

Quality of Life Evaluation in Czech Districts

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Abstract

The article explores regional comparison of quality of life (QOL) in the Czech Republic (CR) districts. In the CR there are 77 districts. A district is a territorial unit mainly used for statistical reporting purposes. This territorial classification corresponds with Eurostat Local Administrative Unit level 1. A set of 32 indicators from economic, social and environmental areas was chosen for the measurement of QOL at the district level. The model was designed for the evaluation, comparison and explanation of regional differences in the QOL. Algorithms of hierarchical cluster analysis were applied for the whole set of objective indicators in the model. The results show that QOL on the district level is very similar across the CR; only the districts located in the highland areas in Šumava (mountains), Jeseníky (mountains) and Krušné hory (Krušné mountains) have lower level of QOL. On the other hand, the highest QOL is observed in the district Capital city of Prague as actually expected.

Keywords: District; indicator; hierarchical cluster analysis; quality of life.

JEL Classification: C88, H59, H76

1 Introduction

In recent decades the term QOL, or rather well-being gets more and more attention from political representations, professional communities and citizens themselves. In order to make this complex issue somewhat more easily observable it is possible to say that this concept has two dimensions, under various approaches, there is an objective and a subjective dimension [15]. According to [6] it is possible to understand real quality of life as concrete and measurable life conditions of an individual or of inhabitants. Objective QOL is influenced by a number of indicators. Life conditions and a certain life standard also influence to a large extent the possibility to succeed in life for individuals, individuals starting points for possible attainment of certain status of living. Thus living conditions influence also further development of individuals. Life conditions and the living standard mutually overlap and influence each other. Higher material and financial living standards are linked to larger selection of and larger accessibility of specific and higher quality services and products. There are big differences however between objective living conditions and objective standard of living and the subjective perception of this objective quality. These differences are determined socially and psychologically. Some socio-demographic factors as e.g. age, life experience but also generation based specific needs are primarily among the most important factors that influence the subjective perception of the objective quality of life. Following this are also the level of education, type of profession, personality type, personal direct experience with the given environment or passed on information about quality of life in various regions, social status and similar.

The subjective evaluation of the QOL is the most sensitive and the most difficult area of such evaluation. Problems are encountered here that are related with embarrassment to respond to questions about one's own life satisfaction. Other problems in this area are the reliability or objectivity of the provided responses, the issues of relation to the objective QOL and with continuously changing value orientation of individual people and the society as a whole, the issue of measuring the achieved level of one needs' satisfaction and of relevant life objectives and so on.

As it is obvious from the above-stated text the QOL cannot be measured neither easily nor directly. It is a large-scale concept that covers and includes a lot of dimensions (political-societal, social, economic and also environmental) and it is measured by means of indicators and

aggregated (composite) indexes of QOL. Any quantitative facts, that are data, which have or can have a relation to the quality of human life, can become indicators for QOL measurement. According to the UN Commission for Sustainable Development indicators have a number of functions. They can provide explanations, they can simplify and they can provide aggregate information for decision-making, they can help to include natural and social sciences into decision-making and they can help to measure the path to sustainable development. Further they can provide early warning about potential economic, social and environmental threats. QOL indicators are also important tools for translation and transfer of ideas and values [13, 16, 17].

A number of databases and indicators exist both on the world level and in the CR (e.g. the UN Development Programme, the World Bank, United Nations DESA, Eurostat, OECD, [13, 17] that monitor and evaluate QOL from various points of view and aspects. These are, in majority of cases, partial indicators that do not explain the complex QOL issue. This is the reason why compound, in other words aggregated QOL indicators, are used - *Human Development Index, Physical Quality of Life Index, Index of Corruption, Index of Sustainable and Development Index*, and similar.

Basic differences can be observed between the objective and the subjective QOL indicators. Sets of objective indicators focus on anticipated sources of the QOL, subjective indicators are usually obtained from qualitative research. Among QOL objective indicators belong e.g. GDP per Inhabitant, savings, emissions, number of registered cars, and average number of years of education or crime levels. Subjective indicators are such indicators as feeling of happiness, feeling of satisfaction and similar [17].

For the national, regional, or potentially the local level, other types of QOL evaluation indexes are used then are those used for the international level. For these lower levels the international indicators are not statistically observed, or potentially other indicators are more objective and more accurate for this level of observation.

Some authors have researched into QOL on the regional level in the CR. These authors themselves individually selected suitable indicators while being constrained by the availability of the relevant data on the regional level [13, 16, 17]. Abroad e.g. [12].

In the evaluation of the QOL on the regional level there are dramatic differences observed in the approaches to the evaluation, as well as there is a dramatic level of ambiguity. This happens due to alternative approaches taken by various authors, due to socio-cultural conditions, due to different scale and availability of data. One of the causes of this situation is the fact that there does not exist any umbrella organization or recommended methodology for the evaluation of objective QOL. Another cause of this situation on the regional level is also a geographic issue-no consideration is given to the definition of an territory for which it is meaningful to observe the QOL. According to [6] such meaningful territories could be so called commute micro-regions. In the CR such commute micro-regions are territories managed by municipalities with extended administrative duties or ORPs (municipalities that must provide also for some state administration functions). However on this level a number of indicators that could provide objective side of the QOL evaluation are not observed and such observation would require a separate individual research.

For the evaluation of the QOL on the micro-region level we have thus decided to select indicators on the district level (districts). Districts are under the statistical and territory classification Local Administrative Units (LAU) level 1. With regard to the enormous complexity of this issue we deal in this article only with the objective indicators of QOL evaluation-these indicators are from economic, social and environmental areas. The objective is to execute a comparison and an evaluation of QOL amongst the CR districts. For the purpose of the comparison a classification model has been designed. This model utilizes hierarchical clustering algorithm.

Concept of QOL evaluation and it's possible application in decision-making proceses is suitable for utilization in each area of public administration. Public administration representatives (at national, regional, municipal level) are able to evaluate QOL differences amongst regions in the CR, to identify their pros and cons and opportunities for improvement, to set the priorities for providing and financing the services based on the established data.

2 Material and Methods

For evaluating the QOL at a micro-regional level we had to create a classification model on the basis of cluster analysis (CA). The model works with the CR districts real data sets in year 2014. Data collected by the Czech Statistical Office (CZSO) are analysed [3].

The CA is used for defining clusters of QOL based on the value of the indicators (attributes). CA is an exploratory data analysis tool for solving classification problems [1, 4, 5, 9-11, 19]. The object is sorted into groups, or clusters, so that the degree of association is strong between members of the same cluster and weak between members of different clusters. The task of clustering is then to divide the set of objects into the disjunctive clusters. The decision-making about the object clustering in cluster is realized on the basis of the similarity by application of metric [5]. The basic division of methods is mentioned for instance in [5] and application in [4].

2.1 Problem formulation

The QOL district model works with data for year 2014 for 77 districts in the CR. For the evaluation of QOL in the CR districts based on data availability by that we mean the availability of open publicly available data) 31 indicators were selected and sorted into 3 groups - the set of economics **E**, social **S** a environmental **N** indicators) where $\mathbf{E} = \{e_1, e_2, \dots, e_k\}$, $\mathbf{S} = \{s_1, s_2, \dots, s_m\}$ and $\mathbf{V} = \{v_1, v_2, \dots, v_n\}$. The specification of the complete set of indicators is in Table 1.

Our suggested indicators do not dispute utilization of indicators used with other foreign [12, 14, 18] or domestic studies surveys [13, 16, 17]. For QOL evaluation at district level preference was given to availability of indicators (from open public databases) from three areas mentioned above. These three areas (economic, social, environmental) are covered for QOL evaluation by other authors as well, nevertheless only at regional (NUTS 3) level.

The economic area includes the basic living standard indicator – the Gross Domestic Product (GDP) per inhabitant. In this analysis this indicator is included only on the regional level, because in the CR territory this indicator is evaluated only down to regional level, and not all the way down to the district level. However it can be stated that this indicator also, to a certain extent, illustrates the economic performance of those districts that are part of the relevant regions. Another indicator from the economic group of indicators is the number of registered economic undertakings. This indicator includes both legal entities (e.g. trading companies, joint stock companies, cooperatives, national companies) and physical entities (self-employed persons and private business subjects) registered in the Register of Economic Entities. Further the analysis includes indicators dealing with the job market and unemployment: share of inhabitants in productive age (from 15 to 64 years of age) in the total number of inhabitants, the indicator available open job positions in the district, share of unemployed people – in total this indicator has been since year 2013 the new percentage indicator of registered unemployment. This indicator defines share of accessible job applicants in the age group from 15 to 64 years of age out of the total number of inhabitants in the same age group. This indicator replaces the previously published rate of registered unemployment that compares all accessible job applicants only to the economic active persons. Other selected indicators from the unemployment category are the shares of unemployed people according to the period of their unemployment as it is registered at the Labour office and shares of unemployed people according their achieved level of education. The last two indicators from this economic indicators group are the length of roads and highways in the district expressed in kms and the number of completed flats.

The Social indicators group includes the death rate indicator. It is the number of deceased people per 1000 inhabitants of middle status in the reference period. The indicator infant death defines the number of infants deceased in first 28 days of their lives per 1000 live birth infants during the reference period. This category of indicators includes also the indicators of marriages

and divorces where the number of marriages is showed per 1000 inhabitants of the middle status in the reference period, the same applies to the number of divorces. The social area includes also, next to other issues, the accessibility of education facilities in a given district. From this group we have selected the following indicators: number of kindergartens, number of elementary schools and number of secondary technical schools and grammar schools. From the area of health care accessibility we have selected for the evaluation 2 indicators. They are number of hospitals in the district and numbers of physicians per 1000 inhabitants.

Table 1. The complete set of indicators (Source: Authors)

Indicators	Description of indicators
e ₁	Number of registered economic undertakings
e ₂	Number of inhabitants in productive age (%)
e ₃	Number of available job positions
e ₄	Unemployment rate – total (%)
e ₅	Unemployment rate accord. to duration of unemployment – 3-6 months (%)
e ₆	Unemployment rate – duration – above 24 months (%)
e ₇	Unemployment rate by education – elementary (%)
e ₈	Unemployment rate by education – complete secondary with school leaving certificate (%)
e ₉	Unemployment rate by education – graduate (%)
e ₁₀	Total length of roads and highways (km)
e ₁₁	Number of completed dwelling units/flats
s ₁	Death rate per 1000 people/inhabitants
s ₂	Mortality, infant (per 1,000 live births) (number)
s ₃	Marriage rate 1000 people/inhabitants
s ₄	Divorce rate 1000 people/inhabitants
s ₅	Number of kindergartens
s ₆	Number of elementary schools
s ₇	Number of secondary technical/special schools and grammar schools
s ₈	Number of hospitals
s ₉	Number of physicians per 1000 people/inhabitants
s ₁₀	Number of traffic accidents
s ₁₁	Crime - total number
v ₁	Population density (number of people/inhabitants per 1km ²)
v ₂	Area of small protected areas (ha)
v ₃	Emissions TZL (particulate matter pollutants) (tonnes/year)
v ₄	Emissions SO ₂ (tonnes/year)
v ₅	Emissions NO _x (tonnes/year)
v ₆	Emissions CO (tonnes/year)
v ₇	Emissions VOC (volatile organic matters) (tonnes/year)
v ₈	Emissions NH ₃ (tonnes/year)
v ₉	Coefficient of Ecological Stability

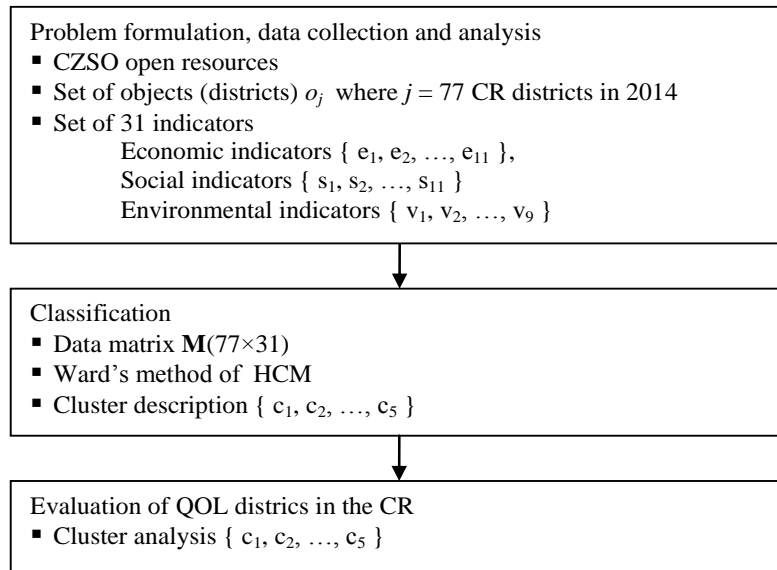
The environmental indicators group includes the indicator of population density. Another indicator in this group is the area of small-protected areas expressed in ha. Such areas are national nature conservation areas, nature conservation areas, national nature heritage and nature heritage. Among the major indicators from the environment category belongs the emissions balance. We selected values of stationary sources emissions according to REZZO 1-3. To this group there belong emissions TZL (particular matter pollutants), SO₂ (sulphur dioxide), NO_x (nitrogen oxides), CO (carbon monoxide), VOC (volatile organic matters), NH₃ (ammonia).

However they do not include emission of T_{ZL}, NH₃ and VOC from building activities, from breeding and farming animals, from the application of mineral fertilizers and from the not observed usage of dissolving agents. The last indicator from the environmental indicators group is the coefficient of ecological stability. This indicator describes the share of ecologically significant areas (forests, pasture land, marshland, artificial ponds, orchards, vineyards, meadows and similar) to areas of low ecologic stability (build-up surface, arable land, hop gardens and orchards with black wastelands, and similar).

2.2 Classification method

The designed classification model is illustrated in Fig. 1. The model utilizes the set of economics E, social S and environmental N indicators from the CZSO data reported for year 2014.

Figure 1. Model of QOL evaluation of CR districts (Source: Authors)



To identify similarities between objects on the basis of the observed indicators we can utilize the hierarchical clustering methods (HCM) [7]. The HCM could be divided how the similarity measure is calculated. Single-link clustering method (also called nearest neighbour method), complete-link clustering method (also called the further neighbour method), average-link method etc. are examples of the HCM. The dendrogram is the result of the HCM [10]. It is commonly used to represent the process of hierarchical clustering. It shows how objects are grouped together step by step [5, 19]. A clustering of the data objects is obtained by cutting the dendrogram at the desired similarity level [10].

Based on the results of the various HCMs Ward's algorithm of hierarchical clustering was selected. Algorithms were executed in Statistica program.

3 Results and Discussion

Since the indicator GDP per inhabitant is observed on the regional level it was not included into the analysis. By far the highest value of GDP per inhabitant has the Capital City Prague (829 168 CZK). Other regions do not reach even half of this value. Among the remaining regions there are no such significant differences observables. With a certain level of simplification the CR districts could be ranked according to their presence in the individual regions, which would partially illustrate the standard of living demonstrated by the GDP per inhabitant in these territorial units. However, it cannot really be simplified to this level since the GDP values in the individual districts belonging to one single region may differ significantly. The high level of GDP

per 1 inhabitant in the region can be caused by a very high performance of few selected districts in the relevant region (capital cities of the regions), while other districts in the same region may significantly lack behind in their performance.

On the basis of [3] the LAU system on the LAU 1 and LAU 2 level the Capital City of Prague is not further separated into smaller units. Since Prague is a municipality, a district and a region in one, it is different from other regions and its territorial division is thus out of any rules and classification valid for other regions and districts. Prague is divided under the NUTS and LAU systems in the following way: NUTS 2 – Prague is one of the areas, NUTS 3 represents 14 regions-Prague is one of the (administrative unit) regions, LAU 1 represents districts (it used to be NUTS 4), Prague is stated as one unit, LAU 2 represents municipalities (it used to be NUTS 5) – Prague is stated also as one unit.

While analysing QOL in the CR districts including the Capital City of Prague, even when not including GDP, it is assumed that the Capital shall have the best evaluation. It is possible to make such assumption with regard to the fact that the Capital is the principal city of the CR where a large number of economic undertakings is concentrated, it has a large number of inhabitants, it has very good accessibility of education and of medical care and similar.

When modelling the border of distance of objects of maximum 45% was chosen. Ward's method created, in the cluster analysis of districts, in total 5 clusters, (see Table 2). Districts belonging to one cluster are marked as similar from the QOL in these districts point of view. As it is clear from Table 2 in the individual clusters there is uneven frequency of objects.

The district the Capital City of Prague was, as expected, put separately into a cluster, thus it is different from other districts. Further 2 clusters of a smaller size were created including 6 or respectively 7 districts, one cluster of 19 districts was created and biggest cluster including 44 districts was created.

Table 2. Allocation of Districts to Clusters – Ward's method (Source: Authors)

Cluster	Districts	No. of Districts
1	Hlavní město Praha/Capital City Prague	1
2	Frýdek-Místek, Chomutov, Louny, Mělník, Ostrava-město, Pardubice	6
3	Brno-město, České Budějovice, Hradec Králové, Olomouc, Plzeň-město, Praha-východ, Praha-západ	7
4	Benešov, Beroun, Blansko, Brno-venkov, Břeclav, Havlíčkův Brod, Hodonín, Chrudim, Jičín, Jihlava, Kladno, Kolín, Kroměříž, Kutná Hora, Liberec, Litoměřice, Mladá Boleslav, Náchod, Nový Jičín, Nymburk, Opava, Pelhřimov, Písek, Plzeň-jih, Plzeň-sever, Prostějov, Přerov, Přeborn, Rakovník, Rychnov nad Kněžnou, Semily, Strakonice, Svitavy, Šumperk, Tábor, Trutnov, Třebíč, Uherské Hradiště, Ústí nad Orlicí, Vsetín, Vyškov, Zlín, Znojmo, Žďár nad Sázavou	44
5	Bruntál, Česká Lípa, Český Krumlov, Děčín, Domažlice, Cheb, Jablonec nad Nisou, Jeseník, Jindřichův Hradec, Karlovy Vary, Karviná, Klatovy, Most, Prachatice, Rokycany, Sokolov, Tachov, Teplice, Ústí nad Labem	19

To evaluate the QOL in the CR districts the input data were used to build a table (Table 3). Table 3 includes the average values of the individual indicators in the created clusters. Thanks to the average values it can be found out which district groups achieve, in the individual indicators, better or worse results. In case this ranking is done for these average values for each cluster for the individual indicators and then average ranking of a cluster is calculated it can be approximately determined in which districts there is higher QOL and which districts lack behind in this respect.

Table 3 illustrates that the highest quality of life is in the district Capital City of Prague. Then follows Cluster no. 3 that is comprised from districts adjoining Prague and by districts Brno-město, Plzeň-město, České Budějovice, Hradec Králové and Olomouc. In these districts

there are seats of the regional capitals that generate sufficient number of jobs, qualified labour force and low unemployment. At the same these seats have an extensive network of civil facilities and they do not achieve high levels of environmental indicators. The most numerous is Cluster no. 4 that includes 44 districts with similar quality of life; based on the QOL value it takes the third place. The second most numerous cluster is Cluster no. 5 that takes, based on the QOL value, the last but one place. In this cluster there are a number of the border districts that due to their location do not reach any more significant values of the economic and social indicators. The last place goes to Cluster no. 2 that comprises of districts Frýdek-Místek, Chomutov, Louny, Mělník, Ostrava-město and Pardubice. In these districts there is the lowest QOL. The QOL in this Cluster is negatively affected by in particular the environmental indicators, the high volumes of emissions from stationary sources (of emissions). In district Frýdek-Místek there is by far the highest value of the CO emissions, and similarly it is in Ostrava-město district. In other districts - Chomutov, Mělník, and Pardubice – above average values of SO₂ emissions are caused by the existence of coal power stations and of other industry plants.

Table 3. Ranking of Districts Based on Average Indicators Values in the Clusters (Source: Authors)

Cluster	Ranking
1	1st
2	5th
3	2nd
4	3rd
5	4th

From Cluster no. 3 it can be derived that a similar QOL is in the neighbourhood of the Capital City Prague and also in districts including some of the regional capital cities (Brno – město, České Budějovice, Hradec Králové, Olomouc, Plzeň-město) while all these are districts located across the entire territory of the CR. Similar QOL is thereby in, for instance, west-Bohemian district Plzeň – město and in south-Moravian district Brno-město.

4 Conclusion

We are aware of the fact that this executed analysis has its limitations, as described by Heřmanová. Our ambition has not been to design one aggregated QOL indicator on the district level; our ambition has been to demonstrate territorial differences in QOL between individual districts of the CR and also potentially any similar characteristics between these regions. We have decided to work on the district level because the relevant and needed sets of indicators used in this model for the comparison and the analysis are publicly open and available for the district level. That is the advantage of our designed model at district level – it exploits indicators from open database and QOL can be evaluated without conducting any individual research. Moreover model demonstrates lower territorial level of QOL than majority of surveys – usually realised at national or regional level.

The executed analysis and comparison of the QOL in districts of the CR is also influenced by the fact that one of the fundamental economic indicators – the GDP per inhabitant – had not been included in this model since this indicator is not and has not been monitored down to the district level. However, it is possible in any following research to do a cluster analysis with full understanding of a certain managed simplification. In such managed situation the same level of the GDP per inhabitant would be applied to all districts inside one single region. When the indicator GDP per inhabitant was included into the model, obtained results remain without significant change. For this reason regional GDP per inhabitant were not included into the model.

It issues from the analysis that the QOL in the CR is on nearly similar level across the entire territory. Differences are demonstrated in the border districts, in the mountain districts

as is for instance Šumava, Krušné hory or Jeseníky mountains (with low QOL) on the one hand and in districts with high quality of life for the Capital City Prague and the adjoining districts and some other districts where are located the regional capitals (Olomouc, Hradec Králové, Brno-město, Plzeň-město a České Budějovice) on the other hand. Another factor that contributes significantly to a lower QOL in some districts are the above average volumes of stationary sources' emissions given by the location of the specific sources of emissions in the district (Ostrava-město, Frýdek-Místek, Chomutov, Mělník a Pardubice).

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Vyjádření k recenzím – reakce na připomínky jsou v článku zobrazeny červeně.

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Originality of the paper-Recenzent měl zřejmě na mysli HDP (ne DPH jak je uvedeno v recenzi). K připomínce recenzenta lze konstatovat, že byl proveden model i se zahrnutím regionálního HDP na obyvatele, avšak výsledky se příliš nelišily od výsledků popsané clustrové analýzy, tento ukazatel nebyl dale v článku zohledňován (právě proto, že na okresní úrovni není zjišťován). Tato zmínka je přidána v závěru příspěvku.

Paper template- poznámka byla odstraněna

Conclusion notes – obě připomínky byly zohledněny

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Methodology and methods – the explanation is given in article in section 2.1. Our suggested indicators do not dispute utilization of indicators used with other foreign [12, 14, 18] or domestic studies surveys [13, 16, 17]. For QOL evaluation at district level preference was given to availability of indicators (from open public databases) from three areas mentioned above. These three areas (economic, social, environmental) are covered for QOL evaluation by other authors as well, nevertheless only at regional (NUTS 3) level.

Discussion and conclusions - That is the advantage of our designed model at district level – it exploits indicators from open database and QOL can be evaluated without conducting any individual research. Moreover model demonstrates lower territorial level of QOL than majority of surveys – usually realised at national or regional level.

References- there were added some foreign literature (see references)

Pro snížení počtu stránek byl odebrán obrázek 1 v příloze článku