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# LIFE QUALITY EVALUATION IN REGIONS OF THE CZECH REPUBLIC ACCORDING TO SELECTED CRITERIA USING THE DEA METHOD

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## Abstract

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Our work has several aims. We have evaluated the Quality of life of the districts (LAU 1 regions) in the Czech Republic, according to the selected criteria by the Data Envelopment Analysis (DEA) method. This method was initially proposed to evaluate the efficiency. In this paper the level of efficiency represents the level of life quality. The efficiency (quality of life) is in this case represented as a share of output in weighted sum of inputs. In other words, it represents a certain degree to which desirable output can offset undesirable indicators. Hence we have consider three types of input (the unemployment rate, criminality, as well as the specific emissions) and one output (the average salary). In the next stage, the fourth input (the average price of a dwelling per square metre) is added. Its impact on the changing of efficiency score is under consideration with regression analysis. At the same time, we have observed a possible connection between the achieved efficiency score and net migration in following year. In addition to efficiency score DEA method provides weights of particular inputs and outputs. These weights are used to find those contributions of particular criteria to the achieved score. This enables us to determine the strong and weak points of the districts.

data envelopment analysis, districts, efficiency, migration, quality of life, regression

Many authors have dealt with quality of life assessment recently. Life quality at the level of administrative districts (LAU1) of South Moravia is investigated, for example, by Živělová and Jánský (2008). In their work, life quality is assessed on the base of analysis of the population and unemployment increase. Moreover, the authors involve indicators of medical care and transport and technical infrastructure.

The same authors, in another work (Živělová and Jánský, 2008), investigate the development of life quality in regions (NUTS 3) primarily from the social aspects' point of view. The quality of life in given regions is assessed in terms of the unemployment rate, the number of job applicants per one vacancy, the number of physicians per 1000 inhabitants, the number of completed flats and the length of road network.

The assessment of regions resp. regional disparities is considered by the Ministry of Regional Development of the Czech Republic within the scope of the WD-05-07-3 – Regional disparities Program in the availability and affordability of housing, their socioeconomic consequences and tools directed to decrease of regional disparities, for details see Lux and Sunega (2007).

The above mentioned works are focused upon the comparison of the regions, with respect to particular aspects. In the scope of multicriteria regional evaluation, the output of the MasterCard Czech Centres of Development Project (http://www.centrarozvoje.cz) are considered to be important. Life quality and economic potential of towns were assessed in this project, using 11 selected indicators (Master CARD WordlWIDE, 2010), whose weights were determined empirically.

Furthermore, Kuprová and Kamenický (2006) in their work deal with evaluation of life quality in the NUTS 3 regions. The evaluation is based on 47 particular indicators.

To analyse life quality in particular districts in our work, we have used the Data Envelopment Analysis (DEA) models. This method is advantageous because it does not require initial weights for particular criteria. In this case, the regions were assessed according to the achieved input and output so that the efficiency (the ratio of the outputs and the inputs) would be maximal. Therefore, the potential of the particular regions are respected in the maximal way, see more in section Material and Methods.

In the paper by authors Martic and Savic, (2001), the assessment of the regional performance in Serbia was conducted using the DEA Models together with discriminant analysis. To compare effective units between each other, the Andersen-Peterson's Model was used see Andersen and Petersen (1993). The work of Xiong, Liu and Tang (2008) shows problems with the choice of criteria for the assessment made with the DEA Method in the field of regional development and the comparison with the static comparative analysis. The social-economic development in the Province of Sichuan is analysed by Li, Cheng (2010) using the DEA Method. The relationships between the DEA method and some other traditional economic theories used for the assessment of sustainable regional development are discussed in work of Ma, Liu (2008).

Our work has several aims. We have evaluated the efficiency of the districts (LAU 1) in the Czech Republic, according to the selected criteria by the DEA Method. This method was initially proposed to evaluate the efficiency. However, in this paper, its results are used to find those contributions of particular criteria to the achieved score. This enables us to determine the strong and weak points of the districts. In the first stage, we have consider three types of input (the unemployment rate, criminality, as well as the specific emissions) and one output (the average salary). In the next stage, the fourth input (the average price of a dwelling per square metre) is added. Its impact on the efficiency changing score is under consideration. At the same time, we have observed a possible connection between the achieved efficiency score and net migration in following year.

## MATERIAL AND METHODS

The DEA Models come out from Farrel's Model used to measure the efficiency of the units with one input and one output (Farrel, 1957) which was extended by Charnes, Cooper, and Rhodes (CCR) (1978) and Banker, Charnes, and Cooper (BCC) (1984). The CCR Models are assumed to have a constant range yield, i.e. the changes of the number of input are proportionally projected to the changes of the number of output. The BCC Models assume variable range yields. The use of the DEA Method is more detailed described, for example, in work of Cooper, Seiford, and Tone (2007).

The DEA method is used to divide evaluated subjects (Decision Making Units - DMUs), according to expended inputs and produced outputs, into two groups – efficient and inefficient. The DEA method compares units with the best units on the base of the linear programming theory. In this paper, DMUs are districts of the Czech Republic. Efficiency of the district is conceived as a level of the life quality according to chosen criteria.

Basic DEA models (CCR and BCC) are either input or output oriented. The output oriented model aims to maximize outputs without requiring a change of one or more of input values. The input oriented model tries to minimize inputs without requiring a change of one or more of output values. In case of inefficient units, the optimal level of outputs or inputs can be determined. The CCR model has assumed that all inputs and outputs can be varied.

### CCR model output oriented model

Suppose $p$ DMUs and $m$ inputs ($x_i$, $i = 1, 2, \ldots, m$), $n$ outputs ($y_j$, $j = 1, 2, \ldots, n$) for each of these $p$ units. We have to solve $p$ optimizations (one for each of $p$ units) to obtain weight ($v$) for each of $m$ input and weight ($u$) for each of $n$ outputs for $k$-th DMU ($k = 1, 2, \ldots, p$).

Mathematical model for unit $H$ (one of $p$ units) can be described as follows:

Maximize

$$\sum_{j=1}^{n} y_{jH} u_{jH'} \,, \tag{1}$$

subject to

$$\sum_{j=1}^{n} y_{jk} u_{jH} \leq \sum_{i=1}^{m} x_{ik} v_{iH}, \quad k = 1, 2, \ldots, p,$$

$$\sum_{i=1}^{m} x_{iH} v_{iH} = 1, \tag{2}$$

$$u_{jH} \geq 0, v_{iH} \geq 0.$$

Weights in this model are determined so that objective function (1) is maximal (it is dependent on the model orientation). If the objective function is equal to one, the unit is efficient. A non-efficient unit's coefficient is less or more than one (output or input oriented model). For more details see (Cooper, Seiford and Tone, 2007).

The dual problem of LP (primal) model is expressed as follows:

Minimize

$$\theta_H \tag{3}$$

subject to

$$x_{iH}\theta_H - \sum_{k=1}^{p} x_{ik}\lambda_{kH} \geq 0, i = 1, 2, \ldots, m,$$

$$\sum_{k=1}^{p} y_{jk}\lambda_{kH} \geq y_{jH}, j = 1, 2, \ldots, n, \tag{4}$$

$$\lambda_{kH} \geq 0, k = 1, 2, \ldots p$$

where expresses a coefficient of a combination of peer units for unit H.

The value of the objective function of dual model is equal to the value objective function of the primal model (1), (2). We can interpret this value as a necessary reduction of inputs in order to become efficient. The DEA models give for inefficient units a set of recommendations in order to improve their efficiency, with increasing outputs or decreasing outputs.

The coefficients determine a linear combination of inputs (outputs) of peer units creating a virtual efficient unit for unit H (see (5)).

$$x'_{iH} = \sum_{k=1}^{p} x_{ik}\lambda_{kH},\ i = 1, 2, \ldots, m, \tag{5}$$

$$y'_{jH} = \sum_{k=1}^{p} y_{jk}\lambda_{kH},\ j = 1, 2, \ldots, n,$$

where $x'_{iH}$ is the optimal size of the $i$-th input for $H$-th unit and $y'_{jH}$ is the optimal size of the $j$-th output for the $H$-th unit.

Using results of the primary model (results of weights $u$ and $v$), it is possible to determine a contribution of particular criteria to the reached score.

For unit $H$, it is possible to calculate according to (6) the contribution of the $i$-th input. Similarly, for the $j$-th output to according (7).

$$\frac{x_{ik}v_{ik}}{\sum_{i=1}^{m} x_{ik}v_{ik}} \tag{6}$$

$$\frac{y_{jk}u_{jk}}{\sum_{j=1}^{n} y_{jk}u_{jk}}. \tag{7}$$

The disadvantage of the DEA method, when compared with multicriteria decision making methods, is a certain limitation in terms of the number of inputs and outputs included in the model. It stands to reason that with an increase of inputs and outputs under the same number of assessed unit, the number of efficient units increases. For this reason, we involved in efficiency assessment only three resp. four inputs and one output.

In our work, we dealt with life quality on the level of districts (LAU 1). Considering the data accessibility, we assessed regions from year 2008. Likewise as in works (Master CARD WordlWIDE, 2010) and (Kuprová and Kamenický, 2006) aim of our work was to make a comparison with multicriteria evaluation. For this task, we chose the above mentioned DEA method. We tried to involve the economical, social and ecological factors into assessment and the reached results were then compared with net migration.

In the first stage, the following inputs were included into the assessment: unemployment rate (number of unemployed in %), criminality (number of crimes per 10 thousand inhabitants), specific emissions of main pollutants involving solids, sulphur dioxide, nitrogen oxides, carbon monoxide (tone per km$^2$). The source data are available at http://www.czso.cz.

Only one output was involved into the DEA – the average salaries achieved in particular districts. However, there were no data available for the considered year (2008). The Czech Statistical Office observed the average salaries for particular districts only till 2005. Therefore, the input was estimated, based on the year of 2005. Then we used chain indices of the average salary growth for regions NUTS 3 obtained from http://www.czso.cz. The average salaries for particular districts were then calculated using following formula:

$$s_{k,l} = s_{k,b} I(S)_{(b+1)/b} \times I(S)_{(b+2)/(b+1)} \times \ldots \times I(S)_{k/(k-1)}, \tag{8}$$

where

$s_{k,l}$.....is average wages in districts $k$ in year $l$,
$s_{k,b}$.....is average wages in base year $b$,
$I(S)_{b/(b+1)}$....is chain index for average wages in relevant region (NUTS 3) for the period $b$+1.

We computed the average salaries for regions (NUTS 3) from the estimated values and the number of active inhabitants in order to verify the above introduced procedure. The calculated values and the values presented on the websites of the Czech Statistical Office differed by 0.89%.

By the means of the model with the above mentioned inputs and output, we derived efficiency of particular districts. Moreover, we obtained the contribution of separate inputs and output to the achieved efficiency for efficient and inefficient districts.

In the next stage, we added another input – the average price of a square meter of dwelling in the given districts. This entry was obtained from http://www.realitymorava.cz, where the comparison of dwelling prices in all districts of the Czech Republic is periodically published. We monitored how this input influences efficiency and contribution changes of particular indicators. More closely, we observed, to what extent the low price of dwelling in ineffective districts can compensate weak points of the other inputs.

In the last stage, we compared efficiency of districts with net migration in the following year. We supposed that the efficiency of districts would correspond closely with net migration. In addition to this, we attempted to discover dependency between the dwelling price and the efficiency change.

## RESULTS AND DISCUSSION

The source data are available at http://home.ef.jcu.cz/~friebel/research/districts/dea.xls. Data were processed with own application written in Maple. Functionality of the application was verified by SW Frontier Analyst.

Nine districts can be considered as effective after executing the DEA method excluding price of dwelling. The contributions of the particular criteria to the efficiency score calculated in the way (6) are listed in Tab. I. The districts are evaluated according to all the above mentioned criteria. Only one criterion has the impact on the achieved efficiency at the district of Praha-západ (unemployment) and Vyškov (emissions). Both of these districts achieved the lowest values of the mentioned criteria in all assessed districts. In other districts, two or all three criteria influenced the achieved results with a varying degree of contribution. In the districts of Jindřichův Hradec and Prachatice, the share of unemployment and emissions is almost identical. In the districts of Pelhřimov, Žďár n. S. and Třebíč, criminality combined with unemployment and emissions is the most influential. Emissions combined with the unemployment rate are also of a great influence in the district of Praha-západ. Efficiency of the district Hradec Králové is affected variously by all three criteria.

According to the contributions of particular criteria to the achieved score, we can divide inefficient districts too.

Tab. II shows inefficient districts in which unemployment contributes to the achieved score most of the all considered criteria. The table also presents contributions of the other inputs. It is important to be aware of the fact that districts facing problems with unemployment can have the largest contribution of unemployment to efficiency, as they are, in terms of the other criteria, even weaker in the others criteria.

Tab. III shows inefficient districts with the greatest contribution of criminality to the efficiency score.

Districts with the main contribution of emission to the efficiency score are presented in Tab. IV.

In the next stage, we performed DEA evaluation when we included the criterion of average price of dwelling in Czech crowns per square meter. When a next criterion is included, this causes an improvement of efficiency especially in districts with worse results in the rest of the criteria.

I: *Efficient districts and inputs contributions*

| | Contribution [%] | | |
|---|---|---|---|
| **Unit name** | **Unemployement** | **Emissions** | **Crimes** |
| Hradec Králové | 46.87 | 29.81 | 23.32 |
| Jindřichův Hradec | 47.45 | 52.55 | 0.00 |
| Pelhřimov | 39.95 | 0.00 | 60.05 |
| Praha-východ | 21.33 | 78.67 | 0.00 |
| Praha-západ | 100.00 | 0.00 | 0.00 |
| Prachatice | 50.13 | 49.87 | 0.00 |
| Třebíč | 0.00 | 29.81 | 70.19 |
| Vyškov | 0.00 | 100.00 | 0.00 |
| Žďár nad Sázavou | 27.66 | 13.26 | 59.08 |

II: *Inefficient district with the largest contribution of unemployment*

| | | Contribution | | |
|---|---|---|---|---|
| **District** | **Score [%]** | **Unemployment** | **Emissions** | **Crimes** |
| Benešov | 90.55 | 42.90 | 20.17 | 36.93 |
| Chomutov | 39 | 57.58 | 0.00 | 42.42 |
| Jablonec nad Nisou | 55.26 | 55.42 | 0.00 | 44.58 |
| Kladno | 69.98 | 58.00 | 0.00 | 42.00 |
| Kolín | 59.25 | 56.60 | 0.00 | 43.40 |
| Liberec | 59.4 | 57.72 | 0.00 | 42.28 |
| Mělník | 70.56 | 55.80 | 0.00 | 44.20 |
| Náchod | 73.9 | 55.60 | 0.00 | 44.40 |
| Olomouc | 68.31 | 47.49 | 27.65 | 24.85 |
| Ostrava-město | 43.19 | 50.97 | 0.00 | 49.03 |
| Pardubice | 86.2 | 55.54 | 0.00 | 44.46 |
| Plzeň-jih | 99.26 | 56.38 | 0.00 | 43.62 |
| Prostějov | 95.31 | 53.65 | 20.86 | 25.49 |
| Příbram | 48.57 | 50.71 | 0.00 | 49.29 |
| Teplice | 40.54 | 57.76 | 0.00 | 42.24 |

III: *Inefficient districts with the largest contribution of criminality*

| | | Contribution [%] | | |
|---|---|---|---|---|
| **District** | **Score [%]** | **Unemployment** | **Emissions** | **Crimes** |
| Beroun | 81.19 | 42.75 | 0.00 | 57.25 |
| Blansko | 83.78 | 10.66 | 12.78 | 76.56 |
| Brno-město | 55.9 | 45.04 | 0.00 | 54.96 |
| Brno-venkov | 98.46 | 39.05 | 0.00 | 60.95 |
| Bruntál | 55.53 | 12.74 | 13.93 | 73.33 |
| České Budějovice | 90.59 | 44.08 | 0.00 | 55.92 |
| Děčín | 49.93 | 25.88 | 10.57 | 63.55 |
| Domažlice | 91.39 | 23.68 | 9.35 | 66.97 |
| Frýdek-Místek | 65.66 | 20.41 | 0.00 | 79.59 |
| Havlíčkův Brod | 95.61 | 24.92 | 11.18 | 63.90 |
| Hodonín | 94.04 | 0.00 | 0.00 | 100.00 |
| Cheb | 63.4 | 38.51 | 15.97 | 45.52 |
| Chrudim | 83.2 | 27.54 | 0.00 | 72.46 |
| Jeseník | 88.46 | 0.00 | 21.89 | 78.11 |
| Jičín | 77.98 | 21.95 | 11.76 | 66.29 |
| Jihlava | 88.07 | 19.68 | 10.29 | 70.03 |
| Karviná | 44.1 | 25.60 | 0.00 | 74.40 |
| Klatovy | 79.05 | 23.50 | 8.21 | 68.29 |
| Kroměříž | 96.44 | 13.02 | 10.80 | 76.18 |
| Kutná Hora | 80.4 | 22.39 | 10.21 | 67.40 |
| Litoměřice | 48.08 | 38.27 | 0.00 | 61.73 |
| Louny | 50.97 | 25.48 | 0.00 | 74.52 |
| Mladá Boleslav | 92.24 | 38.17 | 0.00 | 61.83 |
| Most | 40.32 | 22.18 | 0.00 | 77.82 |
| Nový Jičín | 75.4 | 24.06 | 0.00 | 75.94 |
| Nymburk | 57.93 | 19.46 | 10.16 | 70.38 |
| Opava | 74.91 | 11.19 | 16.58 | 72.23 |
| Písek | 76.25 | 18.34 | 11.27 | 70.39 |
| Plzeň-město | 81.52 | 42.07 | 0.00 | 57.93 |
| Plzeň-sever | 98.33 | 23.16 | 10.10 | 66.74 |
| Přerov | 74.6 | 26.67 | 0.00 | 73.33 |
| Rakovník | 72.91 | 32.59 | 23.91 | 43.50 |
| Rokycany | 88.25 | 20.54 | 0.00 | 79.46 |
| Rychnov n. K. | 98.77 | 36.13 | 0.00 | 63.87 |
| Semily | 63.9 | 19.73 | 12.44 | 67.83 |
| Sokolov | 56.1 | 22.49 | 0.00 | 77.51 |
| Strakonice | 67.13 | 38.38 | 0.00 | 61.62 |
| Svitavy | 79.69 | 0.00 | 11.05 | 88.95 |
| Šumperk | 76.23 | 11.11 | 15.11 | 73.77 |
| Tábor | 93.1 | 21.33 | 0.00 | 78.67 |
| Trutnov | 59.93 | 35.91 | 0.00 | 64.09 |
| Uherské Hradiště | 98.54 | 11.25 | 11.04 | 77.71 |
| Ústí nad Labem | 43.61 | 36.10 | 0.00 | 63.90 |
| Ústí nad Orlicí | 87.28 | 26.84 | 0.00 | 73.16 |
| Vsetín | 74.47 | 25.78 | 0.00 | 74.22 |
| Zlín | 99.73 | 22.34 | 0.00 | 77.66 |
| Znojmo | 70.52 | 0.00 | 23.26 | 76.74 |

IV: *inefficient districts with the largest contribution of emissions*

| | | Contribution [%] | | |
|---|---|---|---|---|
| **District** | **Score [%]** | **Unemployment** | **Emissions** | **Crimes** |
| Břeclav | 90.06 | 0.00 | 100.00 | 0.00 |
| Česká Lípa | 57.87 | 42.84 | 57.16 | 0.00 |
| Český Krumlov | 88.98 | 0.00 | 100.00 | 0.00 |
| Karlovy Vary | 62.41 | 48.96 | 49.67 | 1.37 |
| Tachov | 89.46 | 0.00 | 100.00 | 0.00 |

V: *inefficient districts with the largest contribution of dwelling price*

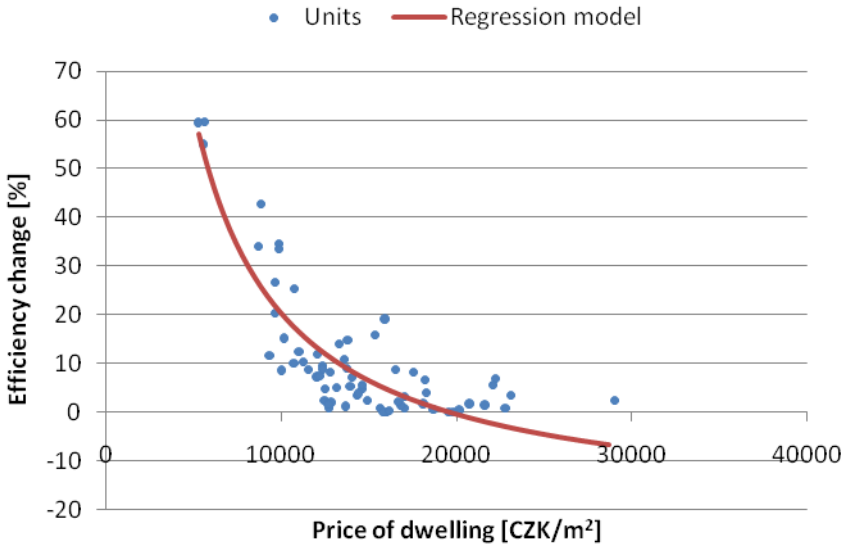
| | | Contribution | | | |
|---|---|---|---|---|---|
| **District** | **Score** | **Unemployment** | **Emissions** | **Crimes** | **Prices** |
| Česká Lípa | 92.42 | 21.66 | 28.90 | 0.00 | 49.44 |
| Děčín | 92.61 | 13.17 | 5.38 | 32.34 | 49.11 |
| Cheb | 70.67 | 26.36 | 10.93 | 31.15 | 31.56 |
| Litoměřice | 62.12 | 22.40 | 0.00 | 36.14 | 41.47 |
| Příbram | 64.32 | 33.24 | 0.00 | 32.32 | 34.44 |

Tab. V introduces districts where the price of dwelling is the most important criterion.

Tab. VI shows results of evaluation efficiency units with four inputs (unemployment, criminality, emissions and price of dwellings) and differences (mark Δ) between the efficiency score with and without prices of dwellings for all districts. Either the scores did not change or they increased.

VI: *Efficiency after addition of average price of dwelling and difference between evaluation without this criterion*

| **Unit** | **Score** | **D** | **Unit** | **Score** | **D** | **Unit** | **Score** | **D** |
|---|---|---|---|---|---|---|---|---|
| Benešov | 100 | 9.45 | Kladno | 70.75 | 0.77 | Prostějov | 95.31 | 0 |
| Beroun | 84.65 | 3.46 | Klatovy | 84.16 | 5.11 | Přerov | 86.48 | 11.88 |
| Blansko | 84.65 | 0.87 | Kolín | 67.42 | 8.17 | Příbram | 64.32 | 15.75 |
| Brno-město | 58.26 | 2.36 | Kroměříž | 96.44 | 0 | Rakovník | 76.05 | 3.14 |
| Brno-venkov | 98.46 | 0 | Kutná Hora | 82.45 | 2.05 | Rokycany | 95.64 | 7.39 |
| Bruntál | 75.93 | 20.4 | Liberec | 65.97 | 6.57 | Rychnov n. K. | 100 | 1.23 |
| Břeclav | 95.33 | 5.27 | Litoměřice | 62.12 | 14.04 | Semily | 64.48 | 0.58 |
| Č. Lípa | 92.42 | 34.55 | Louny | 77.6 | 26.63 | Sokolov | 90.19 | 34.09 |
| Č. Budějovice | 99.25 | 8.66 | Mělník | 74.54 | 3.98 | Strakonice | 76.15 | 9.02 |
| Č. Krumlov | 99.28 | 10.3 | Mladá Boleslav | 99.14 | 6.9 | Svitavy | 87.94 | 8.25 |
| Děčín | 92.61 | 42.68 | Most | 100 | 59.68 | Šumperk | 91.38 | 15.15 |
| Domažlice | 100 | 8.61 | Náchod | 82.76 | 8.86 | Tábor | 97.93 | 4.83 |
| Frýdek-Místek | 70.49 | 4.83 | Nový Jičín | 87.88 | 12.48 | Tachov | 99.4 | 9.94 |
| Havlíčkův Brod | 98.07 | 2.46 | Nymburk | 59.4 | 1.47 | Teplice | 100 | 59.46 |
| Hodonín | 96.05 | 2.01 | Olomouc | 70.02 | 1.71 | Trutnov | 70.72 | 10.79 |
| Hradec Králové | 100 | 0 | Opava | 78.25 | 3.34 | Třebíč | 100 | 0 |
| Cheb | 70.67 | 7.27 | Ostrava-město | 62.3 | 19.11 | Uherské Hradiště | 98.72 | 0.18 |
| Chomutov | 93.97 | 54.97 | Pardubice | 86.62 | 0.42 | Ústí n. L. | 77.17 | 33.56 |
| Chrudim | 85.61 | 2.41 | Pelhřimov | 100 | 0 | Ústí n. O. | 96.07 | 8.79 |
| Jablonec n. N. | 69.98 | 14.72 | Písek | 80.08 | 3.83 | Vsetín | 81.62 | 7.15 |
| Jeseník | 100 | 11.54 | Plzeň-jih | 100 | 0.74 | Vyškov | 100 | 0 |
| Jičín | 78.85 | 0.87 | Plzeň-město | 87.06 | 5.54 | Zlín | 99.73 | 0 |
| Jihlava | 89.77 | 1.7 | Plzeň-sever | 100 | 1.67 | Znojmo | 76.02 | 5.5 |
| J. Hradec | 100 | 0 | Praha-východ | 100 | 0 | Žďár n. S. | 100 | 0 |
| Karlovy Vary | 63.86 | 1.45 | Praha-západ | 100 | 0 | | | |
| Karviná | 69.41 | 25.31 | Prachatice | 100 | 0 | | | |




1: *Regression model*

The biggest increments of efficiency (greater than 20%) were recorded in the districts of Most, Teplice, Chomutov, Děčín, Česká Lípa, Sokolov, Ústí nad Labem, Louny, Karviná, and Bruntál, where the price of dwelling is low. It means that the price of dwelling compensate the values of the other criteria.

Observing the XY graph in Fig. 1, we can see a certain dependency between the efficiency change and the price of dwelling. We suggested a hyperbolical approximation by means of regression analysis, whose equation is given in formula (9). This relation is also relatively important with regard to the achieved index of determination (see (9)).

$$y' = \frac{414\,285}{x} - 21{,}25. \qquad I^2 = 0{,}7768 \qquad (9)$$

We investigate if the low price of dwelling, or the other of criteria, has also an impact on net migration in the year 2009. Net migration represents difference between the number of immigrants and emigrants in a particular district. Net migration is not significantly dependant on neither of the criterions. It means that neither the price of dwelling nor the other considered criteria are main reason for migration to a particular district. Migration is conditioned by a set of criteria as well as habits, tradition, family etc.

Based on the net migration and the assessment according to unemployment, criminality, emission and price of dwelling in the year 2008, we can say that people move in average to the districts with higher efficiency level, see Tab. VII. This statement is not valid generally mainly as the assessment was proceeded according to the above mentioned criteria, and the other were not taken into account.

VII: *Dependency between efficiency and net migration*

| Efficiency | Net migration |
|---|---|
| > 95 | 2.889 |
| ≤ 95 | 0.857 |
| = 100 | 5.221 |
| < 100 | 0.701 |

## CONCLUSION

All districts were assessed according to the following criteria: the unemployment rate, the criminality rate, the emission burden per one square kilometre, the average price of flats per one square meter, and finally the average salary. We tried to determine a mutual connection between these criteria and the net migration. Neither of these criteria was significantly influenced by the migration of inhabitants.

People making a decision as to where to live have also considered other aspects which are not included in this presented assessment. These aspects can be objective, measurable criteria, but also the characteristics and nature of these people. For sure, their decisions can be also influenced by the place where their families live, where they were studying etc. From those people, those who have already settled down somewhere, mainly people in higher managerial positions or, for example, doctors are willing to move.

Based on our assessment, it is possible to choose stronger and weaker points of these particular districts. The weaker points are considered in case there is a zero contribution of the relevant criteria to the reached rate of effectiveness. It can be concluded that the reached rate of effectiveness, the most important criterion is the criterion in which the district in the relationship with similar districts is well given. This is also true for districts with a low

total efficiency which also fall behind more in other criteria. This means that the main criterion, regarding the effectiveness, it is always the strongest point of the given district. If the assessment includes any criteria, then, when making those decisions about possible improvements of the quality of life in the districts, we would recommend paying attention mostly to the weaker points.


## SUMMARY

We have evaluated the life quality in the districts (LAU 1) of the Czech Republic, according to the selected criteria by the Data Envelopment Analysis (DEA) method. This method was initially proposed to evaluate the efficiency. The DEA method compares units with the best units on the base of the linear programming theory. In this paper, units are particular districts of the Czech Republic. Efficiency of the district is conceived as a level of the life quality according to chosen criteria. In addition to efficiency score DEA method provides weights of particular inputs and outputs. These weights are used to find those contributions of particular criteria to the achieved score. This enables us to determine the strong and weak points of the districts. In the first stage, the following inputs were included into the assessment: unemployment rate (number of unemployed in %), criminality (number of crimes per 10 thousand inhabitants), specific emissions of main pollutants including solids (tone per km$^2$). As the inputs for DEA method there are used criteria where the low values are desired. Vice versa the criteria with the high desired value are used as the outputs. Only one output was involved into the DEA – the average salaries achieved in particular districts. However, there were no data available for the considered year (2008). The Czech Statistical Office observed the average salaries for particular districts only till 2005. Therefore, the input was estimated, based on the year of 2005. Then we used chain indices of the average salary growth for regions NUTS 3. In the next stage, we added another input – the average price of a square meter of dwelling in the given districts. We monitored how this input influences efficiency and contribution changes of particular indicators. More closely, we observed, to what extent the low price of dwelling in ineffective districts can compensate weak points of the other inputs. In the last stage, we compared efficiency of districts with net migration in the following year. We supposed that the efficiency of districts would correspond closely with net migration. In addition to this, we tried to discover dependency between the dwelling price and the efficiency change (difference between evaluation without price of dwellings and with this criterion).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