

THEORETICAL MODEL OF ESTIMATING THE QUALITY OF LIFE INDEX

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Abstract. The goals of this paper are: to determine the stages of calculation of the quality of life index, to identify the quality of life index estimation branches, to distinguish the main indicators depicting the quality of each working area, to introduce the corresponding mathematical models of each area, and present the method of calculation of the integral quality of life index.

Plenty of models are used to measure the quality of population's life index, but as a rule they estimate influence of economical variables. The author of this paper tries to include many more indicators covering all the important dimensions.

The originality of the paper includes determination of major dimensions, which define the quality of life index, two proposed mathematical models of calculation of the integral quality of the life index and the specific indicators suitable for every situation, the estimation of ways to measure weigh constituent coefficients, choosing the unit of measurement for any indicator and the discussion of different ways to obtain the necessary information.

The models referred above are modern ones and have not been used before.

This research is a theoretical one. The author is going to take practical steps to employ this methodology in the research under the project "Creation of system of measurement indicators and evolution model of the quality of life of Lithuanian population".

JEL classification: J17.

Keywords: indicators, integral quality of life index, mathematical models, quality of life index.

Reikšminiai žodžiai: indikatoriai, integralusis gyvenimo kokybės indeksas, matematiniai modeliai, gyvenimo kokybės indeksas.

Introduction

Research object is the quality of life of the population of the Lithuanian Republic.

The goals of this paper are: to determine the stages of calculation of the quality of life index, to identify the quality of life index estimation branches, to distinguish the main indicators depicting quality of each working area, to introduce the corresponding mathematical models of each area, and present the method of calculation of the integral quality of life index.

Design of research. The paper includes introduction, determination of major dimensions defining the quality of life index, mathematical models of calculation of the integral quality of life index and the specific indicators suitable for every situation, the estimation of ways to measure weigh constituent coefficients, choosing the unit of measurement for any indicator and the discussion of different ways to receive the necessary information.

The main findings. Major dimensions are established, two mathematical models are proposed, the ways to find the necessary information are described and the stages of using this method are presented.

Research limitations. This research is a theoretical one. The author is going to take practical steps to use this method in the research under the Project “Creation of system of measurement indicators and evolution model of the quality of life of Lithuanian population”.

Practical implications. This theoretical study will be used during the research in the above-mentioned project.

Originality. This method is a modern one and has not been used before.

Short background. Researches made in this area are very wide. It is impossible to review all of them. It may be a separate goal of research. The author mentioned and used only the fundamental researches.

The real situation of the economy and the efficiency of economic policies in Lithuania are reflected by the people’s quality of life indicators [6]. As the world’s most famous economists (Nobel Prize winner Joseph Stiglitz [9], Amartya Sen [7], Paul Krugman [2], James Galbraith [1], etc.) confirm, general economic indicators, such as GDP, inflation, budget deficit, are far from evaluating the real economic situation in the country. Consequently, it is necessary to have indicators reflecting full human life quality, covering various areas of human activity, including the most important ones.

First of all, it is necessary to define the areas where people can realise their possibilities at different levels to use the services provided, to communicate efficiently, to participate in the relevant decision-making processes, to feel safe, to live in dignity, and other areas.

1. Mathematical model to calculate the quality of life index

In assessing the diverse status of the country, it is necessary to move the centre of gravity towards human welfare and quality criteria.

As stated by Stiglitz, [8 p. 14], “To define what well-being means a multidimensional definition has to be used. Based on academic research and a number of concrete initiatives developed around the world, the Commission has identified the following key dimension that should be taken into account. At least in principle, these dimensions should be considered simultaneously:

- i. Material living standards (income, consumption and wealth);
- ii. Health;
- iii. Education;
- iv. Personal activities including work
- v. Political voice and governance;
- vi. Social connections and relationships;

- vii. Environment (present and future conditions);
- viii. Insecurity, of an economic as well as a physical nature.”

All these dimensions shape people’s well-being, and yet many of them are missed by conventional income measures.”

In our project, we have chosen the following major dimensions:

1. Health state (physical, psychological).
2. Working and occupation state.
3. Social connections state (social relations, sociality, public spirit).
4. Income state.
5. Consumption state.
6. Accommodation and residential state.
7. Education state.
8. Social security state.
9. Legality and corruption state.
10. Moral-ethical, spiritual, cultural values state.
11. Leisure state.
12. Physical security/public order state.
13. Inequalities in quality of life state (gender inequalities, social disjuncture, public tolerance).
14. Personal happiness state.
15. Development of infrastructure and technology state.

As it can be seen, we try to widen the number of dimensions seeking better express the well-being features.

In the proposed mathematical model, the quality of life index is calculated by summing up the aggregated and weighted values of the indicators mentioned above.

Suppose that each of the above status summarised indicators is determined and weigh coefficients of these indicators are known, thus the integral quality of life index can be calculated using the following formula:

$$I = \sum_{i=1}^{15} a_i b_i,$$

where: $b_1; a_1$ – value of summarised health status indicator of population (b_1) and weight coefficient of this indicator (a_1) correspondingly;

$b_2; a_2$ – value of summarised working and occupation state of population (b_2) and weight coefficient of this indicator (a_2) correspondingly;

$b_3; a_3$ – value of summarised quality social connections state indicator of population (b_3) and weight coefficient of this indicator (a_3) correspondingly;

$b_4; a_4$ – value of summarised income state indicator of population (b_4) and weight coefficient of this indicator (a_4) correspondingly;

$b_5; a_5$ – value of summarised consumption state indicator of population (b_5) and weight coefficient of this indicator (a_5) correspondingly;

$b_6; a_6$ – value of summarised accommodation and residential state indicator of population (b_6) and weight coefficient of this indicator (a_6) correspondingly;

$b_7; a_7$ – value of summarised education state indicator of population (b_7) and weight coefficient of this indicator (a_7) correspondingly;

$b_8; a_8$ – value of summarised social security state indicator of population (b_8) and weight coefficient of this indicator (a_8) correspondingly;

$b_9; a_9$ – value of summarised legality and corruption state indicator of population (b_9) and weight coefficient of this indicator (a_9) correspondingly;

$b_{10}; a_{10}$ – value of summarised moral-ethical, spiritual, cultural values state indicator of population (b_{10}) and weight coefficient of this indicator (a_{10}) correspondingly;

$b_{11}; a_{11}$ – value of summarised leisure state indicator of population (b_{11}) and weight coefficient of this indicator (a_{11}) correspondingly;

$b_{12}; a_{12}$ – value of summarised physical security/public order state indicator of population (b_{12}) and weight coefficient of this indicator (a_{12}) correspondingly;

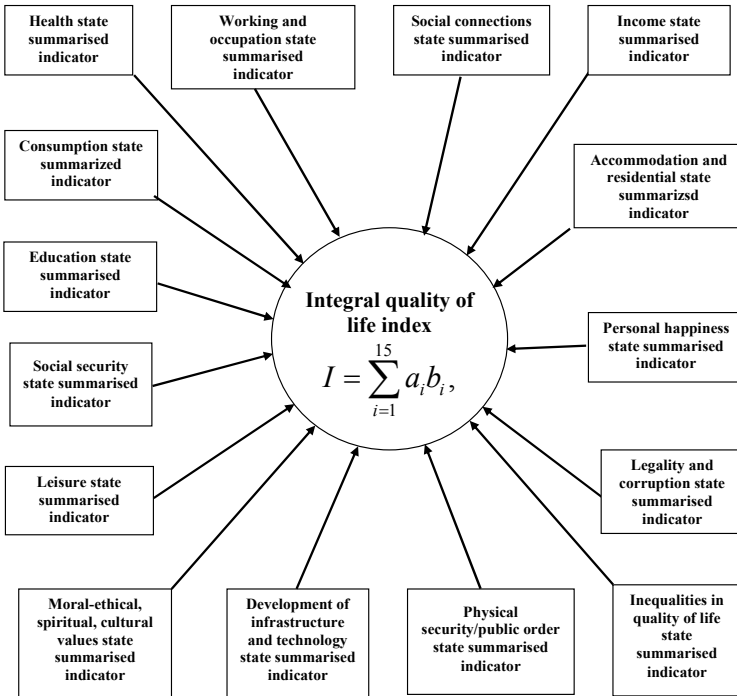
$b_{13}; a_{13}$ – value of summarised inequalities in quality of life state indicator of population (b_{13}) and weight coefficient of this indicator (a_{13}) correspondingly;

$b_{14}; a_{14}$ – value of summarised personal happiness state indicator of population (b_{14}) and weight coefficient of this indicator (a_{14}) correspondingly;

$b_{15}; a_{15}$ – value of summarised development of infrastructure and technology state indicator of population (b_{15}) and weight coefficient of this indicator (a_{15}) correspondingly.

The system of assessment of quality of life indicators is presented in Figure 1.

Figure 1. The system of assessment of quality of life indicators



As stated by Stiglitz [8, p. 206] The most obvious way of estimating the joint distribution of various attributes of QoL would be through a survey in which comprehensive data on all dimensions of QoL were collected for the same sample of people. A less ambitious (but sub-optimal) technique would consist in using different samples for different dimensions, but with enough variables common to the various surveys to allow estimating the joint distribution. This could be achieved by including questions that allow classifying respondents by socio-economic status, education, ethnicity or migrant status within the surveys used in specialized domains. Whatever technique is used, developing information on the joint distribution of various QoL dimensions would constitute real progress”.

Despite of this mentioned shortage that is typical for all additive indicators, using additive indicators is a prerequisite and sometimes a unique method for preliminary estimations. Links between different dimensions or other factors are very specific and could be described reliably only, if characteristics of community under estimation are strictly determined.

2. Determination of weight coefficients

It is necessary to note that one meets an extremely difficult problem of determining the above-mentioned weight coefficients. In general, scientists do not know how to determine weight coefficients and use only some recommendations. In our case it seems appropriate to follow such recommendations. First, it is appropriate to take advantage of the hierarchical list of motives developed by psychologist Maslow [3]. He has found that there are five levels of human needs: physiological (food, clothes, rest, sex), security (to defend themselves from bandits, animals, cold, heat, etc.), communication (everyone needs to live and work in a group by fulfilling some social needs), respect and recognition in the community, self-actualisation (everyone seeks to achieve higher position, to have higher education level, better skills and to get acknowledged for their achievements).

According to Maslow, these needs are arranged in a strict hierarchy. The higher level needs for an individual become important only when he or she has satisfied the lower-level needs.

Secondly, it should be recognised that the priorities of representatives of the different groups in a society in different areas of performance may vary significantly, so it is necessary to evaluate the structure of the community, the number of members in each group, and to find a way to assess these differences. Thirdly, it is necessary to realise that the factors affecting the weight have a volatile character. Fourthly, we need to maximise the use of available statistical data, although in many cases there is a lack of some important indicators in the statistics, it is therefore necessary to invite experts and use a questionnaire for the survey of population.

It is necessary to select the suitable experts, who should determine the system of indicators for each area of activity, to suggest the ways to range these indicators, the sources of information to use, how to determine the reliability of selected information, how to take into account the views of the population, and to address other relevant issues.

3. Indicators used in each area

During the evaluation of the influence of each area's indicators on the integral quality of life index it is necessary to decide on the indicators to be used in each area, to base their portfolio, to establish the values of each indicator enabling to make a decision on its qualitative impact, to identify the ways of measuring the values of each indicator. There is a complex set of issues to be tackled: to define who can formulate a suitable set of indicators for each area, to identify the levels of significance of each indicator, to determine the ways to make a summary conclusion on the influence of each indicator used to calculate the quality of life index. Again experts having perfect understanding of the characteristics of the operation in the specific area should be invited to propose the ways for collecting the necessary information, determining its relevance and the selection of possible sources of information, and assessing the validity and reliability of that information.

4. Summarised quality of life indicators

The value of summarised quality of life indicator of population in particular area can be calculated using the following formula:

$$b_i = \sum_j c_{ij} \cdot d_{ij},$$

where: d_{ij} ; c_{ij} – value of a particular (j) indicator d_{ij} used for estimation of particular summarised (i) indicator of population and the weight coefficient c_{ij} of this particular indicator correspondingly.

Index (j) varies from one to the number of the selected indicators in each area.

5. Units of measurement of each indicator

It is important to choose the unit of measurement of each indicator. Because all indicators must have one and the same unit, or not to have any, it is recommended to select a unit of measure based on an assumption whether it is a qualitative or a quantitative one. If an indicator is measured by qualitative scale – the measurement unit may be score, if an indicator is measured by a quantitative scale – it does not have the measurement unit, because its value is calculated as a ratio using the standardised formula:

$$e_{ij} = \frac{d_{ij} - d_{0ij}}{d_{0ij}},$$

where: e_{ij} – value of a standardised indicator;

d_{0ij} – value of the basic indicator chosen as a comparison level.

It is recommended to pick up the value of the basic indicator chosen as a comparison level based on the average of this indicator among the countries of the region that are the subject of the study. It may be European Union, the world or some parts of the world. Obviously, the value of a standardised indicator may be positive, if an

indicator in Lithuania is better than the average of this indicators in the countries under investigation, or negative in an opposite case.

If an indicator is measured by a qualitative scale, the measurement unit score may have three or even five graduations; in the first case, it would be good, average and bad scores; in the second case it would be very good, good, average, bad and very bad scores.

6. Graduations of each quality indicator

The graduations of each quality indicator should be labelled by some quantitative ratings, because the integral quality of life index must be expressed in digital form. What labels should be attached can be decided by the experts, depending on the importance of any indicator. If qualitative assessments are obtained during the survey of population by applying the five grade scale, the score of one is applied, if she/he at least agrees with the formulated question, and five, if she/he mostly agrees, then the average of assessments of the qualitative indicator may be calculated according to the following formula:

$$r_{ij} = \frac{1}{N_{ij}} \sum_{k=1}^5 kn_{kij},$$

where: r_{ij} – value of whatever indicator calculated using the survey data of population;

N_{ij} – total number of respondents who have expressed their opinion by replying to this question;

k – number of attached scores by respondents;

n_{kij} – number of respondents who attached score k .

When the necessary indicators are selected and their values are determined, it is necessary to carry out a survey of the population and to compose the questionnaires reflecting the summary of the assessment of population opinions. Only when the residents express their opinion about each indicator, one can determine if they really agree with this indicator for assessment of the population's quality of life, in particular, the index value.

It should be noted that both in Lithuania and elsewhere in the other countries statistical data systems are not widely developed, and some necessary indicators for assessing the population's quality of life are not gathering and estimated. In addition, the indicator's measuring technique is insufficiently developed. This problem is formulated in the paper by Puškorius [5], based on the analysis of the efforts of world scientists to deal with it.

This problem is investigated by many scientists, for example, Poister [4] believes that the necessary measurements are possible only when the corresponding measurement systems are created.

The measurement system must be created individually for each indicator. The composition of such a system, the purpose and functions depend on what is necessary to measure, which area the indicator refers to, what stages of the process are investigated and on many other factors and their combinations.

Hence, the common features of creating and functioning of the measurement systems and specific features must be created that fit to particular object, the goals of the evaluation, the environment in which the system works and other specific factors influencing the perception and measurements.

An important stage in the functioning of the measurement system is associated with the data selection procedures, analysis of available information from different sources, the validity of the information and the reliability of the assessments, application of the specific test parameters for the choice of the design methods, the validity and reliability of the data collected, proper processing and presentation, formulation of interim and final findings and other factors necessary to ensure the efficient use of data sampling and analysis. There are many problems needed to consider separately. Among them the following problems can be mentioned: whether the time for selection of information, price, and other efforts have adequate influence on the accuracy, reliability and objectivity of the results obtained; is it necessary to make special experiments, surveys, interviews, etc.; is it necessary to create new test methods, suitable only for this specific indicator in order to examine and evaluate it [5].

The implementation phase of the measurement system encompasses many factors, among which the following may be mentioned: the approbation of the system, i.e. the perception whether it may function properly; the introduction of the necessary data for the selection procedures; the establishment of the mechanism and the approbation of the data processing; the creating and approbation of the procedures for the formulation of conclusions and recommendations; the inclusion of the recommendations of the measuring system in the decision-making procedures.

Conclusions

The proposed mathematical model to calculate the quality of life index estimates health status, employment and occupancy rate status, quality of lifetime work status, income status, consumption status, environment and accommodation status, education status, safety, law and order and corruption status, moral-ethical, spiritual, cultural values and leisure time status and gender equality status.

To calculate this index, we need to determine the appropriate weigh coefficients. It is suggested to use Maslow's hierarchical list of motives, expert and population opinion.

To compose a formula to evaluate the value of the summarised quality of life indicator of population in a particular area.

To propose the ways to choose and unify the units of measurement of each indicator used in particular area, to determine the graduations of each quality indicator.

It is pointed out that globally the measurement systems for calculation of the quality of life index are not developed enough and must be created individually for each indicator.

It is stated that additive indicators have some shortage which is typical for all additive indicators, using of them is a prerequisite and sometimes a unique method for preliminary estimations. Links between different dimensions or other factors are very

specific and could be described reliably only, if characteristics of community under estimation are strictly determined.

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TEORINIS GYVENIMO KOKYBĖS VERTINIMO MODELIS

Santrauka. Straipsnio tikslas – pristatyti gyvenimo kokybės indekso apskaičiavimo etapus, identifikuoti gyvenimo kokybės vertinimo sritis, išskirti pagrindinius rodiklius, kurie nusako kiekvienos srities veiklos kokybę, preliminariai nustatyti, kaip gali būti matuojami atrinkti rodikliai, pateikti kiekvienos srities veiklos apskaičiavimo matematinis modelius ir integralaus gyvenimo kokybės vertinimo kriterijaus apskaičiavimo metodiką.

Yra daugybė gyvenimo kokybės indeksų vertinimo modelių, bet dažniausiai jie vertina tik ekonominių veiksnių įtaką. Autorius išskiria daug daugiau kintamųjų, kurie visapusiškai apibūdina žmonių gyvenimo kokybę. Straipsnio naujumas apima pagrindinių dimensijų formuluotes, du matematinis modelius – vienas skirtas apskaičiuoti integralųjį gyvenimo kokybės indeksą, kitas – specifinis modelis, skirtas apskaičiuoti suminius indeksus kiekvienoje srityje. Siūlomi svorio koeficientų ir jų mato vienetų nustatymo būdai, aptariamai būdai, kaip gauti reikiamą informaciją.

Šie modeliai yra originalūs, anksčiau netaikyti.

Tyrimas – teorinis. Jis bus taikomas praktiškai atliekant tyrimus projekte „Creation of system of measurement indicators and evolution model of the quality of life of Lithuanian population“.

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Mokslinių interesų sritys: sprendimų priėmimo teorija ir praktika, veiklos audito teorija ir praktika, institucijų struktūros, atsakomybės ir funkcijų pagrindimas, valstybės valdymo reformų analizė, viešojo ir privataus sektoriaus institucijų veiklos efektyvumo ir veiksmingumo vertinimas, vadybos ir valdymo problemų analizė.