Regional development of districts in the Lesser Poland Voivodship

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Abstract

Purpose of the article Regional development includes qualitative changes in economy (e.g. in production, investments, employment) as well as qualitative changes (regarding the structure of economy and society, changes in the environment). The research of regional development is important and necessary in order to make appropriate decisions at the regional and local level. The main purpose of the article is comparative analysis of districts in the Lesser Poland Voivodship in the area of economic, social and ecological development.

Scientific aim The scientific aims of paper are verifying the hypothesis concerning eco-development and forecasting the level of regional development in districts of Lesser Poland Voivodship.

Methodology/methods In the research of regional development the quality index of economic, social and ecological development has been proposed which has been calculated on the basis of a certain aggregation of the results of the Principal Component Analysis made on the correlation matrix of standardised variables being the components of the index. Forecasts of the regional development level in districts were calculated with the use of different econometric models as linear model, exponential model, or power model.

Findings The findings prove that the Lesser Poland Voivodship is characterised by considerable disproportions in regional development. The most favourable conditions for economic and social development are in the districts with large city agglomerations as well as extensive municipality infrastructure and transport infrastructure. The presented results demonstrate that the majority of districts have not exhibited a constant tendency to changes in the positions in successive ranking lists in terms of the economic, social and ecological development. The positions occupied by most districts are generally stable and have not changed considerably in the examined period.

Conclusions The research has confirmed the negative interdependence between the level of socio-economic development and ecological development. Thus, it was not possible to verify positively the concept of eco-development expressed in keeping balance between the economic, social and ecological system.

Key words: Eco-development, forecasting, Principal Component Analysis, regional development

JEL Classification: C22, R10

Introduction

The theoretical and empirical literature demonstrates many suggestions of synthetic measures of development. Usually, the synthetic variable is created by aggregating properly the diagnostic variables led to comparability through e.g. standardisation, unitarisation or quotient mapping. Two groups of synthetic variable creation methods are distinguished: model methods and non-model methods (Grabiński, 1984). Non-model methods involve the operation of putting normalised values of variables to an average value, taking into account the assumed weighting factors. In model methods, distances of particular objects from a certain model object are calculated. Some of the best known measures of development are: the arithmetic mean of normalised values of primary variables (Malina, 1993), the measure based on the method of average ranks (Malina and Wanat, 1995), the taxonomic measure of development (Zeliaś, 2000) and others proposed by Malina and Zeliaś (1998), Młodak (2006), Strahl (1978).

This article proposes a non-model quality index of the social and economic development. It is calculated on the basis of a certain aggregation of the results of the analysis of main components made on the correlation matrix of standardised variables – index components. The index will be used to evaluate the regional development at the level of districts in the Lesser Poland Voivodship. Since quantitative changes in economy (e.g. in production, investments, employment) as well as qualitative changes (concerning the structure of economy and society) are decisive for the development of a territorial unit (Woźniak, 2008), the regional development index has been calculated separately in the field of economy and society.

Due to the increasing importance of environmental comfort as one of the aspects of regional development, separate comparison of districts in the field of ecological development has been chosen. The calculated values of the index enable the ordering of districts by various aspects of regional development, the assessment of changes in the developmental level in the dynamic perspective as well as the forecasting of the development level of districts.

1 Construction of the regional development index

The construction of the development index takes advantage of the results of the Principal Component Analysis. Each main component (main factor) can be expressed as a linear combination of normalised primary variables (Dobosz, 2004):

$$U_j = a_{1j}X_1 + a_{2j}X_2 + ... + a_{pj}X_p, \quad (1)$$

j =1,2,..,t,
where:
X1, X2,...,Xp – normalised primary variables,
Uj – main factor.

Similarly, each primary variable Xi can be expressed with the use of the linear combination of factors, in the following form:

$$X_i = a_{i1}U_1 + a_{i2}U_2 + ... + a_{it}U_t, \quad (2)$$

i =1,2,..,p,
where:
U1, U2,...,Ut – main factors,
a_{ij} – loading of j-th common factor in variable X_i.

Since factor loading refers to independent and standardised variables, it can be proven that loading aij is equal to the index of linear correlation between i-th primary variable Xi and j-th main factor Uj. Thanks to this, squared factor loading represents the proportion of variability explained by the linear relationship Xi(Uj) to the total variability of variable Xi (Dobosz, 2004). On the other hand, the variance of the main component is represented by the own value of the matrix of correlation of standardised variables (Aczel, 1998). Finally, own value of j-th factor can be expressed as follows (Dobosz, 2004):

$$\lambda_j = \sum_{i=1}^{p} a_j^2 \quad (3)$$

Own values of the correlation matrix have been used in the construction of the regional development index I. Formula (4) proposed for its calculation is the product of vector X of normalised values of features and transpose of vector W containing the weights representing average shares of the explained variability by particular variables within the separated main components:

$$\mathsf{I} = \mathsf{X} \cdot \mathsf{W}^T \quad (4)$$

where:
X – vector of normalised features with the dimensions 1 p,
W– vector of weights with the dimensions 1 p.

The mode of normalising a characteristic de-

pends on whether this characteristic is a stimulant or a destimulant (Wierzbiński and Sobolewski, 2002; Kukuła, 2005). Stimulants are normalised according to the formula (Kukuła, 2000):

$$x_{ij} = \frac{z_j - \min_i\{z_j\}}{\max_i\{z_j\} - \min_i\{z_j\}} \quad (5)$$

while destimulants are normalised according to the following formula(Kukuła, 2000):

$$x_{ij} = \frac{\max_i\{z_j\} - z_j}{\max_i\{z_j\} - \min_i\{z_j\}} \quad (6)$$

where: zij – i-th realisation of primary variable Zj.

The following formula has been used to calculate the vector of weights W:

$$W = \frac{\sum_{j=1}^{t}(\lambda_j A_j)}{\sum_{j=1}^{t}\lambda_j} \quad (7)$$

where:
is calculated according to the formula (3) and $A_j = [a_j^2 \quad a_{2j}^2 \quad \ldots \quad a_{pj}^2]$.

Vector W contains variants of variables weighted with the shares of own values corresponding main factors. Therefore, its value is an aggregate of the information resources of primary variables and information resources for which main components are a medium. The greater the information resources brought by primary variables or the main factor, the higher the value of the development index. The adopted system of variable normalisation and the construction of the weight vector make the values of the development index (4) non-negative. The higher the value taken by index I, the higher the level of development in a given area (region) and vice versa.

2 Results of empirical research

Values of index I have been calculated for 22 districts in the Lesser Poland Voivodship (including three cities/towns with district rights) in three areas of development: economic, social and ecological. Regional development entail complex interactions among activities within the regional economy, so it is not reasonable to expect that any single factor of development can be identified. The regions have many factors that influence the development of their region. But some regions perform better than others. So what drives a region to achieve the competitive advantage and the economic growth? Factors affecting regional development can be also physical and human capital, technological progress, local productivity, R&D expenditure, innovativeness, effective dissemination of knowledge, social cohesion, and so on.

Usually, indices enabling the specification of the volume and structure of the gross domestic product, values and kinds of capital expenditures (including foreign direct investments) are used to describe the economic development of a country. Apart from that, indices describing the degree of urbanisation, industrialisation, technical infrastructure, transport infrastructure, the use of labour resources and other give evidence of the level of economic development (Malina, 1993). The choice of specific characteristics to be analysed describing the level of economic development has resulted from the availability of data at the assumed level of information aggregation. In the final selection of characteristics, the degree of completeness and comparability of data in the examined period has been taken into account as well as the sufficient diversification of data and degree of variable correlation (in case of excessive correlation, respective characteristics have been eliminated). Finally, the following changes have been proposed for the evaluation of the economic development level of districts in the Lesser Poland Voivodship:

- Z_1 – income of the budgets of municipalities and cities/towns with district rights per 1 resident (in PLN),
- Z_2 – expenses of the budgets of municipalities and cities/towns with district rights per 1 resident (in PLN),
- Z_3 – capital expenditures and gross value of fixed assets per 1 resident (in PLN),
- Z_4 – gross value of fixed assets in enterprises per 1 resident (in PLN),
- Z_5 – sold industrial production per 1 resident (in PLN),
- Z_6 – number of entities entered into the national official register of businesses (REGON) per 10 thousand people,
- Z_7 – number of new buildings admitted for occupancy,
- Z_8 – network of hard-surfaced district roads (in km),

- Z_9 – local transport routes (in km),
- Z_{10} – energy consumption per 1 resident (in kWh).

The factors decisive for the level of social development, in turn, are as follows: progress in education, culture and arts, health care and welfare as well as the situation in the labour market (Szymla, 1994).

Widely understood conditions of people's life affected e.g. by the housing situation of the population, the equipment of households, transport infrastructure and other (Strahl and Sobczak, 1998) are considered to be the barometer of the social development level of the society. Taking into consideration the completeness and availability of data as well as the criteria of choosing characteristics to be analysed (similar to the characteristics describing the economic development), 17 variables describing various aspects of social development have been finally taken into account:

- Z_{11} – average monthly gross salary (in PLN),
- Z_{12} – registered unemployment rate (in %),
- Z_{13} – apartments per 1 thousand residents,
- Z_{14} – percentage of people using water systems (in %),
- Z_{15} – percentage of people using sewerage systems (in %),
- Z_{16} – percentage of people using gas installations (in %),
- Z_{17} – number of doctors per 1 thousand residents,
- Z_{18} – number of residents per one pharmacy available to the general public,
- Z_{19} – number of residents per one outpatient health care facility,
- Z_{20} – volume of consultations in health care centres per 1 resident,
- Z_{21} – beds in hospitals per 10 thousand residents,
- Z_{22} – value of granted welfare benefits per 1 resident (in PLN),
- Z_{23} – share of lower secondary schools equipped with computers with Internet access (in %),
- Z_{24}– number of students per 1 computer

Table 1 Development indices of districts in the area of economic, social and ecological development in 2009

district	Area of development		
	economic	social	ecological
Bochnia district	0.978	1.535	2.743
Brzesko district	0.500	1.321	2.592
Chrzanów district	1.148	1.829	1.642
Dąbrowa Tarnowska district	0.327	1.231	2.653
Gorlice district	0.561	1.479	2.694
Krakow district	1.297	1.565	2.125
Limanowa district	0.635	1.066	2.631
Miechów district	0.419	1.316	2.740
Myślenice district	0.729	1.271	2.541
Nowy Sącz district	0.667	1.019	2.690
Nowy Targ district	0.616	1.166	2.830
Olkusz district	0.990	1.654	2.257
Oświęcim district	0.921	1.733	2.249
Proszowice district	0.365	1.595	2.514
Sucha Beskidzka district	0.471	1.265	2.573
Tarnów district	0.538	1.064	2.700
Tatra district	1.085	1.694	2.807
Wadowice district	0.685	1.156	2.674
Wieliczka district	1.225	1.242	2.634
Krakow city district	2.799	2.989	0.479
Nowy Sącz town district	1.576	1.866	2.638
Tarnów city district	1.574	2.432	1.813

Source: Own study based on the data of the Central Statistical Office of Poland

with Internet access intended for upper secondary school students,
- Z_{25} – number of residents per one 1 library,
- Z_{26} – number of residents per one 1 seat in stationary cinemas,
- Z_{27} – number of residents per one museum.

Eight characteristics have been taken into consideration in the evaluation of the ecodevelopment level of the compared districts:
- Z_{28} – expenditures on fixed assets used on the protection of the environment per 1 resident (in PLN),
- Z_{29} – percentage of people using water treatment plants (in %),
- Z_{30} – legally protected green areas (in ha),
- Z_{31} – waste produced per 1 km2 (in tonnes),
- Z_{31} – emission of sulphur dioxide (in tonnes per year),
- Z_{32} – emission of nitrogen oxide (in tonnes per year),
- Z_{33} – emission of carbon oxide (in tonnes per year),
- Z_{34} – emission of carbon dioxide (in tonnes per year).

The majority of the characteristics have had the character of stimulants, except for Z_{12}, Z_{18}, Z_{19}, Z_{24}–Z_{27}, Z_{31}–Z_{34} which have been treated as destimulants. The stimulants have been normalised according to formula (5) while destimulants have been normalised according to formula (6).

The analysis of the main components has been conducted separately for each of the three development areas for the data as of 2009. Then, on the basis of the obtained factor loadings, the values of the weight vector have been calculated according to formula (7). Finally, with formula (4) the values of the development index have been calculated. The results of calculations for all three development areas are presented in Table 1.

On the basis of the presented results, it can be stated that the most strongly urbanised areas, i.e. cities/towns with district rights: Krakow, Nowy Sącz and Tarnów, had the highest level of economic and social development. The weakest

Table 2 Ranking lists of districts by the level of economic, social and ecological development in selected years

district	Area of development								
	economic			social			ecological		
	2005	2007	2009	2005	2007	2009	2005	2007	2009
Bochnia district	13	10	9	9	9	10	9	9	3
Brzesko district	15	17	18	19	16	12	10	14	13
Chrzanów district	4	6	6	5	5	4	21	21	21
Dąbrowa Tarnowska district	22	22	22	15	17	17	13	10	9
Gorlice district	18	18	16	10	11	11	7	8	6
Krakow district	5	4	4	11	10	9	20	20	19
Limanowa district	17	15	14	21	20	20	8	7	12
Miechów district	20	20	20	12	13	13	5	6	4
Myślenice district	11	11	11	13	12	14	15	15	15
Nowy Sącz district	16	14	13	22	22	22	4	5	7
Nowy Targ district	14	16	15	18	18	18	3	1	1
Olkusz district	6	7	8	4	4	7	17	18	17
Oświęcim district	7	9	10	6	7	5	18	17	18
Proszowice district	21	21	21	7	8	8	16	16	16
Sucha Beskidzka district	12	13	19	14	14	15	11	11	14
Tarnów district	19	19	17	20	21	21	6	4	5
Tatra district	8	8	7	8	6	6	1	2	2
Wadowice district	10	12	12	16	15	19	12	12	8
Wieliczka district	9	5	5	17	19	16	14	3	11
Krakow city district	1	1	1	1	1	1	22	22	22
Nowy Sącz town district	3	2	2	3	3	3	2	13	10
Tarnów city district	2	3	3	2	2	2	19	19	20

Source: Own study based on the data of the Central Statistical Office of Poland

level of economic development has been noted in the Dąbrowa Tarnowska, Proszowice and Miechów districts. In terms of the social development, the lowest results have been in the districts of Nowy Sącz, Tarnów and Limanowa. The situation has become reversed in case of ecological development: strongly urbanised areas, like Krakow city, Tarnów city and the district of Krakow and Chrzanów have had the lowest level of environmental comfort observed by residents. The most "ecological districts" are the districts of Nowy Targ, Tatra Mountains and Bochnia.

In order to check whether the development of particular districts in the economic, social and ecological sphere has exhibited any regularity in time, the values of the index have been calculated separately for the period 2005-2009. Then, the districts have been ranked by the value of index I in such a way that rank 1 has been given to the district with the highest value of the index, rank 2 – to the second district, etc. The suitable ranking list of the district development in selected years 2005, 2007 and 2009 are presented in Table 2.

The presented results (cf. Table 2) demonstrate that the majority of districts have not exhibited a constant tendency to changes in the positions in successive ranking lists in terms of the economic, social and ecological development. The positions occupied by most districts are generally stable and have not changed considerably in the examined period. If we compare the dynamics of changes in the position occupied by the districts in 2009 with 2005, the greatest increase in the position in the ranking list of economic development is observed in case of the Bochnia district (promotion by 4 positions from the thirteenth place) and the Wieliczka district (promotion by 4 positions from the ninth place). The greatest decrease in the position in the ranking list of economic development, in turn, has taken place in the compared years in the Sucha Beskidzka district (decrease by 7 positions from the twelfth place).

The greatest increase in the position in the ranking list of the level of social development in 2009 as compared to 2005 has been observed in the Brzesko district (promotion by 7 positions from the nineteenth place). The greatest fall in the considered ranking list has been noted in the Olkusz district (fall from the fourth to the seventh position) and the Wadowice district (fall from the sixteenth to the nineteenth position). In the ranking list prepared on the basis of the value of the ecological development index, more than a half of the districts have changed their position

Table 3 Spearman's rank correlation coefficients between rankings of districts in the area of economic, social and ecological development in selected years

year		economic development			social development			ecological development		
		2005	**2007**	**2009**	**2005**	**2007**	**2009**	**2005**	**2007**	**2009**
economic development	**2005**		0,967 (0,000)	0,920 (0,000)	0,648 (0,001)	0,696 (0,000)	0,691 (0,000)	-0,463 (0,030)	-0,569 (0,006)	-0,566 (0,006)
	2007	0,967 (0,000)		0,971 (0,000)	0,595 (0,004)	0,631 (0,002)	0,634 (0,002)	-0,411 (0,058)	-0,476 (0,025)	-0,507 (0,016)
	2009	0,920 (0,000)	0,971 (0,000)		0,566 (0,006)	0,599 (0,003)	0,605 (0,003)	-0,343 (0,118)	-0,400 (0,065)	-0,411 (0,058)
social development	**2005**	0,648 (0,001)	0,595 (0,004)	0,566 (0,006)		0,983 (0,000)	0,949 (0,000)	-0,472 (0,027)	-0,664 (0,001)	-0,511 (0,015)
	2007	0,696 (0,000)	0,631 (0,002)	0,599 (0,003)	0,983 (0,000)		0,965 (0,000)	-0,450 (0,036)	-0,689 (0,000)	-0,520 (0,013)
	2009	0,691 (0,000)	0,634 (0,002)	0,605 (0,003)	0,949 (0,000)	0,965 (0,000)		-0,461 (0,031)	-0,676 (0,001)	-0,555 (0,007)
ecological development	**2005**	-0,463 (0,030)	-0,411 (0,058)	-0,343 (0,118)	-0,472 (0,027)	-0,450 (0,036)	-0,461 (0,031)		0,841 (0,000)	0,891 (0,000)
	2007	-0,569 (0,006)	-0,476 (0,025)	-0,400 (0,065)	-0,664 (0,001)	-0,689 (0,000)	-0,676 (0,001)	0,841 (0,000)		0,900 (0,000)
	2009	-0,566 (0,006)	-0,507 (0,016)	-0,411 (0,058)	-0,511 (0,015)	-0,520 (0,013)	-0,555 (0,007)	0,891 (0,000)	0,900 (0,000)	

Source: Own study based on the data of the Central Statistical Office of Poland

by at least 3 places in the compared years. The ranking list of ecological development in 2009 in comparison to 2005 has shown the greatest promotion in case of the Bochnia district (increase by 6 places from the ninth position). The greatest decrease in the ranking list has been noted by the district of Nowy Sącz town (fall by 8 places from the second position).

The Table 3 presents values of the correlation coefficients between rankings of districts in the area of the economic, social and ecological development in selected years.

In brackets, under the parameter estimates in Table 2 , p-values are included.

Most of the correlation coefficients in Table 3 is significant at the significance level p<0,05. Correlations between the ranks of districts in development ranking lists in the area of economic and ecological development, and in the area of social and ecological development in selected years are negative and strong. This means that peoples in districts with a high level of socio-economic development usually have the low level of environmental comfort.

Thus, the concept of the balance between social system, economic system and ecological system was not confirmation in the Lesser Poland Voivodship. It is worth noting the fact that the correlation coefficients between the values of index in the area of economic development in the years 2005, 2007 and 2009 were positive and statistically (as in the area of the social development and ecological development). This confirms that the positions of districts in the ranking lists of economic, social and ecological development are stable over time.

On the basis of the variables values Z_1-Z_{34} in the years 2001-2009 were forecasted the future values of these variables in 2010. In the study were tested different econometric models as linear model (8), exponential model (9) or power model (10).

$$Z_{it} = \alpha_0 + \alpha_1 \cdot t + \xi_t \tag{8}$$

$$lnZ_{it} = h\ \alpha_0 + h\ \alpha_1 \cdot t + \xi_t \tag{9}$$

$$lnZ_{it} = h\ \alpha_0 + \alpha_1 \cdot lnt + \xi_t \tag{10}$$

i = 1,2,…,34, t =1,2,..,9,

where:

Z_{it} – variable describing the regional development of districts,

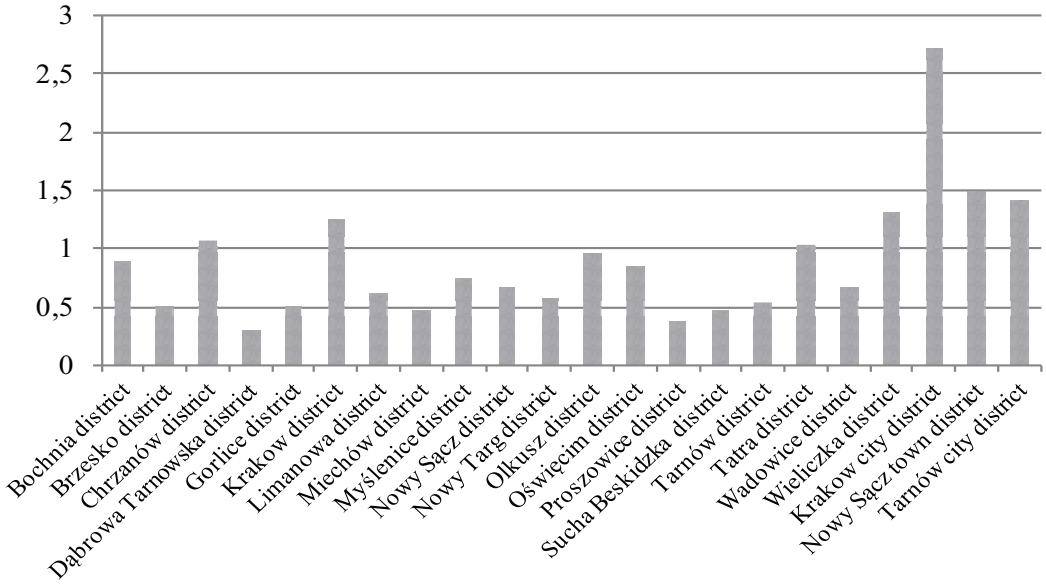
t – time variable,

α_0, α_1 –parameters of econometric model,

ζ_t – random term.

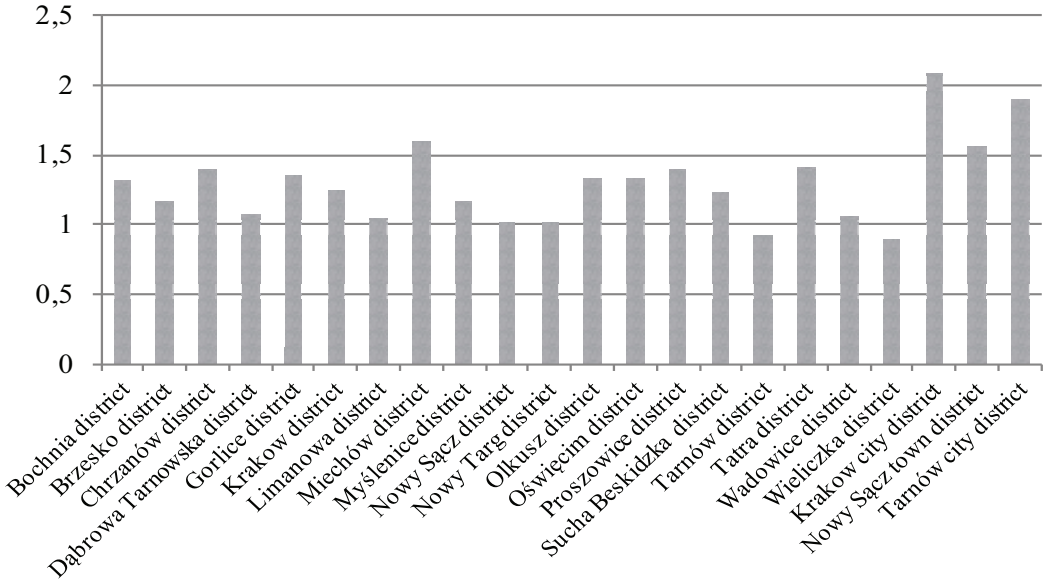
For each variables Z_{it} was chosen econometric model with the satisfactory degree of fit to the data and with the statistically significant parameters. Then were calculated the predicted values of the index I in the area of economic, social, and ecological development in accordance with the procedure presented in Chapter 2. The forecasts are presented in Graphs 1-3.

The forecasts of the index I allow to create ranking lists of districts which do not differ



Source: Own study based on the data of the Central Statistical Office of Poland

Graph 1 Forecasts of the development index in the area of the economic development in 2010



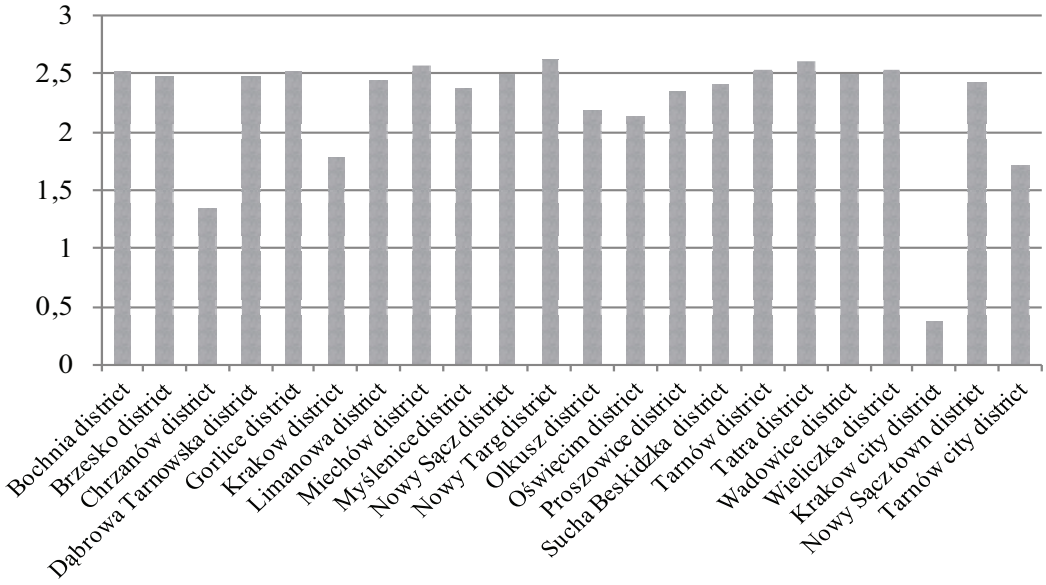
Source: Own study based on the data of the Central Statistical Office of Poland

Graph 2 Forecasts of the development index in the area of the social development in 2010

substantially from ranking lists of districts in the development in the area of economic, social, and ecological development in 2009. So the results of the research do not give rise to state that the concept of eco-development will be implement in the near future in districts of the Lesser Poland Voivodship.

Summary

The presented results of research have demonstrated that the Lesser Poland Voivodship is characterised by considerable disproportions in regional development. The most favourable conditions for economic and social development are in the districts with large city agglomerations as well as extensive municipality infrastructure and transport infrastructure. A low level of economic and social development is mainly evident in the districts which are economically weak, without sufficient investments, usually with agricultural profiles and weak infrastructural equipment. The situation looks completely different from the perspective of the categorisation of districts in the area of ecological development. The highest values in terms of the ecological development



Source: Own study based on the data of the Central Statistical Office of Poland

Graph 3 Forecasts of the development index in the area of the ecological development in 2010

index are observed in the districts lying beyond the range of large city agglomerations, usually having agricultural traditions and weakly developed infrastructure, free of environmental pollution from heavy industry and offering landscape and tourism value.

The research has confirmed the negative interdependence between the level of social and economic development and ecological development. In the light of the obtained results, it can be stated that social and economic development is realised at the cost of the lower quality of the natural environment in the district and the environmental comfort of its population. Thus, it was not possible to verify positively the concept of eco-development expressed in keeping balance between the economic, social and ecological system. The analysis of the value of the development index in the dynamic perspective suggests the conclusion that the change processes in the level of the regional development in particular districts are slow and usually stable. This may be treated as evidence of the lack of material transformations in the economic, social and ecological structure in the compared districts in the period 2005-2009.

It seems that the proposed measure of regional development has turned out to be an effective tool in the evaluation of the development level of districts. This enables a synthetic description of the economic, social and ecological structure of districts and allows for ordering them from the best to the weakest in the development scale. The fact that it takes into account the share of the variability of each main component and the variability resources of diagnostic variables should be treated as an important asset of the development index.

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Doručeno redakci: 30.5.2011
Recenzováno: 15.11.2011
Schváleno k publikování: 30.11.2011

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