



## MULTIDIMENSIONAL ANALYSIS OF SOCIAL DEVELOPMENT AND INEQUALITY IN THE EUROPEAN UNION: A PCA APPROACH

Ancuța ROTARU<sup>1</sup>, Anamaria VÂTCA<sup>1</sup>, Iulia COROIAN<sup>1\*</sup> and Luisa ANDRONIE<sup>1\*</sup>

<sup>1</sup> University of Agricultural Sciences and Veterinary Medicine, Cluj-Napoca, Romania

**• Abstract:** *This paper aims primarily to follow aspects related to development and social inequalities in the countries of the European Union. The scop of the paper is to compare socio-economic indicators in the countries of the European Union, using principal component analysis (PCA) to identify groups of statistical indicators that explain the level of development and social inequalities.*

### • Introduction

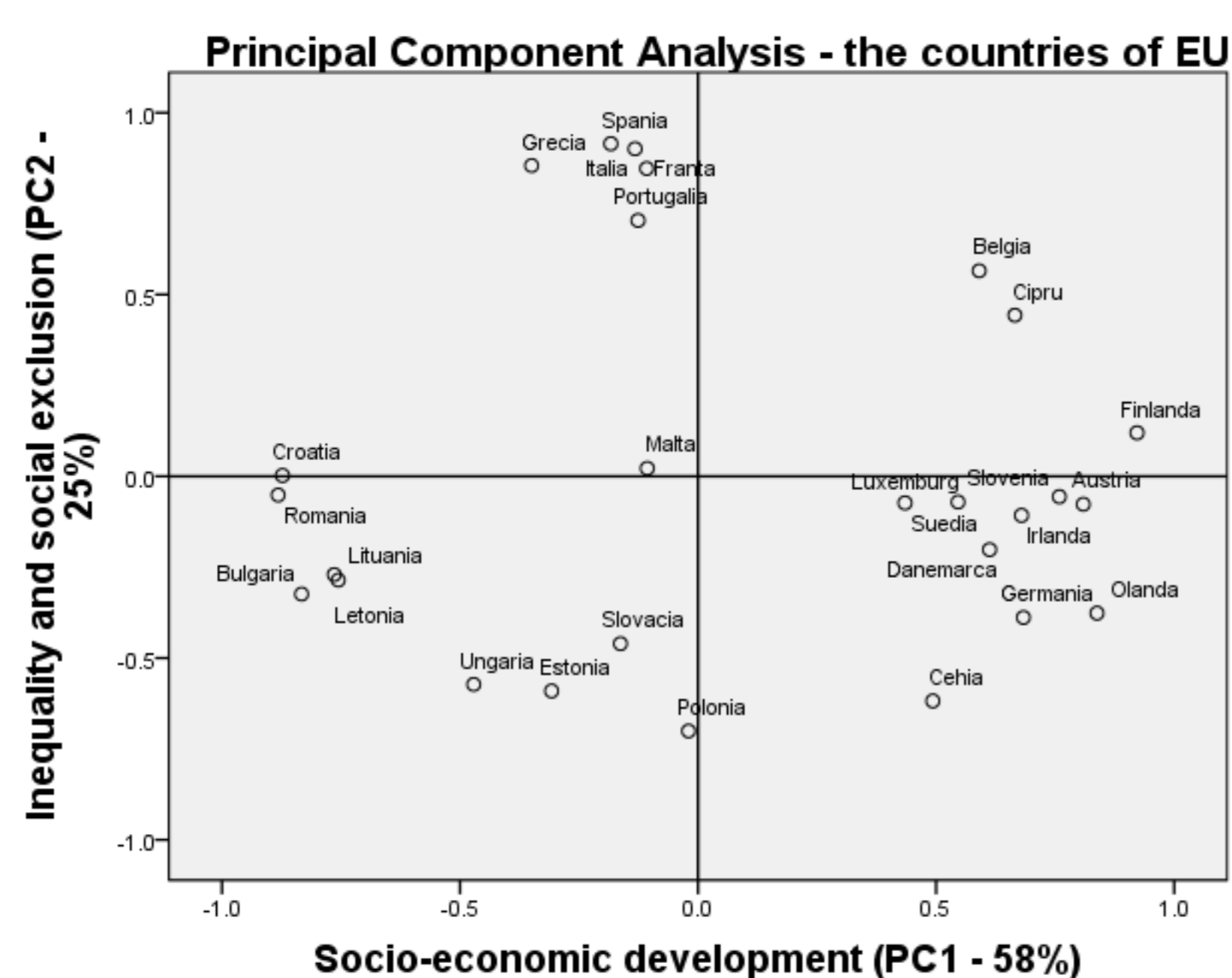
This paper aims primarily to follow aspects related to development and social inequalities in the countries of the European Union. The scop of the paper is to compare socio-economic indicators in the countries of the European Union, using principal component analysis (PCA) to identify groups of statistical indicators that explain the level of development and social inequalities.

### • Material and method

The nine statistical indicators from the European Union countries were taken into account. PCA is a statistical method for dimensionality reduction. It transforms a large set of correlated variables into a smaller set of new variables, called principal components, which retain as much information as possible from the original data. This statistical indicators are: Gross Domestic Product (GDP) per capita, Consumer Price Index (CPI) %, Employment rate %, Poverty and social exclusion rate %, Gini coefficient score %, Life expectancy at birth – year, The deficit and the public debt % of the GDP, Infant mortality rate % and CO<sub>2</sub> emissions per capita.

### • Results and discussions

In the first step, the data are standardized since they do not have the same unit of measurement, then the correlation matrix is used. After that, the calculation of the eigenvalues and eigenvectors is performed.



### PC1: GENERAL DEVELOPMENT

**High positive loadings:** GDP per capita, life expectancy, education.

**Negative (low) loadings:** Gini coefficient, unemployment rate.

**Interpretation:** This component reflects the overall level of socio-economic development. Countries with high values on PC1 are characterized by high development, low inequality, and overall well-being.

### PC2: INEQUALITY AND EXCLUSION

**High positive loadings:** Gini coefficient, unemployment.

**Weak/negative loadings:** GDP per capita, education.

**Interpretation:** This component captures inequalities and structural dysfunctions in the economy. Countries with high scores on PC2 may have relative economic development but also strong inequality and limited access to education and employment.

➤ Countries positioned in the upper part of the graph, such as Greece, Spain, Italy, and Portugal, record high levels of inequality and social exclusion, even though some of them have a moderate level of economic development. This suggests the existence of structural imbalances, particularly in the labor market and income distribution.

➤ In the lower part of the graph, countries such as the Czech Republic, Poland, Slovakia, Estonia, and Hungary can be found, which present lower levels of inequality and social exclusion compared to other economies. Although some of these countries do not reach high levels of development (according to PC1), they demonstrate relatively better social cohesion.

### • Conclusions

Countries with **high scores on PC1** and **low scores on PC2** are the **most developed and equitable**.

Countries with **high scores on PC2** and **low scores on PC1** face major structural problems: **low development and high inequality**.

PCA highlights the inverse relationships between development and inequality.