Comparative Economic Research, Volume 21, Number 1, 2018
10.2478/cer–2018–0004

AGATA SZYMAŃSKA*, ELŻBIETA ZALEWSKA**

Towards the Goals of the Europe 2020 Strategy: Convergence or Divergence of the European Union Countries?

Abstract

The aim of this article is to investigate the similarities between the EU countries in terms of achieving the Europe 2020 Strategy goals. Due to the latest data availability, the analysis is based on the year 2014. The study uses grouping methods, including the k-means algorithm. The results indicate the existence of a division between the "old" and "new" European Union Member States. However, as is shown, some of the Strategy's targets have already been achieved and some indicators have been nearly achieved, whereas among others, such as implementation of the headline indicator for investment in the R&D sector as a % of GDP is uncertain. The average performance of headline indicators for the EU–15 and EU–13 countries seems to be similar and exhibits the same trend of changes.

Keywords: *Europe 2020 Strategy, cluster analysis, European Union*

JEL: *C10, Q01*

* Institute of Economics, University of Lodz, e-mail: agata.szymanska@uni.lodz.pl
** Institute of Statistics and Demography, University of Lodz, e-mail: zalewska.e@uni.lodz.pl

1. Introduction

The European Union intends to be a very competitive and innovative region. One of tools introduced in order to achieve that goal is the Europe 2020 Strategy.

The strategy was officially formulated at the European Council summit in March 2008. It was formulated as a tool for continuing the structural reforms, sustainable development and social cohesion that were begun by the previously introduced goals in the Lisbon Strategy. However, the goals of the Lisbon Strategy were not fully implemented. Under these circumstances a need for a new strategy appeared. The date set for efficient implementation of the new strategy goals was established as 2020. Thus, within a couple of years the Europe 2020 Strategy will reach its deadline. Taking into account the above, there is a need to analyze the implementation of the strategy goals within the EU countries and to evaluate their performance over the last decade.

The aim of this paper is to analyze the implementation of the Europe 2020 Strategy's goals and to investigate the similarities between European Union countries. The study is important in the context of the future evaluation of the adopted indicators and preparation of a summary about the efficiency of the Agenda.

The structure of the paper is as follows: In the first section we describe the genesis of the Europe 2020 Strategy. In the next section we present goals and targets of the Agenda. Next we describe our data and methodology. In the fourth section we present our results, and in particular point out the situation in the CEE countries. The last section offers conclusions.

2. Genesis of the Europe 2020 Strategy

The Europe 2020 strategy is a new plan for transforming the EU economy into a competitive economy by strengthening employment, economic reforms and social cohesion. The Europe 2020 strategy follows up on the Lisbon Strategy.

The Lisbon Strategy was launched in 2000 and was aimed at two very important and ambitious goals: first, to make the EU economy a knowledge-based economy and the most competitive in the world, and second to make the EU economy an innovative economy (Natali 2010, p. 93). In other words the aim of the Lisbon Strategy was to transform the EU economy into an economy of the 21st century (ibid). That strategy was a response to problems of globalization and population aging (European Commission 2010b). As a result in 2000 a new strategic goal for the next decade was established: "to become the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth

with more and better jobs and greater social cohesion" (European Council 2000). In order to achieve this goal, a set of additional targets was prepared. There were aimed at: (i) preparing the transition of the EU economy into a knowledge-based economy by implementing better policies for the information society and R&D, as well as by preparing structural reforms aimed at increasing the competitiveness and innovation of the EU economy, especially by completing the internal market; (ii) modernizing European social policy, investing in people and preventing and combating social exclusion; (iii) sustaining healthy and favorable growth prospects (European Council 2000). In practice, the strategy defined two important goals for 2010: to reach a 70% employment rate and to achieve at least a 3% share of GDP in investments into the R&D sector (see European Commission 2010b).

In 2010 the Lisbon strategy met a deadline. The goals had been poorly implemented due to the fact that in the last years of the first decade of the 21st century European economies faced a recession. As a result, there was a deterioration in the implementation of the Lisbon strategy's targets. Despite this, the perspective of completion of the Lisbon Agenda created the challenge to adopt a refreshed strategy which would include Lisbon-type goals. The need for a new post–2010 Lisbon strategy was officially formulated at the European Council summit in March 2008, during which the need for continuing structural reforms, as well as the need for sustainable development and social cohesion were expressed (European Council 2008). These strivings led to the Europe 2020 Strategy (or 2020 Agenda), which is a continuation of the Lisbon Strategy's goals.

3. Main Goals and Headline Indicators of the Europe 2020 Strategy

The main goals of the 2020 Strategy were defined in the document published by the European Commission in 2010 (see European Commission 2010). According to it, the Europe 2020 is perceived as a new strategy for jobs and smart, sustainable and inclusive growth. In this context, the 2020 Strategy is a tool for supporting a new quality of growth. It was constructed in order to help the European Union Member States mitigate the consequences of the crisis and to promote medium-term and long-term structural reforms. As a result, the Strategy is aimed at increasing the competitiveness of the EU economy via higher employment and to boost social cohesion and economic convergence inside the EU. The key objectives are centred on common problems afflicting all Member States before and during crisis: i.e. low investments in the research and development sector, a too-low employment rate, population aging, climate changes, and social conditions. It should be pointed out that the effort which was made to improve the socio-economic performance of the EU was not only limited to the former crisis period and its con-

sequences, but also extended to the future and post-crisis perspective. On the other hand, the problems identified by the EU and the efforts to mitigate them are very important in the context of the long-run sustainability and future development of the EU as a whole. As a result, the formulated goals were not only limited to the latest crisis, and the Strategy responds to challenges aimed at "reorienting policies away from crisis" (European Council 2010c). In this context the Strategy is aimed at securing long-term fundamentals for smart, sustainable, and inclusive growth. As can be seen, the projected growth is described using three adjectives: (i) it is *smart* because of more effective investments in key sectors like education, research and innovation; (ii) moreover, the growth is *sustainable* because of efforts related to the shift towards a low-carbon and low-emission economy and more environmental friendly energy; and (iii) the growth is *inclusive* through creation of more jobs (including "green" workplaces) and through poverty reduction (see European Commission 2010, 2012 for details).

Table 1. The headline indicators of the Europe 2020 Strategy

Area	Headline indicator	2020 Target
Employment	Employment rate, total (% of the population aged 20–64)	75.0 (both EU28 and EU27
R&D	Gross domestic expenditure on R&D (% of GDP)	3.00 (both EU28 and EU27)
Climate change & energy	Greenhouse gas emissions* (index 1990=100)	80 (both EU28 and EU27)
	Share of renewable energy in gross final energy consumption (%)	20 (both EU28 and EU27)
	Primary energy consumption (Million tons of oil equivalent)	1483 for EU28 (1479 for EU27)
	Final energy consumption (Million tons of oil equivalent)	1086 for EU28 (1078 for EU27)
Education	Early leavers from education & training, total (% of population aged 18–24)	<10.0 (both EU28 and EU27)
	Tertiary educational attainment, total (% of population aged 30–34)	≥40.0 (both EU28 and EU27)
Poverty or social exclusion***	People at risk of poverty or social exclusion** (Cumulative difference from 2008 in million)	–20 (only EU27)

** Total emissions, including international aviation, but excluding emissions from land use, land use change, and forestry.*

*** The definition of people at risk of poverty or social exclusion includes at least one of the following three conditions: (i) at-risk-of-poverty after social transfers (income poverty), (ii) severely materially deprived, or (iii) living in a household with very low work intensity. The methodology specifies that persons are only counted once even if they are present in several sub-indicators.*

**** The overall EU target is to lift at least 20 million people out of risk of poverty or social exclusion by 2020, using 2008 as a baseline year. The target for this indicator refers to the EU27.*

Source: Authors' own compilation based on European Commission data.

Special indicators were constructed in order to monitor, assess, and analyse the progress made in achieving the objectives of the EU 2020 Strategy. A wide range of indicators are presented in the newest Eurostat publication "Smarter, Greener, More Inclusive? – Indicators to Support the Europe 2020 Strategy" (Eurostat 2016).

A set of indicators called 'headline indicators' was introduced in order to reach these key objectives. They are aimed at monitoring the possibility of the EU economies to achieve the key targets of the Strategy. These indicators are divided into five groups, related to:

- The desired level of the employment rate;
- The desired level of investments in the research and development sector;
- Climate change and energy;
- The desired level of the number of school leavers;
- The desired reduction in social exclusion and the risk of poverty.

The Strategy's main indicators and their targets for 2020 are presented in the Table below. Please note that the targets are laid down as EU-averages, without indicators related to the area of poverty and social exclusion – the target for this indicator refers only to the EU27.

According to the guidelines of the Strategy, in 2020 the average employment rate in the population aged 20–64 should be at least 75%, and at least 3% of GDP should be invested in the research and development (R&D) sector throughout the EU. Both goals occupy a significant position in the Strategy goals. In the area of climate change and energy, the headline measures should satisfy the following guidelines[1]: in 2020 greenhouse gas emissions are to be reduced by 20% in comparison to 1990, the share of renewable energy sources in final energy consumption should increase up to 20%, and as a result energy efficiency should be improved by 20%. In the field of education, the Europe 2020 Strategy focuses on reduction of the share of early school leavers to 10% or less, and assumes that at least 40% of people aged 30–34 will have completed tertiary or an equivalent education by the end of 2020. The fight against poverty and social exclusion also occupies a very important place in the Strategy goals – the appropriate headline indicator is based on measuring the reduction of the poverty by lifting at least 20 million people out of the risk of poverty or social exclusion (calculated as a cumulative change in comparison to 2008 in the EU27).

The Figure below shows the development of selected headline indicators over 2010–2015.

[1] In accordance with Article 2 of the Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, the "primary energy consumption" means gross inland consumption, excluding non-energy uses, the "final energy consumption" should be understood as all energy supplied to industry, transport, households, services and agriculture (it excludes deliveries to the energy transformation sector and the energy industries themselves), the "energy efficiency" should be understood as the ratio of output of performance, service, goods or energy, to input of energy.

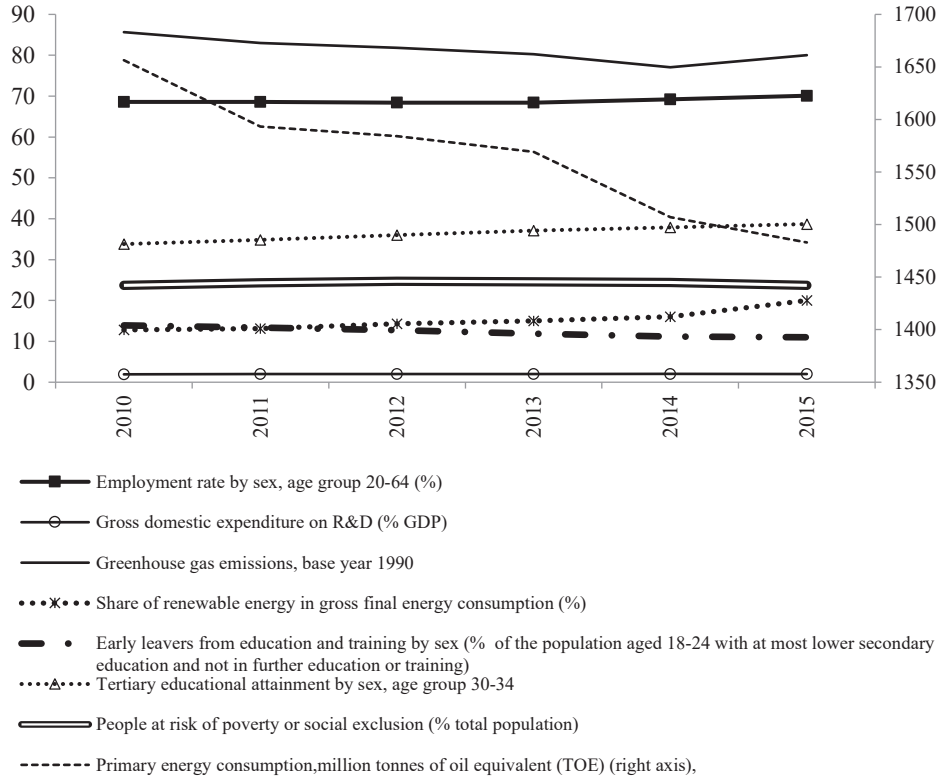


Figure 1. Selected headline indicators (EU level averaged) over 2010–2015

Source: Authors' own compilation based on Eurostat database.

As can be observed, over the 2010–2015 period the EU-averaged trend was decreasing in the case of greenhouse gas emissions (a decrease of indicator from 85.66 in 2010 to 80 in 2015), as well as in the case of early leavers from education and training (from 13.9% in 2010 to 11% in 2015). In 2015 the index for greenhouse gas emissions reached its target, while the indicator for early leavers was higher one percentage point above the goal. We can also observe a decline in the indicator for primary energy consumption. In 2010 the value of that headline indicator was 1656.4 (the peak year of the sample) and in 2015 it reached 1529.6, i.e., it was reduced by nearly 127 units (presented in million tonnes of oil equivalent). Moreover, increasing trends were observed in the cases of: the employment rate (in 2015 the EU-average was 70.1% – less than the target); while the indicator for tertiary educational attainment as a % of population aged 30–34 rose from 33.8% in 2010 up to 38.7% in 2015 (note that in 2020 this headline indicator should not be lower than 40%). In 2010 the indicator for the share of renewable energy in gross final energy consumption was 12.8% whereas in 2015 it was nearly 20%. It means that in the case of this indicator the target was achieved several years before 2020 (similar to the situation

in the case of the indicator for greenhouse gas emissions). Unfortunately investments in the R&D sector are still low. In 2000 in EU countries the average share of R&D expenditure as a % of GDP was 1.77%, in 2010 it was 1.93% of GDP, and in 2015 it was only slightly higher: 2.03%. In 2015, the highest share of R&D expenditure as a % of GDP was in Sweden (3.26%), Austria (3.07%), and Denmark (3.03%), and the lowest in Cyprus (0.46%), Romania (0.49%), and in Latvia (0.63%). In 2014, in 8 out of 28 EU countries the indicator was below 1% of GDP, and only in 9 out of 28 EU countries was it higher than 2% of GDP. Thus, it will probably be quite difficult to reach an average of 3% of GDP for the European Union in 2020.

The Table below presents more details. It shows the results for five EU headline targets measured by nine headline indicators over 2010–2014 (the latest dates for which data is available for all indicators). The data are presented in the context of the targets formulated for EU28 countries (without the indicator for measurement of poverty risk and social exclusion).

Table 2. Headline targets and headline indicators over 2010–2014 (EU28 average)

INDICATOR	2010	2011	2012	2013	2014	target
Employment rate – age group 20–64 (%)	68.6	68.6	68.4	68.4	69.2	75.0
Gross domestic expenditure on R&D (% of GDP)	1.93	1.97	2.01	2.02	2.03	3.0
Greenhouse gas emissions (index 1990 = 100)	85.89	83.25	82.1	80.45	**77.39**	80.0
Share of renewable energy in gross final energy consumption (%)	12.9	13.2	14.4	15.2	16.1	20.0
Primary energy consumption (million tonnes of oil equivalent – TOE)	1656.7	1594.2	1585.4	1569.9	1508.3	1483
Final energy consumption (million tonnes of oil equivalent – TOE)	1162.8	1105.6	1106.2	1105.5	**1059.6**	1086
Early leavers from education and training (% of population aged 18–24)	13.9	13.4	12.7	11.9	11.2[b]	10.0
Tertiary educational attainment (% of population aged 30–34)	33.8	34.8	36.0	37.1	37.9[b]	40.0
EU28 – People at risk of poverty or social exclusion (cumulative difference from 2008, in thousands)	448	3437	6384	5474	4680	target refers to EU27
EU27 – People at risk of poverty or social exclusion (cumulative difference from 2008, in thousands)	448	3374	6322	5524	4759	–20000

b=break in time series

Source: Authors' own compilation based on Eurostat database.

The improvement of the headline indicators can be observed. In case of two of them (greenhouse gas emissions index and indicator for final energy consumption measured in TOE units), the targets were achieved in 2014 (shaded cells in Table 2).

4. Data and methodology

Our sample consists of the 28 EU countries. We derive our headline indicators from the Eurostat database. In our study we focus on the following indicators:

X1 – employment rate, age group 20–64 (in %);
X2 – gross domestic expenditure on R&D (in % of GDP);
X3 – greenhouse gas emissions (index, base year 1990 i.e., 1990 = 100);
X4 – share of renewable energy in gross final energy consumption (in %);
X5 – primary energy consumption (in million tonnes of oil equivalent);
X6 – final energy consumption (in million tonnes of oil equivalent);
X7 – early leavers from education and training by sex (% of the population aged 18–24 with at most lower secondary education and not in further education or training);
X8 – tertiary educational attainment, age group 30–34 (in % of total population);
X9 – people at risk of poverty or social exclusion (as a % of total population).

The analysis is made for 2014 (being the most recent year for which data are available for all nine variables for all EU Member States). In our sample we replace the main indicator for poverty. Instead of the headline indicator expressed as a cumulative difference from 2008 in number of people at risk of poverty or social exclusion (see Table 1), we use an indicator measuring the number of people at risk of poverty or social exclusion as a % of total population. This variable is included as X9 variable in our set of variables.

We first built a correlation matrix and checked the results. According to this we decided to remove the indicator for final energy consumption due to its collinearity with indicator for primary energy consumption (between X5 and X6 the correlation coefficient is very high and positive and equals 0.99). Thus, our list of headline indicators has been shortened from the nine initially included to eight. The set of final variables is as follows: X1, X2, X3, X4, X5, X7, X8, and X9.

In Figure 1 we present the historical implementation of selected headline indicators averaged for the EU as a whole. However our goal is to find similarities between EU countries in reaching the strategy's goals. Taking into account the goal of our study we decide to employ cluster analysis. We used both hierarchical clustering and the k-means method in order to present more precise results of our study. In order to employ these approaches we needed to standardize our data so as to build clusters. For standardization, we used formula (1), as follows:

$$u_{ij} = \frac{x_{ij} - \overline{x_{ij}}}{s_{x_{ij}}} \tag{1}$$

where: – represents the value of the ith variable for the jth object (country) in the original data set, – is the mean of the ith variable for the jth object, – standard deviation of the ith variable for the jth object.

The goal of the agglomerative cluster is to join in clusters objects which are very similar. In general, the greater the distance between objects the lower is the similarity between them (see Domański 2011). In the case of agglomerative hierarchical clustering models, an initial partition of *N* clusters is formed (each object is a cluster) and next the number of those clusters is reduced until all *N* objects are in one cluster (see Mojena 1977 for details). Moreover, the k-means method is a kind of non-hierarchical method. It is based on finding the optimal structure of a cluster; however it is important to find the optimal k-number of clusters. In the case of k-means method the intra-group volatility is the lowest, but inter-group volatility is the highest (Stanisz 2007). In this approach the goal is to prepare the optimal classification of objects to the number of determined k-clusters (see Dziechciarz 2003).

At first we started with hierarchical clustering and used an agglomerative clustering. In this approach we used Ward's method (Ward 1963) and a squared Euclidian distance matrix. In our analysis we included all EU28 countries and all eight previously standardized variables. We used this agglomerative method in order to find the number of clusters, which we next employed as our k-number of clusters in our k-means algorithm.

5. Results and implications for Central and Eastern European countries

The common practice for presenting results of hierarchical clustering is to use a dendrogram. The result for our method of grouping units is presented in the figure below.

At first glance we can see two big clusters which consist of smaller groups of countries exhibiting similarities in implementing the Europe 2020 goals. However, it is difficult to find the proper point where the dendrogram should be divided. In practice there are several ways to find that point. One of them is to use the method based on the maximum difference in distance between the consecutive steps. When we employ this approach to our data, we obtain four clusters as a result (the division of our dendrogram should be made after 24th step). This approach gives us the following clusters:

1) Malta, Italy, Portugal, and Spain;
2) Latvia, Lithuania, Estonia, Croatia, Greece, Hungary, Romania, and Bulgaria;
3) Sweden, Austria, Finland, and Denmark;
4) United Kingdom, France, Germany, Cyprus, Poland, Luxembourg, Ireland, Slovakia, the Czech Republic, Slovenia, the Netherlands, and Belgium.

Taking into account the structure of clusters, we obtain two small and two big clusters. The last cluster No. 4 includes 12 out of the 28 EU countries. When we analyse

our clusters in more detail, then we can observe that these clusters are geographically linked. For example, the closer distance is observed in the following cases in each cluster (countries are neighbors): (1) Portugal, Spain, (2) Baltic countries: Latvia, Lithuania and Estonia and three CEE countries: Hungary, Romania, Bulgaria, (3) Scandinavian countries: Sweden, Finland, Denmark, (4) the Netherlands and Belgium as well as the group including UK, France, Germany, and Slovakia and the Czech Republic.

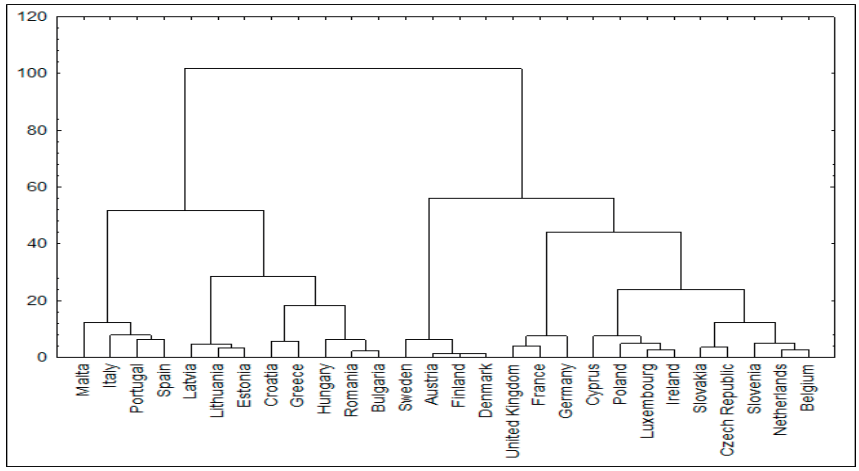


Figure 2. Dendrogram for the 28 EU countries

Source: Authors' own compilation.

Because of the fact that the obtained clusters are very 'big' and as a result heterogonous, we decided to use another method for division of the dendrogram. The alternative approach is based on the so-called Mojena's rule (1977), using the following formula:

$$\hat{d}_{h+1} > \bar{d} + k\, S(d) \tag{2}$$

where: – represents the value of the criterion in stage *j+1,* – is the mean, – parameter, – unbiased standard derivation.

As proposed by Stanisz (2007) and Milligan, Cooper (1985) we assume that *k* in the formula (2) equals 1.25. Then, according to our data the distance is calculated as follows:

$$\hat{d}_{h+1} > 16 + 1.25 \cdot 22.813 = 44.516 \tag{3}$$

Unfortunately, as a result of this approach we are able to obtain only three clusters, and with higher heterogeneity of our clusters. The structure of the new clusters is as follows:

1) Malta, Italy, Portugal, Spain, Latvia, Lithuania, Estonia, Croatia, Greece, Hungary, Romania, and Bulgaria;
2) Sweden, Austria, Finland, and Denmark;
3) United Kingdom, France, Germany, Cyprus, Poland, Luxembourg, Ireland, Slovakia, the Czech Republic, Slovenia, the Netherlands, and Belgium.

In order to extend our analysis we use a k-means method. As was mentioned, agglomerative clustering allows us to find the number of clusters which next will be used in the k-means approach. Taking into account the results from the hierarchical clustering based on the Ward's method, we assume the existence of four clusters. Due to the fact that the Moyena's rule gives us three clusters, we also prepare an alternative analysis with three clusters.

When we employ four clusters, we obtain the optimum structure of countries as follows:

1) Belgium, Germany, Ireland, France, Cyprus, Luxembourg, the Netherlands, Poland, and United Kingdom;
2) Spain, Italy, Malta, and Portugal;
3) the Czech Republic, Denmark, Estonia, Lithuania, Austria, Slovenia, Finland, and Sweden;
4) Bulgaria, Greece, Croatia, Latvia, Hungary, Romania, and Slovakia.

The figure below presents the significance of selected variables in creating optimal clusters for our countries. This analysis is very important because it makes it possible to recognize the impact of our set of variables on created clusters and differences between these clusters.

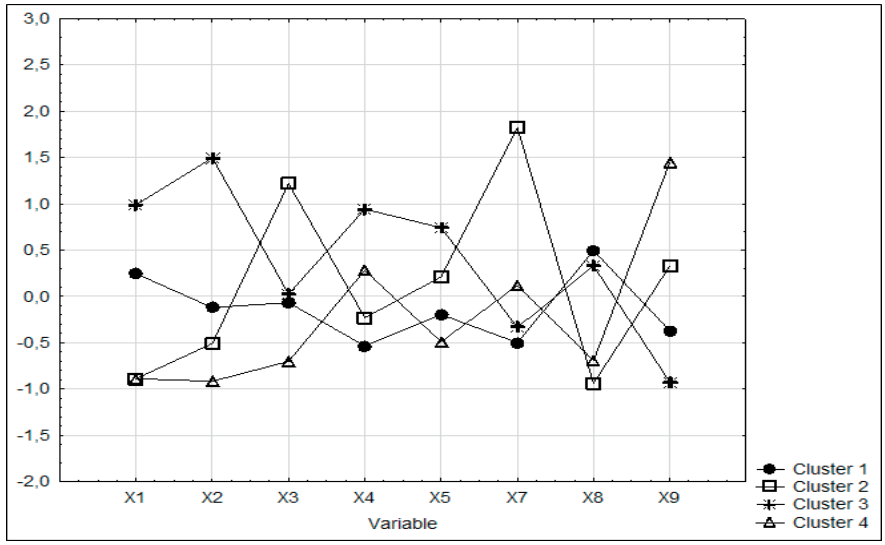


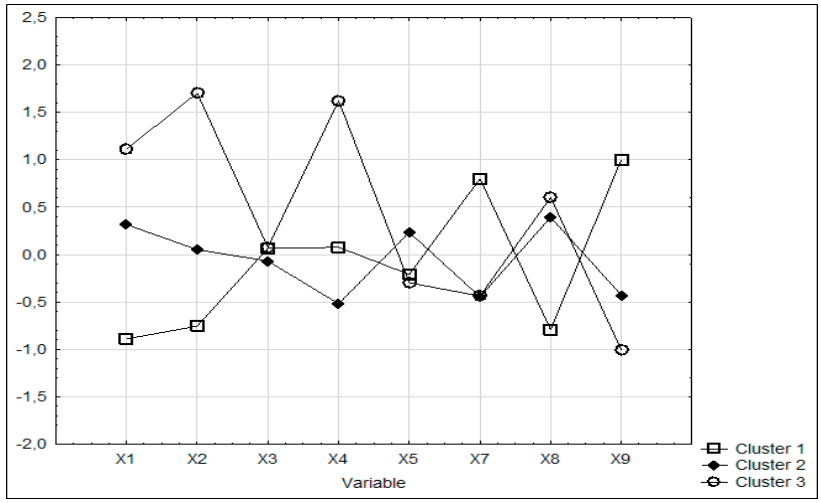
Figure 3. Means for each cluster (k=4)

Source: Authors' own compilation.

When we analyse the impact of our set of variables on the optimum division of countries between clusters (see Figure 3), we should emphasize the importance of variables X8, X9 and X1. The first cluster is influenced by a high values of variable X8 and variable X1; while the variables X4 and X7 have low values. The second cluster is influenced by high values for variables X7 and X3, and relatively low values of variables X1 and X8 (as opposed to the impact of these both variables in the case of cluster 1). In the case of cluster No. 3 variables X1, X2 and X4 have relatively high values; while in cluster No. 4 the variable X9 has the highest value out of the set of included variables.

The alternative approach is based on three clusters (as a result of a division made by Mojena's rule). This approach gives us the following structure of clusters:

1. Bulgaria, Greece, Spain, Croatia, Italy, Latvia, Hungary, Malta, Portugal, and Romania;
2. Belgium, the Czech Republic, Germany, Estonia, Ireland, France, Cyprus, Lithuania, Luxembourg, the Netherlands, Poland, Slovenia, Slovakia, and United Kingdom;
3. Denmark, Austria, Finland, and Sweden.



In the case of the analysis when k=3, the following variables have the most important impact on assigning countries to clusters (see Figure 4): cluster 1 – high value of variables X9 and X7; cluster No. 2 – high value of variables X8 and X5; and in the case of cluster No. 3 – relatively high values of variables X2, X4, X8 (as opposed to the values in cluster No 1, where those variables have low values).

Figure 4. Means for each cluster (k=3)

Source: Authors' own compilation.

As we can observe, in the case of k=3, the variables which most differentiate clusters are as follows: X1, X2, X4, X9 (i.e., employment rate, gross domestic expenditure on R&D as a share of GDP, the share of renewable energy in gross final

energy consumption, and people at risk of poverty or social exclusion, respectively). Moreover, the impact of variables X3 and X5 (index for greenhouse gas emissions and indicator for primary energy consumption, respectively) is quite low.

The results show the similarities between countries in reaching the Europe 2020 Strategy goals. We should acknowledge that the assumption about the point of the dendrogram's division has a large impact on the obtained results. This is very visible in the case of the k-means method, where an increase of our *k* only by one unit resulted in completely different outcomes. What's more, the analysis of k-means structure informs us about the different impact of variables in creating clusters.

Regardless of our division (three or four clusters), we can observe the difference between "old" and "new" EU countries. What is interesting, Greece in each variant of the analysis is included in the group of clusters containing the CEE countries. In our study Greece exhibits similarities with, e.g., Romania, Bulgaria, Croatia, Hungary or Latvia in the implementation of the Agenda 2020 goals. Poland, regardless of the number of k (k=3 or k=4), is included in the same group with e.g. Belgium, Germany, Ireland, France, Luxembourg, the Netherlands, or the UK. This means that Poland exhibits a convergence with some of the "old" EU countries from the point of view of reaching the targets of the Strategy. It should be noted that analysis of the impact of variables influencing the cluster (the cluster which includes Poland) shows that in each case the biggest impact on that cluster is the implementation of the employment rate and the number of people with tertiary education (see Figures 3 and 4).

In this study we also analysed the situation of selected CEE countries viewed against the background of the rest of the EU–28. The average differences in implementation of selected headline indicators between the EU–15 and EU–13 and eight CEE countries (i.e. Bulgaria, Croatia, Czech Republic, Hungary, Poland, Romania, Slovakia, and Slovenia) are presented in the Figure below.

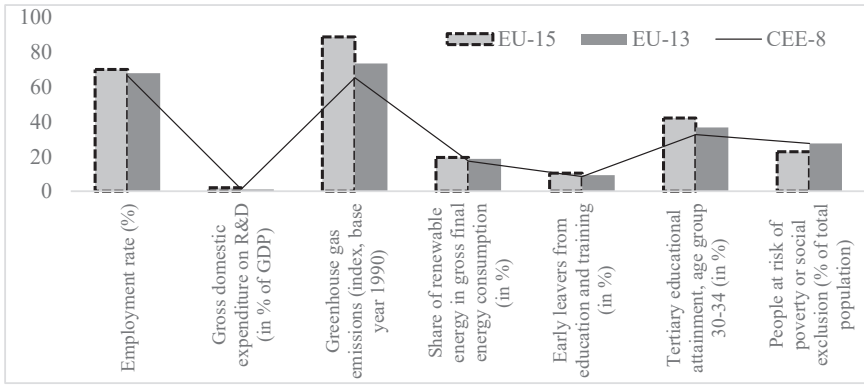


Figure 5. Average implementation of selected goals in 2014 in EU–15, EU–13 and CEE–8 countries

Source: Authors' own compilation based on Eurostat data.

As we can see, both groups of countries, on average, implemented the goals in a very similar way, although better performance can be observed in the EU–15 countries for most of the analysed indicators. When we analyse the situation in EU–13 countries in more detail, we can see that a high employment rate (more than 70%) prevailed in the Baltic countries (Lithuania, Latvia, and Estonia), and that the goal of more than a 3% share of R&D expenditure in GDP has not been achieved in these countries. The implementation of the goals for the employment rate, early leavers from school, and greenhouse gas emission was very similar (on average) for both the EU–15 and EU–13. However the risk of poverty or social exclusion was higher in EU–13 and CEE–8. The indicators for CEE–8 countries were generally worse than those for the EU–13.

In general, our study demonstrates the same direction of changes in the implementation of headline indicators among the EU–28; however there is a disproportion between individual countries. This study shows that countries with similar levels and progress in the implementation of the Strategy's goal create clusters.

6. Conclusions

The aim of this paper is to analyse the implementation of the Europe 2020 Strategy's goals and to investigate the similarities between European Union countries. The results of our study show that there is a convergence between the EU–15 and EU–13 countries in the implementation of the Europe 2020 Strategy goals; however our algorithm shows that individual countries create smaller clusters. Despite the similar trend in the implementation of indicators, we can observe a few clusters. For each cluster, by using k-means algorithm we were able to investigate the impact of selected headline indicators on creating their optimal structure. According to our analysis, in the cases of Romania, Bulgaria, Croatia, Hungary, Latvia or Greece the highest impact on clustering is provided by the share of renewable energy in gross final energy consumption (in %) and the share of people being at risk of poverty or social exclusion. In the case of the cluster for the Scandinavian countries and Austria, the highest impact on clustering is investments in the R&D sector and the share of renewable energy in gross final energy consumption, However, the lowest impact is related to the shares of risk of poverty or social exclusion. When we compare EU-averaged data in 2014 with the targets for 2020, we can conclude that better performances were related to the implementation of "ecological" goals such as renewable energy in gross final energy consumption and greenhouse gas emissions. The worst situation was in the case of indicator for investments into the R&D sector, where it will most likely be difficult to reach the sought-after average of 3% of GDP throughout the whole European Union in 2020.

Our study shows that countries with a similar progress in the implementation of the Strategy's goals create clusters; however their structure shows us that these clusters are quite similar to the division into the "old" and the "new'' EU countries.

References

Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC, Official Journal of the European Union, L 315/1.

Domański Cz. (ed.), Białek J., Bolonek-Lasoń K., Mikulec A. (2011), *Nieklasyczne metody oceny efektywności i ryzyka. Otwarte fundusze emerytalne*. PWE, Warszawa.

Dziechciarz J. (ed.) (2003), *Ekonometria. Metody, przykłady, zdania*. Wydawnictwo Akademii Ekonomicznej im. Oskara Langego we Wrocławiu, Wrocław.

European Commission (2010), *EUROPE 2020. A Strategy for Smart, Sustainable and Inclusive Growth*, Communication from the Commission, Brussels, 3.3.2010.

European Commission (2010b), *Lisbon Strategy Evaluation Document*. SEC (2010) 114 final. Brussels. 2 February 2010.

European Commssion (2012), *The European Union Explained: Europe 2020: Europe's Growth Strategy*, European Commission, Belgium.

European Council (2000), Lisbon European Council 23 and 24 March 2000 Presidency Conclusions.

European Council (2008), Presidency Conclusions. 7652/1/08 REV 1. Brussels. 13–14 March 2008.

European Council (2010c), Council of the European Union. Council Conclusions on Europe 2020, 7586/2010, Brussels, 16 March 2010.

Eurostat (2016), *Smarter, Greener, More Inclusive? – Indicators to Support the Europe 2020 strategy,* Eurostat.

Milligan G.W., Cooper M.C. (1985), *An Examination of Procedures for Determining the Number of Clusters in a Data Set,* 'Psychometrika', Volume 50, Issue 2, pp. 159–179

Mojena, R. (1977), *Hierarchical Grouping Methods and Stopping Rules; An Evaluation*, 'Computer Journal', No. 20, 359–363.

Natali D. (2010), *The Lisbon Strategy, Europe 2020 and the Crisis in Between* [in:] E. Marlier, D. Natali (eds.), *Europe 2020: Towards a More Social EU?* P.I.E. Peter Lang, Brussels.

Stanisz A. (2007), *Przystępny kurs statystyki z zastosowaniem STATISTICA PL na przykładach z medycyny. Tom 3 – Analizy wielowymiarowe*, StatSoft, Kraków.

Ward J. H. (1963), *Hierarchical Grouping to Optimize an Objective Function*, 'Journal of the American Statistical Association', 58, 236–244.

Streszczenie

W KIERUNKU CELÓW STRATEGII EUROPA 2020: KONWERGENCJA CZY DYWERGENCJA KRAJÓW UNII EUROPEJSKIEJ?

Celem artykułu jest zbadanie podobieństwa krajów Unii Europejskiej pod kątem realizacji celów strategii Europa 2020. Z uwagi na dostępność danych, analizę oparto na realizacji wskaźników za 2014 r. W badaniu posłużono się metodami grupowania obiektów, w tym metodą k-średnich. Uzyskane wyniki wskazują na podział krajów z wyraźną dominacją podziału na kraje starej i nowej Unii Europejskiej. Jak pokazuje analiza część założonych celów już została osiągnięta, część zbliża się do wartości ustalonych celów, podczas gdy np. realizacja celu dla wskaźnika wydatków na badania i rozwój wyrażonych jako ich udział w PKB jest niepewna. Średnie wykonanie w zakresie głównych wskaźników dla krajów UE–15 i UE–13 wydaje się być zbliżone i o podobnym trendzie.

***Słowa kluczowe**: Strategia Europa 2020, analiza skupień, Unia Europejska*