Standards of Living Modeling based on Objective Indicators with Using Cluster Analysis

Jiří Křupka, Romana Provazníková, Miloslava Kašparová, and Jan Langer

***Abstract*—**A modeling of standard of living in Eurozone countries is provided in the article. Models are designed with using cluster analysis algorithm TwoStep. The modeling of standard of living index is compared with real investigated indexes of standard of living – Index of quality of live realized with Czech journal E15 and Prosperity index realized with Legatum Institute. The software SPSS Clemetine was used for the models proposal.

***Keywords*—**Cluster analysis, objective evaluation, prosperity index, quality of life.

I. Introduction

AT present the European Union member states struggle with considerable economics and social problems produced with economics and financial crises. Significant impact of crisis appears mainly in some countries of European Monetary Union - Eurozone. In the article we asses standards of living (SL) in 17 member states of European Monetary Union. SL is assessed by means "Standards of living I", which is focused on evaluation of living standard, and "Standards of Living II", focused on economic prosperity of the country.

It does not exist any generally accepted definitions of SL. It should be considered as social- economics category. According to [1] SL is historically conditioned level of fulfillment peoples living conditions (material and spiritual), sum of living, existential, labor and others conditions, under which are these needs fulfilled. SL depends on existing production relations and on the level of production factors development.

The most important become those segments of SL which are connected with the general need to preserve and improve the living conditions on the Earth, to face ecological crisis, mainly air and water pollution, protect the nature and as well to avoid war catastrophes [1].

SL should be expressed by the system of quantitative and qualitative indicators, mostly aggregated into the composite indexes based on subjective SL and quality of life evaluation as well as objective indicators characterized socio-economical, ecological and political conditions [2]-[6]. Objective assessment of SL is mainly focused on assumed sources of living standard and quality of life [7], [8]. Subjective assessment is based on accomplishing personal targets, individual's self-realization and satisfaction with own life (human well-being).

The objectives of the paper are:

- Selection of appropriate characteristics (indicators) for objective SL measurement based on the expert evaluation of selected indices and approaches to the SL assessment
- Design models of SL evaluation in Eurozone countries with using two selected approaches for SL assessment and well-being of individuals and countries
- Creation own assessment of objective segment of SL in Eurozone countries by means of the cluster analysis (CA) modelling
- Compare own modeling evaluation of Eurozone countries SL with real results obtained in two selected approaches generated with E15 Czech journal and Legatum Institute

II. Problem formulation

Among the most frequently used indicators for expressing SL belongs: Index of Sustainable Economic Welfare [9], Human Development Index [10], life fulfillment indicators - Quality of Life Index [11], Better Life Index [12], Legatum Prosperity Index [13], Happiness Indicators [14], Ecological Footprint [15], etc.

On the very similar components (ecological, economic, and social) are based indicators, which are developed for estimating of sustainable development of a country, region and an enterprise e.g. Sustainable Society Index [16].

This work was supported by the project No. SGFES02 of the Ministry of Education, Youth and Sports of CR with title Research and Development Activities in the area of System Engineering and Informatics at the Faculty of Economics and Administration, University of Pardubice in 2013.

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Quality of life and SL measurement is provided by number of researches and institutions, namely e.g. United Nations [10], with its Human Development Index created in 1990, OECD [12],with quite new Better Life Index, Legatum Institute and its Prosperity index [13], Mercer Human Resource Consulting with Mercer´s quality of Living Survey Liveability [7] and the Economist Intelligence Unit's Global Liveability Report [17].

Two last mentioned (latter) create world's most live able cities as they rank on a reputable annual survey of living conditions. Last but not least is necessary to mention the indicator Gross National Happiness [14], which is presented by Bhutan state as guidelines on measuring subjective well-being, (measures of life satisfaction, happiness, and similar concepts).

Very interesting results and methodological approach of the sustainable development investigation in rural territories are presented by studies developed in Baltic countries [18]. A large area of rural territories, a relatively small number of populations in them, and a high percentage of senior people, influence quality of life in them. The historically development environment of rural areas in these countries (and other "new" European member states) is undoubtedly of great significance for the development of the whole country.

A. Standards of Living Models and Indicators

On account of analysis of above-citied approaches to assessment SL and quality of life, appropriate indicators what characterize economical, socio-demographical and environmental aspects in Eurozone countries were assorted. Apart from economic factors (Gross Domestic Product, industrial production, government debt, current account of balance of payments, unemployment and inflation) also socio-demographic indicators (health care expenditures, poverty and social exclusion, fertility, life expectations) and environmental indicators (greenhouse gas emissions, electricity generated from renewable resources, municipal waste generation and treatment) were inserted.

The most common, the simplest and the most frequently used indicator for the performance of the economy, is the Gross Domestic Product (GDP). GDP is an indicator of the output of a country or a region. GDP at market prices is the final result of the production activity of resident producer units.

Harmonized indices of consumer prices (HICPs) give comparable measures of inflation for the countries and country groups they are produced. They are economic indicators that measure the change over time of the prices of consumer goods and services acquired by households. They are a set of consumer price indices calculated according to a harmonized approach and a single set of definitions. HICPs are produced and published using a common index reference period (2005=100). In the article growth rates with respect to the previous month (month / (month-1)) are used.

The indicator General government gross debt as a percentage of GDP. is defined (in the Maastricht Treaty) as consolidated general government gross debt at nominal value, outstanding at the end of the year in the following categories of government liabilities (as defined in ESA95): currency and deposits, securities other than shares excluding financial derivatives, and loans. General government sector comprises the subsectors: central government, state government, local government and social security funds.

Indicator current account of balance of payments (BoP) is the sum of the balance of trade (exports minus imports of goods and services), net factor income (such as interest and dividends) and net transfer payments (such as foreign aid). The current account is one of the three balance of payments sub-balances together with capital account and financial account. The balance of payments is the statistical statement that systematically summaries, for a specific time period, the economic transactions of an economy with the rest of the world.

The unemployment rate represents unemployed persons as a percentage of the labor force based on International Labor Office definition. The labor force is the total number of people employed and unemployed. Unemployed persons comprise persons aged 15 to 74 who: a) are without work during the reference week; b) are available to start work within the next two weeks; c) and have been actively seeking work in the past four weeks or had already found a job to start within the next three months. Data are presented in seasonally adjusted form.

The industrial production index shows the output and activity of the industry sector. It measures changes in the volume of output on a monthly basis. Data are compiled according to the Statistical classification of economic activities in the European Community. The current base year is 2010 (index 2010 = 100). Growth rates are presented with respect to the previous month (month / (month-1)) and are calculated from calendar and seasonally adjusted figures.

From the socio-environmental area following indicators were chosen:

Total fertility rate indicates the mean number of children that would be born alive to a woman during her lifetime if she were to pass through her childbearing years. This indicator conforming to the fertility rates by age of a given year. This rate is therefore the completed fertility of a hypothetical generation, computed by adding the fertility rates by age for women in a given year (the number of women at each age is assumed to be the same).

Life expectancy at certain ages represents the mean number of years still to be lived by a person who has reached a certain exact age, if subjected throughout the rest of his or her life to the current mortality conditions (age-specific probabilities of dying).

Public health care expenditure is expressed in percentage of GDP. Data provide information on expenditure in the functionally defined area of health distinct by provider category (e.g. hospitals, general practitioners), function category (e.g. services of curative care, rehabilitative care, clinical laboratory, patient transport, prescribed medicines) and financing agent (e.g. social security, private insurance

company, household).

People at risk of poverty or social exclusion are expressed in percentage of total population. This indicator corresponds to the sum of persons who are: at risk of poverty or severely materially deprived or living in households with very low work intensity. Persons are only counted once even if they are present in several sub-indicators. At risk-of-poverty are persons with an equalized disposable income below the risk-of-poverty threshold, which is set at 60% of the national median equalized disposable income (after social transfers). Material deprivation covers indicators relating to economic strain and durables. People living in households with very low work intensity are those aged 0-59 living in households where the adults (aged 18-59) work less than 20% of their total work potential during the past year.

Indicator total greenhouse gas emissions (in CO_2 equivalent) indexed to 1990 (index =100) shows trends in total man-made emissions of the "Kyoto basket" of greenhouse gases. The "Kyoto basket" of greenhouse gases includes: carbon dioxide CO_2, methane CH_4, nitrous oxide N_2O, and the so-called F-gases (hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride SF_6). These gases are aggregated into a single unit using gas-specific global warming potential factors. The aggregated greenhouse gas emissions are expressed in units of CO_2 equivalents. The indicator does not include emissions and removals related to land use, land-use change and forestry; nor does it include emissions from international aviation and international maritime transport.

Indicator electricity generated from renewable sources (as a share on gross final energy consumption) represents the ratio between the electricity produced from renewable energy sources and the gross national electricity consumption for a given calendar year. It measures the contribution of electricity produced from renewable energy sources to the national electricity consumption. Electricity produced from renewable energy sources comprises the electricity generation from hydro plants (excluding pumping), wind, solar, geothermal and electricity from biomass/wastes. Gross national electricity consumption comprises the total gross national electricity generation from all fuels (including auto production), plus electricity imports, minus exports.

Indicator municipal waste generation and treatment express in kg per capita. Municipal waste consists to a large extent of waste generated by households, but may also include similar wastes generated by small businesses and public institutions and collected by the municipality; this part of municipal waste may vary from municipality to municipality and from country to country, depending on the local waste management system. For areas not covered by a municipal waste collection scheme the amount of waste generated is estimated.

III. Data Description and Data Analyzing

With using selected indicators [7], [8], [10]-[15], [19] the SL indicator has been constructed. For its derivation were used two attribute (variables, indicators) sets from economical and socio-environmental area.

For creation of entering data set, real data from the Eurostat database between 2002-2011 [20] have been used. There are 15 attributes total, among them 2 are demographical attributes – state g_1 and year g_2 which identifies the particular country in time. For economical area was defined vector $a = (a_1, \ldots, a_6)$ and for social-environmental area vector $b = (b_1, \ldots, b_7)$. Variables are described in two parts of data dictionary, see the Table I and Table II.

Table I Data dictionary (Part 1)

Variable			
Name	***Type***	***Range***	***Unit***
State / Country	Set	{Austria, ..., Spain}	-
Year	Set	{2002, ..., 2011}	year
HICPs	Range	[83.29; 132.93]	%
Government debt	Range	[3.57; 162.45]	%
Current account of BoP	Range	[-27 782; 45 377]	mil. EUR
Unemployment	Range	[2.47; 21.45]	%
Industrial production	Range	[67.39; 148.52]	%
GDP	Range	[1 225; 20 475]	EUR per inhabitant
Fertility rate	Range	[1.19; 2.07]	person
Life expectancy	Range	[70.5; 81.7]	age
Public health care expenditures	Range	[4.8; 12]	%
People at risk of poverty or social exclusion	Range	[14.9; 33.5]	%
Greenhouse gas emissions	Range	[663.66; 2 807.71]	tons per 100 thous. inhabitants
Electricity generated from renewable sources	Range	[0; 67.69]	%
Municipal waste generation and treatment	Range	[23.9; 78.49]	kg per capita

Values for attribute g_1 and g_2 were defined by the following way: g_1 = {Finland, Netherland, Ireland, Luxembourg, Germany, Austria, Belgium, France, Spain, Slovenia, Malta, Portugal, Cyprus, Italy, Estonia, Slovakia, Greece} and g_2 = {2002, 2003, …, 2011}.

The input matrix have been formulated M(170×15), which includes 17 countries in time horizon 10 years and 15 attributes. The elementary statistical analysis of input set of data has been provided. For each attribute were calculated count, mean, minimum, maximum, median, mode, variance and stand. deviation [20], [21].

For absolute number of modeling techniques and algorithms complete input set of data is needed. Based on verifying completeness of data in some attributes (b_1 "Number of children per woman" and b_2 "Life expectancy") were fulfilled 5 missing values. There are available several methods for

calculating missing values. As a simplest method the substitution of one value is considered. According to this method the missing value is replaced by median or mode of the particular set of data [23]. In our case the method of regression substitution [23], [24] have been used with using correlation in set of data [25], [26].

Table II Data dictionary (Part 2)

Variable		**Atribut**
Name	***Description***	***Name***
State / Country	Country description	g_1
Year	Year describtion	g_2
HICP	Rate of inflation (year average from monthly growth rates)	a_1
Government debt	Percentage of GDP	a_2
Current account of BoP	Balance of current account	a_3
Unemployment	Rate of unemployment	a_4
Industrial production	Increasing of industrial production (year average from monthly growth rates)	a_5
GDP	Level of Gross Dmestic Product	a_6
Fertility rate	Number of children per women	b_1
Life expectancy	Life expectancy at birth at certain age	b_2
Public health care expenditures	Percentage of GDP	b_3
People at risk of poverty or social exclusion	Percentage of total population	b_4
Greenhouse gas emissions	trends in produkce per 100 thouts. inhabitants	b_5
Electricity generated from renewable sources	Share of electricity produced from renewable energy sources and the gross national electricity consumption	b_6
Municipal waste generation and treatment	Waste generated by household	b_7

IV. The Design of Standards of Living Models

With using selected indicators [7], [8], [10]-[15], [19], [27] the SL indicators have been constructed. For its derivation were used two attributes (variables, indicators) from economical and socio-environmental area. Based on data analysis and survey of available relevant resources has been appeared that it is necessary the process of modeling SL to divide into two parts - SL index I s_1 and SL index II s_2. SL index I focuses on quality of life and SL index II describes economic prosperity the examined countries.

CA is used for defining clusters of SL based on the value of the attributes. CA [23], [28]-[31] is an exploratory data analysis tool for solving classification problems. The object is sorted into groups, or clusters, so that the degree of association is strong between members of the same cluster and weak between members of different clusters. The task of clustering is then to divide the set of objects into the disjunctive clusters. The decision making about the object clustering in cluster is realized on the basis of the similarity by application of metric [23], [32]. The basic division of methods is mentioned for instance in [23] and application in [28].

A. Modeling of Quality of Life

Design of the model (Fig. 1) is based on the comparison quality of live in 27-European Union member countries [33]. In that approach the Index of quality of live has been constructed on 10 indicators (mainly from economic and social areas) with data of 2009 year. For each indicator the rank of the best and the worst country was defined in observed area. Subsequently was calculated arithmetic mean of ranking for each country. This parameter represents quality of live index.

The authors ranked the countries according to the following economic indicators: GDPs per capita (in purchasing power parity in USD), average salary in country (in purchasing power

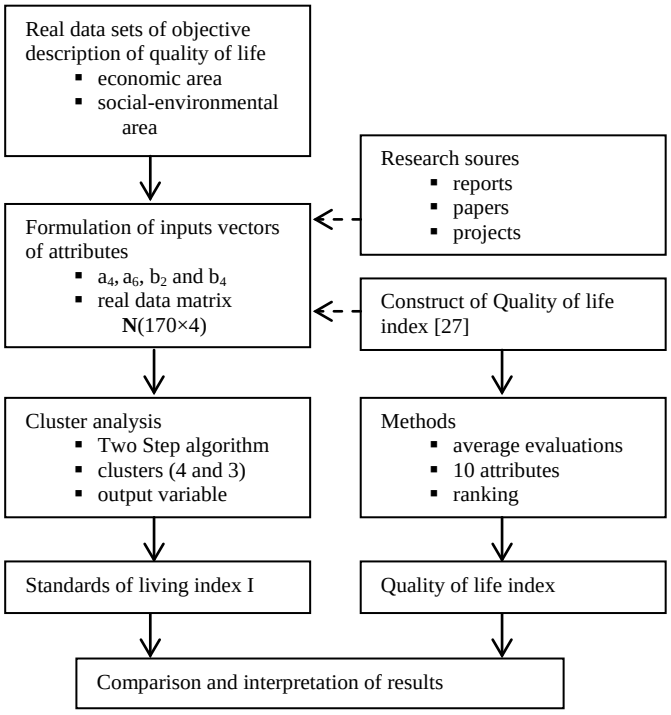

Fig. 1 Model of Quality of life indexes

parity, in EUR), rate of unemployment (in percentage), level of taxation as a percentage of GDP (so called tax quota), the length of working week (number of working hours per week under condition of the full time job). Among socio-demographic indicators belong these indicators - life expectancy, the level of expenditures on food (as a portion of total household expenditures, in percentages), people at risk of poverty or social exclusion (as a percentage of total population, so called poverty rate), rate of corruption expressed with Corruption perception index (adopted from research provided each year by international organization Transparency International [34] and number of women-managers. Number of women in managerial positions expresses the equal approach (attitude) of society to both genders in a country.

On the basis of [27] and data analysis 4 input attributes a_4, a_6, b_2 and b_4 have been designed. Output derived variable SL index I s_1 has been constructed with using CA TwoStep method with 4 and 3 values (number of clusters) for s_1. More useful results have been reached for three clusters c_1, c_2 and c_3, presented by values {low, middle, high} level of s_1 (Table III). Countries have been assigned to particular clusters as value of attribute g_1.

Table III Cluster description for s_1

Cluster	**Value of attribute**	
Name	***Meaning***	***Representation of attribute g_1***
c_1	low	Estonia, Slovakia
c_2	middle	Ireland, Spain, Portugal, Cyprus, Italy, Greece
c_3	high	Finland, Netherland, Luxembourg, Germany, Austria, Belgium, France, Slovenia, Malta,

It is possible to characterize identified clusters by normalized values of attributes in Fig. 2 where green line represents high, red line represents middle and blue line represents low value of this index.

Cluster c_1 represents countries with lowest GDP, lowest life expectancy, high level of people at risk of poverty or social exclusion and high unemployment. Cluster c_2 is characterized

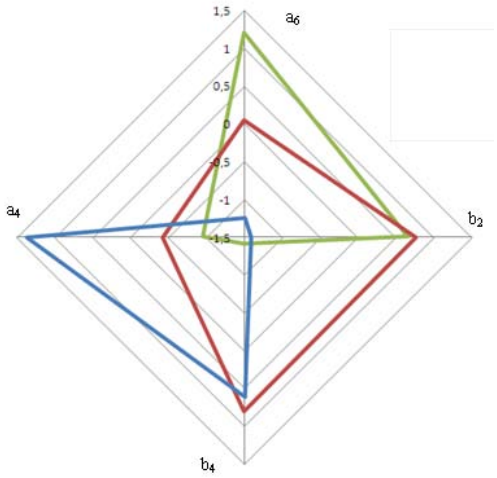

Fig. 2 Representation of normalized values of attributes a_4, a_6, b_2 and b_4 for SL index I s_1

by high level of GDP, high life expectancy years, very low level of people at risk of poverty or social exclusion and unemployment. Cluster c_3 is characterized with highest value of life expectancy. Remaining attributes of this cluster demonstrate inferior results as cluster c_2.

In comparison the results of evaluation with Quality of life approach [33] and our modeling of SL index I some differences are obvious. Results are identical in countries with high SL (cluster c_3), except Ireland (in our assessment was qualified as country with average SL in cluster c_2) and Malta (this country was by our model evaluated better than assessed in Quality of life approach – it was on 14th place ranked only). The best evaluation in both approaches was reached by Luxembourg. Countries classified to the category of average SL (cluster c_2) and low level of SL (cluster c_1) is consistent only for Slovakia. Countries as Portugal, Greece and Spain are ranked on last places in Quality of life approach.

Incomparability of time in assessment can be indicated as the main reason of results discrepancy mentioned above. Whereas in our analysis we use data from 2002-2011, Quality of life approach worked with data from 2009 year. This is important mainly in South European countries, where impact of economic crises was significant in following years. Ranking of the Ireland in our model could be explained by higher level of people at risk of poverty or social exclusion and higher rate of unemployment in Ireland contrary to the rest of countries with high level of living standard.

The other reason of different results is also the smaller number of indicators used in our analysis. For modeling were used four indicators (variables) comparable with indicator in Quality of live index [33]: GDP per capita, rate of unemployment, number of people at risk of poverty and social exclusion and life expectancy. Because in our model we have used the data of longer time period (series) than in Quality of life index, the results are influenced by longer time horizon (instead of data used for one particular year). In particular impact of economic crisis was more significant in the past years on these four indicators than on the other indicators used by the authors of Quality of life index (as already mentioned they used 10 indicators).

Our modeling of SL index I omitted subjective judgment of quality of live. Corruption perception index can be considered as a substantial indicator of subjective evaluation of quality of live. From the point of European policy of equal opportunities, important indicator is number of women-managers. These indicators included in Quality of life index are not in such degree influenced by economic crises.

B. Modeling of Prosperity Indexes

Design of the model (Fig. 3) comes out from Legatum Prosperity index (LPI) which works with objective as well as subjective variables to measure prosperity [13]. LPI assesses global wealth and well-being and benchmarks 142 countries around the world. Index is based on 89 different variables grouped into 8 sub-indices which are averaged using equal weights. The 8 sub-indices are: Economy, Education, Entrepreneurship & Opportunity, Governance, Health, Personal Freedom, Safety & Security, and Social Capital.

Each sub-index is constructed using econometric analysis to determine what increases both per capita income and life satisfaction of a country's citizens. Within each sub-index is used regression analysis to identify and retain those variables that are statistically relevant to income and well-being. Regression analysis sets the weight (regression coefficient) of each variable within sub-index. Prosperity index score is determined by assigning equal weights to all 8 sub-indices for

each country. The average of the 8 sub-indices yields a country's overall prosperity score [13].

On the basis of [13] and data analyze 5 input attributes a_1, a_4, a_6, b_3 and b_4 have been constructed. Output derived variable SL index II s_2 has been constructed with using CA

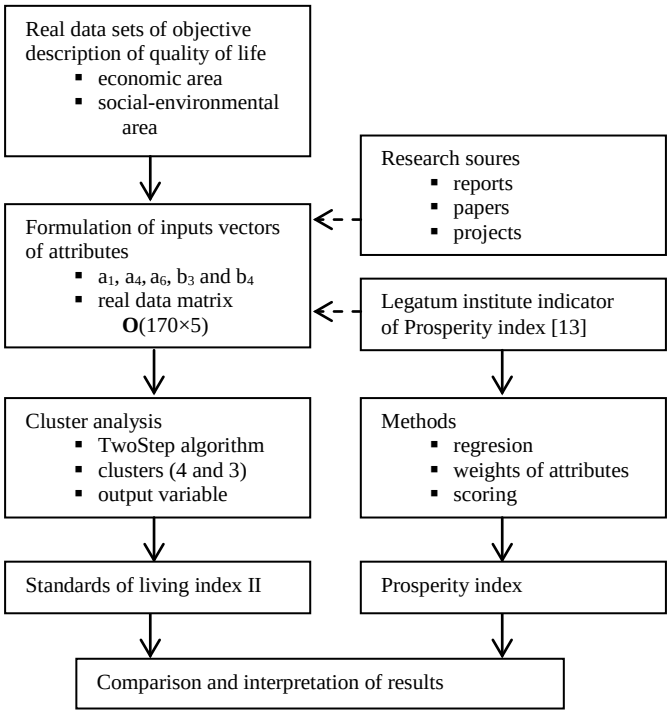

Fig. 3 Model of Prosperity indexes

TwoStep method with 4 and 3 values (number of clusters) for s_2. As in previous case, better results were obtained for clusters c_1, c_2 and c_3, represented by values {low, middle, high} level of s_2 (see Table IV).

Table IV Cluster description for s_2

Cluster	**Value of attribute**	
Name	***Meaning***	***Representation of attribute g_1***
c_1	low	Spain, Portugal, Italy, Estonia, Slovakia, Greece
c_2	middle	Finland, Ireland, Luxembourg, Slovenia, Malta, Cyprus
c_3	high	Netherland, Germany, Austria, Belgium, France

Designed clusters could be characterized by normalized values of attributes in Fig. 4 where green line represents high, red line represents middle and blue line represents low value of this index. The CA algorithm identified the attribute a_1 as unimportant variable and from this reason is not included in the figure.

Cluster c_1 is characterized with the lowest GDP, high number of people at risk of poverty or social exclusion and unemployment. This cluster represents countries with low SL. Cluster c_2 illustrates countries with average SL (higher level of GDP, quite high number of people at risk of poverty or social exclusion and low unemployment). It is characterized wit lowest health care expenditures. Cluster c_3 comprises countries with the highest GDP and health care expenditures, lowest number of people at risk of poverty or social exclusion and unemployment.

Countries are divided into four categories according to the overall score in LPI. The first 30 countries (from 142 of total) are High Ranking Countries, next 41 countries are considered

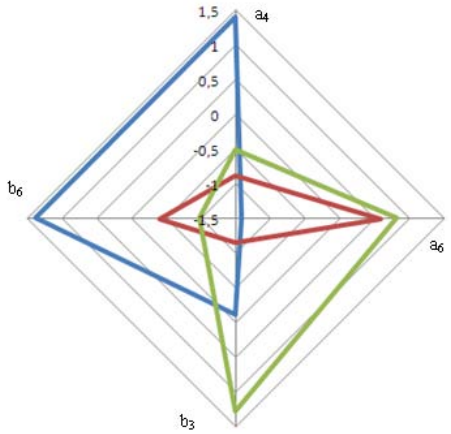

Fig. 4 Representation of normalized values of attributes a_4, a_6, b_3 and b_4 for SL index II s_2

as Upper Middle Ranking Countries, next 41 countries are Lower Middle Ranking Countries, and remaining 30 are Low Ranking Countries. In the overall ranking, most of Eurozone countries rank in the top 30 (with the exception Italy, Estonia, Slovakia and Greece, they have upper middle ranking), see Table V.

In confrontation of LPI ranking with our modeling of SL index II (see Table V), some interesting findings we can observe in case of Finland. This country ranks the seventh position in Prosperity index, which is the best result among the Eurozone countries. Nevertheless, in segmentation analysis, Finland repeatedly reached only cluster with middle SL (see Table IV). It could be explained with lower level of public expenditures on health care comparing b_3 with the other examined countries (see Table VI).

The other different country categorization could be observed in case of Ireland and Luxembourg. In Prosperity index they ranked third, respectively fourth successfully place among Eurozone countries, whilst in modeling analysis they were assigned in cluster with countries of middle living standard. This reality could be explained with different character and wider number of variables included in Prosperity index. Ireland reached high score in sub-indexes concentrated on evaluation of well-being areas – particularly in Personal Freedom, Safety & Security, and Social Capital, which were not taken into consideration in our analysis. Luxembourg placed in Prosperity index behind Ireland – the reason is surprisingly very poor score of Luxembourg in sub-index Education (only 48th position). See more [35]).

Our modelling of SL index II shoved that it does not

correspond with results in ranking countries according to the LPI. It can be explained by number of indicators (variables) entering to the calculation of index. As was already mentioned, the LPI works with 89 variables, whilst for our SL index II we have chosen only 5 indicators. Moreover one third of variables in Prosperity index is obtained on respondent surveys (Gallup World Poll) and refers to well-being measurement. Our analysis is based only on objective variables.

Table V Eurozone countries rank on the basis of LPI and SL index II

Country	LPI order	Ranking category of SL index II
Finland	7th	middle
Netherland	8th	high
Ireland	10th	middle
Luxembourg	11th	middle
Germany	14th	high
Austria	16th	high
Belgium	17th	high
France	21st	high
Spain	23rd	low
Slovenia	24th	middle
Malta	25th	middle
Portugal	26th	low
Cyprus	30th	middle
Italy	33rd	low
Estonia	35th	low
Slovakia	36th	low
Greece	49th	low

Table VI Comparison of attributes values a_4, a_6, b_3 and b_4 for countries from the "high" cluster c_3 and Finland

Country	Attribute			
	a_4	a_6	b_3	b_4
Austria	4.495	7860.000	10.540	17.480
Belgium	7.922	7663.889	10.133	21.278
Finland	8.090	7882.500	8.420	17.280
France	8.985	7047.500	11.180	19.220
Germany	8.768	7107.500	10.900	19.730
Netherland	4.112	8252.500	10.590	16.100

For the LPI, most variables are based on data from 2011 or 2010 (86%), however, there are some variables and countries that use data from previous years. About a third of the variables in the Health and Education sub-indices refer to 2009 or earlier. The data period of time again does not fully correspond with data used in our model for SL index II. This aspect should be also main the reason of incompatibility of analysed indices. LPI is constructed.

C. Modeling of Complete Standard of Living Index

In this part of the article we designed the model of Complete SL (Fig. 5). This model includes all variables described in Table II and work with complete input matrix M(170×15).

Output derived variable Complete SL index s_3 has been designed with using CA TwoStep method with 4 and 3 values (number of clusters) for s_3. As in previous two cases again more appropriate cases have been reached for three clusters c_1, c_2 and c_3, presented by values {low, middle, high} level of s_3 (see Table VII). Countries have been assigned to particular

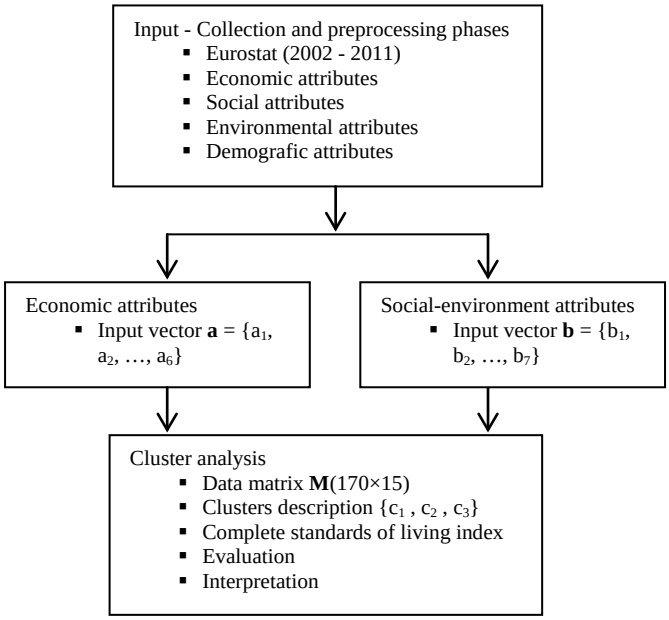

Fig. 5 Model of Complete SL

clusters as value of attribute g_1. Identified clusters could be characterised by normalised values of attributes in Fig. 6 where green line represents high, red line represents middle and blue line represents low value of this index.

Table VII Cluster description for s_3

Cluster	Value of attribute	
Name	*Meaning*	*Representation of attribute g_1*
c_1	low	Spain, Slovenia, Portugal, Italy, Estonia, Slovakia, Greece
c_2	middle	Ireland, Luxembourg, Malta, Cyprus,
c_3	high	Finland, Netherland, Germany, Austria, Belgium, France,

Cluster c_1 illustrates lowest GDP, lowest life expectancy, and lowest fertility among three designed clusters. Current account of BoP exhibits deficit. There is also high unemployment and high number of people at risk of poverty or social exclusion. It can be considered as cluster with negative values in economic and socio-demographic indicators. Only in the area of environmental indicators it reaches sufficient values. This cluster comprises countries with low index of SL.

Cluster c_2 is characterized by high GDP, the highest level of life expectancy, and highest fertility rate. Includes countries with high level of health care expenditures, and low number of people at risk of poverty or social exclusion. Even the share of electricity generated from renewable sources is high. This cluster demonstrates countries with high index of SL. Cluster

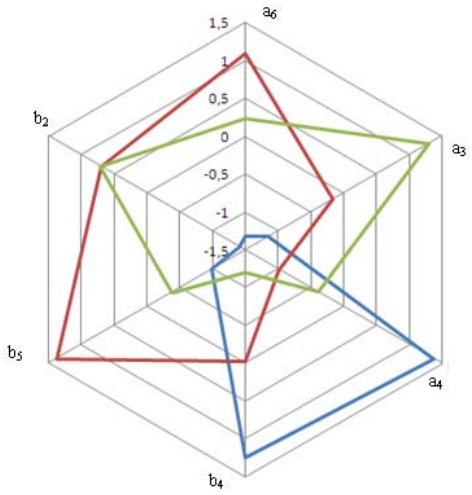

Fig. 6 Representation of normalised values of choosing attributes a_3, a_4, a_6, b_2, b_4 and b_5 for Complete SL index

c_3 represents countries with high level of GDP, low unemployment and level of government debt. The values of environmental indicators are unsatisfactory (high level of greenhouse emissions and household waste generation and low level of electricity generated from renewable sources. This cluster includes countries with average Index of SL.

In Fig. 7 we can find distributive graph of countries assigned into the three clusters according the model of Complete SL index (based on real data series of 15 indicators). Table VIII illustrates countries categorization according to the cluster analyses on modeling SL index II (based on Legatum Institute approach with using 5 indicators), Complete SL index (based on real data series of 15 indicators) and overall rank of countries according to the Prosperity index.

The difference is again in ranking of Ireland – cluster analysis in both models (SL index I and Complete SL index) assigned into the cluster of countries with middle SL, whilst according to the Prosperity index, Ireland ranked tenth place of total and third place of Eurozone countries.

Luxembourg is on the fourth place in LPI, however in our model of Complete SL index was assigned among countries with average living standard. The reason is that its environmental indicators reach very low values. It should be due to the relatively small size of country, size of industry etc. Prosperity index does not include environmental indicators in this form.

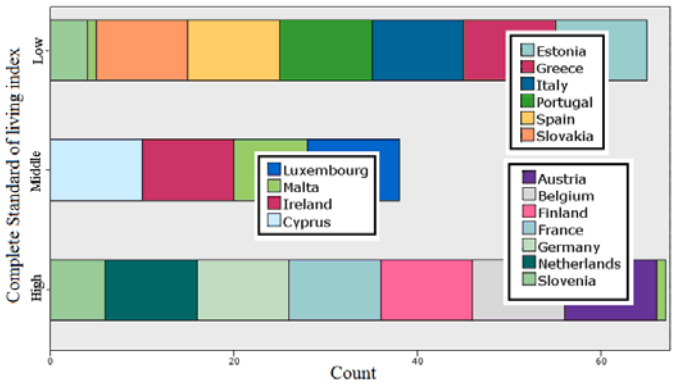

Fig. 7 Representation of distributive graph of countries in the three clusters based on the model of Complete SL index

Table VIII Eurozone countries ranking on the basis of LPI, SL index II and Complete SL index

LPI country order	SL index II ranking category	Complete SL index ranking category
Finland	middle	high
Netherland	high	high
Ireland	middle	middle
Luxembourg	middle	middle
Germany	high	high
Austria	high	high
Belgium	high	high
France	high	high
Spain	low	low
Slovenia	middle	high
Malta	middle	middle
Portugal	low	low
Cyprus	middle	middle
Italy	low	low
Estonia	low	low
Slovakia	low	low
Greece	low	low

Spain reached 23 position in overall Prosperity score (and ninth position among Eurozone countries). It ranged ahead of Malta and Cyprus which are in modeling indexes assorted into the clusters with middle SL, whereas in our models Spain belongs to clusters with low living standard. It could be explained with structure of used indicators – our models works mostly with objective data, Prosperity index has attempted to provide a comprehensive measurement of prosperity using a combination of variables based on economic wealth and quality of life.

Slovenia, the only one country from Eastern Europe, ranked in overall Prosperity index 24th score (and tenth among Eurozone countries), which is excellent result. Its score deteriorate with worsen values in Economic and Social capital sub-indices [35]. In SL index II model, Slovenia was assigned

to cluster with middle SL, on the contrary according to the Complete SL index is assessed as country with high SL. The explanation is larger number of indicators used in model of Complete SL index (15) than in model of SL index I based on 5 indicators. The obtaining result of cluster analysis from the first model more correspond with the Prosperity index score.

V. CONCLUSION

In the article three models of SL of Eurozone countries have been designed. In two cases were used indices Quality of life index and Prosperity index. Our models were designed by mean of CA TwoStep method and in all three models where three clusters created. The result of our models demonstrated, that created clusters of group of countries are not fully comparable with assessment of countries according to the Quality of life index and Prosperity index. The main reason of incomparability in the model of Quality of life can be considered different time horizon for input data. Whereas in our analysis data from 2002-2011 have been used, quality of life approach worked with data only from 2009 year. This is not the aspect of discrepancy in model of Prosperity Index where both approaches worked with very similar time period. LPI is constructed for data from period 2006-2011 years. The difference in second models could be explained by number of indicators (variables) entering to the calculation of indices. Prosperity index uses much greater number of variables comparing with our SL model.

The third model have been designed with variables characterized all aspects of SL (economic and socio-environmental). The results demonstrate that the western countries of Eurozone together with Slovenia and Finland correspond with high level of SL index. Contrary to the South and East European countries, which represent low level of SL index. These countries exhibit substantial results in environmental area however in economic and socio-demographic exhibit weak values.

The objectives of the article - to create own models of SLs by means of CA and to compare them with existing evaluation of SL in Eurozone countries were fulfilled.

Our analysis and quality of life models were designed only on the pattern of Eurozone countries. Generally are "old" EU member states considered as countries with highest level of SL and quality of life [36]. Non all of them are members of Eurozone (e.g. Denmark, Sweden) and therefore were not included in our analysis. Conversely countries, which joined EU after year 2004, so called "new" member states could be considered as countries with lower level of SL and quality of life. In our modeling only Eurozone countries (Estonia, Slovakia, Slovenia) have been included and our models confirmed their lower quality of live level. These "new" countries are altogether net recipients (their contributions into the common European budget are less than the amounts received from this budget) – sources are dedicated for support of their further development. Majority of "old" countries are net contributors to the common EU budget. Surprising is comparison of these receipts (contributions) recalculated per capita: according to this recalculation Luxembourg is the biggest recipient [37]. Relationship between SL, quality of life and net position of an each EU member country could be area of our further research and modeling.

From the longer point of view some trends are appearing: in Eastern and Central European countries notable improvements in overall prosperity we can see [13], [38]. By contrast, many of Western European countries are either just keeping pace with the European average (such as France and Spain), or are seeing substantial falls in their scores (notably Italy, which has seen the largest decrease in the whole Europe) [13].

To express and evaluate SL is necessary to use not only the objective data, but also the data obtained from the subjective evaluation of life quality by the respondents. General fact is that countries economically rich with better economical fundamentals (as GDP, salaries, level of unemployment, investment, etc.) reach better results in evaluation of living standard and quality of life by citizens. It is not possible to demark the economic side from social, environmental and other subjective aspects. Usually score of living standard indices are higher in this kind of countries.

Modeling of SL indexes provided in our article was based on the data obtained from open sources available from Eurostat database. Because of wide extent of research, we did not consider subjective aspects of quality of live evaluation (we did not conduct any own survey). Quality of live evaluation with using objective data is quite simpler and less exacting, moreover based on available data. Results in rank of Eurozone countries based on modeling of "Complete SL index" were not so different from results of LPI (including also subjective evaluation). This confirms the hypothesis, that SL index is influencing in a major degree by economic indicators.

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