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Multidimensional comparative analysis of populations and deaths of people in European countries in terms of economic security

Wielowymiarowa analiza porównawcza populacji i zgonów ludzi w państwach Europy w aspekcie bezpieczeństwa ekonomicznego

Abstract

The objective of the article is to carry out a multidimensional comparative analysis of populations and human deaths in European countries in terms of economic security. The research applies tools of comparative analysis, first by grouping and unraveling the data and then by their charting and evaluation. The study covers 32 European countries focusing on populations and deaths of people in 2005–2018. The research question has been formulated as: "Will the application of multidimensional comparative analysis of populations and deaths of people in 32 European countries allow to detect any regularities occurring in the phenomenon?" The article provides multidimensional comparative analyses of dependent variables (32 European countries, years) and explanatory variables (population and human deaths) in terms of the impact on economic security. The results of the studies carried out are repetitive relationships in monomial intervals — years.

Detecting regularities persistent in populations and human deaths in 32 European countries using multidimensional comparative analyses may allow their predicting in the future. Death rates expressed in percentage points in populations of 32 European countries in 2005–2018 were calculated and enabled observation of similarities in the time series analyzed.

Keywords:

population, deaths, multidimensional comparative analyses, economic security

Streszczenie

Celem artykułu jest przeprowadzenie wielowymiarowej analizy porównawczej populacji i zgonów ludzi w państwach Europy w aspekcie bezpieczeństwa ekonomicznego. Do badań zastosowano wielowymiarowe analizy porównawcze. Dane poddawano grupowaniu i rozplataniu. Następnie zestawiano je na wykresach i oceniono. Podmiotem badań są 32 państwa Europy, zaś przedmiotem populacja i zgony ludzi w latach 2005–2018. Sformułowano pytanie badawcze, które brzmi: „Czy zastosowanie wielowymiarowej analizy porównawczej populacji i zgonów ludzi w 32 poszczególnych państwach Europy pozwoli wykryć prawidłowości rządzące rozpatrywanym zjawiskiem?”.

Artykuł zawiera wielowymiarowe analizy porównawcze zmiennych zależnych (32 państwa Europy, lata) i zmiennych je objaśniających (populacja i zgony ludzi) w aspekcie wpływu na bezpieczeństwo ekonomiczne. Rezultatem przeprowadzonych badań są zależności powtarzające się w jednoimiennych przedziałach czasowych — latach.

Wykrycie prawidłowości utrzymujących się w populacji i zgonach ludzi w 32 poszczególnych państwach Europy poprzez zastosowanie wielowymiarowych analiz porównawczych może pozwolić na ich prognozowanie na przyszłość. Wyliczono indeksy zgonów w populacjach w punktach procentowych w każdym z 32 rozpatrywanych państw Europy w latach 2005–2018. Pozwoliły one na zaobserwowanie podobieństw w analizowanych szeregach czasowych.

Słowa kluczowe:

populacja, zgony, wielowymiarowe analizy porównawcze, bezpieczeństwo ekonomiczne

JEL: C51, E31, E37, E64

Introduction and literature review

In 32 European countries, the population and the number of deaths of people in 2005–2018 are increasing steadily. The total of 506,947,964 people were recorded in 32 European countries in 2005 and by 2018 this number increased to 529,108,246. In 2005, there were 4,975,928 deaths in 32 European countries, increasing to 5,418,241 in 2018. According to literature, Europe owes the increase of its population to migration because the difference between birth and death rates is negative (Tracz-Dral, 2018, p. 6).¹

In terms of population, number of deaths, and economic power, among 32 European countries Germany is the leader,² followed by France and the United Kingdom.

Undoubtedly, the number of people in the European countries is and will be affected in the future by the COVID-19 pandemic. COVID-19 is an infectious disease that first appeared in the world in Wuhan, China in December 2019 (Zhu *et al.*, 2020). It tended to spread rapidly and it was declared a pandemic on 11 March 2020 (Satomi *et al.*, 2020). COVID-19 has contributed to an increase in the number of human deaths worldwide. Countries have taken measures to overcome the disease: closure of borders, limitation of movement and other restrictions that citizens have had and still have to comply with (Manurung, 2020).

As yet, no complete and detailed data on global human deaths between 2019–2020 are available in online databases so the study intends to examine trends seen before the COVID-19 pandemic (2005–2018) for the sake of future studies on this issue in terms of economic security. It was observed that in the preliminary stage of the COVID-19 pandemic — *i.e.* March 2020 — the number of deaths in European countries collectively hovered around a statistical error of around 0.005 percentage point (Kozicki, Mitkov, 2020).

According to T. Szubrycht, security is a condition that gives a sense of confidence, a belief this is going to last, and an opportunity of improvement (Szubrycht, 2006, p. 87). This paper considers one type of security, focusing on the issue of economic security.

In literature, economic security is seen as the provision of economic conditions essential for survival, prosperity and sustainable development of a society, for smooth operation of the state with its institutions. It is also seen as a condition achieved through effective overcoming of external or internal destructive factors that could entail developmental disorders (Kitler, 2011, p. 49). When assessing this interpretation of the meaning of economic security

in the context of this paper, it should be observed that it addresses the issue of preserving, in European countries taken into account, of regularities concerning lasting trends in the level of populations and deaths. These are studied in dynamic terms as they occur over time.

Multidimensional comparative analyses were applied for the research. These belong to a group of statistical methods where at least two variables describing each object (phenomenon) in question (Łuniewska, 2006, p. 9) are analyzed simultaneously. Within multidimensional comparative analyses, the linear ordering methods were applied, ranked from largest to smallest. Tools including grouping and unraveling were used in examining the data. The study consists of the summary where research methods are described, two key research sections, and the conclusion.

Multidimensional comparative analysis of populations and deaths in European countries

The study began with preparation of a line chart showing the human population in 32 European countries between 2005 and 2020.

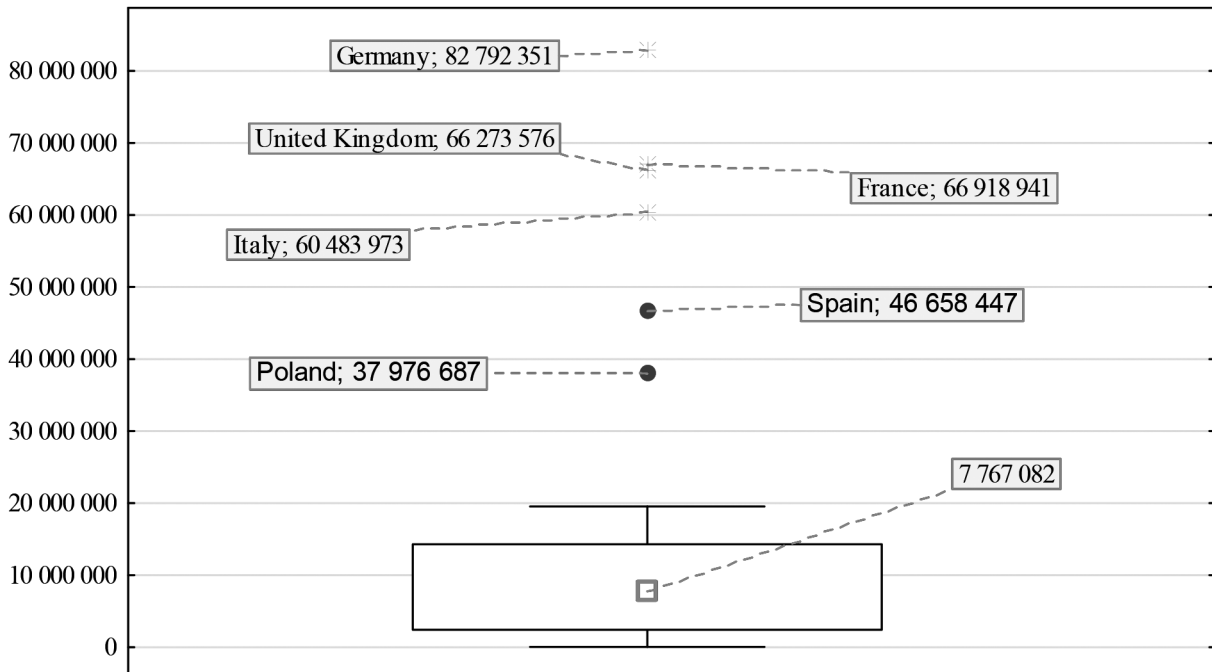
Data presented in Figure 1 reveal that Germany is the largest human population in Europe. The arithmetic mean of the population in this country between 2005 and 2020 is 81,874,408. France ranks second (65,351,430), followed by the United Kingdom (63,674,803), Italy (59,585,742), Spain (46,097,154), Poland (38,049,443), Romania (20,183,813), Netherlands (16 768 194), Belgium (11 031 317), Greece (10 938 206), the Czech Republic (10 472 088), Portugal (10 446 754), *etc.* For the remaining 20 countries the arithmetic mean of populations is less than 10,000,000, Liechtenstein ranking lowest with an arithmetic mean of population at 36,634 in 2005–2020.

Then, for illustrative purposes, Figure 2 outlines data on the number of deaths in 32 European countries between 2005 and 2018.

Figure 2 shows that the highest arithmetic mean of the number of deaths in 32 European countries between 2005 and 2018 is 874 579 in Germany. This is followed by Italy (600,133), the United Kingdom (579,492), France (563,377), Spain (395,046), Poland (384,433). In the remaining 26 European countries, the arithmetic mean of the number of deaths is less than 260 000.

The same rankings (Figure 1–2) of the arithmetic means of populations and deaths in 32 European countries were recorded in the half of the countries

Figure 3
Box plot of populations in 32 different European countries in 2018



- Median = 7 767 082
- 25%-75% = (2 437 891, 14 289 837)
- ┌ Outlier range = (38 114, 19 530 631)
- Outliers
- + Extreme values

Source: see Figure 1.

positions of France and the United Kingdom are similar in terms of values (distance). The outliers in 32 populations included two positions: Spain (46,658,447) and Poland (37,976,687), differing between them in terms of the values recorded. The distribution of 32 populations due to observed outliers and extreme values is not normal and our experience allows us to observe a slight right-slanted tendency in Figure 3.

Figure 4 shows four identical extremes (taking the nationality into account) as in the case of the data compiled in Figure 3. The position of the three extreme points (Italy — 633,133, the United Kingdom — 614,313 and France — 609,747), taking their distances into account, differs between Figures 3 and 4. In Figure 4, they are accumulated, while in Figure 3, Italy deviates from the others. Germany has the highest and most distant extreme value with 954,874 deaths. Also, as with outliers, it was observed that the points: Spain (425,153) and Poland (414,200) for the number of deaths are close to each other, whereas in Figure 3 they are distant. The distribution of the data analyzed (Figure 4) is not

normal and shows a right-slanted tendency greater than in Figure 3.

Figures 1–4 show the probability of hypotheses that mortality in each country hovers around the index at about 1 percentage point described by the function:

$$Y = Z/P \times 100\%$$

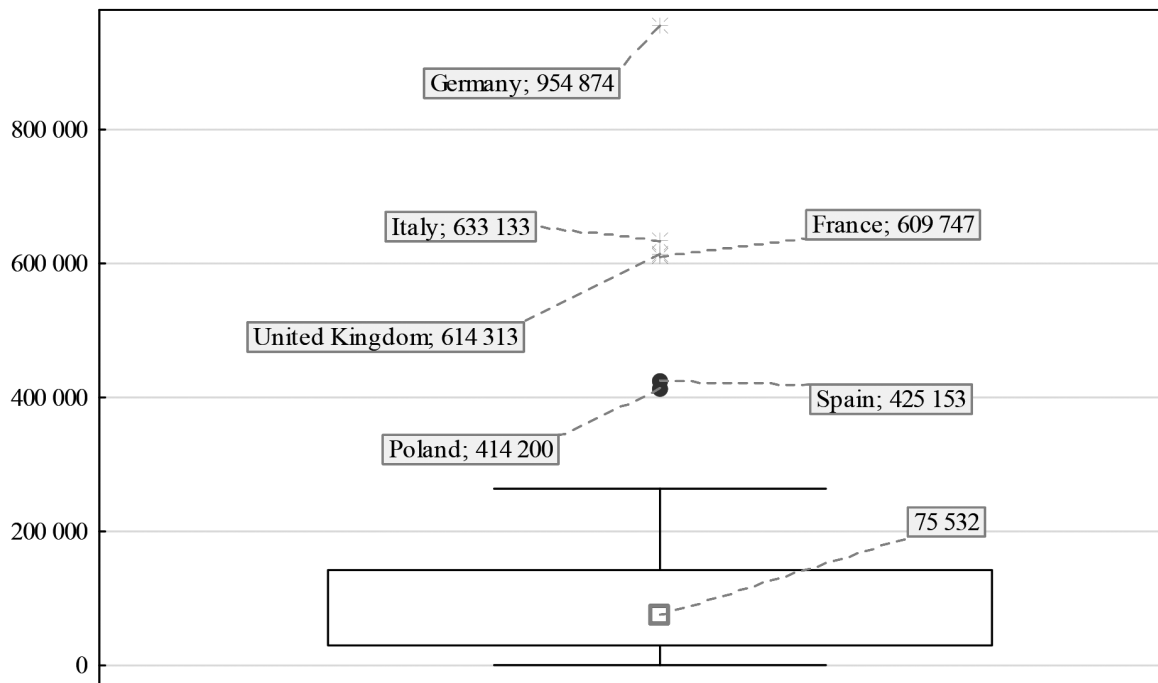
- Y — death rate in populations in percentage points;
- Z — number of deaths of people;
- P — population.

In order to respond to this hypothesis, it was decided to analyze and evaluate the Y models described above. The study began by outlining, in Figure 5, indices of deaths in percentage points in 32 European countries between 2005 and 2018, and ranking the results from highest to lowest, with 2018 taken as the reference.

Figures compiled in Figure 5 show that the arithmetic mean of the index is 0.98 out of 448 deaths in 32 European countries between 2005 and 2018. Thus, the hypothesis is confirmed. The regularity

Figure 4

Box plot of the number of deaths in 32 respective European countries in 2018



- Median = 75 532
- 25%-75% = (29 915, 142 305)
- ┌ The range of non-outliers = (274, 263 911)
- Outliers
- + Extreme values

Source: see Figure 1.

observed allows us to conclude that in 32 European countries, each year between 2005 and 2018, around 1 percentage point of the human population dies.

In addition, it was found that the median of the index concerned is lower than the arithmetic mean and equals 0.96 percentage points. The minimum index is 0.58 percentage points in Liechtenstein in 2008 and the maximum, in Bulgaria, is 4.55 percentage points in 2017. The standard deviation from the arithmetic mean is 0.23 percentage point. In half of 32 European countries, the index exceeds 1 percentage point, and in the second half it remains below this value. This means that the half of the European countries concerned have higher human mortality per population, whereas in the second half the situation is the opposite, so it can be presumed that in that other half of the countries either people live longer or their societies are younger.

The final stage of the study was an analysis of the distribution of calculated death indices in 32 populations between 2005 and 2018. The results are outlined in Figure 6.

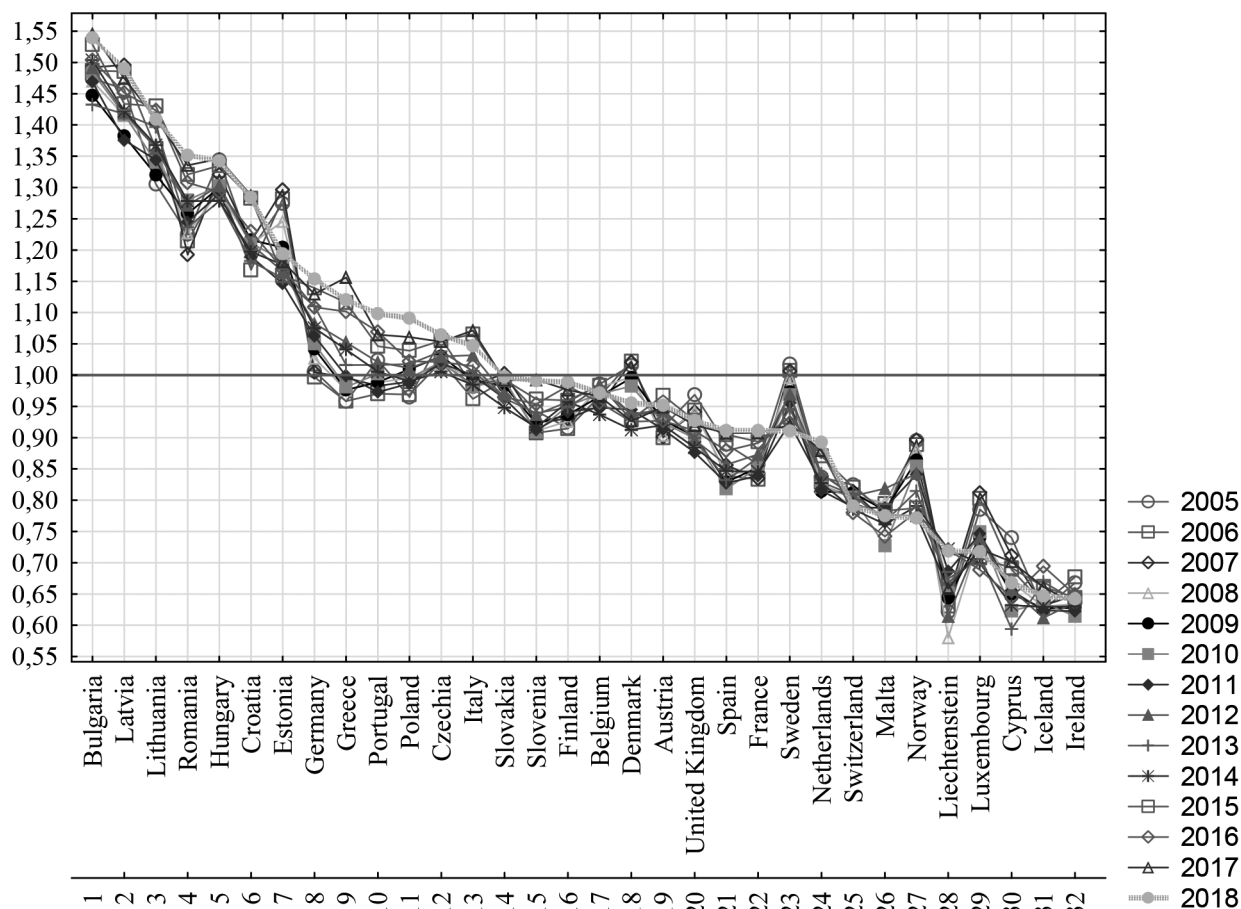
Considering the histogram itself (Figure 5), the distribution of the data resembles normality. The Shapiro-Wilk test, on the other hand, clearly indicates that the data in question are not normal. In addition, it has been observed that the best-suited distributor is the one of an extreme nature. The largest N group of 159 elements includes variables between 0.77 and 0.97 percentage point. Next, there are 121 variables between 0.97 and 1.16 percentage point. Third in the ranking is N equal to 73 variables between 0.58 and 0.77. The fourth group represents 57 N elements between 1,16 and 1.35 percentage point. On the other hand, the last ranked group consists of 38 N elements from 1.35 to 1.55 percentage point.

Summary and conclusions

Studies have shown that in 32 European countries in question there is a group of six countries which, in terms of population numbers, have outperformed

Figure 5

Linear chart of death indices by percentage points in 32 countries in Europe between 2005 and 2018



Note: axis X2 — ranking death in populations from highest to lowest in 2018)
 Source: see Figure 1

the other between 2005 and 2020 (Figure 1). These leaders include Germany (81,874,408), France (65,351,430), the United Kingdom (63,674,803), Italy (59,585 742), Spain (46,097,154), and Poland (38,049,443).

When considering the number of deaths, the same ranking positions (Figure 1–2) of arithmetic means of two dependent variables, *i.e.* populations and deaths in 32 European countries, were recorded in half of the countries concerned, namely in Germany, the United Kingdom, Spain, Poland, Romania, the Netherlands, Greece, Denmark, Slovakia, Slovenia, Estonia, Cyprus, Luxembourg, Malta, Iceland and Liechtenstein.

The arithmetic mean of the death index (Figure 5) in populations in 32 European countries is 0.98 percentage point. This means that around 1 percentage point of each population of countries in Europe under consideration accounts for human deaths every year.

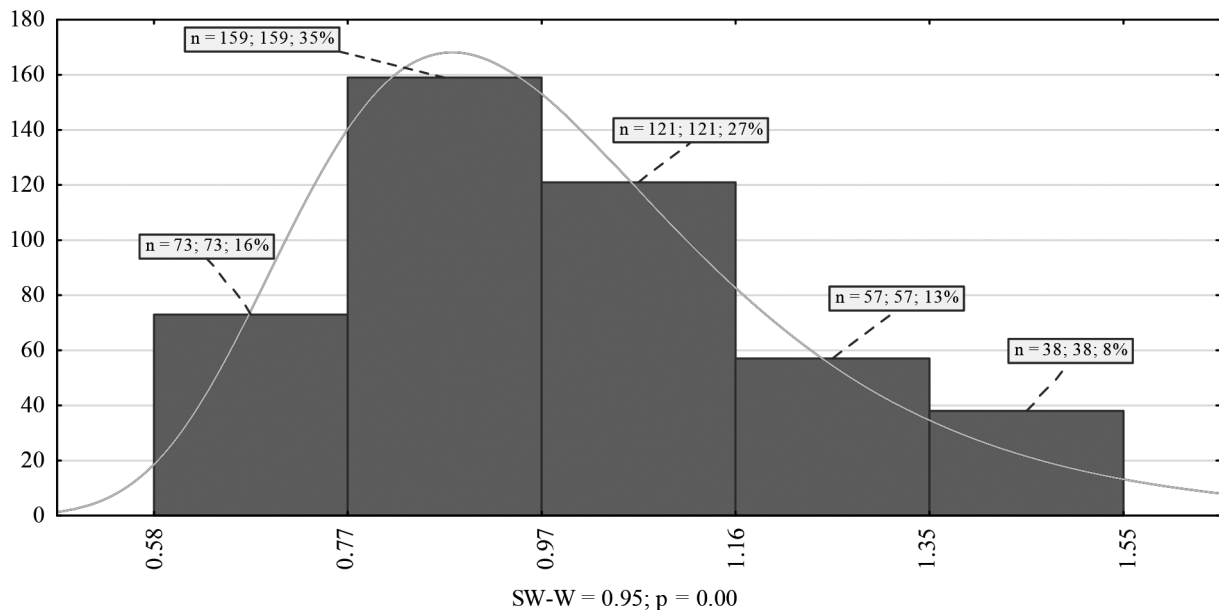
The distribution of the total number of deaths in 32 European countries between 2005 and 2018 (Figure 6) is not normal and the best suited distributor is the one of an extreme nature.

The resulting evaluations, revealing persistent regularities related to the number of deaths in 32 European countries between 2005 and 2020, are useful for selection of method and for future forecasting. The forecasts received may be relevant in terms of planning for future budget revenue and expenditure, education and other aspects related to economic security.

The observed regularity related to the persistent level of the death index in 32 European countries (Figure 5) between 2005–2018 may prompt one to conclude that, witnessing the mortality increase caused by the COVID-19 pandemic in 2020, in subsequent years the number of deaths will decline, in proportion to the increases caused by a random factor which is a persistent infectious disease.

Figure 6

Histogram of the Shapiro-Wilk test of death indexes in percentage points in 32 respective countries in Europe between 2005 and 2018



Source: see Figure 1.

The increase in human deaths in 2020 led to a situation where the broadly understood funeral industry recorded higher revenues in the analyzed period than in previous years. The crisis caused by the infectious disease COVID-19 has generally led to a decline in consumption which has hit industries such as tourism, transport and catering the most. The continuing restrictions and the absence of employees

at workplaces led to a slowdown in the functioning of the global supply chains. This, in turn, affected the global stock market and declines in exchange rates, especially in emerging countries. In Europe, an increase in financial outlays for health care has been observed which has directly contributed and will cause a decline in other entities of budgetary expenditure.

Przypisy/Notes

¹ See also: <https://forsal.pl/artykuly/1187464,populacja-panstw-ue-dane-demograficzne-eurostat-2018.html> (19.01.2021).

² <https://www.pb.pl/25-najpoteczniejszych-krajow-na-swiecie-980397>, as of 19.01.2021

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