Median classification of the European Union countries regarding the level of selected strategic goals' implementation – dynamic approach

Małgorzata Markowska[1], Danuta Strahl[2]

Abstract

Europe 2020 is the strategy covering the united Europe, in force for the current planning period (2010–2020). It is a strategy for smart, sustainable and inclusive growth (Europe 2010). This plan adopted three priorities: smart development, sustainable development and inclusive growth. The goals for each EU country, set in the National Reform Programme, were adopted to be implemented by these countries until 2020, based on socio-economic conditions and following negotiations with the European Commission.

The purpose of the study is to identify similar groups of countries regarding the level of the EU strategic goals' implementation in terms of smart development by applying the median classification and using the dynamic approach. The assessment period – taking into account the statistical data availability – covers the years 2010–2017, and the indicators used are: employment rate in the age group 20–64, the percentage of tertiary education graduates in the group.

Keywords: *Europe 2020, strategic goals, smart growth, the EU countries*
JEL Classification: *C19, F63, O52*

1. Introduction

Europe 2020. A European strategy for smart, sustainable and inclusive growth (Europe, 2010) is a strategy of the united Europe binding during the present decade, and includes three related priorities (Europe, 2010): smart growth: developing an economy based on knowledge and innovation; sustainable growth: promoting a more resource efficient, greener and more competitive economy; inclusive growth: fostering a high-employment economy delivering social and territorial cohesion.

For each of the priorities being implemented under the strategy, indicators were assigned for the purpose of assessment. It is expected that by 2020 the following levels of the indicators will be achieved (Europe, 2010):

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

[1] Wroclaw University of Economics, Department of Regional Economy, 118/120 Komandorska St., 53-345 Wroclaw, Poland, malgorzata.markowska@ue.wroc.pl.

[2] WSB University in Dabrowa Gornicza, Department of Management, 1c Cieplaka St., 41-300 Dabrowa Gornicza, dstrahl@wsb.edu.pl

The values given relate to the European Union as a whole. At the same time, each EU country committed itself in the National Reform Programme (NRP) to implement national goals, resulting from socio-economic conditions. Common "efforts" of the EU countries make up the ability to achieve the EU goals.

The aim of this study is to determine groups of countries similar to each other regarding the degree of implementation of the EU objectives in the scope of one of the priorities, i.e. smart development using the median classification – in the dynamic approach.

2. Method

Estimates of the level of full filling strategic goals are important issues for researchers. New measures are proposed (Pasimeni, 2013; Pasimeni and Pasimeni, 2016; Markowska, 2019), classifications performed (Stec and Grzebyk, 2018; Fura et al., 2017), and composite measures calculated (Hudrliková, 2013).

The method of classification described in the works by D. Strahl (Markowska and Strahl, 2003, Strahl, 2002) will be used to accomplish the principal purpose of the paper. The classification based on positional statistics, allows for value judgements. Multidimensional phenomena which are subjected to grouping can be described with a set of characteristics – variables. These variables are assigned to objects constituting sets. A data matrix is created, illustrating a selected phenomenon characterised by a set of m variables, marked with the symbols $X = \{X_1, ..., X_m\}$, observed on the objects of the study. For each variable X_j ($j = 1, 2, \ldots, m$) the median, i.e. the middle value will be calculated. Below and above the median there is 50% of the realisation of the variable.

The proposed classification procedure includes two variants: in the first of them a classification algorithm leads to the construction ($m + 1$) of classes, in the second – to the construction of 2^m classes of possible combinations with m-variables, $m > 1$. The latter option may be applied when we want to consider several possible assessments to support the decision-making process (Markowska and Strahl, 2003).

In the first variant, the first class (S_1) contains these objects for which the values of all m variables X_j are equal to or higher than the median (maintaining the preference direction). The second class (S_2) includes objects whose values of $m - 1$ variables are equal to or higher than the median. The S_m class consists of objects for which the value of only one variable X_j from the set X is equal to or higher than the median. The S_{m+1} class includes these objects for which all variables are lower than the median.

In the second variant, S_1 class includes these objects from the set, for which the values of all m variables X_j are equal to or higher than the median. The S_2 class contains these objects from the set, for which the values of only ($m - 1$) variables constituting one of the combinations $\binom{m}{m-1}$ are equal to or higher than the median. In the third class (S_3) there are objects for which the values of variables of the next ($m - 1$)-element combination are equal to or higher than the median. Having exhausted ($m - 1$)-element combinations we create classes for ($m - 2$)-element

combinations and set a condition that they are equal to or higher than the median. We create S_g ($g = 2^m$) class, comprising objects for which the values x_{kj} of all variables X_j are lower than the median.

3. Variables

For the purpose of the work, it was assumed that (Europe 2020) smart development is based on obtaining positive effects in the field of education, research and innovation and the effective use of ICT techniques. With regard to both the given definition and the goals included in the Europe 2020 strategy, it was decided that the numerical illustration of the concept of smart development should include the following characteristics (EARLY – destimulant, the others are stimulants):

- EMPLO – employment rate in the 20–64 age group,
- TERTIARY – participation of people with higher education in the 30–34 age group,
- EARLY – early leaver from education and training, previously named early school leaver, refers to a person aged 18 to 24 who has completed at most lower secondary education and is not involved in further education or training; the indicator 'early leavers from education and training' is expressed as a percentage of the people aged 18 to 24 with such criteria out of the total population aged 18 to 24,
- BR_GDP – expenditures on R&D in relation to GDP.

Table 1 presents the target values of indicators set in the NRP, while table 2 shows the values of characteristics and basic statistics for the years 2010–2017.

Table 1. Target values of the indicators – EU and national goals

Country (acronym)	EMPLO	BR_GDP	EARLY	TERTIARY
the European Union (EU)	75.0	3.00	10.0	40.0
Austria (AT)	77.0	3.76	9.5	38.0
Belgium (BE)	73.2	3.00	9.5	47.0
Bulgaria (BG)	76.0	1.50	11.0	36.0
Cyprus (CY)	75.0	0.50	10.0	46.0
Czech (CZ)	75.0	1.00	5.5	32.0
Germany (DE)	77.0	3.00	10.0	42.0
Denmark (DK)	80.0	3.00	10.0	40.0
Estonia (EE)	76.0	3.00	9.5	40.0
Greece (EL)	70.0	1.20	10.0	32.0
Spain (ES)	74.0	2.00	15.0	44.0
Finland (FI)	78.0	4.00	8.0	42.0

Country (acronym)	EMPLO	BR_GDP	EARLY	TERTIARY
France (FR)	75.0	3.00	9.5	50.0
Croatia (HR)	62.9	1.40	4.0	35.0
Hungary (HU)	75.0	1.80	10.0	34.0
Ireland (IE)	69.0	2.00	8.0	60.0
Italy (IT)	67.0	1.53	16.0	26.0
Lithuania (LT)	72.8	1.90	9.0	48.7
Luxembourg (LU)	73.0	2.30	10.0	66.0
Latvia (LV)	73.0	1.50	10.0	34.0
Malta (MT)	70.0	2.00	10.0	33.0
Netherlands (NL)	80.0	2.50	8.0	40.0
Poland (PL)	71.0	1.70	4.5	45.0
Portugal (PT)	75.0	2.70	10.0	40.0
Romania (RO)	70.0	2.00	11.3	26.7
Sweden (SE)	80.0	4.00	7.0	45.0
Slovenia (SI)	75.0	3.00	5.0	40.0
Slovakia (SK)	72.0	1.20	6.0	40.0
United Kingdom (UK)	x	x	x	x
Maximum (country)	80 (SE, NL, DK)	4 (SE, FI)	16 (IT)	66 (LU)
Minimum (country)	62.9 (HR)	0.5 (CY)	4 (HR)	26 (IT)

S – standard deviation, V – coefficient of variation, x – a lack of goal in the National Reform Programme (NRP)
Source: own elaboration on the basis of data (https://ec.europa.eu/eurostat/web/europe-2020-indicators/europe-2020-strategy/overview)

When analysing national goals and their extreme values it is interesting to note that for example in Italy the high percentage of students leaving the education is accompanied by a low share of young people with higher education while in Croatia the lowest level of the goal related to the employment rate is accompanied by the lowest rate of early leavers from education.

The values of characteristics selected to assess the level of smart development in the EU countries were changing in the analysed period: mean values – of the analysed characteristics improved, as far as EU goals are concerned, minimum values in the EU countries decreased for EMPLO and increased for other characteristics, maximum values decreased for BR_GDP and increased for other characteristics, standard deviation was stable for two characteristics (EMPLO, BR_GDP) and decreased for others (EARLY, TERTIARY).

In order to achieve the aim of the work – grouping countries according to the degree of implementation of the smart development goals – it was necessary to determine for the EU

countries differences between the values of variables and the objectives: the EU objectives from the Europe 2020 strategy (2010) and national objectives from the NRP. Therefore, the following variables have been specified:

A_UE – difference between the value of the EMPLO and the values of the EU goal,
B_UE – difference between the value of the TERTIARY and the value of the EU goal,
C_UE – difference between the value of the EU goal and the value of the EARLY,
D_UE – difference between the value of the BR_GDP and the value of the EU goal.
and
A_ country – difference between the value of the EMPLO and the value of the NRP goal,
B_ country – difference between the value of the TERTIARY and the value of the NRP goal,
C_ country – difference between the value of the NRP goal and the value of the EARLY,
D_ country – difference between the value of the BR_GDP and the value of the NRP goal.

While carrying out the study, it was assumed that if the value of the variable in the country is more favourable than the goal (from the EU strategy in the first case and from the National Reform Programme in the second case), for the differences obtained, which are obviously positive, we will assume zero for the calculation of the median (cutting off in zero) (Markowska, 2019).

4. Results

As a result of a double use of positional classification with the median (Strahl 2002, Markowska, Strahl 2003) for the differences between the target level – firstly for the Europe 2020 goals (2010) and secondly for the goals from the NRP – and the values of variables (stimulants) and between the values of a variable and a goal (destimulants) five classes of countries were obtained. The first one (I) – comprising countries for which the differences in all characteristics of smart development are equal to or more favourable than their medians established for the EU countries. The second one (II) – countries for which the difference of one of the selected characteristics of smart development is lower than the median (for example class II ABC – is the class of countries for which the value of variable D_UE in comparison with goals from the Europe 2020 strategy or D_ country, when compared with goals from the NRP was lower than the median). Next classes are built in the same manner with the diminishing number of differences above median.

For most of medians of differences – aside from the median of difference between the value of the goal from the EU strategy and the value of the BR_GDP characteristic – the median was decreasing. Medians of differences (including "cut" values) are set in table 2.

Table 2. Medians of differences

Specification		2010	2011	2012	2013	2014	2015	2016	2017
The EU goals									
Median	A_UE	-7.80	-7.30	-6.80	-7.80	-7.00	-5.70	-4.10	-1.85
	B_UE	-5.20	-2.80	-0.85	0.00	0.00	0.00	0.00	0.00
	C_UE	-1.40	-1.15	-0.40	0.00	0.00	0.00	0.00	0.00
	D_UE	-1.58	-1.54	-1.67	-1.64	-1.66	-1.69	-1.74	-1.70
National goals									
Median	A_country	-5.10	-5.90	-4.85	-5.00	-4.40	-3.55	-2.45	-1.55
	B_country	-6.45	-5.70	-4.15	-3.65	-1.70	-0.90	-0.20	0.00
	C_country	-1.90	-1.35	-1.15	-0.45	0.00	-0.15	0.00	-0.05
	D_country	-0.80	-0.68	-0.72	-0.71	-0.70	-0.72	-0.74	-0.71

The results of the median classification for the goals of the Europe 2020 strategy (2010) are given in table 3 and for the purposes of the NRP in table 4. In these tables, for classes II, III and IV, there are variables for which the differences were equal to or more favourable than the median. It is significant considering the level of achievement of the EU objectives.

Table 3. Assignment of countries to groups – the EU goals – in the years 2010–2017

Class		2010	2011	2012	2013	2014	2015	2016	2017
I (ABCD)		FI, SE, DK, NL, LU, SI	FI, SE, DK, NL, EE, LU, SI	FI, SE, DK, NL, EE, SI	FI, SE, DK, NL, EE, FR, SI	FI, SE, DK, NL, IE, FR, AT	FI, SE, DK, NL, FR	FI, SE, DK, NL, AT	FI, SE, DK, NL, AT, SI
II	ABC			LT, LU	LV, LT, LU	LT, LU	LV, LT, LU, IE	LV, LT, IE	LV, LT
	ABD	UK, FR, BE	UK, FR	UK, FR	UK, BE	UK, EE	UK, EE	UK	UK
	ACD	AT	AT, CZ	AT, CZ	AT, CZ, CY, DE	CZ, DE	AT, CZ	CZ	CZ
	BCD	EE	IE	IE	IE	SI, BE	SI	SI, FR, LU, BE	FR, BE

	Class	2010	2011	2012	2013	2014	2015	2016	2017
III	AB	CY	CY	CY				EE	EE
	AC	CZ				LV			
	AD	PT, DE	PT, DE	DE			DE	DE	PT, HU, DE
	BC	PL, LT	LT		PL	CY, PL	CY, PL, EL	CY, PL, EL	CY, LU, PL, IE, EL
	BD	IE	BE	BE			BE		
IV	A	HU						MT, HU	
	B	ES	ES	ES	ES	ES	ES	ES	ES
	C	SK, HR	SK, HR, PL	SK, HR, PL	SK, HR	SK, HR, EL	SK, HR	SK, HR	SK, HR
	D			PT	HU	HU	IT, HU	IT, PT	IT
V		BG, RO, EL, IT, LV, MT	BG, RO, EL, IT, LV, HU, MT	BG, RO, EL, IT, LV, HU, MT	BG, RO, EL, IT, MT, PT	BG, RO, IT, MT, PT	BG, RO, MT, PT	BG, RO	BG, RO, MT

Table 4. Assignment of countries to groups – national goals – in the years 2010–2017

	Class	2010	2011	2012	2013	2014	2015	2016	2017
I (ABCD)		SE, DK	NL, DK, CY	FI, NL, DK	SE, DK	AT, DK	AT, DK	AT	
II	ABC	SI	SE, FI, LT, EE	SE, LT, EE	NL, LT, LV, EE	SE, LT, LV	SE, LT, LV	LT, LV	LT, LV
	ABD	FI, NL, CY		CY				SE, CZ	SE, PL, CZ
	ACD	LU, HR, DE, CZ	HR, CZ	HR, DE, CZ	DE, CZ	HR, IE, DE, CZ	HR, DE	HR	HR
	BCD		SI	SI	SI, EL, CY	SI, CY, EL	CY, IT EL	NL, CY, IT, EL, DK	AT, NL, CY, IT, EL, DK

Class		2010	2011	2012	2013	2014	2015	2016	2017
III	AB	UK	UK	UK	UK, FI	UK, RO, EE	UK, EE	UK, EE	UK, MT, EE
	AC	AT	AT, LU	AT, LU	AT, LU	LU	LU, IE	LU, IE	LU, IE
	AD	IE	IE, DE	IE	IE		PL, CZ	SK, DE	SK, DE
	BC	LT, EE		LV			SI	FI, SI	SI
	BD	IT, ES, EL	IT, ES, EL	IT, ES, EL	HU, IT	NL, HU	NL, HU		
	CD	SK, HU	SK	SK	SK	IT		BE	BE
IV	A	PT			MT	MT	MT	PL, MT	RO
	B	LV, BE	LV, BE	BE	ES	FI, ES	FI		FI
	C	PL, BG	PL, BG		FR	SK, FR	SK, FR	FR	FR
	D		HU	HU	HR, BE	BE	BG, BE	HU, BG	HU
V (-)		RO, MT, FR	RO, PT, MT, FR	RO, PT, PL, MT, FR, BG	RO, PT, PL, BG	PT, PL, BG	RO, PT, ES	RO, PT, ES	PT, ES, BG

10 out of 28 countries (35.7%) in the analysed period belonged to the same classes: Finland, Sweden, Denmark and the Netherlands – Class I, Great Britain – Class II ABD, Spain – Class IV B, Slovakia and Croatia – Class IV C, Bulgaria and Romania – Class V.

As regards the evaluation of the implementation of national goals – in the results of the classification only Great Britain remained in the same class for the entire period (III AB). The assignment of Poland to the classes in both considered variants is as follows:

- for differences in relation to the Europe 2020 strategy goals: the year 2010 and the period 2012–2017 (class III BC – differences for EMPLO and BR_GDP variables are less favourable than the median), the years 2011–2012 (IV C – only the EARLY difference is more favourable than the median),
- for differences regarding national targets in 2010–2011 class IV C (only the difference between the value of the EARLY characteristic and the value of the NRP goal is equal to or more favourable than the median), in the consecutive three years all differences were less favourable than the median. In 2015 Poland was in class III AD, in 2016 in class IV A, in 2017 it was in class II ABD (differences of three variables were more favourable than the median – except for EARLY).

Conclusions

Taking into account (the first variant) national goals, the most numerous group includes countries with one or two characteristics approaching the adopted strategic goals according to the criterion ‘value more favourable than the median of difference’ (75% of the countries in the

last year of the survey), and only three, two, one country over eight years of research is not in a situation where all the characteristics meet this criterion. The stability of the size of the other two groups indicates that the pace of achieving the goals by the countries was maintained. The structure of countries' classification in terms of European strategic goals is insignificantly different. Slightly more countries (6%) than in the case of achieving national goals are in the first group comprising states closest to the adopted target, taking into account all the variables used in the study. In the last analysed year in the II and III group there are 15 the EU countries (53% of the total number), which implement the European strategic goals, achieving for two and three variables more favourable values in comparison to the adopted median criterion. Poland is in the III or IV class of this classification. The decrease in the value of median of differences between the strategic goal and the value of the variables indicates a consistent pursuit of goals. Dynamic aspects of the implementation of strategic goals, both in the European and national dimension, should be subject to further attention and analysis.

Acknowledgements

The paper is financed by the National Science Centre: 2015/17/B/HS4/01021 and from the sources awarded to the Department of Management at WSB University in Dąbrowa Górnicza as a grant for maintaining research potential.

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