Measurement of Life Satisfaction across the Czech Republic

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Abstract

Examining the quality of life raises many questions and approaches for assessment. Many subjective indicators of living conditions may characterize the quality of life. In the paper we discuss the multidimensional aspect of life satisfaction. The paper focuses on the role of various factors, at aggregate level, in explaining observed regional differences in life satisfaction. The differences will be illustrated by cartographic visualization. At the regional level, we examine what factors make respondents more satisfied. Specifically, we focus on the role of personal job situation, cost of living, and the financial situation of households. The analysis is based on Eurobarometer research. The paper evaluates and compares the life satisfaction across various regions in the Czech Republic. For this purpose, the multivariate linear regression analysis will be used to examine and describe the relationship between life satisfaction as a response variable and selected predictor variables. Data will be analyzed by the SAS 9.2 software.

Keywords

Life satisfaction, regional disparities, multiple linear regression analysis, cartographic visualization, SAS software

JEL code

C29, J17, J28

INTRODUCTION

The aim of this paper is to find and quantify factors affecting the life satisfaction. The multivariate linear regression technique was applied to evaluate the role of regional factors in determining the life satisfaction of individuals across regions of the Czech Republic. We study to what extent questions make respondents more satisfied. Specifically, we concentrate on the role of financial and job situation, cost of living, household and health care. These questions were used as predictor variables, together with other selected questions, which affect the partial satisfaction in the various areas of life. The proportion of satisfied respondents with their life within selected regions was used as a response variable.

The quality of life is determined by the subjective perceptions of individual life stories. According to Maslow's theory the quality of life is about needs, satisfaction and values. This theory is closely as-

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sociated with theories of motivation. Everyone has different needs, everyone prefers — more or less — something different (Maslow 1970). This term is used in a wide range of contexts and various indicators influence the assessment of the quality of life. The evaluation of differences in quality of life has two aspects: objective and subjective. Therefore the research on disparities among regions can be realized both by quantitative and qualitative research (Jánský et al., 2009). The standards of living are evaluated by objective aspects, which can be measured in financial terms. The main data sources are the Czech Statistical Office and various ministries. Subjective well-being is subject to multiple determinants (Sheldon and Hoon, 2007).

The different types of indicators are used as objective characteristics of life satisfaction, for example indexes that are used primarily to compare different groups of inhabitants. These include the Human Development Index (HDI), the Human Poverty Index (HPI), the Gender-related Development Index (GDI) and the Gender Empowerment Measure (GEM). The HDI reflects the inequality between women and men. The GEM measures the active participation of women in economy and politics (Galvasová and Chabičovská, 2009).

The characteristics of subjective satisfaction are largely affected by levels and changes at country level, macroeconomic variables, such as inflation, GDP per capita, unemployment rate and social welfare indicators (Di Tella et al., 2003). In addition, social indicators, e.g. marital status, monthly earnings, and the level of education, can be considered.

This paper offers an analysis of subjective aspects of life satisfaction focusing on views and opinions of Czech residents. The analysis is based on the opinion research (Eurobarometer 71.2). The paper focuses on the role of various factors, at aggregate level, in explaining observed regional differences in life satisfaction. We used multivariate regression and correlation analysis to examine and describe the relationship between life satisfaction and selected predictors. The correlation analysis helps to find the variables that have the greatest impact on the overall life satisfaction of respondents. The differences in the quality of life in various regions can be illustrated by cartographic visualization, which represents the innovative methodical approach (more in Galvasová and Chabičovská, 2009).

1 LIFE SATISFACTION

We may come across lots of definitions and indicators focusing on description and examination of life satisfaction and the overall quality of life. Svobodová and Galvasová (2009) state that the concept of quality of life is very abstract, affected by many factors, which are of long-term character and sometimes contradictory. The terms such as quality of life, well-being and life satisfaction actually identify a maze of closely interrelated but subtly different concepts and show that every relationship between subjective and objective levels of well-being can be dynamically complex. A person's subjective well-being includes both these emotive and cognitive judgments, and different people weigh them differently (Grossi et al., 2010, Dvořáková et al., 2006). Ra (2010) states that subjective well-being includes our response, perceived satisfaction, and assessment of life.

Life satisfaction is not synonymous to happiness, even if these two terms are often used interchangeably. Both are broadly consistent measures of subjective well-being, but have to be considered separately. When asked how happy they are, people tend to consider the more volatile concept of current emotional state, while life satisfaction is closer to the concept of an overall and more stable living flourishing and realizing the best potential within oneself. Beutell (2006) points out that life satisfaction is an overall assessment of feelings and attitudes about one's life at a particular point in time ranging from negative to positive. It is related to better physical and mental health, longevity, and other outcomes that are considered positive in nature. Huppert et al. (2005) state that happiness is considered a more immediate human response whereas life satisfaction refers to a more collectively motivated mindset. In addition, self-ratings of 'happiness' tend to reflect short-term, situation-dependent expressions of mood, whereas

self-ratings of life satisfaction appear to measure longer-term, more projectable evaluations, indicating the extent to which one's experiences match one's expectations.

2 METHODS

The Eurobarometer 71.2 was used as a source for this analysis. It covers the population of the respective nationalities of the European Union Member States, resident in each of the Member States and aged 15+ years. The Eurobarometer was created at the request of the European Commission. The research was made between the 25th of May and the 17th of June 2009 and 1033 citizens of the Czech Republic participated in this Eurobarometer. Nine sub questions, referring to the quality of life, were chosen for detailed analysis.

The sampling points were drawn systematically from each of the "administrative regional units", after stratification by individual unit and type of area. They thus represent the whole territory of the countries surveyed according to the Eurostat NUTS II and according to the distribution of the resident population of the respective nationalities in terms of metropolitan, urban and rural areas. For the purpose of analysis the regions were selected according to the CZ NUTS II territories and the area of residence: village, small / middle size town or large town. Therefore the class variable contains 22 regions.

The global question on the life satisfaction was posed: "On the whole, are you very satisfied, fairly satisfied, not very satisfied or not at all satisfied with the life you lead?" (A1). The proportion of satisfied respondents within the selected regions was chosen as a response variable. The proportion of positive response is a continuous variable therefore the multiple linear regression analysis can be used.

Respondents also answer the question: "How would you judge the current situation in each of the following?"

- Health care system in the Czech Republic (A2);
- The provision of pensions in the Czech Republic (A3);
- The cost of living in the Czech Republic (A5);
- Affordability of energy (A8);
- How affordable housing is in the Czech Republic (A9);
- The economic situation in the Czech Republic (A11);
- Personal job situation (A12);
- The financial situation of a household (A13);
- The employment situation in the Czech Republic (A14).

For each question four possible answers could be given: very good, rather good, rather bad, and very bad. We exclude interviewers who responded 'don't know' or did not respond. For the purposes of analysis the input variables were recoded into two categories (good / bad). The proportions of positive responses within each region were used as predictor variables in the multiple regression analysis.

Finally, maps of the NUTS II regions were produced on the basis of answers to the selected questions. The cartographic visualization is a possible way for presentation of differences in the spatial distribution of reference indicators in various territories and also for comparison with the results of another analysis.

2.1 Regression analysis

The presented paper deals with modeling of relation between life satisfaction as a response variable and more predictor variables. Multiple regression and correlation analysis explores the interaction of several factors on the dependent variable, so there is no significant simplification of reality as in the case of simple linear regression. The aim of this paper was using the multiple regression and correlation analysis to estimate a type of relation between chosen variables and assess the strength of this relationship.

The main objective of the multiple linear regression analysis is to assess the significance of the predictor variables in explaining the variability or behavior of the response variable and predict the values of the response variable given the values of the predictor variables.

The multiple linear regression analysis models the dependent variable Y as a linear function of K independent variables $X_1, X_2, \ldots, X_K$, as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_K X_K + \varepsilon, \tag{1}$$

where β_0 is the intercept term and $\beta_1, \beta_2, \ldots, \beta_K$ are the partial regression coefficients; ε indicates random errors. Estimates of the unknown population parameters $\beta_0, \beta_1, \beta_K$ are obtained by the method of least squares. The method of least squares minimizes the sum of squares of the residuals. If the assumptions of linear regression are valid, the least squares estimates are unbiased estimates of the population parameters and have minimum variance (Hebák et al., 2005, Johnson and Wichern, 2007).

To determine whether the predictor variables explain a significant amount of variability in the response variable, the linear regression model is compared to the baseline model. In a baseline model, there is no association between the response variable and the predictor variables.

Thus, the null hypothesis of the regression model is defined as:

$$\beta_1 = \beta_2 = \ldots = \beta_K = 0. \tag{2}$$

It means that regression model does not fit the data better than the baseline model. Alternative hypothesis is the following: The regression model does fit the data better than the baseline model and not all β_Ks equal zero (Huber et al., 2006, Mason et al., 2003).

The quality of the regression models fit can be measured by the coefficient of determination. This coefficient is usually referred to as the R^2 value. The value is the proportion of the total variation observed in the data explained by the regression model. The coefficient of determination is written:

$$R^2 = 1 - \frac{SS_E}{TSE}, \tag{3}$$

where SS_E is the sum of squares of residuals and TSE is the total sum of squares (Johnson and Wichern, 2007, Mason et al., 2003).

2.2 Regression diagnostics

The regression analysis is followed by regression diagnostics. It verifies that the data have met the regression assumptions, otherwise the results may be misleading. Assumptions for the linear regression analysis are: The mean of the response variable is linearly related to the predictor variables. The random error terms, ε_j, where $j = 1 \ldots J$ and J is the number of residuals, are assumed to have following properties (Johnson and Wichern, 2007):

- $E(\varepsilon_j) = 0$;
- $Var(\varepsilon_j) = \sigma^2$ (constant); and
- $Cov(\varepsilon_j, \varepsilon_k) = 0, j \neq k$.

In other words the errors should be normally distributed with a mean of zero for all j; the variance of the errors should be constant for all j; and the errors associated with one observation are not correlated with the errors of any other observation.

Additionally, there are issues that may arise during the analysis. A single observation that is substantially different from all other observations can make a large difference in the results of the regression analysis. There are three ways how an observation can be unusual. Firstly, an outlier, this is an observation with a large residual. An outlier may indicate a sample peculiarity or may indicate a data entry error or other problem. Residuals should be plotted in various ways to detect possible anomalies. Secondly, the high leverage points can affect the estimate of regression coefficients. Habshah et al. (2009) point out that leverage values are being used in regression diagnostics as measures of influential observations in the space of predictor variables. Detection of high leverage values is crucial because of their responsibility for misleading conclusion about the fitting of a regression model, causing multicollinearity problems, masking and / or swamping the outliers, etc. Thirdly, the influence observation means that an individual observation may exert undue influence on the coefficients. The observation is influential if removing the observation substantially changes the estimate of coefficients. Influence can be thought of as the product of leverage and outlierness. To detect influential observations, we used Cook's D statistic. This statistic measures the change in the parameter estimates that results from deleting each observation (Chen et al., 2003, Hebák et al., 2005, Huber et al., 2006).

The multicollinearity also requires attention. It means that the predictor variables are highly collinear, i.e. linearly related, and it can cause problems in estimating the regression coefficients. Variance inflation factor (VIF) provides a measure of the magnitude of collinearity. The problems caused by colinearity can be overcome by (1) deleting one of a pair of predictor variables that are strongly correlated or (2) relating the response Y to the principal components of the predictor variables (more in Huber et al., 2006, Johnson and Wichern, 2007).

2.3 Correlation analysis

The Pearson correlation coefficients were used to measure the degree of linear relationship between two input variables. This coefficient is symmetric and ranges in value from –1 to +1. The sample correlation coefficient, r, can be obtained by dividing the covariance ($Cov(X,Y)$) of the two variables by the product of their standard deviations (σ_X, σ_Y), as follows:

$$r(X,Y) = r(Y,X) = \frac{Cov(X,Y)}{\sigma_X, \sigma_Y}, \tag{4}$$

(Hebák et al., 2005, Huber et al., 2006, Salvatore and Reagle, 2002).

3 THE MODEL OF LIFE SATISFACTION

First the distribution of data was examined. The normal distribution is characterized by a bell shape and two parameters: the mean and the standard deviation. The Shapiro-Wilk test verified that the distribution of all input variables is not significantly different from the normal distribution. Next the correlation analysis was used to qualify the degree of linearity between input variables. A common correlation statistic used for continuous variables is the Pearson correlation coefficient of the pair of variables and corresponding p-value. The sample correlation coefficients (Table 1) were produced for all combinations of variables.

The sample correlation coefficient between life satisfaction and financial situation of household is 0.61. The p-value is small, which indicates that the variables are linearly dependent. The second largest sample correlation coefficient is between life satisfaction and satisfaction with personal job situation (0.52). These coefficients are positive, which means that the life satisfaction tends to increase in value as the other variables increase in value. The life satisfaction is negatively correlated with the provision of pensions (–0.45). This negative relationship is probably caused by lack of interest of unsatisfied respondents in the general situation of pensions.

Table 1 Matrix of Pearson correlation coefficients

Var	A1	A2	A3	A5	A8	A9	A11	A12	A13	A14
A1	1	.25	–.45	.48	–.09	.20	.33	.52	.61	.23
A2	.25	1	.16	.14	–.02	.17	.05	.01	.21	–.09
A3	–.45	.16	1	–.01	.00	–.16	–.27	–.05	–.31	–.05
A5	.48	.14	–.01	1	.32	.52	.66	.37	.52	.52
A8	–.09	–.02	.00	.32	1	.26	.16	.22	.19	.16
A9	.20	.17	–.16	.52	.26	1	.49	.09	.30	.30
A11	.33	.05	–.27	.66	.16	.49	1	.16	.32	.62
A12	.52	.01	–.05	.37	.22	.09	.16	1	.66	.44
A13	.61	.21	–.31	.52	.19	.30	.32	.66	1	.43
A14	.23	–.09	–.05	.52	.16	.30	.62	.44	.43	1

Legend:
Are you satisfied with the life you lead? (A1)
Health care provision (A2)
The provision of pensions (A3)
The cost of living (A5)
Affordability of energy (A8)
How affordable housing is (A9)
The economic situation (A11)
Personal job situation (A12)
The financial situation of household (A13)
The employment situation (A14)

Source: Own construction

The objective of multiple regression analysis is to examine and describe the relationship between continuous variables. The null hypothesis is: the linear regression model does not fit the data better than the baseline model. The backward selection method was applied to select the most appropriate model for this analysis. The backward selection starts with fitting a model with all input variables. Then the least significant variable is dropped, so long as it is not significant at the chosen critical level. It continues by successively re-fitting reduced models and applying the same rule until all remaining variables are statistically significant. The null hypothesis of the regression model was also tested. The *p*-value of the final regression model was less than .05, so we have enough evidence to reject the null hypothesis at the .05 significance level. It means that regression model does fit the data better than the baseline model and the selected predictor variables explain a significant amount of variability of life satisfaction. The coefficient of determination of our resulting model is 0.71, which means that the predictor variables explain 71 % of the total variation in the response values.

The regression model contains the following variables (which represent the proportion of positive responses to these questions):

- Health care in the Czech Republic (A2);
- The provision of pensions in the Czech Republic (A3);
- The cost of living in the Czech Republic (A5);
- Affordability of energy (A8);
- Personal job situation (A12).

Next the regression diagnostics was created. Regression diagnostics verifies that the data have met the regression assumptions. Two observations with high leverage (according to Cook's D statistic) were found in the data, as follows: large cities in Central Moravia (SM3) and medium sized towns in Central Bohemia (SC2). The large cities in Central Moravia (SM3) were found to be influential as well as medium sized towns in Northeast (SV2), which means that removing these observations substantially changes the estimate of coefficients.

The possible reason why the SM3 observation is highly influential is the low number of responses in this region. This combination of NUTS II region and place of living brings only 7 respondents in this category (SM3). Therefore it was excluded from the analysis. The second slightly influential observation (SV2) was correct, so it was kept in the analysis. Then, the data was reanalyzed. The refitted regression diagnostics plots are shown in the Figure 1.

The refitted model achieved a low value (in comparison to the other considered models) of the Mean Square Error measure (MSE = 21.18). The coefficient of determination decreases to 62 %, however, the model is still appropriate. The relationship between the response variable and predictor variables can be characterized by the regression equation, as follows:

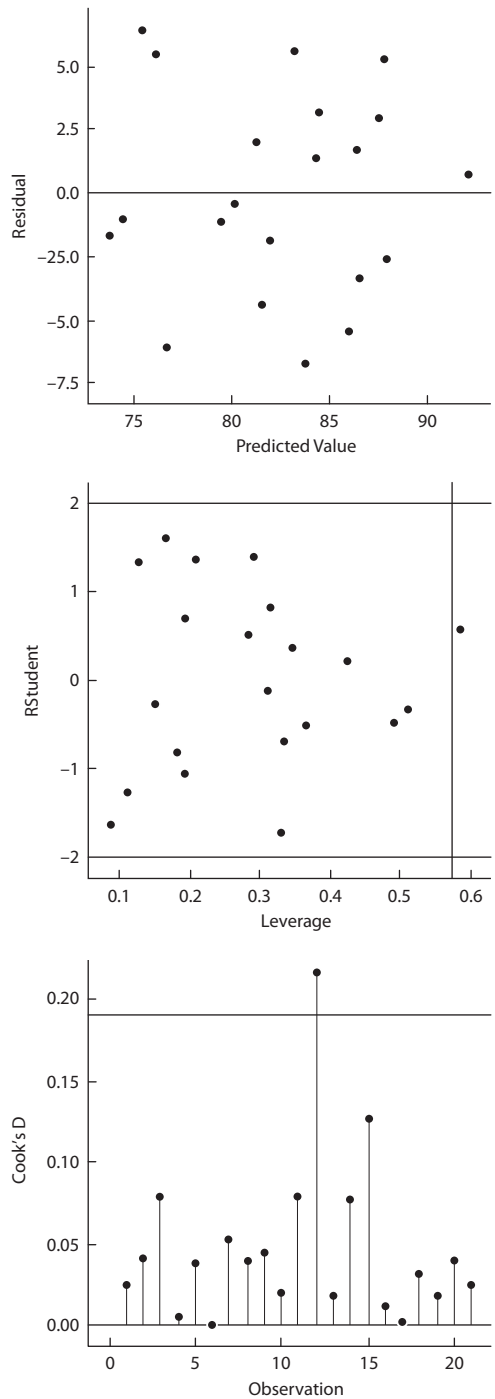
life satisfaction = 64.499 + 0.298(job situation) – 0.161(affordability of energy) + 0.335(cost of living) – 0.347(provision of pensions) + 0.194(health care provision).

The estimated coefficients for predictor variables correspond to the magnitude of change in the response variable given a one-unit change in the predictor variable. The positive value of the coefficient means that life satisfaction tends to increase in value as the predictor variable increases in value. In case of negative value of coefficient it is the reversed. For example, an increase of one percent in the satisfaction with the cost of living (A5) will increase the life satisfaction score by 0.34 percent (ceteris paribus). This variable has a high positive impact on the life satisfaction. The satisfaction with personal job situation (A12) and health care system (A2) also positively affect the life satisfaction. Otherwise provision of pensions (A3) and affordability of energy (A8) has negative effect to the life satisfaction. The negative effect of affordability of energy to the life satisfaction is probably obvious. It is related to the fact, that the price of energy is generally higher in the regions with higher life satisfaction (Prague, Central Bohemia, and Southeast). Therefore the high price of energy causes dissatisfaction.

Next, we realized the regression diagnostics of the refitted model. The variance inflation factor examined the presence of multicollinearity, but it was not identified in the model. Therefore the predictor variables are uncorrelated. The other assumptions of the multiple linear regression analysis were also examined. It was found out that the error terms are normally distributed and have equal variances.

As the scatter plot of residual values (Figure 1) shows, the residuals appear to be randomly scat-

Figure 1 Regression diagnostics plots



Source: Own construction

tered about the reference line at zero. There are no apparent trends or patterns in the residuals. Normality of residuals was verified by the Shapiro-Wilk test (p-value .59, the null hypothesis was not rejected). The homogeneity of variance was checked by the White test (p-value .53, the null hypothesis was not rejected). Therefore all assumptions of the multiple linear regression model have been proven.

Figure 2 shows the spread of individual observations in two dimensions. There are actual and predicted percents of respondents satisfied with their life. The first two letters in figure mark the CZ NUTS II territories and the third determines the place of living as follows: 1 — village, 2 — small / middle size town, 3 — large town. The NUTS II and NUTS III classification is shown in the Table 2.

Table 2 CZ NUTS II and NUTS III classification

Short title	Nuts II region	Nuts III region
Pha	Prague	Prague
SC	Central Bohemia	Středočeský
JZ	Southwest	Plzeňský, Jihočeský
SZ	Northwest	Karlovarský, Ústecký
SV	Northeast	Liberecký, Královehradecký, Pardubický
JV	Southeast	Vysočina, Jihomoravský
SM	Central Moravia	Olomoucký, Zlínský
MS	Moravian-Silesian	Moravskoslezský

Source: Czech Statistical Office, own construction

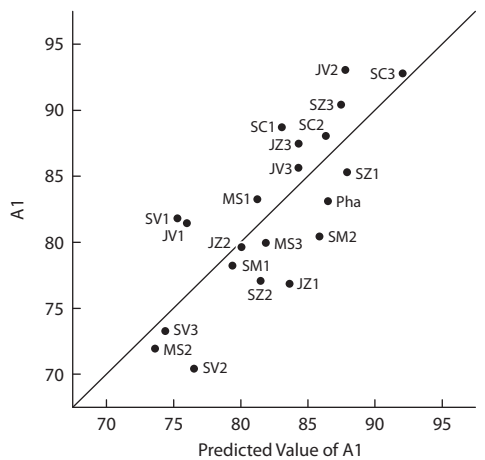
The predicted values of the life satisfaction in all regions were computed by the multiple linear regression model. Figure 2 shows that respondents from all regions of Central Bohemia and Southeast are more satisfied than the regression model predicted. Other regions are not clearly separated. Respondents from large towns in Southwest and Northwest also rated their life satisfaction more positively. Cities in these western regions have more job opportunities than other regions. This fact confirms the results of previous analysis. The personal job satisfaction is correlated with the life satisfaction.

Respondents living in villages of the Northeast and Moravian-Silesian regions are also more satisfied with their life than the prediction indicates. This probably happened because these respondents generally feel satisfied but they are less satisfied in more specific questions. Respondents from remaining regions are less satisfied with their life than the prediction indicates.

Further analysis focuses on comparison of NUTS II regions by overall satisfaction of respondents and by proportion of respondents satisfied with their personal job situation (A12). The personal job situation was selected because the correlation coefficient of this variable and life satisfaction was significant at the .01 significance level. This means that the life satisfaction is significantly affected by personal job situation. This wasn't the highest coefficient of correlation, but the comparison of the answers to these two questions brings interesting results. Regional differences were illustrated by cartographic visualization.

First, the question: "On the whole, are you very satisfied, fairly satisfied, not very satisfied or not at all satisfied with the life you lead?" was analyzed. Figure 3 reflects a proportion of positive responses ranging from 77.6 % to 89.0 %. The most satisfied inhabitants live in Central Bohemia,

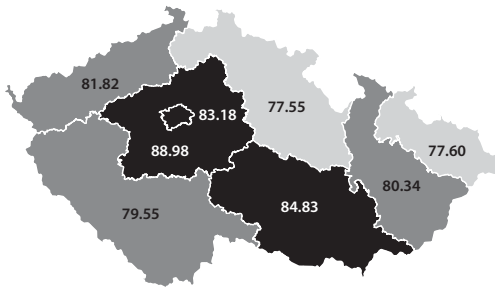
Figure 2 Actual and predicted values of life satisfaction in selected regions (in %)



Source: Own construction

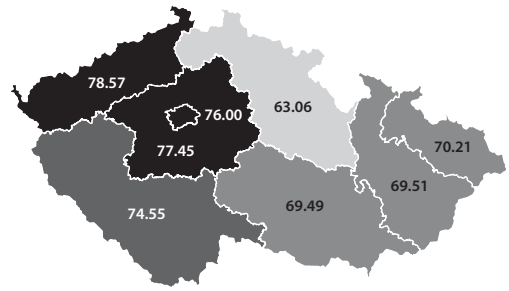
Southeast region, or in Prague. In these territories, the overall proportion of positive responses ranges from 83 % to 89 %. On the other hand, the lowest satisfaction rate is in the Northeast and Moravian-Silesian regions (77.6 %).

Figure 3 Proportion of respondents satisfied with their life (in %)



Source: Own construction

Figure 4 Proportion of respondents who judge their personal job situation positively (in %)



Source: Own construction

The Figure 4 shows an indicator of job satisfaction. It is evident that satisfied respondents live in Prague (76 %) and Central Bohemia (77 %), but the highest satisfaction with job situation surprisingly reached the Northwest region (79 %). This region was highly affected by the transformation process. Therefore, it has the lowest value of GDP per capita and the highest unemployment rate in comparison with other regions of the Czech Republic. However, the Eurobarometer survey shows that the subjective opinions of respondents may be different from the objective indicators. The survey also shows that Northwest is the region with the lowest proportion of respondents who had problems with paying bills. On the other hand, the lowest proportion of satisfied respondents is in the Northeast region (63 %).

Comparing the questions A1 — Are you satisfied with the life you lead? and A12 — How would you judge your personal job situation?, the most significant differences are in the Southeast regions. There is a high proportion of respondents satisfied with their life, but low percent of respondents satisfied with the job situation. Southeast is primarily a rural region with high proportion of agriculture. There is generally low income; lack of jobs; and the unemployment rate is steadily high. These indicators can negatively affect the satisfaction with the job situation. The satisfaction with other partial questions is also low in this region. This means that the overall life satisfaction is not affected by the job situation neither by other sub-questions. The inhabitants of this region are generally satisfied in spite of unfavorable financial and economic situation.

CONCLUSION

The paper focused on examining and quantifying the relationship between life satisfaction and selected variables. We examined to what extent factors make respondents more satisfied. For this purpose, the multivariate linear regression analysis was used. The proportion of respondents satisfied with their life was selected as a response variable. The cartographic visualization was also used as an interpretation support.

The multiple linear regression analysis defined the linear relationships between the response variable (life satisfaction) and predictor variables. Only 5 input variables were used in the final model. These predictors explain a significant amount of life satisfaction. The factors, which affect the life satisfaction most, are: personal job situation, provision of pensions, cost of living, health care provision, and affordability of energy.

The final linear regression model equation is estimated:

life satisfaction = 64.499 + 0.298(job situation) – 0.161(affordability of energy) + 0.335(cost of living) – 0.347(provision of pensions) + 0.194(health care system).

The coefficient of determination of this model is 0.62. This means that the regression line explains 62 % of the total variation in the response values. The estimated regression coefficients correspond to the magnitude of change in the response variable given a one-unit change in the predictor variable. Therefore an increase of one percent in the satisfaction with the cost of living (A5) will increase the life satisfaction score by 0.34 percent (ceteris paribus). It is similar in the case of other coefficients. From the equation we can see that provision of pensions has a negative effect on life satisfaction. This negative relationship is probably caused by lack of interest of unsatisfied respondents in the general situation of pensions. On the other hand, the respondents satisfied with their life are generally unsatisfied with the situation of pensions, because they do not trust the state that it will take care of them in retirement. In the context of older people we can say that the level of life satisfaction is subjective and depends on feelings of people and not just on material things.

The analysis also shows that life satisfaction of respondents is closely related to the personal job satisfaction. Therefore these variables were selected for graphical visualization. The created maps display that the levels of life satisfaction in different regions correspond with the levels of job satisfaction. The only exception is the Southeast region, where only 69.49 % of respondents are satisfied with their job situation, but the overall life satisfaction is more than 80 %. The overall life satisfaction is not considerably affected by partial questions in this region. The satisfaction with these sub-questions is generally low.

Finally, it should be noted that the multiple regression and correlation analysis is only one of many possible approaches to analyze this problem. For the life satisfaction evaluation only a few selected indicators were used, however, the final model identifies the differences between the regions and recognizes what factors make respondents more satisfied.

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