Institute of Economic Research Working Papers

No. 123/2015

Europe 2020 Strategy Implementation. Grouping the Countries with the Application of Natural Breaks Method

Adam P. Balcerzak

The paper submitted to 8th INTERNATIONAL CONFERENCE ON APPLIED ECONOMICS CONTEMPORARY ISSUES IN ECONOMY under the title MARKET OR GOVERNMENT?, Institute of Economic Research and Polish Economic Society Branch in Toruń, 18-19 June 18-19, 2015, Toruń, Poland. Quoting:

Balcerzak, A. P. (2015). Europe 2020 Strategy Implementation. Grouping the Countries with the Application of Natural Breaks Method. In A. P. Balcerzak (Ed). *Proceedings of the 8th International Conference on Applied Economics Contemporary Issues in Economy under the title Market or Government? 18-19 June 2015, Economics and Finance*, Toruń: Institute of Economic Research, Polish Economic Society Branch in Toruń, pp. 172-181.

Toruń, Poland 2015

Adam P. Balcerzak
adam.balcerzak@umk.pl
Nicolaus Copernicus University

Europe 2020 Strategy Implementation. Grouping the Countries with the Application of Natural Breaks Method

ABSTRACT. In the year 2015 the European Union reaches the five year period of Europe 2020 strategy implementation. Thus, the aim of the research is to group the European countries based on the level of fulfillment aims of the strategy with the application of natural breaks method. Special consideration was given to the results of New Member States of European Union. As a result in the first part of empirical research a ranking of EU countries with application of zero unitarization method for the year 2004, 2008 and 2013 was made. Based on the rankings the countries were grouped in five classes with natural breaks method. The analysis showed that in spite of economic difficulties in Europe after global financial crisis, from the year 2004 till the year 2013 New Member States had made an important progress in the implementation of Europe 2020 strategy.

Keywords: Europe 2020 strategy, multivariate analysis, zero unitarization method, natural breaks method

JEL classification: C00, E61, O52

Introduction

In the year 2015 the European Union has reached the halfway of implementation of Europe 2020 strategy, which should result in building the conditions for sustainable and inclusive economy delivering high levels of employment, productivity and social cohesion. The strategy is based on three mutually reinforcing priorities: a) Smart growth: developing an economy based on knowledge and innovation; b) Sustainable growth: promoting a more resource efficient, greener and more competitive economy; c) inclusive growth: fostering a high-employment economy delivering social and territorial cohesion (European Commission 2010, p. 3).

Europe 2020 is a continuation of the Lisbon Strategy. With its implementation Europe was aiming at "becoming the most competitive and dynamic economy in the world; based on knowledge, capable of sustainable economic growth with more and better jobs and greater social cohesion" (see. Royuela-Mora et al., 2005, p. 54-58; Lenain 2005, pp. 9-31). The Lisbon Strategy was adopted during the economic changes associated with development of the global knowledge-based economy (see. Balcerzak 2009, p. 3-22).

The aim of the paper is to analyze the fulfillment of the goals of Europe 2020 strategy from the perspective of the years 2004-2013 with special consideration to the progress obtained by ten New Member States.

The first year of the analysis is the year of the biggest European Union enlargement, which can be considered as the most significant institutional change in Central and Eastern Europe. In the same time it is the first year of the availability of the data for all the specific diagnostic variables for reaching targets of Europe 2020. The year 2013 is the last year when the data is available.

This article is a continuation of the research on the realization of Lisbon strategy made in the year 2008 (Balcerzak et al., 2008, pp. 77-88) and refers to the further research, which was aimed at evaluation of "starting position" of Poland in the context of Europe 2020 (Balcerzak 2011, pp. 31-41, Balcerzak 2015, pp. 343-352).

Method of dynamic taxonomic research

European Commission has proposed the following headline targets for Europe 2020 Strategy (Europe 2020…, 2010, p. 3; Balcerzak 2011, pp. 31-41):

a) 75 % of the population aged 20-64 should be employed.
b) 3% of the EU's GDP should be invested in R&D.
c) The "20/20/20" climate/energy targets should be met (including an increase to 30% of emissions reduction if the conditions are right).
d) The share of early school leavers should be under 10% and at least 40% of the younger generation should have a tertiary degree.
e) 20 million less people should be at risk of poverty.

The problem of fulfillment these aims should be considered as a complex phenomenon. As a result, in order to evaluate the progress of European Union member states a classic taxonomic approach for organizing and sharing of objects was applied based on normalization of variables with zero unitarisation method (Kukuła 2000, pp. 7-16; Kukuła, Bogocz 2014, pp. 5-13). In the research a constant reference point for the years 2004-2013 was used[1].

The method allows to create rankings of countries. Based on the method it is possible to group the countries into five classes: a) countries with very high level of synthetic measure of fulfillment aims of the strategy; b) countries with a high position; c) the countries with an average position; d) countries with low position; e) countries with very low position in the sphere of reaching the targets of Europe 2020 strategy. For this purpose the method of natural breaks (Jenks optimization method) was applied. The idea of natural breaks method consists of minimization of variance for objects from the chosen subsets and maximization of variance between the subsets (Jenks, 1967, pp. 186-190). The division of object into subsets gives the possibility for obtaining relatively homogeneous classes of objects in terms of the level of development of the analyzed phenomenon (see Balcerzak, Pietrzak 2014a, 2014b). The grouping procedure was applied for three years: 2004, 2004 and 2013.

In the research the data form Eurostat was used (Europstat, Europe 2020 indicators, http://ec.europa.eu/eurostat/data/database, 15.03.2015).

The fulfillment of headline targets is monitored with the following specific diagnostic criteria:

Target 1. 75 % of the population aged 20-64 should be employed

x_{1t} – Employment rate of females – age group 20-64 (% of the population);
x_{2t} – Employment rate of males – age group 20-64 (% of the population);

Target 2. 3% of the EU's GDP should be invested in R&D.

x_{3t} – *Gross domestic expenditure on R&D (% of GDP)*
Target 3. The "20/20/20" climate/energy targets should be met (including an increase to 30% of emissions reduction if the conditions are right)

x_{4t} – Greenhouse gas emissions, base year 1990;
x_{5t} –Share of renewable energy in gross final energy consumption;
x_{6t} – Intensity of energy consumption estimated final energy consumption in millions tons of oil equivalent in relations to GDP;

[1] The research for Europe 2020 and Lisbon Strategy with changeable reference points for different years can be found in the following papers: Balcerzak et al., (2008, pp. 77-88, 2011, pp. 31-41; 2015, pp. 343-352), Olczyk (2014, pp. 21-43), Baležentis (et al. 2011, pp. 6-21).

Target 4. The share of early school leavers should be under 10% and at least 40% of the younger generation should have a tertiary degree

x_{7t} – Early leavers from education and training – females – % of the population aged 18-24 with at most lower secondary education and not in further education or training;
x_{8t} – Early leavers from education and training – males – % of the population aged 18-24 with at most lower secondary education and not in further education or training;
x_{9t} – Tertiary educational attainment – females – age group 30-34;
x_{10t} – Tertiary educational attainment – females – age group 30-34;

Target 5. 20 million less people should be at risk of poverty

x_{11t} – People at risk of poverty or social exclusion – percentage of total population;
x_{12t} – People living in households with very low work intensity – percentage of total population;
x_{13t} – People at risk of poverty after social transfers – percentage of total population;
x_{14t} – Severely materially deprived people – percentage of total population;

Among the diagnostic variable one can find both benefit (x_{1t}, x_{2t}, x_{3t}, x_{5t}, x_{9t}, x_{10t}), and negative variables (x_{4t}, x_{6t}, x_{7t}, x_{8t}, x_{11t}, x_{12t}, x_{13t}, x_{14t}). The stimulants were normalized with the formula 1 and the destimulants with the formula 2.

$$z_{ijt} = \frac{x_{ijt} - \min\limits_{it}\{x_{ijt}\}}{\max\limits_{it}\{x_{ijt}\} - \min\limits_{it}\{x_{ijt}\}} \qquad (1)$$

$$(i = 1, 2 \ldots n);\ (j = 1, 2 \ldots m);\ (t = 1, 2 \ldots l),\ z_{ij} \in [0, 1]$$

$$z_{ijt} = \frac{\max\limits_{it}\{x_{ijt}\} - x_{ijt}}{\max\limits_{it}\{x_{ijt}\} - \min\limits_{it}\{x_{ijt}\}} \qquad (2)$$

$$(i = 1, 2 \ldots n);\ (j = 1, 2 \ldots m),\ (t = 1, 2 \ldots l),\ z_{ij} \in [0, 1]$$

Assessment of the variable that characterizes the objects – a synthetic measure SM_{it} – was obtained with the formula 3.

$$SM_{it} = \frac{1}{m}\sum_{j=1}^{m} z_{ijt} \qquad (3)$$

$$(i = 1, 2 \ldots n);\ (j = 1, 2 \ldots m);\ (t = 1, 2 \ldots l);\ SM_i \in [0, 1];\ z_{ij} \in [0, 1]$$

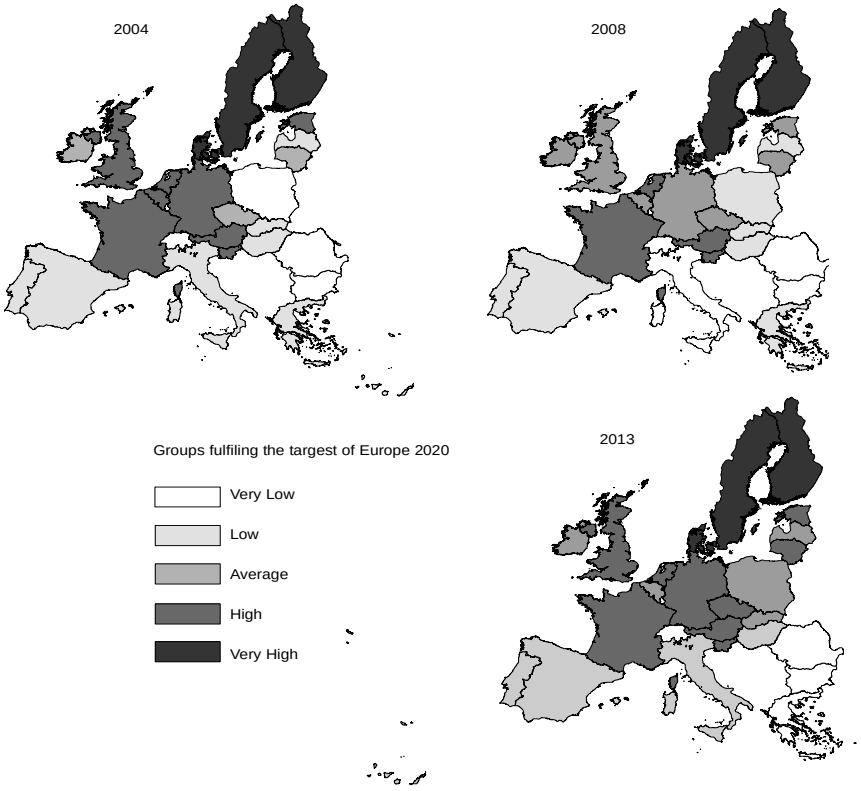
The result of the research is presented in table 1 and in figures 1 and 2.

Table 1. The result of multivariate analysis of fulfilment targets of Euro 2020 strategy in the years 2004, 2008 and 2013

	2004			2008			2013		
No	**Country**	**SM**	**Group**	**Country**	**SM**	**Group**	**Country**	**SM**	**Group**
1	Sweden	0,8012	A	Sweden	0,8715	A	Sweden	0,8814	A
2	Finland	0,7768	A	Finland	0,8209	A	Finland	0,8117	A
3	Denmark	0,7643	A	Denmark	0,7746	A	Denmark	0,8047	A
4	Slovenia	0,6716	B	Netherlands	0,7308	B	Netherlands	0,7444	B
5	Netherlands	0,6631	B	France	0,7045	B	Estonia	0,7440	B
6	France	0,6598	B	Slovenia	0,7026	B	Slovenia	0,7290	B
7	Austria	0,6434	B	Estonia	0,6969	B	France	0,7261	B
8	Germany	0,6242	B	Lithuania	0,6904	B	Austria	0,7208	B
9	Estonia	0,6136	B	Austria	0,6693	B	Germany	0,7114	B
10	United Kingdom	0,6133	B	Ireland	0,6602	C	Lithuania	0,7041	B
11	Belgium	0,6105	B	Belgium	0,6560	C	Czech Republic	0,6972	B
12	Ireland	0,5880	C	Germany	0,6534	C	United Kingdom	0,6861	B
13	Czech Republic	0,5731	C	United Kingdom	0,6414	C	Belgium	0,6776	C
14	Lithuania	0,5599	C	Czech Republic	0,6285	C	Latvia	0,6651	C
15	Latvia	0,5091	D	Latvia	0,6018	D	Poland	0,6404	C
16	Spain	0,5066	D	Slovakia	0,5892	D	Ireland	0,6279	C
17	Hungary	0,4967	D	Poland	0,5683	D	Slovakia	0,6181	C
18	Slovakia	0,4907	D	Spain	0,5592	D	Portugal	0,5764	D
19	Greece	0,4896	D	Portugal	0,5382	D	Hungary	0,5613	D
20	Portugal	0,4674	D	Hungary	0,5305	D	Spain	0,5271	D
21	Italy	0,4525	D	Greece	0,5194	E	Italy	0,5215	D
22	Poland	0,4250	E	Italy	0,5033	E	Romania	0,4815	E
23	Romania	0,3815	E	Bulgaria	0,4712	E	Bulgaria	0,4665	E
24	Bulgaria	0,3417	E	Romania	0,4305	E	Greece	0,4661	E

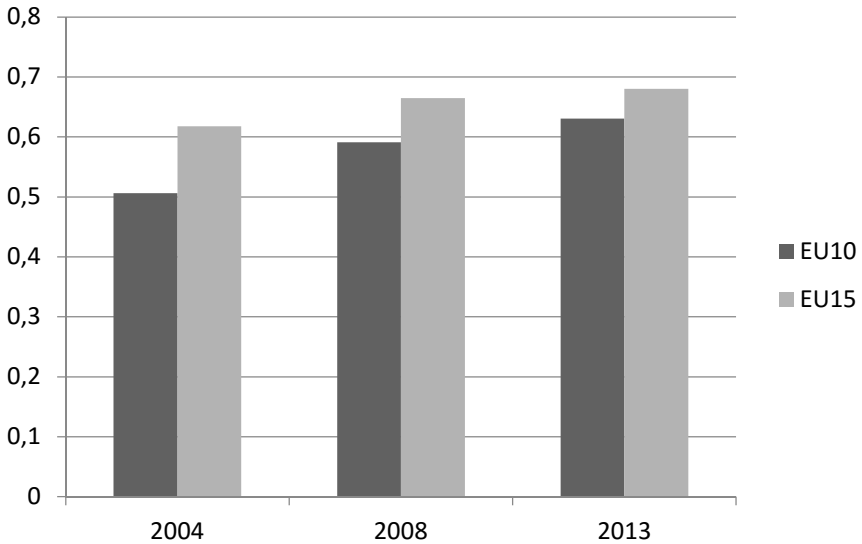
Source: own estimation based on Eurostat data: http://ec.europa.eu/eurostat/data/database (15.03.2015).

Figure 1. Grouping of the countries with natural breaks method in the years 2004, 2008 and 2013



Source: own estimation based on Eurostat data: http://ec.europa.eu/eurostat/data/database (15.03.2015).

Figure 2. The average level of fulfilment targets of Euro 2020 strategy in case of EU10 and EU15 in the years 2004, 2008, 2013



Source: own estimation based on Eurostat data: http://ec.europa.eu/eurostat/data/database (15.03.2015).

Figures 1 and 2 show significant heterogeneity between New and Old Member States in the beginning of the analysis. However, during the following years the NMS reached an important progress in reducing the gap to the Old Member States of the European Union. In 2004 the average value of synthetic measure for fulfillment the Europe 2020 targets for EU-10 was equal to almost 82% of the average value reached by EU-15. In the year 2013 this relation reached 92%. Also very good results of Baltic countries or Czech Republic with grouping in the same clusters with Old Members states, can be considered as significant success.

Conclusions

The analysis confirms existing diversity between Old EU members and NMS in the sphere of reaching all the targets of Europe 2020 strategy. However, the research also points that since 2004 till 2013 NMS achieved significant progress and managed to reduce the gap to EU15 by half. When one concentrates on the results of most important economies of Eurozone the research shows rather moderate progress made by Germany and very weak results of Italy, which is analogues to the results obtained by these economies at the halfway of implementation of Lisbon strategy in the period 2000-2005 (Balcerzak et al. 2008, pp. 77-88). Taking into consideration the leading political and economic role of these economies, their lack of significant progress for almost last ten years shows the scale of structural problems of the EU.

References

Balcerzak, A.P. (2015), *Wielowymiarowa analiza spójności społecznej w krajach Unii Europejskiej w kontekście strategii Europa 2020*, In: B. Bartniczak, K. Trzeciak (ed.), *Aktualne trendy w zarządzaniu środowiskiem*, Wydawnictwo AD REM, Jelenia Góra, pp. 343-352.

Balcerzak, A.P. (2011), Pozycja Polski w kontekście planu Europa 2020: analiza z wykorzystaniem metod porządkowania liniowego, *Zeszyty Naukowe Wydziałowe Uniwersytetu Ekonomicznego w Katowicach – Studia Ekonomiczne*, nr 81, pp. 31-41

Balcerzak, A.P., (2011), Taksonomiczna analiza jakości kapitału ludzkiego w Unii Europejskiej w latach 2002-2008, *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu, Taksonomia 18 Klasyfikacja i analiza danych – teoria i zastosowania*.

Balcerzak, A.P., Pietrzak, M.B. (2015), Are New EU Member States Improving Their Institutional Effectiveness for Global Knowledge-based Economy? TOPSIS Analysis for the Years 2000-2010, Institute of Economic Research Working Papers, No 16/2014, Indexed in REPEC EconPapers: http://econpapers.repec.org/paper/peswpaper/2014_3ano16.htm.

Balcerzak, A.P., Pietrzak, M.B. (2014), Efektywność instytucjonalna krajów Unii Europejskiej w kontekście globalnej gospodarki opartej na wiedzy, Institute of Economic Research Working Papers, No 17/2014, Indexed in REPEC EconPapers: http://econpapers.repec.org/paper/peswpaper/2014_3ano17.htm.

Balcerzak, A.P., Górecka, D. andRogalska, E. (2008), Taksonometryczna analiza realizacji Strategii Lizbońskiej w latach 2001-2005, *Wiadomości Statystyczne*, 6, pp. 77- 88.

Baležentis, A., Baležentis, T. and Brauers, W.K.M. (2011), Implementation of the Strategy Europe 2020 by the multi-objective evaluation method Multimoora, *E&M Ekonomie a Management*, 2.

European Commission (2010), Europe 2020 A strategy for smart, sustainable and inclusive growth, Communication from the commission, Brussels, 3.3.2010 COM(2010) 2020.

Eurostat, Europe 2020 indicators, http://ec.europa.eu/eurostat/data/database.

Lenain, P., (2005), *Strategia Lizbońska na półmetku – Jak poprawić wyniki gospodarcze Europy?* In: Lenain P., Mogensen U.B., Royuela-Mora V. (eds), *Strategia Lizbońska na półmetku: oczekiwania a rzeczywistość*, Raporty CASE, 58/2005, Warszawa: Centrum Analiz Społeczno-Ekonomicznych, pp. 9-31.

Jenks, GF. (1967), The Data Model Concept in Statistical Mapping, *International Yearbook of Cartography*, 7, pp. 186-190.

Kukuła, K. (2000), *Metoda unitaryzacji zerowej*, Warszawa: Wydawnictwo Naukowe PWN.

Kukuła K., Bogocz, D. (2014), Zero Unitarisation Method and its Application in Ranking Research in Agriculture, *Economic and Regional Studies*, 7(3), pp. 5-13.

Olczyk, M. (2014). Structural Heterogeneity Between EU 15 and 12 New EU Members – the Obstacle to Lisbon Strategy Implementation?, *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 9(3), pp. 21-43, DOI: http://dx.doi.org/10.12775/EQUIL.2014.023.

Royuela-Mora V., Moreno R., Vaya E. (2005), *Monitorowanie celów Strategii Lizbońskiej*. In: Lenain P., Mogensen U.B., Royuela-Mora V. (eds.), *Strategia Lizbońska na półmetku: oczekiwania a rzeczywistość*, Raporty CASE, nr 58/2005, Warszawa: Centrum Analiz Społeczno-Ekonomicznych, pp. 54-58.