ANALYSIS OF THE EUROPEAN UNION COUNTRIES ON THE BASIS OF SELECTED MACROECONOMIC INDICATORS USING THE DISTANCE METHOD FROM THE FICTITIOUS OBJECT*

Ľubica Hurbánková[1]
Dominika Krasňanská[2]

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Abstract: *The aim of the paper is to compare the European Union countries on the basis of selected socio-economic and demographic indicators for the year 2016. The following indicators are selected for analysis: gross domestic product per capita, government gross debt as a percentage of gross domestic product, inflation rate, unemployment rate, total fertility rate, infant mortality rate and crude divorce rate.*

The contribution of the paper is the order of countries on the basis of the above-mentioned indicators, from the best country to the worst country using one of the multidimensional comparison methods – the distance method from the fictitious object. The aim of these methods is to replace a number of selected indicators, on the basis of which we compare EU countries, with one final characteristic – an integral indicator to order the countries. By creating an integral indicator, heterogeneous variables, which are expressed in different units and therefore can´t be direct aggregated, are transformed to homogeneous indicators. Since the used indicators do not have the same weights, by the calculation are used the data weighted by weights I (calculated using the coefficient of variation) and weights II (calculated on the basis of the correlation matrix).

The application of individual statistical methods is implemented through the programme Microsoft Office Excel.

Keywords: *Distance method from the fictitious object, European Union countries*

1. INTRODUCTION

Oftentimes, it is not enough to pay attention to only one characteristic in the analyzed file, but it is desirable to examine the file from several aspects, represented by multiple statistical character, taking into account its multiple characteristics [1]. In this analysis, it is necessary to use multidimensional comparison methods – the weighted sum order method, the scoring method, the method of standard variable and the distance method from the fictitious object. The aim of these methods is to replace several selected indicators by which we compare the selected objects – in our case the EU countries, one final characteristic – an integral indicator, based on which we rank selected objects.

In the paper is used one of the multidimensional comparison method – the distance method from the fictitious object – to compare the EU countries on the basis of selected socio-economic and demographic indicators (gross domestic product per capita, government gross debt as a percentage of gross domestic product, inflation rate, unemployment rate, total fertility rate, infant mortality rate and crude divorce rate).

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[1] University of Economics in Bratislava, Dolnozemská cesta 1, 852 35 Bratislava, Slovak Republic

[2] University of Economics in Bratislava, Dolnozemská cesta 1, 852 35 Bratislava, Slovak Republic

This method is applied using three types of weights – in the first case without weight determination. In the second case, weights are calculated using the coefficient of variation, and in the last case we determine the weights based on the correlation matrix [2], [3].

2. DISTANCE METHOD FROM THE FICTITIOUS OBJECT

The distance method from the fictitious object is based on the comparison of the individual objects of the file with the so-called a fictitious object that represents an abstract model and achieves the best values for all selected indicators – in the case of stimulating indicators (the desirable value is the highest value) the maximum value and in the case of destimulating indicators (the desirable value is the lowest value) the minimum value [4].

The first step in this method is to calculate arithmetic averages and standard deviations for selected indicators. In the next step, we must transform all indicators into a standard shape to eliminate the problem of different measurement units of the selected indicators. Then we compute an integral indicator, which expresses the Euclidean distance of each selected object (the EU country) from the fictitious object [5]:

$$d_i = \sqrt{\frac{1}{k}\sum_{j=1}^{k}\left(z_{ij} - z_{0j}\right)^2 v_j} \tag{1}$$

where: d_i is an integral indicator,
z_{ij} is the normalized shape of the j-th indicator in the i-th object,
z_{0j} is the normalized shape of the "best value" of the j-th indicator,
v_j is the weight of the indicator,
k is the number of indicators.

The last step in the distance method from the fictitious object is the determination of the resulting order of the objects, which is determined by the fact that the best object is the object with the smallest distance from the fictitious object – object with the smallest value of the integral indicator. The smallest value, which one object can achieve, is zero. An object that would achieve this value would have to achieve the best values in all selected indicators, it means that a fictitious object would be constructed from its values. The object in the first place will be the one that has the smallest distance from the fictitious object. The object that has reached the biggest distance from the fictitious object will be on the last place.

The distance method from the fictitious object as the only one of the methods of multi-criteria evaluation works with squares of deviations, which implies that the results of evaluation always take negative values. This method allows you to compare objects by rate; we can determine how many times the value of the indicator in country X is higher or lower than in country Y [6].

3. INPUT DATA

We have selected 28 member countries of the European Union for the analysis. We will make a comparison of the selected countries with the use of 7 socio-economic and demographic indicators for the year 2016. The Eurostat website will serve as a source of the data. We will also briefly define the selected indicators:

Gross domestic product per capita – the ratio of gross domestic product and average population in the year. Gross domestic product is an indicator for a nation′s economic situation. It reflects the total value of all goods and services produced less the value of goods and services used for intermediate consumption in their production. Calculations on a per head basis allows for the comparison of economies significantly different in absolute size [7].

General gross debt as a percentage of gross domestic product – represents the total general debt as a share of GDP in percent. It is made up of government commitments and is generated by a deficit financing of the state budget [8].

Inflation rate – is defined as the devaluation of the monetary unit, which is manifested by the persistent growth in the price level of products and services in the economy [9].

Unemployment rate – represents unemployed persons as a percentage of the labour force. The labour force is the total number of people employed and unemployed. The indicator is based on the EU Labour Force Survey [10].

Total fertility rate – the mean number of children that would be born alive to a woman during her lifetime if she were to survive and pass through her childbearing years conforming to the fertility rates by age of a given year [11].

Infant mortality rate – the ratio of the number of deaths of children under one year of age during the year to the number of live births in that year. The value is expressed per 1 000 live births [12].

Crude divorce rate – is the ratio of the number of divorces during the year to the average population in that year. The value is expressed per 1000 persons [13].

4. APPLICATION

Input indicators do not have the same weights, so we need to use weighted data in the calculations (Table 1):

- Weights I – weights calculated using the coefficient of variation,
- Weights II – weights calculated on the basis of correlation matrix.

Table 1: Weights calculating. Source: own calculations

Indicator	Weights I	Weights II
Gross domestic product per capita	0,2080	0,2154
Government gross debt as a percentage of GDP	0,1691	0,0565
Inflation rate	0,2138	0,1761
Unemployment rate	0,1594	0,1473
Total fertility rate	0,0341	0,2831
Infant mortality rate	0,1170	0,0106
Crude divorce rate	0,0986	0,1110
Total	1,0000	1,0000

The essence of this method is to compare individual objects with so-called fictitious object. A fictitious object is an abstract model that achieves the best value for all indicators.

The countries such as the Netherlands, Ireland and Luxembourg rank among the top three places in the application of the distance method from the fictitious object without using weights (Figure 1). On the last places are Portugal, Hungary and Greece. The Slovak Republic is on the 20th place. The other V4 countries rank as follows: the Czech Republic 14th place, Poland 15th and Hungary 27th.

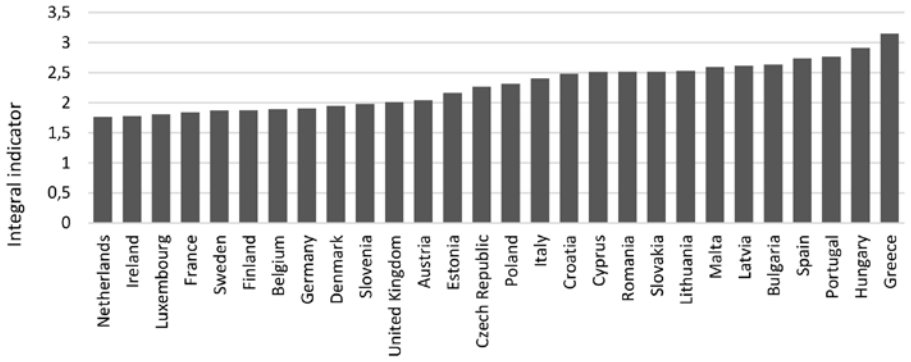

Figure 1: Country ranking without weights
Source: own calculations

If we applied weights I (Figure 2) – the weights calculated using the coefficient of variation, on the first place is Luxembourg, followed by Finland, third is the Netherlands. Hungary was placed last. The Slovak Republic ranks 21th place. The best from the V4 countries is Poland on the 14th place, the Czech Republic is on the 16th place.

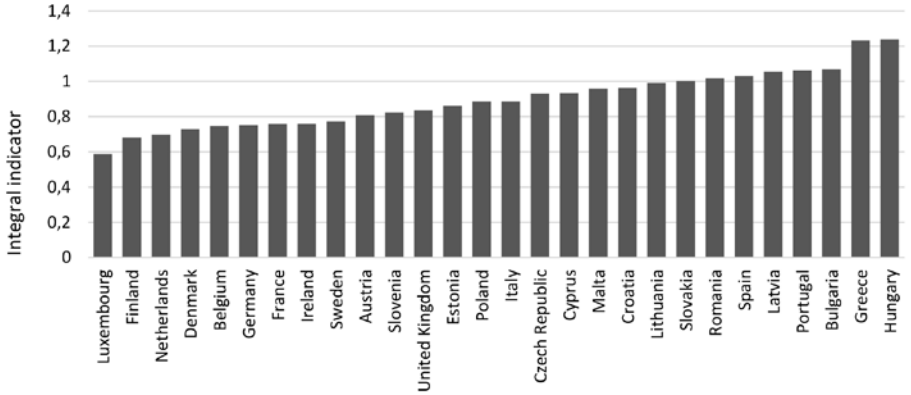

Figure 2: Country ranking with weights I
Source: own calculations

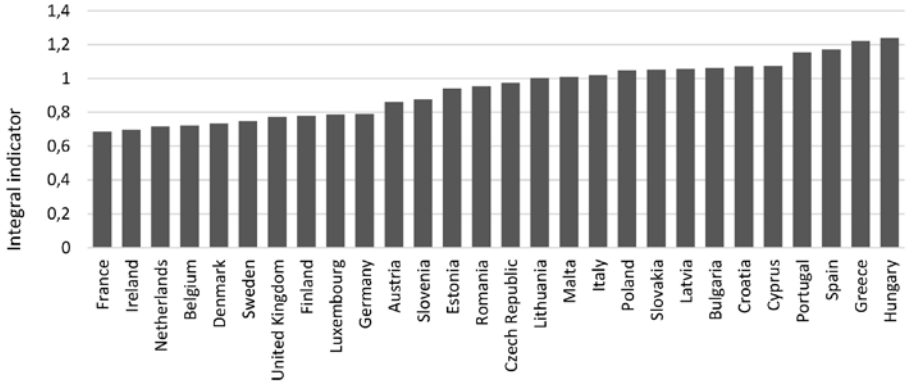

Figure 9: Country ranking with weights II
Source: own calculations

The results of applying the weights II (Figure 3), which we calculated on the basis of the correlation matrix, did not change significantly compared to the previous results. On the first places are France, Ireland and the Netherlands. On the last places are Spain, Greece and Hungary. The Slovak Republic is on the 20th place (similar to calculating without using weights). The ranking of other V4 countries is as follows: the Czech Republic is on the 15th place, Poland on the 19th.

5. CONCLUSION

The aim of the paper was to tank the European Union countries on the basis of selected socio-economic and demographic indicators: gross domestic product per capita, government debt as a percentage of gross domestic product, inflation rate, unemployment rate, total fertility rate, infant mortality rate and crude divorce rate. In the analysis, we used one of the multidimensional comparison methods – the distance method from the fictitious object. Analyze was realized on data from year 2016 from Eurostat´s website.

Using the distance method from the fictitious object on the first places are countries such as the Netherlands, Luxembourg, Ireland, France and Finland. It was Finland that was the first world country to give women the right to vote. The Netherlands, together with Luxembourg, belong to the founding members of the European Union. The largest beer exporter in Europe and also the country with the largest natural gas reserves is also the Netherlands. As one of the few countries stood Luxembourg at the birth of the United Nations and NATO. The ranking of France among the top countries could also affect the fact that in 2016 public administration, defense, education, health, wholesale and retail trade were among the most important sectors of the economy. One of the factors that may have influenced the order of the countries may be their location, as these countries are relatively close to each other.

Among the worst countries according to the analysis, we include Greece, Hungary, Portugal, Bulgaria and Spain. Greece faces a long-standing economic problem. However, at the time of joining the European Union, Greece did not meet one of the Maastricht criteria, namely indebtedness and nevertheless entered the European Union. Spain has huge problems with unemployment. Up to about 52% of young people in Spain are out of work. Unemployment in Spain has many reasons, one of which is the over-regulation of the labour market. Its regulations have been created to protect workers, but in fact it only protects the unemployed from getting jobs. Another reason is the long-term low growth of the Spanish economy. Portugal, like Spain, has a big problem with unemployment. Youth unemployment was up to 40% in 2013. In addition to the selected socio-economic and demographic indicators themselves, factors such as the geographic location of the countries, as well as the year of accession to the European Union, could also influence the order of the countries.
From the V4 countries on the first and second place alternate Czech Republic and Poland. Slovakia ranked third in the application of three types of weights and Hungary ranked last.

When we compare the results of using weights, we reached approximately the same results.

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