ACTA UNIVERSITATIS AGRICULTURAE ET SILVICULTURAE MENDELIANAE BRUNENSIS

Volume LX 16 Number 4, 2012

METHODOLOGICAL APPROACHES TO EVALUATION OF DISPARITIES IN REGIONS OF THE CZECH REPUBLIC

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Received: March 19, 2012

Abstract

JÁNSKÝ, J., VÁLEKOVÁ, S.: *Methodological approaches to evaluation of disparities in regions of the Czech Republic.* Acta univ. agric. et silvic. Mendel. Brun., 2012, LX, No. 4, pp. 155–164

The goal of the paper is to propose a methodological approach to evaluation of regional disparities, which is based on a comparison of life quality in each regions of the Czech Republic. Life quality in regions is influenced e.g. by natural, social-cultural and economical conditions or rather fields. This approach to evaluation of regional disparities is grounded in forming of summary index of development potential of the region. This index includes evaluation of life quality in all three above mentioned fields. Summary index of development potential also allows determine the ranking of regions from the view of life quality.

Compiling of partial indexes comes before determination of summary index of development potential of the region. Partial indexes enable to evaluate development potential of certain regions in the field of natural resources, social and cultural resources and in the field of economic efficiency.

Results of disparities evaluation in regions of the Czech Republic indicate relatively great disparities among individual regions. Evaluation of summary index of development potential evidently shows on significant position of the Capital of Prague and Central Bohemian region. Opposite position have primarily Karlovy Vary Region and Olomouc Region.

region, regional development, quality of life, index of development potential

At present, a balanced development of regions constitutes one of the principal objectives of the regional policy of the state as well as of the European Union. It is a complex set of processes contributing to positive transformations in the economic, social and environmental situations of the regions. Svatošová (p. 41, 2005) points out that socio-economic changes in the regions will not do without substantial allowance from structural funds. The aim of the support is to increase activities of regions towards the ensurance of harmonic and well-balanced development, reduction of unemployment, development of human resources, environment protection etc.

Regional development is therefore subject to various influences affecting the quality of life. Quality of life can be measured by countless numbers of indicators. Variation of measuring of quality of life is based on a thesis that combines objective and subjective aspects of individual perception (Phillips, p. 36, 2006). Among the most important ones are development of entrepreneurial activities and of economic potential in each region, development of human potential associated with increasing employment levels, sufficient technical facilities and equipment, transport services in the area in question, environmental care and, last but not least, tourism from its position of one of the principal entrepreneurial activities (Hrabánková, pp. 156–160, 2009). All of the above stated factors consequently affect the disparities in given regions.

The existence of disparities can be considered a strong impulse for social development and a premise for the creation of more efficient forms of specialization and regional division of labour (Hampl, p. 901, 1998). The causes for the origination of disparities have to be analyzed since only then the activation strategies of the entire regional

potential can take place in which economic efficiency plays a crucial role. And so the research of regional disparities is solved since 2007 under the auspices of the project of the Ministry for Regional Development.

MATERIAL AND METHODS

The goal of this paper is to propose a methodological approach to evaluation of disparities of regions in the Czech Republic. The methodological approach is based on evaluation of disparities using the general index of development potential of the region, which includes an assessment of quality of life according to natural, cultural and socio-economic conditions.

To meet this objective were determined following sub-objectives:

- compilation and verification of the general index of the development potential of the region, including the assessment of quality of life in the regions. This aggregate index of the development potential to build the ranking of regions in terms of quality of life in the Czech Republic,
- verification of the three sub-indices of the development potential of the region according to basic areas of quality of life compliance with natural resources, with social and cultural resources or with economic performance.

To build the index of development potential is used methods of multivariate analysis – factor analysis, which allows to identifying variables whose influence on the overall state is the strongest. Another basic task of factor analysis is to form new uncorrelated variables (factors) in hope that these new variables enable better understand analysed data or eventually enable also another using (Hebák, p. 232, 2005).

For all these indicators (or variables) has been tasted mutual interdependence. Variables with high correlation were excluded from consequential processing. The following variables use factor analysis clarifying the structure of observed dependencies and simplifying the system of studied variables. It was used to discard variables affected by information double counting. This reduction leads to a minimal loss of information. The basic building stone of factor analysis is correlation relation (Pearson correlation coefficient). From the correlation matrix of real variables we insulate factors that explain monitored dependences in the simplified way. If initial variables correlate together and if they make sense, we can apply the factor analysis. By factoring of correlation matrix it is possible to gain only factor – vector of numbers – where the information engaged in correlation matrix is coded.

Factor analysis divided the selected variables into three or four factors. The most suitable variables were selected to determine the ranking of regions, these variables were standardised on the basis of the relation (Dufek and Minařík, p. 75, 2009).

$$\frac{x_i - \overline{x}}{s_x}, \tag{1}$$

where:
xi... variable in the i-th period,
x .... average value,
sx .. standard deviation.

Subsequently only these standardised values were considered. After the multiplication of these values by weights assigned to individual variables, the group indices were obtained for the individual regions of Czech Republic. If an indicator had a negative line of action, the sign was changed. To the determination and calculation of development potential index in regions it is necessary to say that weight significance of result indicators were set for calculation by experts (Jánský and Somerlíková, pp. 204–209, 2010).

Due to the available underlying data needed to build these indices of development potential, it is necessary to distinguish different levels of the analyzed regions. The indices are compiled in the full range at the level of regions of the Czech Republic. With some limitations in this manner it is possible to compare individual districts of regions.

With respect to the accessibility of empirical data needed for evaluation of disparities between regions, the paper works with the administrative regions of the CR. The suggested methodology is applied to data from individual regions of Regional statistical yearbooks of the Czech Republic in the time series from 2002 to 2007.

RESULTS AND DISCUSSION

Compiling of partial indices comes before a determination of summary index of development potential of the region. Partial indices enable to evaluate development potential of certain regions in the field of economic efficiency, social and cultural resources and in the field of natural resources (Jánský and Somerlíková, pp. 98–104, 2009).

1. Determination and verification of the index of development potential of economic performance in the regions of the Czech Republic

Economic performance of a specific region is determined by its economic base. This base can be considered a system formed by economic entities, their interrelations and relations they maintain with their environment. The action of market forces results in the concentration of economic activities into selected regions and in their development together with the ensuing benefits and creation of new activities.

In each regions of the Czech Republic was determined and found a total of 68 indicators. Of these indicators, it was chosen 11 to calculate the index by using the factor analysis. Chosen indicators (or variables) were: number of registered

I: *Rotated matrix of factors*

Indicator	Factor 1	Factor 2
Number of 'enterprise-type' registered units	0.895	0.451
Agriculture, game management, fisheries	0.421	-0.712
Industry	0.989	-0.001
Civil engineering	0.954	0.249
Trade, repairs, accommodation, boarding	0.880	0.411
Transport, warehousing, communications	0.812	0.545
Per capita GDP (CZK)	0.498	0.865
Per capita GAV (thousands of CZK)	0.581	0.788
Per capita GFCF (CZK)	0.505	0.847
Total per capita receipts (CZK)	0.319	0.929
Total per capita expenditures (CZK)	0.322	0.925

Source: own calculations

II: *Factor scores*

Region	Factor 1	Factor 2
Capital of Prague	1.533	3.083
Central Bohemian R.	2.125	-1.233
South Bohemian R.	0.337	-0.429
Pilsen R.	-1.537	0.830
Karlovy Vary R.	-0.605	-0.125
Ústí n. Labem R.	-0.513	-0.198
Liberec R.	-0.500	-0.154
Hradec Králové R.	-1.041	0.618
Pardubice R.	-0.438	-0.369
Vysočina R.	-0.553	-0.021
South Moravian R.	1.540	-1.041
Olomouc R.	-1.039	0.169
Zlín R.	-0.175	-0.359
Moravian-Silesian R.	0.864	-0.770

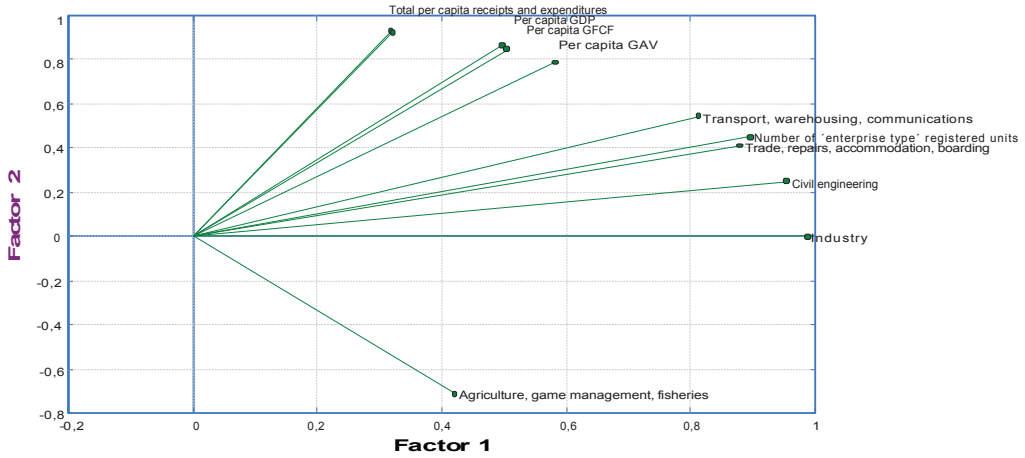
Source: own calculations.

units of enterprise type, agriculture, hunting, fisheries, industry, civil engineering, trade, repairs, accomodation, boarding, transport, storage, communications, GDP per capita (in CZK), gross value added per capita (in thousands CZK), GFCF per capita (in CZK), total receipts per capita (in CZK), total expenditures per capita (in CZK).

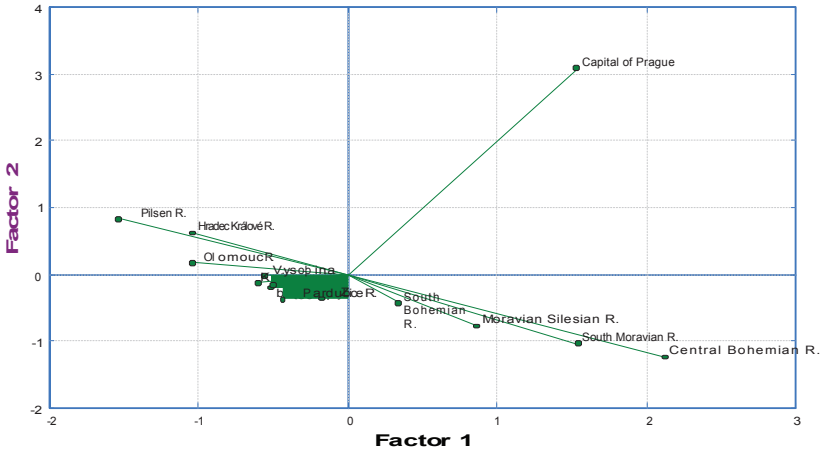
To determine the sequence of the regions in the Czech Republic we selected the most suitable indicators (variables) from the individual factors by using the factor analysis (see Tab. I and Fig. 1) – orthogonal rotation – varimax method maximizing the variance of squared factor loadings standardised by relevant communalities. These indicators were subsequently standardised based on the relation (1). Based on the factor analysis, individual indicators can be taken into account in so-called factors whose informative values differ. The factor analysis was applied for all administrative regions of the Czech Republic with the use of all 11 established indicators. The purpose of this factor analysis is to find an as low as possible number of acceptable factors – in our case 2. Factor loads of the respective indicators are presented in Tab. II and Fig. 2.

The following four indicators for the regions of the CR were standardised to determine the partial index of development potential for economic performance: number of enterprise-type registered units, industry, per capita GDP in CZK and per capita receipts in CZK.

For the evaluation of the index of development potential, the indices are listed in a descending fashion by the respective regions to express their ranking level. As to the established index of development potential in the regions of the CR, we can state that the disparities are recorded with a growing negative value of the index.



1: *Rotated matrix of factors*
Source: own calculations



2: *Factor scores*
Source: own calculations

III: *Sub-index of development potential of economic performance*

Region	Index 1	Rank 1	Index 2	Rank 2
Capital of Prague	2.85891	1	----------	----------
Central Bohemian R.	0.56744	3	1.40582	1
South Bohemian R.	-0.28217	7	0.43796	4
Pilsen R.	-0.31251	8	0.21454	6
Karlovy Vary R.	-0.87394	14	-0.91560	13
Ústí n. Labem R.	-0.41263	10	0.34702	5
Liberec R.	-0.48163	12	-0.20170	7
Hradec Králové R.	-0.24433	6	-0.49632	10
Pardubice R.	-0.42429	11	-0.77935	11
Vysočina R.	-0.49877	13	-0.47795	9
South Moravian R.	0.59290	2	1.03266	2
Olomouc R.	-0.39391	9	-0.79969	12
Zlín R.	-0.19082	5	-0.36222	8
Moravian-Silesian R.	0.09574	4	0.59484	3

Source: own calculations

In option 1 (Tab. III) are evaluated all regions of the Czech Republic including the Capital of Prague. The factor analysis indicated that 11 given indicators can be classified into four factors. The factors, whose own value was less than 1, were not considered. They are following four indicators that were standardized to determine the sub-index of development potential of economic performance and it was used expertly defined and validated weights of these indicators. Number of registered units of enterprise type – weight of indicator is 0.25, industry – weight of indicator is 0.25, GDP per capita (in CZK) – weight of indicator is 0.25, total receipts per capita (in CZK) – weight of indicator is 0.25.

In option 2 are assessed by using the index all regions except of Capital of Prague. The factor analysis indicated that 11 given indicators can be classified into three factors. So the sub-index of development potential of economic performance consists of the following variables: industry – weight of indicator is 0.33, the GDP per capita (in CZK) – weight of indicator is 0.33, total expenditures per capita (in CZK) – weight of indicator is 0.33.

2. Determination and verification of the index of development potential of social and cultural conditions in the regions of the Czech Republic

Methodically was the same manner as for determination of the index of development potential of economic performance. In each regions of the Czech Republic was determined and found a total of 55 indicators. Of these indicators, it was chosen 12 to calculate the index by using the factor analysis. Chosen indicators (or variables) were: population per km^2, rate of urbanization, the secondary education with maturita examination, terciary education, the employment rate, rate of economic activity, unemployment rate, average monthly wage in agriculture, the disposable income

of households per capita (in CZK), paid social benefits per capita (in CZK), the average old-age pensions (in CZK), completed apartments per 1 000 inhabitants.

In option 1 (Tab. IV) are evaluated all regions of the Czech Republic including the Capital of Prague. The factor analysis indicated that 12 given indicators can be classified into four factors. The factors, whose own value was less than 1, were not considered. They are following four indicators that were standardized to determine the sub-index of development potential of social and cultural conditions and it was used expertly defined and validated weights of these indicators. Population per km2 – weight of indicator is 0.25, number of terciary educated – weight of indicator is 0.25, the employment rate – weight of indicator is 0.25, the disposable income of households per capita (in CZK) – weight of indicator is 0.25.

In option 2 are assessed by using the index all regions except of Capital of Prague. The factor analysis indicated that 12 given indicators can be classified into three factors. So the sub-index of development potential of social and cultural conditions consists of the following variables: rate of economic activity – weight of indicator is 0.33, the disposable income of households per capita (in CZK) – weight of indicator is 0.33, the average old-age pensions (in CZK) – weight of indicator is 0.33.

3. Determination and verification of the index of the development potential of natural conditions in the regions of the Czech Republic

In each region was determined and found a total of 58 indicators. Of these indicators it was chosen 21 to calculate the index by using factor analysis. Chosen indicators (or variables) were: non-investment expenses for environmental protection per capita (in CZK), economic benefits of environmental activities per capita (in CZK), production of municipal waste per capita (in tonnes), investment for environmental protection per capita (in CZK), air and climate protection per capita (in CZK), waste water management per capita (in CZK), other wastes per capita (in CZK), national parks per capita (in hectares), the protected area per capita (in hectares), small protected areas per capita (in m^2), the forest-free areas per capita (in m2), non-agricultural land per capita (in hectares), the forest land (hectares per capita), water area per capita (in m^2), built-up area per capita (in m^2), the other area per capita (in m2), farm land per capita (in hectares), vineyards and hop per capital (in m^2), gardens and orchards per capita (in m^2), permanent grassland per capita (in hectares), arable land per capita (in hectares).

In option 1 (Tab. V) are evaluated all regions of the Czech Republic including the Capital of Prague. They are following four indicators that were standardized to determine the sub-index of development potential of natural conditions (including the environmental protection) and it was used expertly defined and validated weights of these indicators. Investments in environmental protection per capita (in CZK) – weight of indicator is 0.35, non-investment expenses for environmental protection per capita (in CZK) – weight of indicator is 0.3, non-agricultural land per capital (in hectares) – weight of indicator is 0.25, permanent grassland (hectares per capita) – weight of indicator is 0.1.

In option 2 are assessed by using the index all regions except of Capital of Prague. The factor analysis indicated that 21 given indicators can be classified into three factors. The factors, whose own value was less than 1, were not considered. So the sub-index of development potential of natural condition consists of the following variables: the arable land per capita (in hectares), weight of indicator is 0.25, the economic benefits of the

IV: *Sub-index of development potential of social and cultural conditions*

Region	Index 1	Rank 1	Index 2	Rank 2
Capital of Prague	2.91997	1	----------	----------
Central Bohemian R.	0.18221	2	1.39415	1
South Bohemian R.	0.06944	4	0.22933	4
Pilsen R.	0.12187	3	0.79481	2
Karlovy Vary R.	-0.55869	12	0.44133	3
Ústí n. Labem R.	-1.02827	14	-0.02429	7
Liberec R.	-0.18943	9	0.14208	5
Hradec Králové R.	0.06677	5	0.00962	6
Pardubice R.	-0.12834	7	-0.54445	10
Vysočina R.	-0.15407	8	-0.68984	11
South Moravian R.	0.05606	6	-0.09731	9
Olomouc R.	-0.42299	11	-0.88637	13
Zlín R.	-0.21086	10	-0.72495	12
Moravian-Silesian R.	-0.72366	13	-0.04412	8

Source: own calculations

V: *Sub-index of development potential of natural conditions*

Region	Index 1	Rank 1	Index 2	Rank 2
Capital of Prague	0.88562	2	----------	----------
Central Bohemian R.	0.10722	5	0.25132	5
South Bohemian R.	0.22408	3	1.29472	1
Pilsen R.	0.21608	4	0.28363	4
Karlovy Vary R.	0.07226	6	-0.49668	10
Ústí n. Labem R.	0.91889	1	0.22248	6
Liberec R.	0.01550	7	-0.82168	13
Hradec Králové R.	-0.08714	8	0.73030	2
Pardubice R.	-0.20377	10	-0.30899	8
Vysočina R.	-0.48466	12	0.09626	7
South Moravian R.	-0.09142	9	0.40584	3
Olomouc R.	-0.59321	14	-0.67024	12
Zlín R.	-0.49484	13	-0.53188	11
Moravian-Silesian R.	-0.48461	11	-0.45507	9

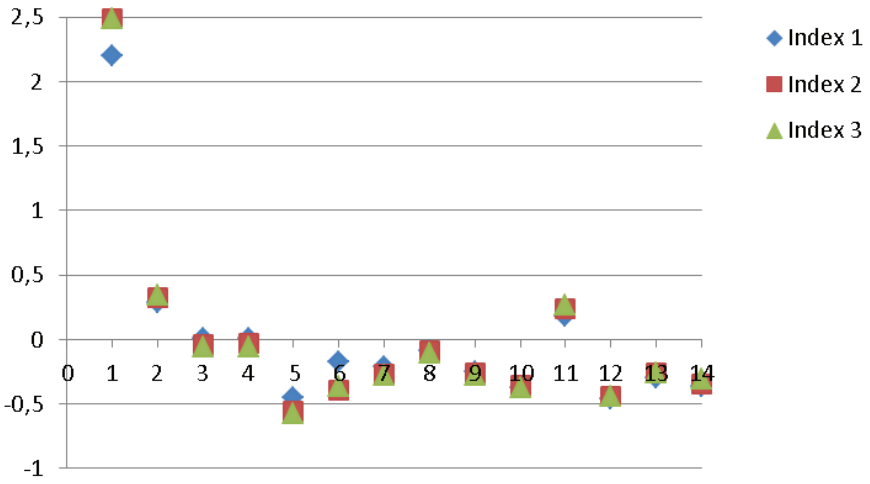
Source: own calculations

activities of environmental protection per capita (in CZK) – weight of indicator is 0.4, the water surface per capita (in m^2) – weight of indicator is 0.35.

4. Determination and verification of summary index of development potential in the regions of the Czech Republic

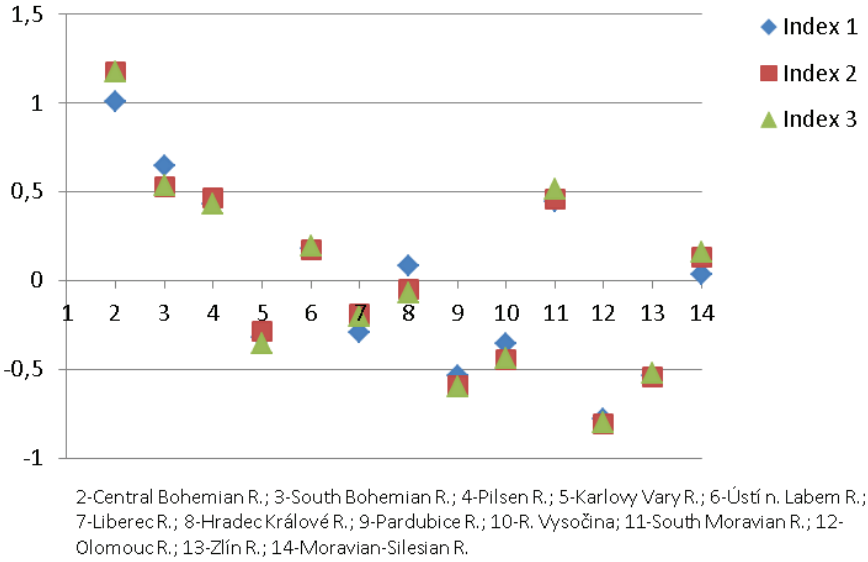
The summary index of development potential is solved as a sum of three sub-indices, namely index of the development potential of natural conditions, the index of the development potential of social and cultural conditions and index of development potential of economic performance by region (Fig. 3, 4). Expertly set weights are considering three alternatives solutions, the first variant (index 1) are expertly set weights in the same amount for all three sub-indices. In the second variant (index 2) are expertly set weights for the sub-index of the development potential of the natural conditions of 0.2 and sub-index of development potential of social and cultural conditions and the sub-index of economic performance in the same amount for both 0.4. In the third variant (index 3) are expertly set weights for the sub-index of the development potential of the natural conditions of 0.2, sub-index of development potential of social and cultural conditions of 0.35 and for the sub-index of economic development potential performance of 0.45.

The first variant represents a hypothetical and comparative situation, the second one rather reflects equal importance to social and economic indicators



1-Capital of Prague; 2-Central Bohemian R.; 3-South Bohemian R.; 4-Pilsen R.; 5-Karlovy Vary R.; 6-Ústí n. Labem R.; 7-Liberec R.; 8-Hradec Králové R.; 9-Pardubice R.; 10-R. Vysočina; 11-South Moravian R.; 12-Olomouc R.; 13-Zlín R.; 14-Moravian-Silesian R.

3: *Summary index of development potential including the Capital of Prague*
Source: own calculations



4: *Summary index of development potential without the Capital of Prague*
Source: own calculations

and the third variant is focused on the indicators of economic performance.

For evaluation of the sub-indices of development potential are the indices for each region evaluated in terms of their amount in absolute order. The identified indices of development potential in individual regions of the Czech Republic indicate that disparities are observed with increasing negative value of the index.

If we evaluate the index of the development potential of natural conditions and thus demonstrates the importance of the Capital of Prague in option 1 and in option 2 it is South Bohemia region which is at the highest level, then Hradec Kralove region and South Moravia region.

The evaluation of the development potential index of regions indicates that apart from the Capital of Prague, the highest levels are achieved by the regions of South Moravia and Central Bohemia. On the other hand, the regions of Karlovy Vary, Vysočina, Pardubice, Zlín and Olomouc are in a completely opposite situation which – in respect of the informative value of this index- gives once again the evidence about the disparate position of these regions. According to Dufek (p. 92, 2009) who analyzed the development potential with using 14 indicators for 2000–2007, the best ranking region is the Capital of Prague, which is followed by the regions of Central Bohemia, South Bohemia and Karlovy Vary. The regions of Ústí and Moravian-Silesian region had the worst ranking. Discrepancies in the results of our analysis and the analysis made by Dufek (p. 93, 2009) are due to the different focus of indicators.

CONCLUSIONS

The evaluation of the regions is given significant attention especially in recent years. On the one hand the aim of this evaluation is to understand the current state of the regions, expressed through the various indicators. On the other hand, it is a comparison and detection of differences in economic level, in socio-cultural and natural conditions and of individual regions, which can be eliminated or at least mitigated by properly oriented regional policy and by using of adequate tools. The evaluation of disparities in the regions is solved by using the index of development potential – the three sub-indices and the summary index.

Results of the evaluation of regions using the index of development potential are suitable for the purposes of national institutions, especially the Ministry for Regional Development, and then for the individual regional offices. Finally, it is suitable for professional, educational and general public.

To determine and quantify the index of development potential in the regions of the Czech Republic was used expertly set weights of resulting indicators. In the further research is necessary to continue to verify these weights with the representatives of the professional public, ministries, regions, etc., to confirm the accuracy and objectivity of quantified indices. Mutual comparisons among regions should lead to a motivation of improvement in quality of live and as well as to the elimination of regional disparities. Various measures supporting and guiding regional development strategy including the use of the Structural Funds may take into account the above methodological evaluation of disparities in different regions and thus significantly help to achieve one of the main objectives of the strategy of regional development that is reducing regional disequilibrium in economic, social and environmental area.

SUMMARY

The aim of this paper is the assessment of regional disparities which is based on comparison of quality of life in regions of the Czech Republic. The assessment of regional disparities is based on evaluation of disparities by using the index of development potential of the region. This index includes evaluation of quality of life through sub-indices according to the economic, socio-cultural and natural conditions. Subsequently, the summary index of development potential allows compile a ranking of the regions in term of quality of life. To build the index of development potential is used multivariate analysis methods – factor analysis, which allows identify the variables whose influence on the overall status is the strongest. The factor analysis divided the selected variables (indicators) in factors, reflecting the economic, socio-cultural and natural conditions. To determinate the ranking of the regions from individual factors were selected the most suitable variables that are then normalized. Afterwards, worked only with these standardized values and after multiplied by weights that have been expertly established for each variable, were obtained the sub-indices for each region of the Czech Republic.

The summary index of development potential is solved as a sum of three sub-indices, namely the index of development potential of economic performance, in the index of development potential of socio-cultural conditions and the index of development potential of natural conditions. Expertly set weights in the compilation of the summary index are considering three options for results. The first option represents hypothetical and comparative situation. The second option reflects the same importance of social and economic indicators. And in the third option are take account of indicators of economic importance as the most important indicators. Results of the summary index of development potential are solved again in two options with regards to the importance and high level of the City of Prague (i.e. with the City of Prague and without the City of Prague) as well as the sub-indices of development potential.

When evaluating the summary index indicate significant position of the City of Prague and Central Bohemian region. The Olomouc region has mainly the opposite position when taking account especially the sub-index 1 and 2, i.e. when are expertly set weights in favour of economic and social indicators. The results of the summary index of development potential indicate relatively large disparities among the individual regions, taking into account economic performance, socio-cultural conditions or natural resources. Equitable development of regions currently represents one of the fundamental tasks of the regional policy of the Czech Republic and the European Union. These are complex processes that contribute to positive changes in the economic, social and environmental situation of regions. For reduction of regional differences may help methodologies evaluating disparities in individual regions, such as by at above mentioned the sub-indices and consequently the summary index of development potential.

Acknowledgement

The paper presents results of the research project No. WD-57-07-1 *Possibilities of overcoming the disparity between selected regions* elaborated under financial aid provided by the Ministry for Regional Development.

REFERENCES

DUFEK, J., MINAŘÍK, B., 2009: *Analýza indikátorů pro hodnocení cílů realizace strategie regionálního rozvoje v České republice (The analysis of indicators for the evaluation of implementation of objectives of regional development strategy in the Czech Republic)*, Brno: MZLU, 119 s. ISBN 978-80-7375-366-5.

HAMPL, M., 2007: Regionální diferenciace současného socioekonomického vývoje v České republice (Regional diferentiation of the contemporary socio-economic development in the Czech Republic), *Czech Sociological Review*, 43: 5, 889–910.

HEBÁK, P. a kol., 2005: *Vícerozměrné statistické metody (Multidimensional statistical methods)*, Praha: Informatorium, pp. 255, ISBN 80-7333-039-3.

HRABÁNKOVÁ, M., BOHÁČKOVÁ, I., 2009: Conditions of sustainable development in the Czech Republic in compliance with the recommendation of the European commission, *Agricultural Economics* – Czech, No. 55, pp. 156–160, ISSN 0139-570X.

JÁNSKÝ, J., SOMERLÍKOVÁ, K., 2009: Analýza disparit ekonomické výkonnosti regionů v ČR (The analysis of disparities in economic performance in the regions of the Czech Republic), *Region v rozvoji společnosti*, Brno, pp. 98–104, ISBN 978-80-7375-330-6.

JÁNSKÝ, J., SOMERLÍKOVÁ, K., 2010: Analýza disparit sociálních podmínek v regionech ČR (The analysis of disparities in social conditions in the regions of the Czech Republic), *Firm and competitive environment*, Brno, pp. 204–209, ISBN 978-80-7375-385-6.

PHILLIPS, D., 2006: *Quality of life: concept, policy and practice,* Oxon: Routledge, pp. 276, ISBN 978-04-1532-355-0.

Regional statistical yearbooks of the Czech Republic, 2002–2008.

SVATOŠOVÁ, L., BOHÁČKOVÁ, I., HRABÁNKOVÁ, M., 2005: *Regionální rozvoj z pozice strukturální politiky (Regional development from position of structural policy)*, České Budějovice: Jihočeská univerzita České Budějovice, pp. 156, ISBN 80-7040-749-2.

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