Quality of life evaluation in NUTS3 regions of Czech Republic and progression of evaluation in years 2000 - 2015

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Abstract

This paper deals with the quality of life evaluation in NUTS3 regions of Czech Republic and progression of this evaluation in years 2000 - 2015 based on selected indicators of Czech statistical office. The set of indicators is organized along a lot of areas: economy, safety, health, education, infrastructure, environment, labor market and other. Indicators for quality of life evaluation were selected from survey between Czech inhabitants from various regions, age and from different demographic characteristics in august 2016. Quality of life is evaluated by the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method. The NUTS3 regions of Czech Republic are evaluated by TOPSIS for each year and the result is a ranking of quality of life in regions. Next result is progress of these ranking regions in years 2000 - 2015. The results of QL evaluation show small differences in the assessment of individual regions, even though they are so different.

Keywords: indicators, quality of life evaluation, NUTS3 regions, TOPSIS

JEL Classification: C69, D89, H83, R59

1   Quality of life

Defining term quality of life (QL) brings many dilemmas. If we occupy ourselves with defining QL term, we have to consider influence of historical, cultural and social changes, which take place in given society. The definition aptly describes the expert discussions [12], which state that QL: "usually refers to the degree to which a person's life is desirable versus undesirable, often with an emphasis on external components, such as environmental factors and income. In contrast to subjective well-being, which is based on subjective experience, quality of life is often expressed as more objective and describes the circumstances of a person's life rather than his or her reaction to those circumstances." This term refers to human existence, comprehension of meaning of life itself of individual being. Quality of life can be observed through two variables – material and non-material part of human life. Quality of life includes individual way of life, not only individual living conditions, but also living conditions of wider groups of society as a whole. We can use a simple model of QL - in this model there are an objective and a subjective aspect of the QL (see Figure 1). [8], [11]

Figure 1. Model of quality of life (Source: Rapley)
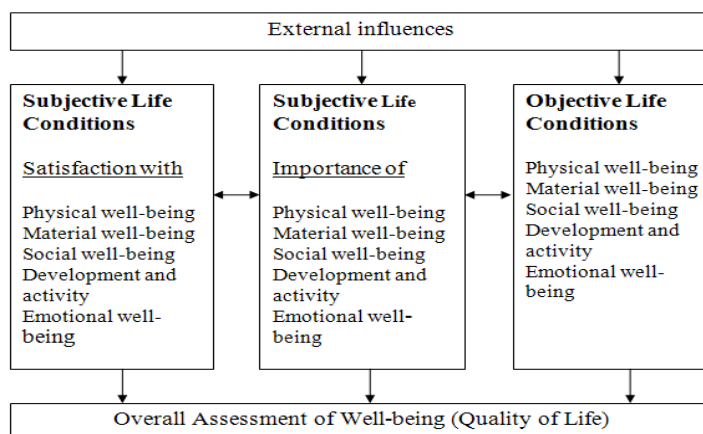
Among some common traits which are typical for the issue of the life quality research also belongs a fragmentation of definitions, an approach to the evaluation as well as multidisciplinary and multidimensionality [1]. The objective dimension is related to the material securing, social conditions, social status and physical health. It is a complex of economic, social, health and environmental conditions which determine human's life. Social dimension of the QL refers to the fact that an individual perceives his/her position in the society in the framework of his/her culture and the system of values. The final satisfaction with life is in virtue of personal goals, expectations and interests of each individual. QL should be looked upon as a multidimensional variable, which contains information about psychosocial status of an individual which is influenced by, for example, age, gender, education, social status, economical situation or individual's values. QL needs to be viewed as a subjective appreciation of own living situation. QL can be viewed as availability of options, from which an individual can pick during filling his life. [3], [9], [10], [11]

The QL is further determined as a magnitude which comprises in itself the fact how a human being perceives his/her position in society. Individual perception of each human being is basically influenced by [15]: system of values, relationship of an individual to his/her goals, expectations, standards and fears, psychosomatic state of an individual, social relationships, personal beliefs, relationship to key areas of the environment where individual lives. Main goal of this paper is a QL evaluation within the NUTS3 regions in Czech republic, progression of this evaluation in the years 2000-2015 and next objectives are to determine the level of development of QL in individual regions and the conjunction of these results due to other data and researches.

2   Quality of life evaluation in NUTS3 regions

2.1 Selected indicators for quality of life evaluation

For QL evaluating of NUTS3 regions of the Czech Republic was chosen example, whose author is the server aktuálně.cz [5]. In this paper is the goal seize and solve this example "by our idea" (in our opinion better) and extend solving problem - goal is the modification and extension of solving problem. In the original article has been selected a total of 24 indicators divided into three groups: prerequisites for a healthy and long life (indicators K1-K8 in table 1), preconditions for a productive life and a decent standard of living (K9-K16) and prerequisites for sustainable development and healthy environment (K17-K8) and QL was evaluated for year 2014. The complete list of QL evaluation indicators is in Table 1.

The first step of "modification article" was the finding, which indicators for QL evaluation are important for inhabitants in Czech Republic. For help of agency STEM/MARK was created survey, whose goal was find important indicators (by inhabitants in Czech Republic). This survey has 7 questions - importance of indicators, knowledge terms of QL and QL evaluation and five demographic questions (NUTS3 region, sex, economic activity, education and age). Demographic data were collected for characteristic of respondents and for next/other research (and for interest too). STEM/MARK's survey [14] held in august 2016 and participated to it 506 respondents (from differently regions, education, age and etc.). Results of the survey - important of indicators are shown in Table 1. In the QL evaluation at server aktualne.cz came out best region Prague (PRA) with ranking 72.5 % and though the evaluations were with relative values, that the quantity has a significant role. With a significant gap is then placed region Hradec Kralove (HKR), Central Bohemian (STČ) and South Moravian (JHM) rated between 54 % and 55 %. Subsequent evaluation of the order of the regions in 2014: Pardubice (PAK) 53.6 %, Vysočina (VYS) 53,56 %, Liberec (LIB) 52,22 %, Plzeň (PLZ) 51,07 %, South Bohemian (JHČ) 50,77 %, Zlín (ZLN) 49,4 %, Karlovy Vary (KVA) 48,09 %. The last trial sites are: Olomouc (OLO) 41.67 %, Ústí n. L. (UST) 34.67 % and Moravian-Silesian (MSZ) 30.97 %. As shown in Table 1, were selected the TOP ten indicators that respondents identified as important - score more than 30% from all respondents. The values for selected indicators for all regions and for the years 2000-2015 we get to the Czech Statistical Office (CZSO) and the statistical series of individual regions, in a public database and other sources of CZSO.

Table 1. Selected indicators (Source: STEM/MARK)

Signification	Indicator (group A/B/C)	Ranking (%)	Important
K1	Life expectancy at birth	50.4	Yes
K5	Doctors per 1,000 inhabitants	49.6	yes
K9	Gross domestic product per capita	47.6	yes
K18	Dust emissions	41.7	yes
K10	Long-term unemployed	37.9	yes
K4	Crimes per 1,000 population	37.5	yes
K24	A household with Internet access	36.2	yes
K12	Median gross monthly wages	35.0	yes
K19	Share of developed areas	31.0	yes
K8	Share of population living in houses connected to public sewage	30.4	yes
K21	Cars per 1,000 population	28.1	no
K15	Number of unsuccessful applicants for the elderly	26.7	no
K23	Proportion of university-educated population	26.7	no
K11	Number of applicants for one position at the labor offices	25.5	no
K20	Waste of companies per capita	24.9	no
K6	Occupational diseases per 100,000 inhabitants	22.5	no
K7	Average duration of incapacity	21.1	no
K14	Value of social aid benefits paid per capita	20.9	no
K2	Total population increase per 1000 population	20.0	no
K13	Number of businesses	19.8	no
K17	Number of small protected areas	18.6	no
K3	Traffic accidents per 1,000 population	13.8	no
K22	Voter turnout in elections to the regional assemblies	13.4	no
K16	Share of the surplus budget to the expenditure in region	12.6	no

2.2 Data

Data matrices where compiled for each of the years 2000-2015 by indicators and corresponding values in individual regions. In Table 2 is example data matrix for year 2010.

Table 2. Data matrix 2010 (Source: own construction from CZSO)

1	K1	K4	K5	K8	K9	K10	K12	K18	K19	K24
HKR	78.20	20.06	4.5	74.1	327440	0.01251	20779	0.67656	0.01942	59.51
JHČ	77.75	23.98	4.01	86.3	317054	0.02298	20583	0.40377	0.01053	51.45
JHM	78.09	25.43	4.791	88.3	353184	0.00597	22026	0.45307	0.01971	59.55
KVA	76.16	25.8	3.88	91.4	269199	0.02529	19700	0.48951	0.00965	54.75
LIB	77.51	31.32	3.69	68.2	287144	0.01643	20739	0.53347	0.01656	47.63
MSZ	76.23	31.91	3.90	80.8	311597	0.01940	21455	1.04955	0.02194	53.10
OLO	77.27	21.38	4.39	77.6	285621	0.01339	20323	0.43086	0.01577	51.62
PAK	77.61	17.18	3.80	71.8	308768	0.01075	20009	0.77634	0.01612	55.72
PLZ	77.61	24.20	4.50	78.3	346459	0.01362	21989	0.46067	0.01281	56.56
PRA	78.90	59.14	7.3	99.2	811822	0.00724	30842	2.48558	0.10153	62.16
STČ	77.43	30.40	3.15	68.7	333679	0.01804	22654	0.80276	0.01947	55.88
UST	75.57	35.22	3.40	81.5	298626	0.01666	21166	0.84420	0.01756	51.68
VYS	78.26	16.86	3.53	84.8	300530	0.02251	20502	0.75745	0.01276	53.01
ZLN	77.34	16.0	3.86	85.6	313137	0.05332	19937	0.37853	0.01820	54.18

2.3 Method TOPSIS

For the QL evaluation in NUTS3 regions of the Czech Republic and progression of evaluation in years 2000 - 2015 was been selected method TOPSIS, because QL evaluation is very complicated issue, then is appropriate to "take the help of" software or programming tools such as expert systems, decision making models or just rule-based systems and using special methodologies and methods. The method TOPSIS is one of Multi Attribute Decision Making algorithms, which is widely adopted. TOPSIS ranks the available networks based on their scores, with the highest being the best solution [13]. It is a multiple criteria method to recognize solutions from a limited set of alternatives. The fundamental rule is that the preferred alternative should have the shortest distance from the ideal solution and longest distance from the negative-ideal solution [6]. TOPSIS algorithm is applied to the network interface selection as follows [7], [13]:

- The value of each attribute are normalized - creating a normalized matrix R = (r_{ij}):

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^2}} \; ; i = 1, 2, ..., m; j = 1, 2, ..., n. \qquad (1)$$

- The matrix is updated with the normalized values.
- Each attribute in the matrix R = (r_{ij}) is assigned a weight w_i – new matrix V = (v_{ij}):

$$v_{ij} = w_j \cdot r_{ij}, \text{ where } \sum_{j=1}^{n} w_j = 1; i = 1, 2, ..., m; j = 1, 2, ..., n. \qquad (2)$$

- Determine ideal A+ and negative ideal A- solution:

$$A^+ = [v_1^+, ..., v_m^+] \; and \; A^- = [v_1^-, ..., v_m^-] \qquad (3)$$

- This step is to find the best and the worst value for each of the attributes (vi+ and vi-), if the attribute is upward then the higher value is the best and if the attribute is downward then the lower value is the best.

$$v_i+ = max \{v_{ij}, j = 1 ... n\}, \; v_i- = min \{v_{ij}, j = 1 ... n\} \qquad (4), (5)$$
$$v_i+ = min \{v_{ij}, j = 1 ... n\}, \; v_i- = max \{v_{ij}, j = 1 ... n\} \qquad (6), (7)$$

- The distances for both best (d+) and worst (d-) cases are measured:

$$d_i^+ = \sqrt{\sum_{j=1}^{m}(v_i^+ - v_{ij})^2}, \; d_i^- = \sqrt{\sum_{j=1}^{m}(v_i^- - v_{ij})^2} \qquad (8), (9)$$

- The coefficient *c* is calculated based on distances *d* from the best and worst solutions, given by:

$$c_i = \frac{d_i^-}{d_i^+ + d_i^-} \qquad (10)$$

- The case with the highest *c* value is selected (is the best).

TOPSIS method was used in this way in 10 indicators for all of regions for each of the years 2000 - 2015. The following section presents the results for the NUTS3 regions of Czech Republic, in individual years and the progress status of regions within the Czech Republic. Weight for indicators was determined 0,1 - for each equally.

3   Results and discussion

QL evaluation results in NUTS3 regions in Czech Republic are shown in Tab. 3. In this table are values of coefficient ci in selected years (for example C2001) and ranking for this year in second line (for example R2001). As this table shows, the differences between regions are not

significant and we can say that the QL is in all regions alike good. For certain regions, we can see stable development, with some regions "interesting" trend or fluctuations...

Table 3. Selected results of coefficient ci and ranking regions in 2000 - 2015 (Source: own construction)

|	C_{2001} R_{2001}	C_{2003} R_{2003}	C_{2005} R_{2005}	C_{2007} R_{2007}	C_{2009} R_{2009}	C_{2011} R_{2011}	C_{2013} R_{2013}	C_{2014} R_{2014}	C_{2015} R_{2015}
HKR	0.522939	0.523369	0.523599	0.523089	0.52531 10	0.523086	0.522785	0.522935	0.520606
JHČ	0.52322 11	0.52140 13	0.51831 10	0.51916 8	0.52320 13	0.52304 10	0.52197 8	0.52322 9	0.51988 13
JHM	0.51818 13	0.51652 12	0.51851 13	0.51972 12	0.52115 14	0.51943 13	0.52073 14	0.51818 13	0.51871 12
KVA	0.53004 5	0.53115 5	0.52732 6	0.52770 5	0.52761 6	0.52675 8	0.52926 9	0.53004 8	0.52477 8
LIB	0.53223 4	0.53287 4	0.53667 4	0.53707 4	0.53856 4	0.53575 4	0.53508 4	0.53223 4	0.53684 4
MSZ	0.54594 2	0.54544 2	0.54441 1	0.54534 1	0.54639 1	0.54662 1	0.54701 1	0.54594 1	0.54695 1
OLO	0.51740 14	0.51510 14	0.51583 14	0.51794 14	0.51954 12	0.51908 12	0.51689 12	0.51740 11	0.51754 5
PAK	0.52093 6	0.52482 8	0.52492 8	0.52503 12	0.52771 7	0.52452 7	0.52684 6	0.52093 6	0.52525 7
PLZ	0.52163 12	0.51978 11	0.51974 12	0.52248 11	0.52515 11	0.52191 14	0.51928 13	0.52163 14	0.51952 14
PRA	0.52253 10	0.52245 10	0.52239 11	0.52250 10	0.52255 9	0.52253 11	0.52246 11	0.52253 12	0.52251 11
STČ	0.54187 3	0.54263 3	0.54191 3	0.54296 3	0.54372 2	0.54297 3	0.54296 3	0.54187 3	0.54408 3
UST	0.54476 1	0.54591 1	0.54627 2	0.54571 2	0.54766 3	0.54658 2	0.54505 2	0.54476 2	0.54188 2
VYS	0.52372 7	0.52470 6	0.52375 5	0.52614 6	0.53108 5	0.53074 5	0.53067 7	0.52372 7	0.53243 9
ZLN	0.52334 8	0.52402 7	0.52425 7	0.52525 7	0.52555 8	0.52532 9	0.52520 10	0.52334 10	0.52509 10

We can show results on Fig. 2, which represent the values for individual regions in years 2000 - 2015. It is worth emphasizing, that the graph seems confused, because it contains many curves, which (as mentioned) is not so differently.

Figure 2. Results of coefficient ci (Source: own construction)
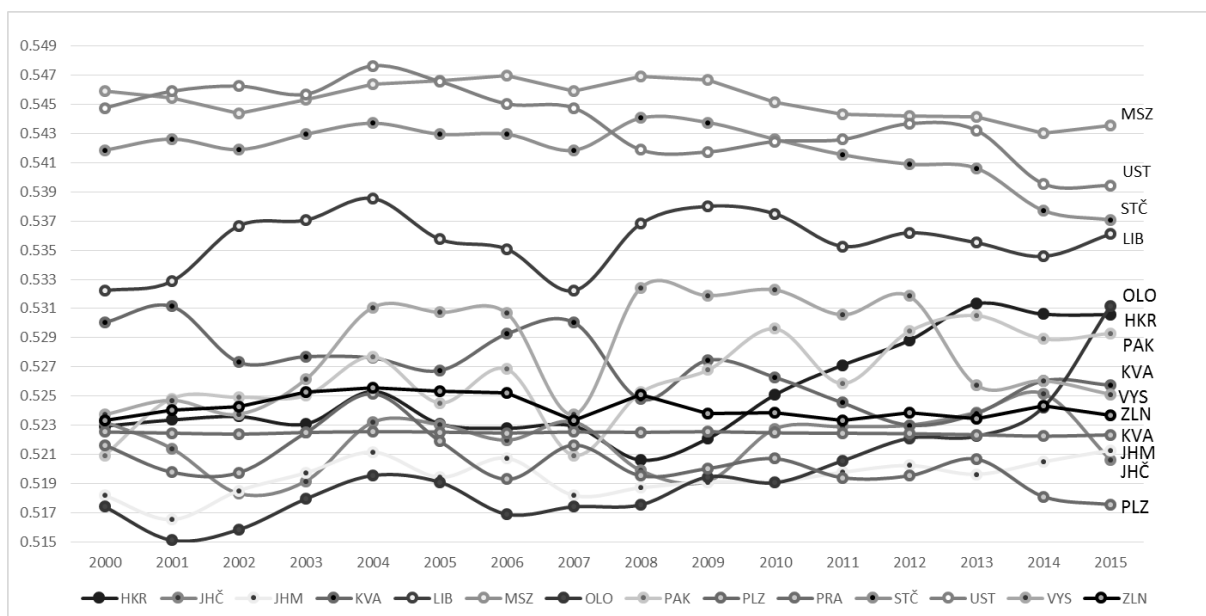
Contrary to expectations, did well regions MSZ and UST, which are generally speaking rather taken as a "regions with problems" - in terms of employment, crimes, environment and other. On the contrary, "unpleasant" surprises was born in Prague, which have remained stable value, but in the ranking moves up to around 10th place. This fact can be taken as an advantage of the used method TOPSIS - even when using relative values the quantity had not a big role (compared with aktuálně.cz article). To complement Figure 3 - This figure shows the average rating for the NUTS 2 regions and has been choosen for better visualisation of QL evaluation in this paper.

Figure 3. Results of coefficient ci – NUTS2 regions (Source: own construction)
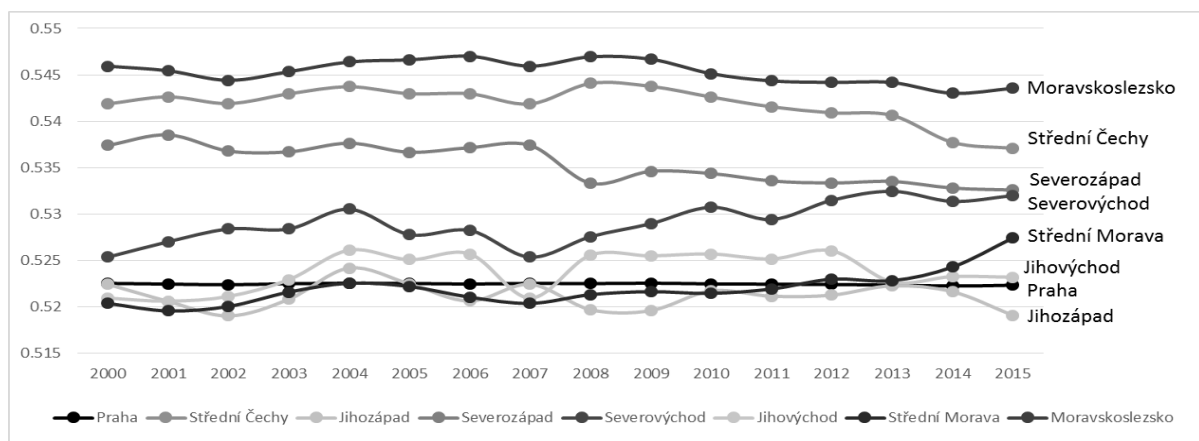
As stated in the section devoted to the results, the results QL evaluation for individual regions were not significantly different, the results can be interpreted as a difference of units percent and results can be interpreted, that all NUTS3 regions in Czech Republic QL are just as good. This result may be however slightly misleading. These presented indexes can be considered "hard data", which do not always reflect the socioeconomic, cultural and geographic disparities various regions and it even though it is a territory of one state or country.

Any objective indicators is difficult to take into account the subjective perception of QL and it is need for a truly objective description of the phenomenon of the quality of life thinking about linking measurement of objective and subjective sides. The fact that indicators show the high quality of life in the region, does not necessarily mean that is high even in the eyes of individual personalities. It's very similar as is to the subjective perception of poverty. Relative truth is between quality, satisfaction and real fact teetering on a very thin line, which defines specific designated indicators. With the empirical cognition of the reality of life an individual we have to always consider the subjective sides of experience. We must therefore necessarily cogitate, how bring in to the practical reasoning data about objective and subjective reality.

If we extend this idea and results even further, we get to do, that data from objective evaluation (or also "hard data") lead for balanced results if (as in our case) is evaluated one state or country and we have not social, cultural, economic and other differences. In such cases like this can then be considered to involve subjective assessment in QL evaluation, because this fact (that the results for all of regions is not bad) is not means, that the people are satisfied. An important part of it is subjective perception and interest in this "soft data" for use in practice.

In regards to the needs of local regional policy we can use, in considering the quality of life concept, for example, the model that states: "Quality of Life is the extent to which objective human needs are fulfilled in relation to personal or group perceptions of subjective well-being. Human needs are basic needs for subsistence, reproduction, security, affection, etc. Subjective well-being is assessed by individual or group responses to questions about happiness, life satisfaction, utility, or welfare. The relation between specific human needs and perceived satisfaction with each of them can be affected by mental capacity, cultural context, information, education, temperament, and the like, often in quite complex ways. Moreover, the relation between the fulfillment of human needs and overall subjective well-being is affected by the

(time-varying) weight of individuals, groups and cultures give to fulfilling each of the human needs relative to others [2].

If we compare the results of the QL evaluation with method TOPSIS and surveys of Czech Television [4] before the regional elections in 2016, where the inhabitants of the region subjectively evaluated QL in NUTS3 regions and its development, we have other results – excellent and very good it feels residents JHM, HKR, PLZ and JHC with the result 58-60%. The worst QL feeling have inhabitants in MSZ, KVA and UST (under 37%). Other regions were around 50%. Improving QL situation feel inhabitants in ZLN, PAK and PLZ (over 50%), People in UST and LIB least about 40%. Other regions were above 45%. As well as the results of TOPSIS method were differences between the regions small, but it turned out as subjective QL evaluation also important.

Table 4 shows the results of QL evaluation with using fuzzy inference systems in MATLAB. With this method, it was necessary to set up an "expert" values that are very bad (value 0) and excellent (value 1). Indicator K1: value 0 = 0/ value 1 = 85 and over; K4: 50 and over/0; K5: 1/10 and over; K8: 0/1; K9: 155000/300000 and over; K10: 0,1 and over/0; K12: 11000/ 35000 and over; K18: 5 and over/ 0; K19: 0,1 and over/ 0; K24: 0/1. As we can see, this method of evaluation also brings other results and, with few exceptions, the differences between regions are small too.

Table 4. Percentage results of using fuzzy inference system (Source: own construction)

	HKR	JHČ	JHM	KVA	LIB	MSZ	OLO	PAK	PLZ	PRA	STČ	UST	VYS	ZLN
2000	21	21	20	20	21	24	19	20	21	20	20	19	20	20
2001	19	21	60	20	23	27	20	21	19	21	20	20	21	20
2002	18	19	60	21	21	27	20	21	24	21	23	21	21	21
2003	18	19	60	21	21	25	21	24	26	21	18	20	20	21
2004	18	60	60	19	21	24	60	21	60	21	18	19	21	19
2005	18	60	60	19	60	23	60	25	60	21	18	27	23	20
2006	60	60	60	20	60	18	60	60	60	21	18	18	18	20
2007	60	60	60	60	60	25	60	60	60	21	19	60	18	21
2008	60	60	60	60	60	19	60	60	60	60	60	60	60	60
2009	60	60	60	60	60	21	60	60	60	60	60	60	18	60
2010	60	60	60	60	60	21	60	60	60	60	60	60	60	25
2011	60	60	60	60	60	21	60	60	60	60	60	60	60	21
2012	60	60	60	60	60	26	60	60	60	60	60	60	60	21
2013	60	60	61	23	60	26	60	60	60	60	60	60	60	21
2014	60	60	78	26	60	60	60	60	60	60	60	60	60	28
2015	60	60	78	60	60	60	60	60	60	60	60	60	65	50

4   Conclusion

As evidenced by this paper, QL evaluation is very difficult problem and for solving of this problematic exist a lot of approaches and methodologies. This fact supports advantage of used rule-based systems, expert systems, multi criteria decision making systems and method of system engineering is useful for solving problems of QL evaluation. Even compared with other methods of QL evaluation showed that subjective QL evaluation cannot neglect and for each method brings different results. Results confirm, that are small differences between regions. For more accurate and better results would be interesting to use other methods. Possibilities for further development of this problem are compared with values of neighbouring NUTS3 regions of Czech Republic. Certainly it would also be interesting to examine the long-term trend from 2015+. As an added incentive for editing and development this problem for greater sensitivity is question of the weight of individual indicators (eventually of areas). The next incentive can be added other approaches or methodologies, for example modification TOPSIS to fuzzy TOPSIS.

Acknowledgements

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