of natural gas and oil/petroleum (Estrada, 2020; Yilmazkuday, 2020), and the increase in the price of certain products such as masks and disinfectants. The situation has resulted in a slowdown of the economies of many countries in various contexts and has introduced a wide range of anxieties (Luisetto, Fiazza, and Latiyshev, 2020; Khan *et al.*, 2020; Grima *et al.*, 2020). In March 2020, state borders were closed, including those in Poland, and passenger air transport was limited (Forbes, 2020).

A critical analysis of the literature makes it possible to state that transport is regarded as the foundation of the world economy and society (Gołbska, 1998). An analysis of the literature shows that the development of transport brings markets closer together, becoming a stimulator of economic growth, activating regions economically, and forcing infrastructure development (Nurzyńska, 2016). One of the fastest types of passenger transport is air transport. It is emphasized that the aviation zone is a high-tech sector of every country's economy, the dynamic development of which requires the improvement of national legislation in this area,

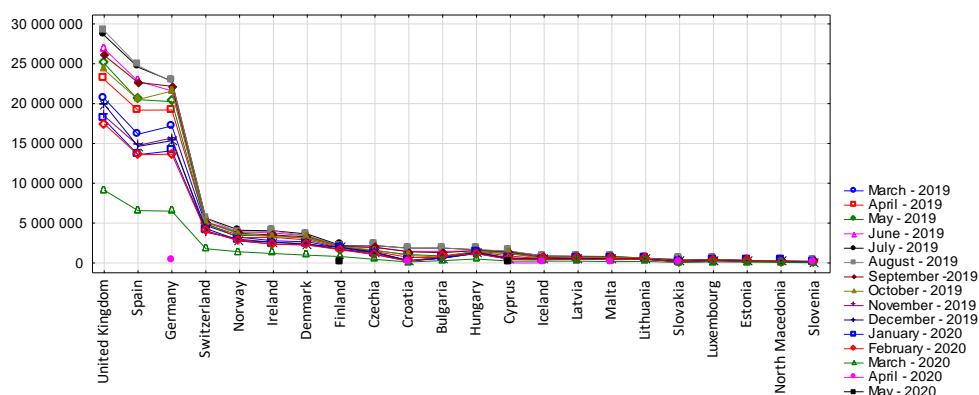
the expansion of international cooperation, the updating of legal instruments used by public authorities in countries' regulations in the air transport area (Brusakova, 2020). Visual observation and own experience make air passenger transport clear until the COVID-19 pandemic has developed dynamically.

The paper attempts to carry out a multidimensional comparative analysis of the COVID-19 pandemic impact on the number of air transport passengers in the dynamic context in the security context. Multidimensional benchmarking concerns a group of statistical methods by which at least two variables describing a dependent variable is compared (Łuniewska, 2006)

### 3. Analysis of Primary Data

The research started with a categorized line chart (Figure 1) of people transported by airlines from March 2019 to May 2020. The primary data for the study were obtained from Eurostat's website.

**Figure 1.** The line chart of the number of air passengers in selected twenty-two European countries from March 2019 to May 2020 (ranking - the base month July 2019)



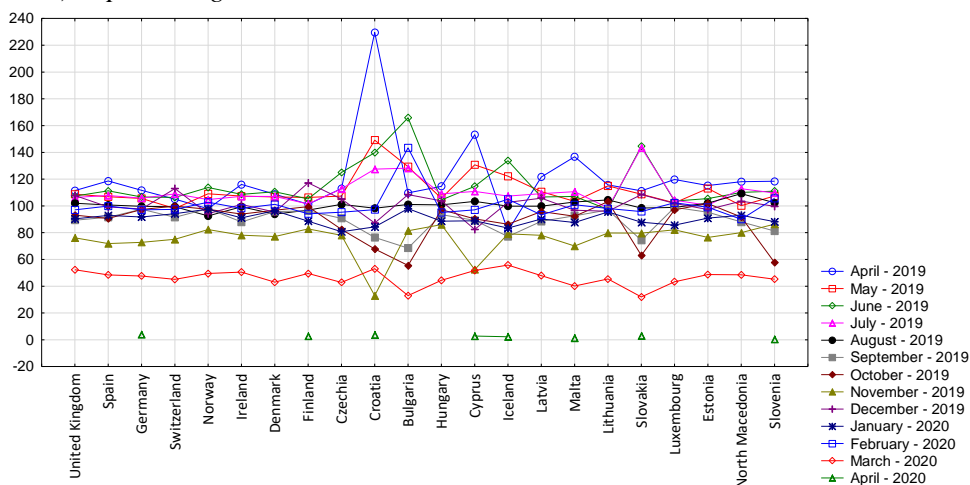
**Source:** In-house elaboration based on data obtained from the <https://ec.europa.eu/eurostat website>; the state as of July 02, 2020.

An assessment of the data in Figure 1 is that the United Kingdom is the leader in terms of the largest air passengers transported. Then Spain and Germany. The lowest rankings are for Slovenia and North Macedonia. An important aspect resulting from visual observation of the data presented in Figure 1 is that the highest number of passengers transported by air in June, July, August, and September. The lowest number is in November, December, January, and February.

The assessment of the visual observation of Figure 1 also shows that during the period of the pandemic (March 2019), there are huge drops in the number of passengers transported in dynamic terms (green line with a triangle).

To observe the regularity in the form of a drop in the number of passengers transported by air during the COVID-19 pandemic, the categorized linear chart of the calculated chain dynamics indicators (with a variable basis) expressed in percentages was used (Figure 2).

**Figure 1.** Categorized linear chart of chain dynamics indicators (base March 2019) in percentages



**Source:** In-house elaboration based on data obtained from the <https://ec.europa.eu/eurostat> website; the state as of July 02, 2020.

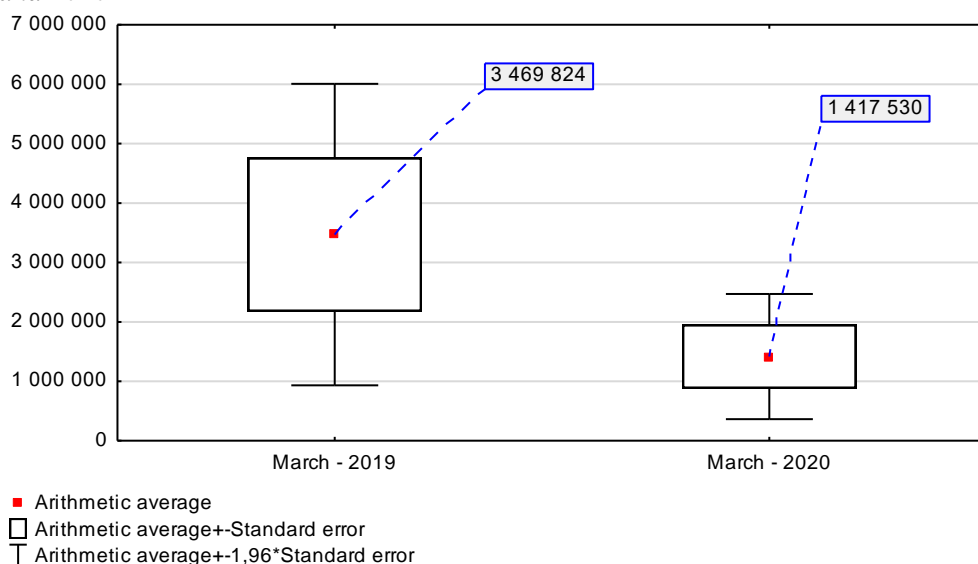
Visual observation of the data in Figure 2 shows that passenger transport is being kept on the same level every month between 60 and 120 percent, with variations observed in several countries such as Croatia, Bulgaria, Cyprus, and Slovenia. An important regularity is that the chain dynamics indicator has dropped below 60% for March 2020 (red line with rhombus), which clearly confirms the pandemic's impact on the reduction in the number of air transport passengers in dynamic terms.

The next step in the research to investigate the drop-in passenger numbers caused by COVID-19 will be using the categorized frame-and-hinge chart with an arithmetic average/mean in two identical months in March (2019 and 2020). The results are shown in Figure 3.

The observation of the frame-and-hinge chart (Figure 3) shows that the number of passengers carried in March 2020 was significantly lower than in March 2019 in twenty-two observed European countries. The arithmetic average/mean in March 2019 was 3,469,824, while in March 2020, it dropped to just 1,417,530.

The next stage of the research will be to analyze descriptive statistics (Table 1) on the number of air passengers carried in twenty-two European countries in a group of variables: March months- period 2019-2020.

**Figure 2.** The frame-and-hinge chart of the arithmetic averages/means of number of passengers carried by airlines in twenty-two European countries in March 2019 and 2020



**Source:** In-house elaboration based on data obtained from the <https://ec.europa.eu/eurostat website>; the state as of July 02, 2020.

**Table 1.** Analysis of descriptive statistics on the number of passengers carried by airlines in uniform units of time (March - 2019 and 2020) in twenty-two European countries

	Arithmetic average/mean	N	Total	Total in %	Std. deviation	Min	Max.
<b>March 2019</b>	3,469,824	22	76,336,122	71	6,072,427	133,403	20,645,202
<b>March 2020</b>	1,417,530	22	31,185,656	29	2,522,657	36,094	9,125,966
<b>In total</b>	<b>2,443,677</b>	<b>44</b>	<b>107,521,778</b>	<b>100</b>	<b>4,711,027</b>	<b>36,094</b>	<b>20,645,202</b>
	Q25	Median	Q75	Percentage 10	Percentage 90		
<b>March 2019</b>	320,896	616,163	2,779,886	169,883	16,164,025		
<b>March 2020</b>	128,453	263,807	1,181,236	71,617	6,503,935		
<b>In total</b>	<b>216,775</b>	<b>519,908</b>	<b>1,839,408</b>	<b>119,489</b>	<b>6,577,836</b>		

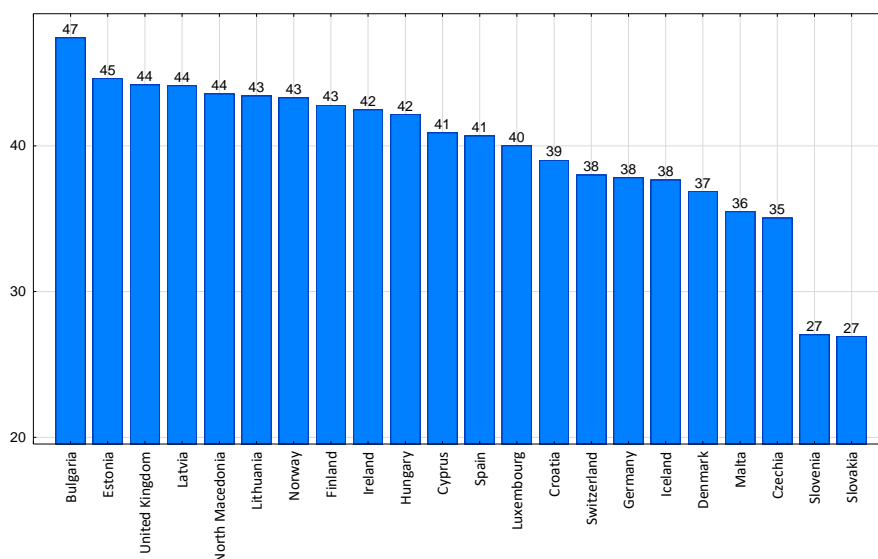
**Source:** In-house elaboration based on data obtained from the <https://ec.europa.eu/eurostat website>; the state as of July 02, 2020.

Forty-four explanatory variables were used to analyze the descriptive statistics in Table 1. In the same month of March (2019-2020), a total of 107,521,778 passengers were carried by air in the twenty-two European countries concerned. Seventy-one percent of this sum (number of passengers) is for 2019, with the remainder, twenty-nine percent for 2020. The standard deviation from the arithmetic average/mean for March 2019-2020 was 4,711,027. In 2019 the standard

deviation was 6,072,427, while in 2020, it was 2,522,657. The results obtained clearly confirm the fall in passenger numbers in March 2020. It is also important to note that the median in the twenty-two countries under consideration is around 519,908 passengers in March (2019-2020).

Then, for illustrative purposes, to observe the change in the number of passengers transported in March months within the 2019-2020 period, fixed-base dynamics indicators were calculated (fixed base - March 2019). The data obtained have been ranked and listed in Figure 4.

**Figure 3.** Bar chart of the fixed base dynamics indicator for uniform time units - months March (2019 and 2020) (base March 2019) in percentages

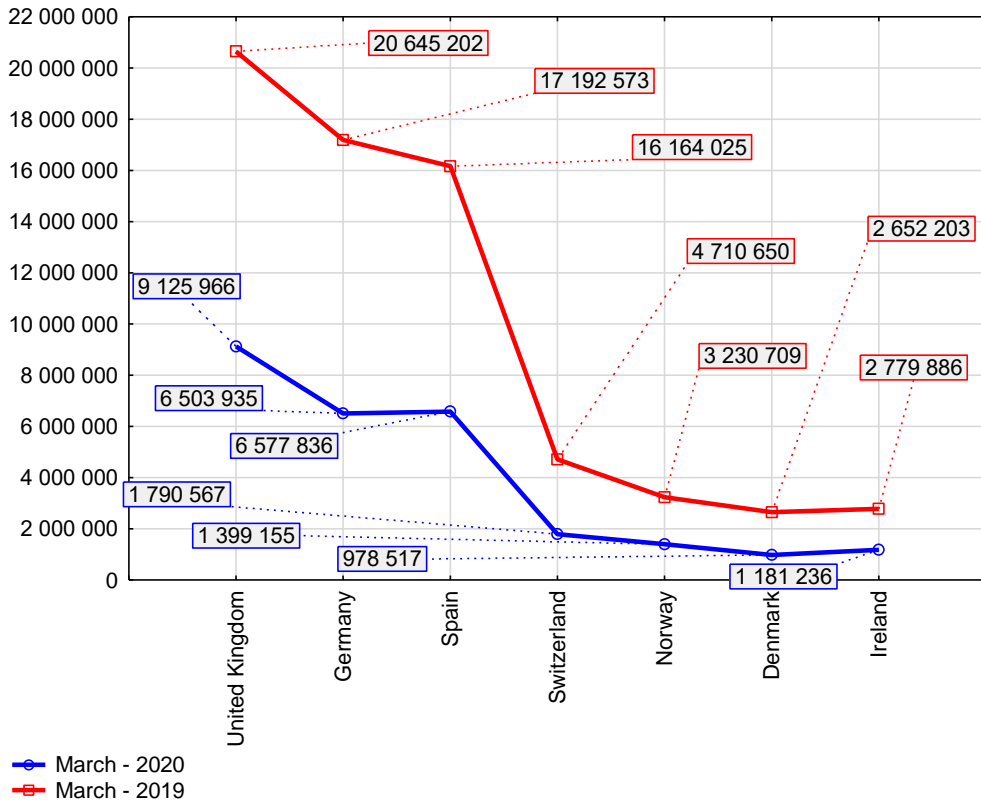


**Source:** In-house elaboration based on data obtained from the <https://ec.europa.eu/eurostat> website; the state as of July 02, 2020.

The data presented in Figure 4 assess that the number of passengers in March 2020 compared with March 2019 has dropped by more than fifty percent. The arithmetic average/mean for the twenty-two countries under consideration is around 40%.

For research purposes, the number of passengers in the same month (2019-2020) was ranked from the highest to the lowest, assuming March 2019 as the base month (Figures 5 and 6). In order to correctly observe the regularities (the gap resulting from the impact of COVID -19) in the group of dependent variables under consideration, in March 2019 and 2020, twenty-two explanatory variables, in months March 2019, were divided into two groups of more than 2,000,000 passengers (Figure 5) and less than 2,000,000 (Figure 6).

**Figure 4.** The line chart of the number of passengers carried by airlines in March 2019 and 2020 in selected European countries (the ranking - data above 2,000,000 passengers in March 2019)



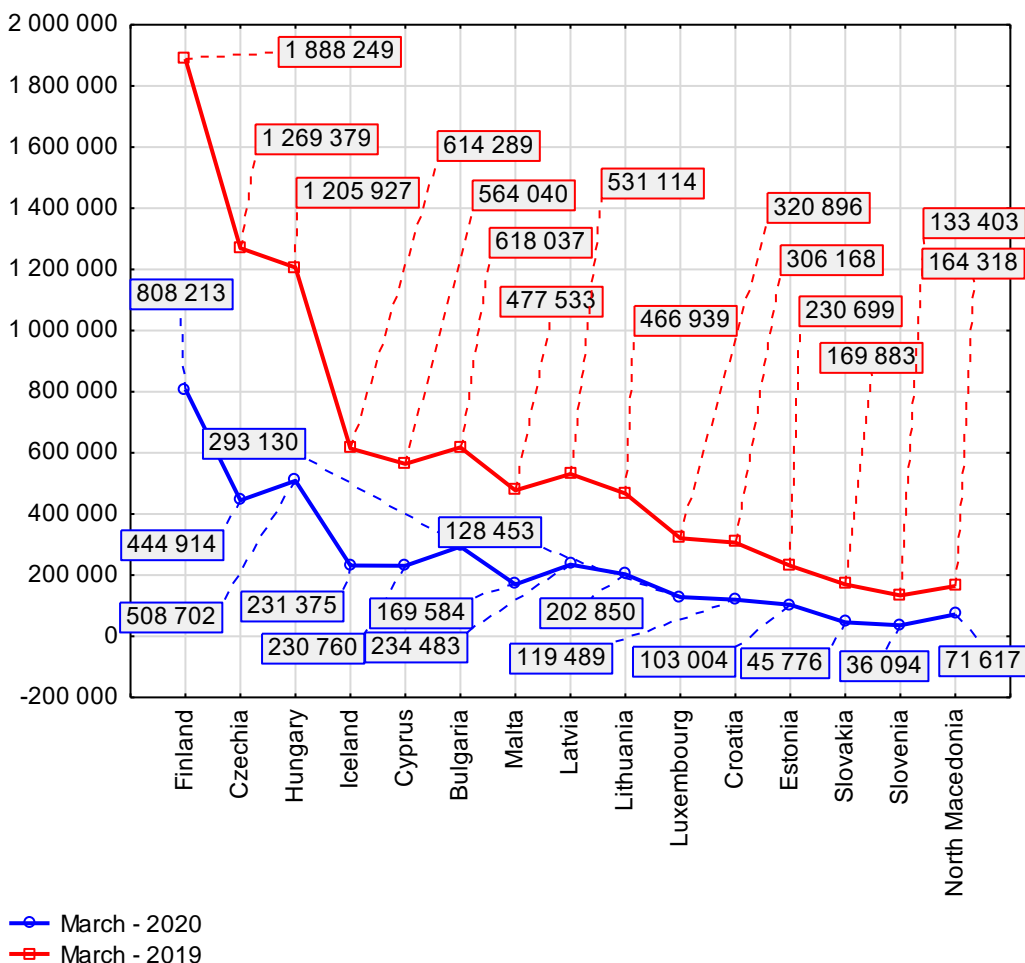
**Source:** In-house elaboration based on data obtained from the <https://ec.europa.eu/eurostat> website; the state as of July 02, 2020.

The assessment of the data in Figure 5 is the statement that the largest gap between March 2019 and 2020 is in the UK, followed by Germany and Spain. Below are Norway, Denmark, and Ireland.

The visual observation of Figure 6 shows that the highest gap in the group of fewer than 2,000,000 passengers carried in March 2019 is in Finland, followed by the Czech Republic, Hungary, Iceland, Cyprus, and Bulgaria. The lowest gap was in Northern Macedonia, Slovenia, and Slovakia.

For illustrative purposes, Figure 7 outlines the quantitative data on the passenger transport gap between March 2019 and 2020 in the twenty-two European countries concerned, ranking the results from the largest ones to the smallest ones.

**Figure 5.** The line chart of the number of passengers carried by airlines in March 2019 and 2020 in selected European countries (the ranking - data below 2,000,000 passengers in March 2019)



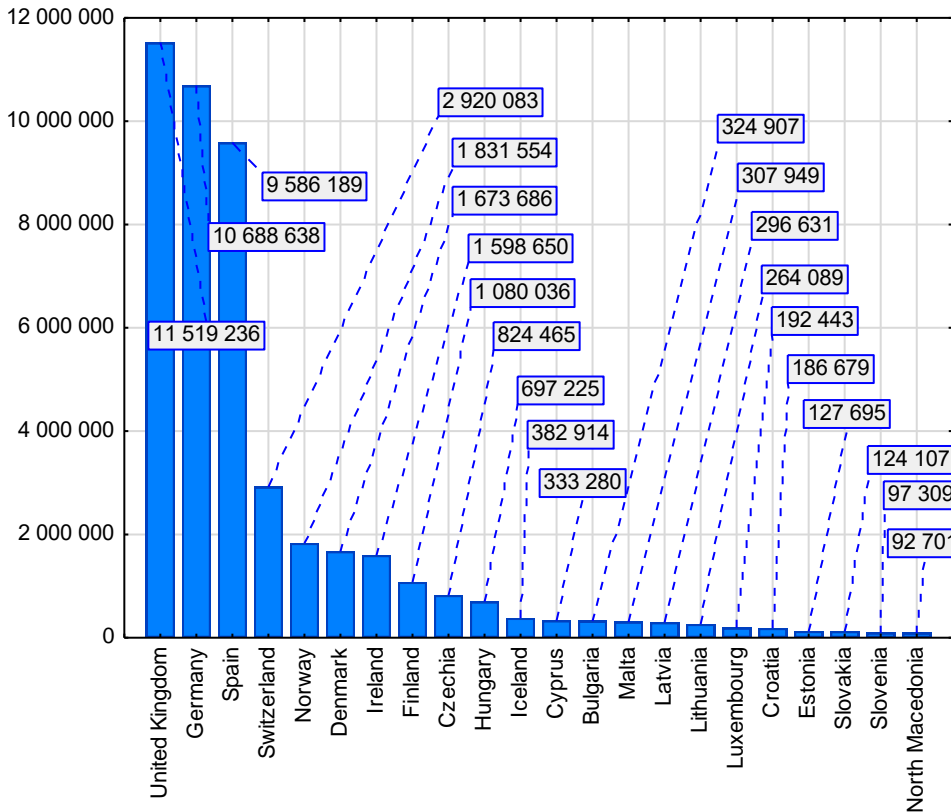
**Source:** In-house elaboration based on data obtained from the <https://ec.europa.eu/eurostat> website; the state as of July 02, 2020.

According to the bar chart in Figure 6, it can be seen that the three leaders in terms of passenger numbers between March 2019 and 2020 have seen the biggest drops: The United Kingdom, Germany, and Spain. The United Kingdom reported a drop of 11,519,236 passengers, while Germany reported a drop of 10,688,638, and Spain reported a drop of 9,586,189. In other countries, the number of passengers' drop was below 3,000,000.

The study's final stage was to carry out a ranking of the standard deviation of the number of passengers transported in twenty-two European countries in identical units of time - March 2019 and 2020 (Figure 8).



**Figure 6.** The bar chart of the gap between March 2019 and 2020 in the number of passengers carried in twenty-two European countries



**Source:** In-house elaboration based on data obtained from the <https://ec.europa.eu/eurostat> website; the state as of July 02, 2020.

The assessment of Figure 8 shows that the three countries have the highest standard deviations: Great Britain, Germany, and Spain. The standard deviation was 8,145,330 in the UK, 7,558,008 in Germany, and 6,778,459 in Spain. The other countries concerned had standard deviations below 2,100,000.

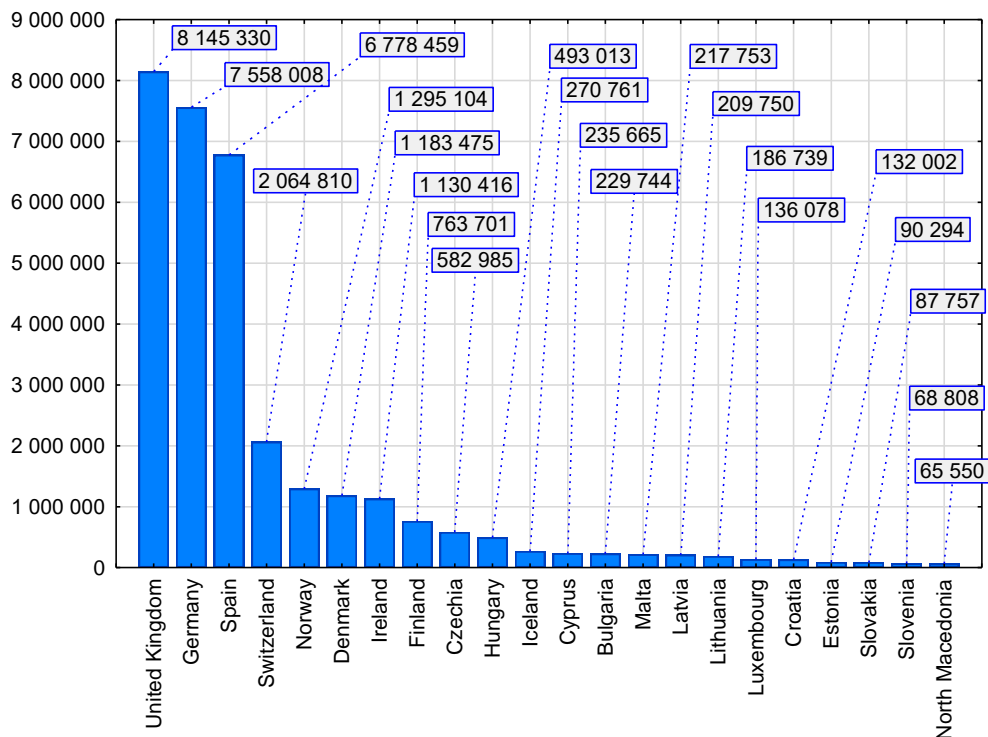
#### 4. Summary and Conclusions

The intended goal of the paper has been achieved. A multidimensional analysis and evaluation of the data on the number of passengers transported by air in twenty-two European countries before and during the COVID-19 pandemic were carried out from a security perspective.

The assessment of the analyses carried out is the detection of a drop in the number of passengers carried in twenty-two European countries in March 2020. The trend could be seen by outlining line diagrams of fixed and chain-based dynamics

indicators and frame-nose charts. The slowdown in air transport has resulted in a drop in world oil/petroleum prices.

**Figure 7.** The bar chart of standard deviations in the number of passengers carried in March 2019 and 2020 in twenty-two European countries



**Source:** In-house elaboration based on data obtained from the <https://ec.europa.eu/eurostat> website; the state as of July 02, 2020.

This situation is a premise for the persistence of unfavorable low oil/petroleum prices and may lead to irreversible changes in world economies, most of whose budget revenue is from oil sales [<https://www.energetyka24.com/premier-rosji-spadek-dochodow-z-ropy-i-gazu-to-bardzo-powazny-cios>]. Russia is the example of an economy where the sale of oil/petroleum accounts for most budget revenue [A. Ismail. May 2020., Russia's Economic outlook Following the Covid-19 (Coronavirus) lockdown and the fall in oil prices, Russian Economy. May 2020, Russia's Economic].

A consequence of the drop in the number of air passengers is a threat to the stable functioning of both private and public companies offering this type of service. Then, when there is a risk of loss of liquidity, the threat of bankruptcy increases, and all economic operators are obliged to defend themselves against it. The offer made by foreign investors may be the only option that they will be obliged to take advantage of to not lead to bankruptcy and mass redundancies.

To sum up, COVID-19 opens new opportunities in those economic areas where an external investor's entry would be severely limited or impossible during a period of normal operation. The alternative is the collapse of domestic air service providers, which creates an opportunity to dominate this market by third parties completely. Air traffic can be placed among the elements of critical transport infrastructure, which should be given special care by the State, given companies operating in the energy or food industry.

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