Modelling Quality of Life in Regional Centres

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Abstract

Quality of life can be understood as objectively or subjectively measurable quantity. Consequently, it is represented either by the quality of environment or by the individual perceptions of quality of life. The paper is focused on the latter approach as it includes an analysis of the quality of life in the EU regional centres. Using a regression model based on Support Vector Machines the factors of satisfaction with life are analyzed. The emphasis is put on the possibilities of public management to influence the life quality of its residents by especially financial decision-making. The quality of life, in particular, is affected by the satisfaction of citizens with transportation, health, safety, culture, environment and housing. At the same time, objective measures like demographic indicators and cultural and social infrastructure proved to be significant factors as well.

Key words: Quality of life, City, Regression model, Support Vector Machines.

JEL Classification: C45, Q56.

1 Introduction

The economic performance and wealth belong to the traditional criteria of social welfare at national, regional and local level. This approach is based on the idea that if the total output of the economy increases the society as such also improves. These indicators are considered to be objective but, at the same time, this means that they cannot include how people themselves perceive their well-being and quality of life [1]. On the contrary, there are opinions that the increasing economic performance leads to the destruction of traditional cultural values, social relations and solidarity among people. Empirical studies show that the growth of the economy leads to increase the quality of life only to a certain level [2]. Further economic development leads to only a slight growth in the quality of life.

Quality of life (QoL) can be understood as subjectively or objectively measurable quantity. Consequently, it is represented either by the quality of environment or by the individual perceptions of QoL (what people think about their lives). Quality of life is under the focus of people and politicians at all levels. In particular, they are interested in how the QoL of the population is changing over time, what is the QoL in relation to other countries, respectively regions and cities. Another key question is what factors have an impact on the QoL of inhabitants. Analysis of these factors allows the public administration management at all government levels to assess the impact of their decisions on the QoL of inhabitants. Cities are considered to be optimal social units for the growth of the QoL [3]. The relationship of the inhabitants to the city in which they live determines the environmental and economic aspects of their life as well as their overall QoL.

In previous studies, the authors focused on the analysis of the QoL at the state level especially [4]. They tried to explain the differences in the QoL among the states using linear regression models. The output of these models is the QoL, while inputs are represented either by socioeconomic indicators, or with the individual QoL areas such as economic, social or environmental. Further experiments were focused on the psychological aspects of the QoL assessment, especially the influence of gender, age, marital status, actual mood, character, culture, etc. Few attempts have been done in modelling the QoL in cities. Only in [5] the impact of individual areas of life to overall QoL in Bogota was studied. But there is lack of studies monitoring the impact of objectively measurable indicators such as unemployment, GDP per capita, income population, cultural amenities and social infrastructure, environmental quality, etc, in the current literature.

Therefore, the paper has the structure as follows. First, the QoL is defined as a component of urban sustainable development. The possibilities of measuring the QoL are presented. Further, basic information will be presented about the research on the QoL realized in the cities of the EU. The results of this research are then analyzed using SVMs. Basic notions on SVMs will be provided in the next part of the paper. The goal of the paper is the design of such regression models making it possible to explain the QoL in the EU cities based on socio-economic and other objective indicators. Further, the impact of individual areas of the QoL to the overall QoL will be studied. In detail, the factors of the satisfaction of residents with the financial management and public services will be analyzed.

2 Measuring and Modelling Quality of Life in Cities

The process of urbanization is inevitable during the process of economic development. This makes the cities important participants in overall economic and social development. In this process, the economic development and material centralization, without taking into account the sustainability of such development, will cause problems in the environmental and social balance [6]. Environmental problems are especially related to environmental pollution, scarcity of natural resources and extinction of animal species. In this case, in addition to economic and social development, the cities play a key role. A sustainable city should be equipped with the following functions [7]: education system and the activities for gaining knowledge; equal opportunities; participation of citizens in decision-making; opportunities for economic development; ability to identify the needs of individual interest groups; responsibility for the environment; safety; sense of solidarity, etc.

Sustainable development means a development that leads to ensuring the needs of current society without endangering those needs of future generations. This definition, however, does not offer guidance for creating strategies for sustainable development and for the decision-making of sustainable development actors. Therefore, the accent is put on improving the quality of human life within the capacity of supporting ecosystems.

Quality of life can be understood as objectively or subjectively measurable quantity. Consequently, it is represented either by the quality of environment or by the individual perceptions of QoL. The subjective definition of QoL is democratic in that it grants to each individual the right to decide whether his or her life is worthwhile [8]. Based on this approach we can substitute the term quality of life with terms like "subjective well-being" and "happiness". Subjective well-being refers to people's evaluations of their lives, evaluations that are both affective and cognitive [8].

Then, the QoL can be measured in two ways. The first is the "top-down" approach where a comprehensive indicator of QoL is designed, e.g. well-being index (International Well-being Index) and personal well-being index (Personal Well-being Index) [5]. The International Well-being Index consists of six measures, namely the satisfaction with economic situation, environment, social conditions, local and national government, employment and security. The Personal Well-being Index includes the satisfaction with the level of housing, career, health, relationships, local communities, safety and future security.

Each individual makes broader judgments about his or her life as a whole, as well as about domains such as marriage and work. Thus, there are a number of separable components of QoL: life satisfaction (global judgments of one's life), satisfaction with important domains (e.g., work satisfaction), positive affect (experiencing many pleasant emotions and moods), and low levels of negative affect (experiencing few unpleasant emotions and moods). [9]. Therefore, the second method, the so-called "bottom-up" approach, measures the different components of QoL individually. However, measuring QoL is problematic in several aspects. For instance, Eid and Diener [10] found that situational factors usually pale in comparison with long-term influences on QoL measures. Another potential problem is that people may respond to the QoL scales in socially desirable ways. If they believe that happiness is normatively appropriate, they may report that they are happier than other types of assessments may indicate [8]. Lucas, Diener and Suh [11] found that QoL measures showed discriminant validity from other related constructs, such as optimism. Moreover, many mistakes in people's answers are random and thus do not bias the estimation results. This holds true for the order of questions, the wording of questions, actual mood, etc [12].

Researchers have also accumulated evidence that many life circumstances correlate with the QoL [8]. For example, Campbell, Converse, and Rodgers [13] estimated that 10 resources, including income, number of friends, religious faith, intelligence, and education, together accounted for only 15% of the variance in happiness. Campbell et al. and later investigators [14] have found small positive correlations within countries between income and QoL as rich people on average are slightly happier than poor people. Diener, Wolsic, and Fujita [15] found that a highly prized possession among college students, physical attractiveness, predicted only small amounts of variance in respondents' reports of pleasant affect, unpleasant affect, and life satisfaction. Perhaps even more striking, a number of studies showed that objective physical health, even among the elderly, is barely correlated with the QoL (e.g., [16]). Further, variables often correlate differently with the QoL in dissimilar cultures [8]. The difference between individualistic and collective cultures is especially stressed out. Diener and Diener [17] found that self-esteem correlated more strongly with life satisfaction in individualistic than in collectivist societies.

Usually, we assume that economic situation is the most important determinant of the quality of our lives. Many researchers studied the economic factors especially in developed countries. The literature on the Economics of Happiness (e.g. [18]) looks at the link between reported individual happiness and factors such as income, unemployment and levels of consumption. It highlights that in the analysis of individual utility (quality of life, subjective well-being, happiness), it is crucial to look at these factors in relative and not in absolute terms: individual happiness will depend mostly on how each individual perceives its level of income, unemployment and consumption in relation to those of other individuals, as well as in relation to its own condition in the past [19]. In the same direction some studies have also analyzed the correlation between income distribution and individual happiness [20].

According to [4] economic things matter only in so far as they make people happier. Deciding how much authentic well-being is bought by economic progress is a difficult task. It seems logically necessary, however, if economic and social policy is to be designed in a rational way. Inglehart [21] studied changing cultural values. Large differences across nations were observed. These divergent numbers are likely to reflect cultural and linguistic differences. There is only slight evidence here that greater economic prosperity leads to more well-being in a nation. Apparently, people's desires increase as their incomes rise, and they therefore adapt to higher levels of income, with no net increase in QoL [8]. This interpretation is supported by Clark's [22] finding that recent changes in pay predicted job satisfaction, whereas mean levels of pay did not.
There are also many other factors of the QoL reported in the literature. As an example, unemployed people are anticipated to be very unhappy [4]. Reported happiness is also high among those who are married, on high income, women, whites, the well-educated, the self-employed, the retired, and those looking after the home. Happiness is apparently U-shaped in age (minimizing around the 30s) [4]. Further, Di Tella et al [23] have used survey measures of QoL to evaluate the short-term welfare trade-off between inflation and unemployment. Frey and Stutzer [18] explain differences in QoL among Swiss cantons using individual variables plus measures of the direct accountability of cantonal administrations, finding that those cantons with more accountable government also show higher average measures of QoL. Putnam [24] explains individual measures of QoL with individual-level and state-level variables to provide preliminary estimates of the relative contributions of income, health, social connectedness and family status to individual well-being. High income, social equality, individualism and respect to human rights are regarded as key factors in [8]. Economic and social aspects of QoL and the satisfaction with the local authorities are statistically significant factors presented in [5] for the city of Bogota.
We can conclude that objective economic events are correlated with QoL (subjective well-being, happiness). However, because of the difficulties with measuring QoL (related especially to cultural and psychological issues), the results are biased. As a result we have to anticipate an error that can not be explained when modelling QoL.

3 Quality of Life in the EU Cities

Approximately 74% of the EU population lives in the cities with more than 5000 inhabitants. For this reason, the QoL in cities is under the focus of politicians and other actors at European, national, regional and local level. Increasing the attractiveness of regions and cities is a priority defined in the Lisbon Strategy as well. High QoL in cities is a key factor in attracting and retaining skilled workers, businesses, students, tourists and residents. Evaluation of the QoL is an essential prerequisite for further development of the city and future monitoring. European Union monitors more than 300 indicators from economic, social and environmental areas. These indicators are monitored at various levels (agglomeration, city, part of the city). In addition to objectively measurable indicators a survey of QoL is carried out in such a way that citizens are asked to evaluate how they perceive their QoL.
In 2004 a QoL survey took place in selected 31 cities of the EU15 in parallel with data collection in the Urban Audit project. 300 randomly selected citizens of each city were subjected to telephone interviews. In 2006 the survey was repeated in 75 cities of the EU27 including Turkey and Croatia (big cities with more than 100.000 inhabitants). Average values of individual elements of the QoL are shown in Fig. 1. The following elements of the QoL are observed: employment opportunities, housing costs, safety, cleanness of cities, public transport, air pollution, integration of foreigners; overall satisfaction with the QoL in the city.

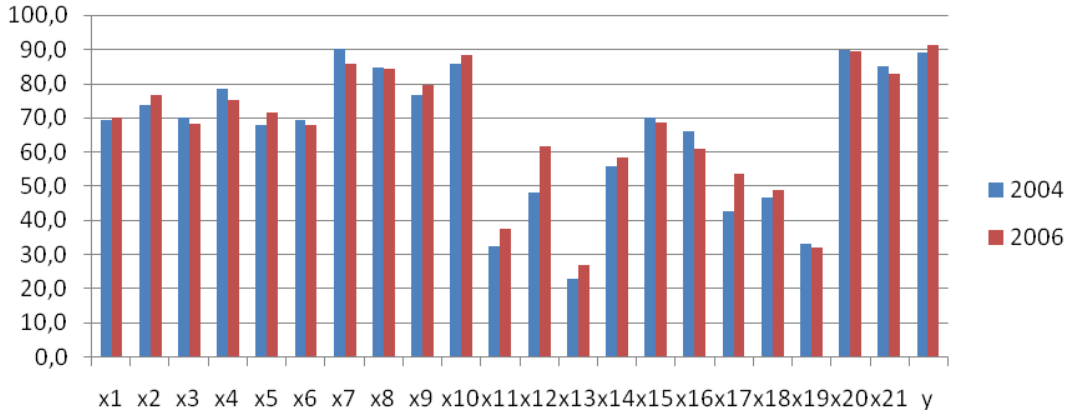

Fig. 1: Mean values of the main elements of the QoL in the EU cities in 2004 and 2006

Legend: x1 is infrastructure, x2 are schools, x3 are hospitals, x4 are doctors, x5 is green, x6 are sports facilities, x7 are cinemas, x8 is culture, x9 is public internet access, x10 is private internet access, x11 is job opportunity, x12 is the integration of foreigners, x13 is housing, x14 are public services, x15 is air pollution, x16 is noise, x17 cleanness of the city, x18 are municipal expenditure, x19 is bill repayment, x20 is the safety in the neighbourhood, x21 is the safety in the city, y is the overall satisfaction with the life in the city.

The results show that the highest satisfaction is achieved in safety (x20 and x21), culture (x7 and x8) and internet access (x9 and x10). The cities dispose of tools for affecting the QoL in these areas. On the contrary, low satisfaction can be observed in labour market (x11), housing (x12) and bill repayment (x19). In these cases, cities have only limited possibilities to influence the situation on labour or real estate market. During the years 2004 and 2006 satisfaction increased in the integration of foreigners (x12) and cleanness of cities (x17) in particular. With the growth of traffic in cities, satisfaction with air pollution (x15) and noise (x16) decreases. It is appropriate to add a degree of diversity to mean values. In Fig. 2 there are therefore standard deviations presented for each area. The biggest differences are evident in the city cleanness (x17), air pollution (x15), satisfaction with hospitals (x3), housing (x13), work (x11) and the integration of foreigners (x12). Conversely, residents of different cities have relatively similar satisfaction with cinemas (x7), internet (x9 and x10), security (x20) and with the overall QoL (y).

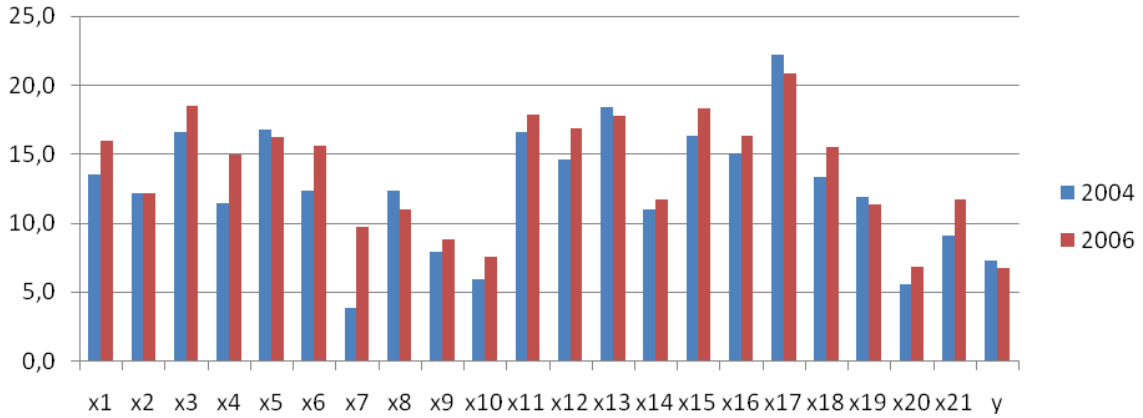

Fig. 2: Standard deviations of elements x1,x2,…,x21,y

4 Modelling Quality of Life in EU cities

A prerequisite for the application of regression analysis is the fact that the QoL in the cities (y) is a function of explanatory variables, i.e. $y=f(x_1, x_2, ..., x_m)$. Linear regression model requires several assumptions which are difficult to satisfy in practice, e.g. the impact of multicollinearity, normality distribution, etc. In addition, this model provides an explanation of only linear dependencies in the data. Using linear regression model, implemented in [25] we were able to explain only 54% of the variance in the same data as used in this study. As a result, the regression model was not reliable. This shows on the complexity of the problem, respectively the existence of non-linear, difficult to explain relationships among variables. It is clear that the linear regression model is not an appropriate tool for the modeling of the QoL in this case. Because of the existence of non-linear dependencies in the data it is appropriate to use regression model allowing the capture of these dependencies. Recently, for example, Gunn [26] confirmed that the method of Support Vector Machines (SVMs) achieved outstanding results for regression problems. The principle of SVMs lies in the non-linear projection of the input space A into multidimensional space B, and on the construction of an optimal hyperplane [26]. This operation is dependent on the estimation of inner product kernel referred to as kernel function $k(\mathbf{x},\mathbf{x}_i)$, where $\mathbf{x}_t$ is the evaluated pattern and $\mathbf{x}_i$ are support vectors. Based on the given facts, it is possible to find linear separators in the q-dimensional space B so that $(\mathbf{x},\mathbf{x}_i)$ is replaced by kernel function $k(\mathbf{x},\mathbf{x}_i)$. Accordingly, the process of learning can be realized so that only kernel functions $k((\mathbf{x},\mathbf{x}_i)$ can be computed instead of full list of attributes for each data point. Evidently, the found linear separators can be transformed back into the original space A.

The experiments are proposed in such a way that the inputs of the model are represented by socio-economic indicators monitored by the Eurostat within the Urban Audit project. Moreover, there were several other (mostly dummy) variables added such as new/old member state, year of monitoring, etc. The data were divided into training and testing set in order to make the model capable of generalization, i.e. to evaluate also the QoL in cities not included into the survey accurately. The sensitivity analysis was realized in order to recognize statistically significant inputs. The resulting model shows that $R^2=0.924$, i.e. 92.4% of the variance in the data was explained. The significant factors of the overall QoL are presented in Table 1.

Table 1: Significant factors of the overall QoL

Indicator		Contribution
EN5101I	Population density - total resident population per square km	100.0
CR1015I	Number of libraries per 1000 residents	55.4
TE1026I	Number of students in universities and further education	47. 5
DE1001I	Total resident population	36.7
DE1058I	Demographic dependency: (<20 + >65) / 20-64 years	31.9
CI1018I	Percentage of elected city representatives who are women	28.9
CI2006I	Annual expenditure of the municipal authority per resident	28.2
DE1059I	Demographic young age dependency index: (<20 years)/ 20-64 years	23.5
SA1022I	Average living area per person m2	18.1
EN2005I	Number of days per year particulate matter PM10 concentrations exceed limit	17.9

Type 1 margins are used for the evaluation of input variables' contribution. The method is working as follows. First, the MSE (mean squared error) for the model is calculated using the actual data values for all input variables. Then for each input variable, it randomly permutes (rearranges) the values of the input variable and computes the MSE for the model using the permuted values. The difference between the MSE with the correctly ordered values and the MSE for the permuted values is used as the measure of importance of the input variable. As a result, the contribution of the most important input variable is 100, and the contribution of other input variables is related to this variable. Only the variables with the contribution above 10 were included in the Table 1.

The overall QoL is influenced by demographic indicators especially. We know, however, only the contribution of the factor, the direction of influence is missing. This is one of the disadvantages of the SVM model, i.e. it is so complex that it is difficult to extract understandable knowledge out of this model. Then we have to use expert knowledge to explain the contributions of input variables. More populated and more densily populated cities show less QoL as residents do not have enough green areas, sports facilities, etc. The traffic is also heavy in these cities. Residents in working age are more satisfied as they have enough job opportunities and leisure acitivities at disposal in bigger cities. On the other hand, the pensioners prefer calmness and comfortable environment. Beside the demographic indicators, residents have higher QoL in cities with sufficient libraries and universities. The possibility to study and pleasant surroundings of these facitilities increase the QoL of citizens. On the contrary, air pollution caused by heavy traffic decreases their QoL. Further, citizens prefer equal opportunities (women as representatives), higher expenditure of the city (more and better public services) and more living area. Using other objective measures did not improve the regression model. So, based on presented indicators we are able to predict the QoL (subjective well-being, happiness) of any other city when these indicators are at disposal.

Further experiments results from the assumption that the overall QoL is based on the QoL in individual areas (elements) of living. The overall QoL (y) represents the aggregated value that can be determined on the basis of knowledge of its individual components $x_1,x_2,\ldots,x_m$. The results show that it was possible to explain 93.6% of variance when using a SVM regression model. This confirms the hypothesis that differences in the QoL of citizens can be modelled on the basis of their satisfaction with various components of life. These results justify the so called "top-down" approach presented above. The significance of the elements of the QoL is illustrated in Fig. 3.

The residents of the cities where the survey was carried out (major regional centers) have usually basic social and economic needs satisfied. Thus, cleanness of the city and safety are on top for their QoL. Furthermore, in order to satisfy the needs of the population, it is important for them to be able to pay bills and, if necessary, to find a job. The overall QoL is also influenced with the culture and environment. On the contrary, satisfaction with health, education, housing and other public services explained only a small proportion of variance in the QoL of the EU cities.

5 The Influence of Municipal Financial Management on Quality of Life

In the previous chapter the so-called "top-down" approach was implemented to the modelling of the QoL. The second approach, i.e. the "bottom-up" approach is expected to be more appropriate to measure the different components of the QoL individually. It follows that it is possible to model each of components (x1,x2,...,x21) individually. For the public management it is important to know how the QoL in different areas can be increased. On the basis of appropriate regression models, it is possible to predict the effects of both the change in the socio-economic conditions of cities and the municipal management decisions on the QoL. It is clear that such effects will often cover several areas simultaneously. In this context, the principles of sustainable urban development should be respected. The scope of this article does not make it possible to model any relationship between social, environmental and economic aspects of urban development. Therefore, two areas of the QoL were selected which relate to the quality of municipal management decisions, namely the satisfaction with public (municipal) finance and the satisfaction with the provision of public services. Representatives of cities follow their own interests when taking decisions. The mechanism of elections should control these interests. Satisfaction with the management of the city increases the likelihood of re-election of the representatives, and should therefore be an important factor in their decision-making. It is important to note that the results of our study can not be generalized to all cities when dealing only with major regional centers here (the average size of surveyed cities is 1 million inhabitants).

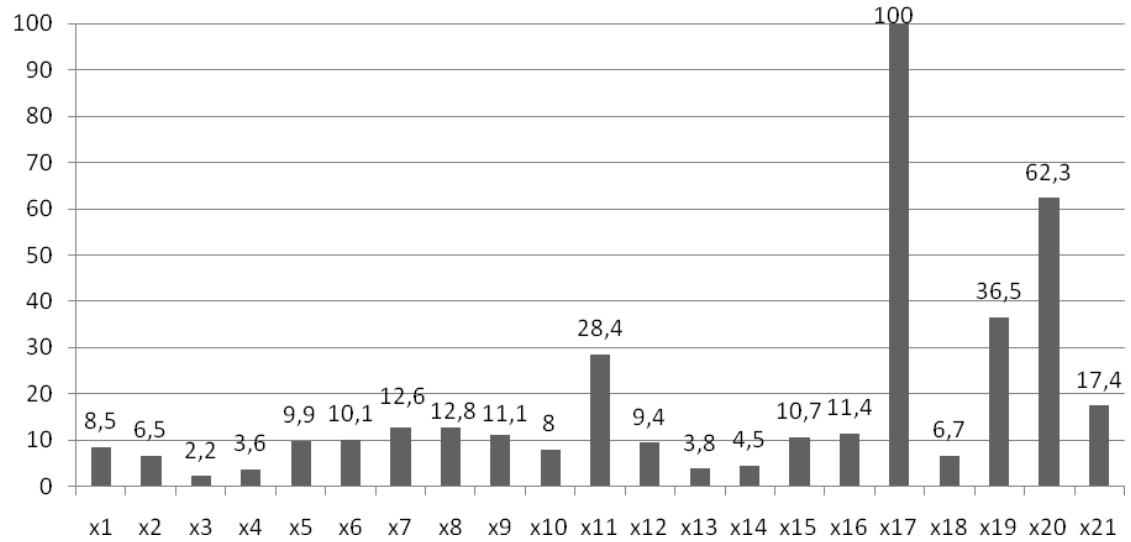

Fig. 3: Contributions of the QoL elements

The maximum well-being (including the QoL) of current and future generations is achieved through a strategy focused on environmental, social and economic objectives and constraints, where the impact of exogenous factors on the development of the city is also taken into account. The strategy defined this way is realized by means of budgetary policy of the city. Deciding on budget revenue and expenditure, the use of municipal property as well as the use of debt for the implementation of investment projects has a direct impact on the lives of citizens, including their QoL. With respect to previous facts, the structure of budgetary expenditure should be focused on the increase in the QoL.

The growth of the QoL leads to a higher attractiveness of the city in terms of migration of labour force and capital. Cities in developed countries started competing in order to attract people and investment. In this context, this strand of urban economic literature highlights the importance of location-specific attributes in generating urban growth. By location specific attributes are meant the local environment (climate and physical), public goods and services, local government policies (taxation and fiscal incentives) and social interactions. Therefore, the type, quality, and level of these location-specific attributes determines the attractiveness of a city as a place to live and work. These attributes are increasingly recognized as being as important as the pure economic factors (GDP per capita, cost of living, employment, etc) in determining urban attractiveness and growth [19]. Wall [27] and Douglas [28] developed the theoretical model in which every individual faces moving to another location if the evaluation of the utility that the alternative location offers, is higher than the evaluation of the utility of the current location. This implies that hen individuals perceive they could improve their QoL (utility), migration will occur. If households migrate in order to improve their QoL, then high house prices in the destination location should reflect high demand, assuming a rigid housing supply [19]. Higher QoL will result on higher house prices. Differences in the local fiscal climate generate compensating differentials across local land and labour markets just as we have long known amenities to do. Thus they should affect the local quality of life. The paper by [29] presents estimates of the QoL that highlight the importance of local fiscal conditions. Unlike standard location amenities, the fiscal climate is under the control of local authorities. Thus the QoL may be more malleable.

Therefore, it is important for the managers of cities to predict the effects of their decisions on the QoL. For this reason, the regression models explaining the satisfaction with financial management and public services will be studied. Again, the SVM regression models were analyzed. Sensitivity analysis was realized in order to find significant factors (objective indicators), and then the contribution of these factors was quantified using Type-1 margin the same way as for the overall QoL (see Table 2 and Table 3).

The results show that the best model explains 90.3% of the variance for the satisfaction with financial management. The satisfaction with public finances is affected by population in the same manner as was the overall QoL. Citizens also perceive good budgetary management of cities and high expenditure per capita positively. With the respect to the structure of public expenditure, people perceive the financing of education and health in a positive manner. Further, the support of business activities represents also a significant factor. The people are more satisfied with financial management which are young, at working age and politically active (participating in the European and local elections). People have also a negative perception of the city debt.

Table 2: Significant factors of the financial management satisfaction

Indicator		Contribution
DE1001I	Total resident population	100.0
CI2016I	Balance of the municipal authority expenditure and income per resident	89.1
CI2006I	Annual expenditure of the municipal authority per resident	61.2
CI1018I	Percentage of elected city representatives who are women	50.1
TE1026I	Number of students in universities and further education	48.6
CI1003I	Proportion of registered electorate voting in European elections	41.0
SA2022I	Number of hospital beds per 1000 residents	38.7
EC1020I	Unemployment rate	35.3
CI2005I	Proportion of municipal authority income derived from other sources	33.2
EC2004I	New businesses registered in proportion of existing	32.7
DE1058I	Demographic dependency: (<20 + >65) / 20-64 years	31.4
CI1009I	Proportion of registered electorate voting in city	30.9
DE1059I	Demographic young age dependency index: (<20 years/ 20-60 years)	25.5
CI2014I	Debt of municipal authority per resident	23.9
CI2002I	Proportion of municipal authority income derived from local taxation	23.6
CI2003I	Proportion of municipal authority income derived from transfers	17.8

Satisfaction with the provision of public services is closely linked to satisfaction with the economy of the city. Public services are financed from public budgets. The scope, quality and cost of public services is determined primarily by financial possibilities of the city, by political orientation and other local factors. The proposed regression model explained 92.9% of variance. In addition to demographic characteristics, satisfaction with public services is the result of the size of public expenditure per capita mainly. Out of the provided services, people especially appreciate the scale of transport infrastructure (railway stations, multimodal accessibility), safety in the city (number of recorded crimes), education (students in universities), culture (cinema seats) and the cleanness of the city (amount of solid waste). Politically active population is more satisfied with public services. Frequent visits of the official internet sites are also linked to this fact. Increased citizen participation leads to higher satisfaction with public services.

Table 3: Significant factors of the public services satisfaction

Indicator		Contribution
DE1001I	Total resident population	100.0
CI2006I	Annual expenditure of the municipal authority per resident	41.9
EN5101I	Population density - total resident population per square km	31.7
CI2002I	Proportion of municipal authority income derived from local taxation	26.6
TT1072I	Accessibility by rail (EU27=100)	22.8
CI1009I	Proportion of registered electorate voting in city	22.3
CI1018I	Percentage of elected city representatives who are women	21.7
SA3001I	Total number of recorded crimes per 1000 population	21.5
CI1003I	Proportion of registered electorate voting in European elections	20.5
IT2005I	Number of daily visits to official internet site per 1000 pop	14.3
TE1026I	Number of students in universities and further education	13.5
EN5004I	Proportion of the area in housing/residential use	13.1
CI2016I	Balance of the municipal authority expenditure and income per resident	11.5
DE1058I	Demographic dependency: (<20 + >65) / 20-64 years	10.1
CR1003I	Number of cinema seats per 1000 residents	9.8
TT1074I	Multimodal accessibility (EU27=100)	9.2

EN4001I	Amount of collected solid waste per capita p.a.	7.7

6 Conclusion

In the paper the results of a survey of the QoL in EU cities are presented. The results show that there is a relative agreement to the satisfaction of citizens in various cities and states. Residents have similar requirements for individual elements (components) of the QoL. High satisfaction is achieved with the social and technical facilities of cities. Contrary, people are often dissatisfied with their economic level. The positive changes are taking place especially in the integration of foreigners into society. Furthermore, we proposed a regression model for the analysis of factors of the overall QoL. It showed that the QoL is affected with cleanness of the city, safety and the economic situation of the citizens in particular. Satisfaction with public services, by contrast, turned out to be an unimportant factor. As regards the objective factors, demographic structure and accessibility of education show to be the most important for the QoL. Satisfaction of the citizens with public finances and services are determined particularly by the structure of income and expenditure of cities, the scope of public services and the economic situation of the population.

These results can be generalized for bigger cities, and allow the management of cities to take into account the QoL in the city as a crucial factor in their decision-making. The result of the modelling showed that the SVM regression model was capable to explain the factors of the QoL in the EU cities. The proposed models are accurate but difficult to interpret. Therefore, our future work will focus on achieving interpretable models so that it would be possible to present recommendations for practice on their basis.

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References

[1] CUMMINS, R.A., HUNTER, B., et al.: The Australian Unity Wellbeing Index: An Overview. In: *Social Indicators Network News*. No.76 (2003), pp. 1 – 4.

[2] ECKERSLEY, R.: The State and Fate of Nations: Implications of Subjective Measures of Personal and Social Quality of Life. In: *Social Indicators Research*. Vol.52, No.1 (2000), pp. 3-27.

[3] HOORNWEG, D., RUIZ NUNEZ, F., et al.: City Indicators: Now to Nanjing. In: *World Bank Policy Research Working Paper*. No. 4114 (2007).

[4] A.J. OSWALD: Happiness and Economic Performance. In: *The Economic Journal*. Vol. 107, No. 445 (2007), pp. 1815 – 1831.

[5] WILLS-HERRERA, E.: *Indicators of subjective wellbeing in cities*. *Bogotá*-Colombia: Universidad de los Andes, 2009.

[6] LIN S. C., LEE Y. J.: Sustainable Community Indicators. In: *Proc. of the 8th International Conference of the Asian Planning Schools Association.* (2005), pp.1 – 19.
[7] HOLLAND L.: Diversity and Connections in Community Gardens: A Contribution to Local Sustainability. In: *Local Environment*. Vol. 9, No. 3 (2004), pp. 285 – 305.
[8] DIENER, E.: Subjective Well-Being: The Science of Happiness and a Proposal for a National Index. In: *American Psychologist*. Vol. 1, No. 55 (2000). pp. 34 – 43.
[9] Diener, E., Suh, E.M., Lucas, R.E., and al.: Subjective Well Being: Three Decades of Progress. In: *Psychological Bulletin*. Vol. 125, No. 2 (1999), pp. 276 – 302.
[10] EID, M., & DIENER, E.: Intraindividual Variability in Affect: Reliability, Validity, and Personality Correlates. In: *Journal of Personality and Social Psychology*. No. 76 (1999), pp. 662 – 676.
[11] LUCAS, R. E., DIENER, E., SUH, E.: Discriminant Validity of Well-Being Measures. In: *Journal of Personality and Social Psychology*. No. 71 (1996), pp. 616 – 628.
[12] HELLIWELL J.F.: How's Life? Combining Individual and National Variables to Explain Subjective Well-Being. In: *Working Paper 9065 National Bureau of Economic Research Cambridge*. (2002).
[13] CAMPBELL, A., CONVERSE, P. E., RODGERS, W. L.: *The quality of american life.* New York: Russell Sage Foundation, 1976.
[14] DIENER, E., HORWITZ, J., EMMONS, R.A.: Happiness of the Very Wealthy. In: *Social Indicators Research.* No. 16 (1985), pp. 263 – 274.
[15] DIENER, E., WOLSIC, B., FUJITA, F.: Physical Attractiveness and Subjective Well-Being. In: *Journal of Personalist and Social Psychology.* No. 69 (1995), pp. 120 – 129.
[16] OKUN, M.A., GEORGE, L.K.: Physician - and Self-Ratings of Health, Neuroticism and Subjective Well-Being among Men and Women. In: *Personality and Individual Differences.* No. 5 (1984), pp. 533 – 539.
[17] DIENER, E., DIENER, M.: Cross Cultural Correlates of Life Satisfaction and Self-Esteem. In: *Journal of Personality and Social Psychology*. No. 68 (1995), pp. 653 – 663.
[18] FREY, B.S., STUTZER, A.: *Happiness and economics*. Princeton: Princeton University, 2002.
[19] BIAGI, B., LAMBIRI, D., ROYUELA, V.: Quality of Life in the Economic and Urban Economic Literature. In: *Working Papers*. No. 10 (2006).
[20] ALESINA, A., DI TELLA, R., MCCULLOCH, R.: Inequality and Happiness: Are European and American Different? In: *NBER Working Paper*. No. 8198 (2001).
[21] INGLEHART, R.: *Culture shift in advanced industrial society.* Princeton, NJ: Princeton University Press, 1990.
[22] CLARK, A.: Are Wages Habit Forming? Evidence from Micro Data. In: *Journal of Economic Behavior and Organization.* No. 39 (1998), pp. 179 – 200.
[23]DI TELLA, R., MACCULLOCH, R.J., OSWALD, A.J.: Preferences Over Inflation and Unemployment: Evidence From Surveys of Happiness. In: *Working Paper*. (2000).
[24] PUTNAM, R.D.: *Bowling alone: The collapse and revival of american community*. New York: Simon & Schuster, 2000.
[25] HÁJEK, P., HÁJKOVÁ, V.: Analýza Faktorů Kvality Života ve městech. In: *Modelování a rozhodování v podnikání i ve veřejné správě 2009*. (2009), in press.
[26] GUNN, S.R.: *Support vector machines for classification and regression*. University of Southhampton: Southhampton, 1998.

[27] WALL, H.J.: Voting with your Feet in the United Kingdom: Using Cross-Migration Rates to Estimate Relative Living Standards. In: *Journal of Regional Science*, No. 80 (2001), pp. 1 – 23.

[28] DOUGLAS, S.: Estimating Relative Standard of Living in the United States using Cross-Migration Data. In: *Journal of Regional Science*, No.37 (1997), pp. 411 – 436.

[29] GYURKO, J., TRACY, J.: The Structure of Local Public Finance and the Quality of Life in United States. In: *Urban Change in the United States and Western Europe* (eds. Summers, A.A., Cheshire, P.C., Senn, L.). Washington: The Urban Institute Press, 1999.