DYNAMICS OF RURAL AREAS DEVELOPMENT IN POLAND - CONVERGENCE ANALYSIS

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Abstract
The article deals with the issue of rural development in Poland. The aim of the article is to determine the dynamics of change in the level of socio-economic development of rural communes in Poland (NUTS 5) in the years 2004 – 2014 through verification of the hypothesis of the existence of beta-convergence. The beta-convergence approach is verified by econometric modelling techniques. The statistical data came from the Local Data Bank (LDB) of the Central Statistical Office (CSO). Based on the analysis of changes in the development level of the rural areas in Poland it was stated that there is convergence. However, the strength of the convergence process is different depending on the dimensions of development. It reported a strong relationship between the average growth rate of aggregate indicators relating to the financial dimension. In other dimensions, such as labour market, living conditions, health and social care, education, demography and culture, it showed the occurrence of slow convergence processes.
Key words: development of rural areas, diagnostic variables, beta-convergence, Poland.

Introduction

The course of socio-economic development in Poland is characterized by spatial differentiation, which can be seen both across regions and districts. Taking into consideration the level of development, we usually distinguish a better developed western part of the country ('Poland A') and the less developed eastern part ('Poland B'), and this distinction is considered to be relatively stable (OECD, 2008; Hryniewicz, 2010). The existence of disparities in the levels of development is a characteristic feature not only of Poland but also of many other European countries (Bański, 2009), especially developing ones. There are many reasons for this and it is worthwhile presenting some of the causes which are specific only to Poland. Among these causes are historical conditioning factors, that is to say subdivisions of Poland's territory dating back at least to the time of the partitions of Poland in the 18th century, the period of centrally planned economy after the Second World War, the effects of system transformation of 1989 and its social and economic consequences (Wilkin, 1999; Bański, 2003; Grosse, 2004). Other important factors included changes in the administrative division of the country[1] and the effective development policy pursued by the authorities of the particular regions (NUTS 2) and local government units (NUTS 4 and 5) (Grosse, 2004; Strzelecki, 2008). The above-mentioned factors were extremely important in shaping the course of development processes.

A detailed discussion about the level of economic development in Poland reveals clear-cut differences between the central part of the country (Mazowieckie Voivodship with Poland's capital Warsaw) and other regions, as well as the disparity between the development level of rural areas, and that of the remaining areas (Grosse, 2004; Rosner & Stanny, 2014). The causes of disparities observed in rural areas are a resultant of multiple economic, social, political and cultural phenomena and they are often determined, like in the case of other areas, by historical heritage (Rosner, 2007). Rural areas are extremely important since they cover the vast part of the country: according to the classification of the Central Statistical Office of Poland (CSO), they occupy 93 percent of the area inhabited by 40 percent of Poland's population (CSO, 2014)[2].

Studies on differentiation of the level of socio-economic development which have been conducted in Poland, including the study of rural areas, show that the differentiation that already exists today tends to deepen, which can especially be observed in the administrative regions, i. e. in voivodships (Stanny & Drygas, 2010). Thus, the question arises whether there is convergence in socio-economic development of rural areas, that is to say whether the relatively less developed areas grow faster than the remaining ones, which leads to decreasing differences and allows the particular areas to reach a similar level.

1 Nowadays in Poland there exists a three-level administrative division, introduced on 1 January 1999. The largest units are voivodeships (there are 16 voivodeships), the second-level units are counties (380), and the smallest units are communes (2479). There are three types of communes (NUTS 5): urban (12%), rural (63%) and mixed (urban-rural) – 25%.

2 Both in Poland and in the EU, there is no universal definition of rural areas (Rakowska & Wojewódzka-Wiewiórska, 2010; Rakowska, 2013), and many criteria are used to classify these areas (Duczkowska-Małysz, 1998; Wieliczko, 2006). The most common method for distinguishing rural areas is definitely the classification used by the Central Statistical Office of Poland according to which rural areas are rural communes and rural parts in urban-rural communes. The Office collects statistical data for these units, which results in the fact that this approach is very frequently used in government documents and in scientific research. Due to a very limited availability of the data regarding the rural part in urban-rural communes, the present study comprises rural areas which are understood as rural communes.

The purpose of the paper is to determine the dynamics of change in the level of socio-economic development of rural communes in Poland in the years 2004 – 2014 through verification of the hypothesis of the existence of convergence. In order to achieve this goal, econometric methods were used in the present study.

Materials and Methods

The level of socio-economic development of 1565 rural communes and its temporal changes were determined using a development index (S). The data were taken from the Local Data Bank (LDB) of the Central Statistical Office (CSO) of Poland and they covered the years 2004 – 2014. The level of development of the communes was determined

Table 1

Set of variables selected to determine the socio-economic development level of rural communes in Poland

Symbol	Variable name and dimension	Character of variable
Public finances/ Wages and incomes of the population		
x_{11}	Own commune budget revenues per capita in PLN	Stimulant
x_{12}	Capital commune budget expenditures per capita in PLN	Stimulant
x_{13}	Total commune budget expenditures per capita in PLN	Stimulant
x_{14}	Total commune budget revenues per capita in PLN	Stimulant
Labour market		
x_{21}	Employment rate within the working-age population	Stimulant
x_{22}	Number of enterprises per 1000 inhabitants	Stimulant
x_{23}	Percentage of registered unemployed in the population of working-age	De-stimulant
x_{24}	Employed persons per 1000 inhabitants	Stimulant
x_{25}	Percentage of the working-age population in the total population (actual place of residence)	Stimulant
Living conditions		
x_{31}	Persons using water supply system in % of total population	Stimulant
x_{32}	Persons using sewage system in % of total population	Stimulant
x_{33}	Persons using gas in % of total population	Stimulant
x_{34}	Length of the water supply network in km per 1 km^2	Stimulant
x_{35}	Length of the sewerage network in km per 1 km^2	Stimulant
x_{36}	Average useful floor area per 1 person	Stimulant
x_{37}	Number of dwellings per 1000 population	Stimulant
x_{38}	Number of dwellings with a central heating (in % of the total of inhabited dwellings)	Stimulant
x_{39}	Number of dwellings with a bathroom (in % of the total of inhabited dwellings)	Stimulant
Health and social care		
x_{41}	Death rate (number of deaths per year per 1000 people)	De-stimulant
x_{42}	Number of health centers per 1000 inhabitants	Stimulant
x_{43}	Number of pharmacies per 1000 population	Stimulant
Education		
x_{51}	Number of local councillors with higher education in relation to the total number of councillors	Stimulant
x_{52}	Number of primary schools pupils per 1000 inhabitants	Stimulant
x_{53}	Number of lower secondary schools pupils per 1000 inhabitants	Stimulant
Demography		
x_{61}	Population per 1 km^2	Stimulant
x_{62}	Natural increase per 1000 population	Stimulant
Culture		
x_{71}	Number of library users per year per 1000 persons	Stimulant

in several stages. First, diagnostic variables were chosen to describe the development level using meritorical, formal and statistical criteria (Strahl, 2006; Wojewódzka, 2007; Zeliaś, 2000; Sej-Kolasa & Zielińska, 2002; Famulska & Znaniecka, 2004). The limitation of the number of variables chosen on the basis of meritorical criteria was the result of the specificity of the Polish public statistical system (including the Local Data Bank), which does not collect some of the data at the level of communes, in which data is incomplete or it is lacking in some years, which makes it impossible to compare some data during the period under review. This study fills the gap in the literature of the subject in the field of a real course of development processes in rural areas in the context of convergence at a local level (Guzal-Dec & Zwolinska-Ligaj, 2012; Kołodziejczyk 2014), especially in view of transformation which took place following Poland's accession to the EU in 2004.

Taking into consideration the formal criteria, the study took into account diagnostic variables which are measurable, universal, high quality, interpretable, complete and available. Variables were grouped into particular categories comprising a definite dimension of development.

Ultimately, on the basis of the methodology presented in the paper twenty-seven variables were chosen from the set of potential indices characterizing the development of rural communes and they were subdivided into seven spheres of development (Table 1).

A set of diagnostic variables contains variables having different directions of influence on the analysed phenomenon. Stimulants are variables, high values of which indicate that a given object (commune) is superior from the point of view of rural development. The opposite holds true for de-stimulants, that is, high values justify classifying an object as being inferior (Dudek & Krawiec, 2007). Two diagnostic variables are recognized as de-stimulants while the remaining ones– as stimulants.

Based on the statistical criteria, to assess the variability of potential diagnostic features (variables) one can use the coefficients of variation. It is commonly required that the variability of the feature should be greater than 10%. Variables that do not meet this condition do not have sufficient discriminant ability. Afterwards, excessively correlated variables should be eliminated, since they carry a similar informational value. For this purpose one can apply the Hellwig's parametric method of variable selection (Hellwig, 1968).

The next step includes the calculation of aggregate indicators encompassing variables from a given dimension. Thus, in order to ensure comparability of the final diagnostic variables, normalization of the data is required (Zeliaś, 2002). This means, among others, that it is necessary to strip variables of their natural units, through which diagnostic characteristics are expressed. Normalization is conducted according to the following formulas (Kukuła & Bogocz, 2014; Chrzanowska & Drejerska, 2016):

$$z_{kji} = \frac{x_{kji} - \min(x_{kji})}{\max(x_{kji}) - \min(x_{kji})} \quad (1)$$

and

$$z_{kji} = \frac{\max(x_{kji}) - x_{kji}}{\max(x_{kji}) - \min(x_{kji})} \quad (2)$$

for stimulants and de-stimulants respectively,
where:
x_{kji} – value of j-th diagnostic variable in k-th dimension for i-th object (commune), i = 1,2, ...1565,
$\min(x_{kji})$ – minimum value of j-th diagnostic variable X_j in k-th group (dimension), k = 1,2, ...7
$\max(x_{kji})$ – maximum value of j-th diagnostic variable X_j in k-th dimension.

The aggregate synthetic indicator is calculated as the arithmetic mean of normalised variables according to formula:

$$S_{ki} = \frac{1}{L_k} \sum_{j=1}^{L_k} z_{kji} \quad (3)$$

where:
L_k – number of variables in k-th group (dimension), k = 1,2, ...7,
z_{kji} – value of j-th normalised variable in k-th dimension for i-th object (commune), i = 1,2, ...1565.

The values of aggregate indicators range from 0 to 1, wherein the higher the value of indicator S_{ki}, the higher the level of development of a given i-th object (commune) in k-th dimension.

In the final step of the statistical analysis, convergence phenomenon in each group (sphere) is examined. There are many approaches to testing the occurrence of this phenomenon. The most common concept of convergence is beta-convergence. This concept has been widely employed in the literature on economic growth.

Beta-convergence occurs when less developed economies tend to grow faster than more developed ones[3]. It involves estimating the following regression model (Próchniak & Rapacki, 2009):

3 The methods applied in the study were derived from the theory of economic growth and are used mainly in modeling GDP *per capita* (Wójcik, 2008). However, in recent years they have been successfully used in the empirical analysis to verify the convergence of the level of development and the standard of living (Mazumdar, 2002; Dudek, 2014; Jordá & Sarabia, 2015).

$$\frac{1}{T}(\ln S_{kiT} - \ln S_{ki1}) = \alpha + \beta \ln S_{ki1} + \varepsilon_i \quad (4)$$

where:
S_{kit} – value of k-th aggregate indicator S_k for i-th object (commune) and t-th year, t=1 or T,
$(\ln(S_{kiT}) - \ln(S_{ki1}))/T$ – average growth rate of indicator S_k,
ε_i – error term with finite variance σ^2 and mean equal zero,
α and β are the parameters to be estimated,
i indicates object and k – number of dimensions (in our analysis i=1, 2,…,1565 and k=7).

Beta-convergence occurs when the average growth rate of an indicator depends negatively on its prior value[4]. It holds when parameter β in regression (4) is significantly negative.

Results and Discussion

Taking into account the statistical criteria, the following four diagnostic variables were excluded from the study:

percentage of the working-age population in the total population, total commune budget expenditures per capita in PLN, total commune budget revenues per capita in PLN and the number of dwellings with a bathroom (in % of the total of inhabited dwellings). The final set of diagnostic variables encompasses 23 diagnostic variables. All these variables are normalised according to formulas (1) and (2) and aggregated into synthetic indicators for each of the 7 groups (spheres) using method (3). Their higher values indicate the higher the level of socio-economic development of the rural communes. Aggregate indicators enable us to examine whether the convergence phenomenon occurs in each dimension.

For each of the seven aggregate synthetic indicators beta-convergence models (4) are estimated. The results of the econometric analysis are presented in Table 2.

On the basis of information given in Table 2, one may record beta-convergence in all seven dimensions. Estimates of regression parameters β in all models built for every dimension are significantly negative. It means that the growth rates of each aggregate indicator depend upon its initial level, and they are inversely correlated. It should be noted that the strongest relationship refers to the first dimension (financial dimension). This relationship is displayed in Figure 1.

The results for the financial dimension indicate that the catching-up process takes place, i.e. poorer communes improved their situation faster than the richer ones. In the case of the other dimensions of the relationships between the average growth rate in the years 2004 – 2014 and their level in 2004 are much weaker. The slope of the regression ranges from -0.016 (for health and social care dimension) to -0.031 (for culture dimension). It indicates a slow convergence process in these areas. Moreover, low values of the R-squared coefficient inform us about heterogeneity of rural communes in these areas. The extreme example is the estimated model for aggregate indicator S_5 (educational dimension) with R-squared below 0.10 (see Figure 2).

Figure 2 shows that many data points fall further from the regression line resulting in high absolute values of residuals and leading to low R-square. Such a situation is caused by a great diversity of rural communes in Poland. Perhaps the division of the communes into more homogeneous groups or/ and inclusion of other explanatory variables which influence economic growth would provide more precise results. A deeper insight into convergence processes could also be achieved by using panel data. It should be noted however that, as seen from Figure 2

Table 2

Regression results of beta-convergence for aggregate indicators of socio-economic development

Dimension		Estimates		
Number	Name	α	β	R^2
1	Public finances/ Wages and incomes of the population	-0.270*	-0.080*	0.686
2	Labour market	-0.021*	-0.020*	0.127
3	Living conditions	-0.011*	-0.019*	0.195
4	Health and social care	-0.013*	-0.016*	0.165
5	Education	-0.049*	-0.029*	0.086
6	Demography	-0.024*	-0.029*	0.255
7	Culture	-0.038*	-0.031*	0.166

Note: asterisk * indicates significance at 0.01.

4 When growth is related to the initial level of the indicator only (other variables do not play significant roles at all), convergence is said to be unconditional or absolute.

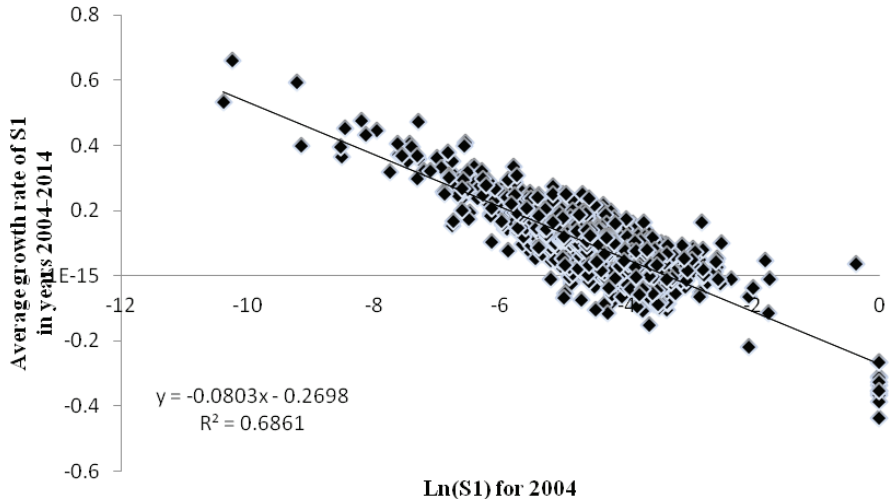

Figure 1. Results of regression analysis for S_1 (financial dimension).

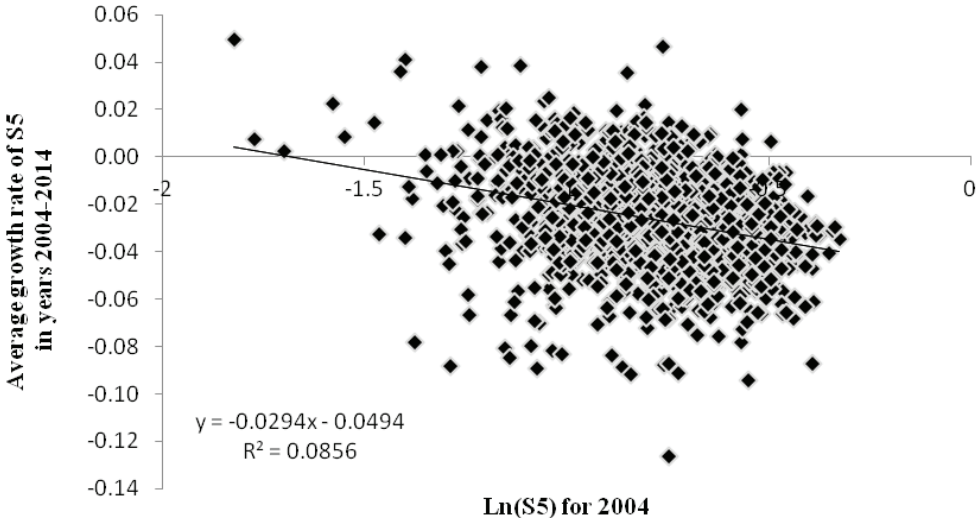

Figure 2. Results of regression analysis for S_2 (educational dimension).

and Table 2, the slope of regression line is significantly negative and therefore there is a beta-convergence among rural communes in the time period 2004 – 2014.

The results confirm the conclusions from research of other authors, namely, that rural areas in Poland are clearly differentiated in terms of the level and dynamics of socio-economic development (Rosner, 2007; Rosner & Stanny, 2014). It turned out that apart from the existing spatial differences they relate to the various spheres of development.

Conclusions

Convergence is defined as the tendency for the levels of a some chosen indicators to equalise over time. This phenomenon has been rarely analysed in the context of the rural development at a local level, thus this study hopes to fill this gap to some extent. The paper presents an empirical application of the concepts of beta-convergence to examine the convergence of socio-economic development between rural communes in the period from 2004 through 2014. The results are as follows:

1. On the basis of this study the occurrence of the process of beta-convergence in the development of rural communes was found.
2. Research results revealed a moderately strong relationship between the average growth rate of aggregate indicator referring to the financial dimension and its levels in 2004.
3. As regards the remaining dimensions considering labour market, living conditions, health and social care, education, demography and culture, the occurrence was found of slow convergence processes.
4. Due to of the heterogeneity of rural communes it would be interesting to carry out in-depth research taking into account the specificities of regions and

determinants of rural development. Such analyses should be conducted in the future research.

The level of rural development is essential from an economic and social viewpoint, thus monitoring changes in this area is an important aspect in the framework of cohesion policy.

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