sciendo

Financial Internet Quarterly 2020, vol. 16 / no. 2, p. 73-86

DOI: 10.2478/fiqf-2020-0014

Financial Internet Quarterly

REGIONAL DIFFERENTIATION FOR LIFE QUALITY OF THE POPULATION IN UKRAINE UNDER INNOVATIVE GROWTH

Natalia Burkina[1], Taras Furman[2], Janusz Soboń[3], Kostiantyn Sapun[4],

Abstract

The article focuses on the analysis of economic growth of Ukraine and its regions, using the proposed by the authors indicators of quality and indicators of the population living standards under innovation growth. The main purpose of the research is developing a method of multi-factor assessment and regional classification of population`s life quality. Moving to the results literature review showed that many approaches to assessing the quality of life of the population have been developed in the statistical theory and practice. However, still, there are many discussions about the question of a single aggregate indicator of living standards and the methodology of regional differentiation by this criterion. So, it has not been found a rational way to combine indicators of the level and quality of life to obtain a comprehensive index that reflects objectively, reliably and verifiable the population`s level and quality of life. The main discovered disadvantage of existing methods is the use of the expert estimation method, which does not allow guaranteeing validity the weight of the criteria for estimation the quality of life indicator. Nevertheless, all authors admitted that today the role of the state rises in solving the most important social and economic problems, therefore, the task to increase the efficiency of the regions` functioning based on innovation activity becomes of key importance. The analysis of regional activity`s effectiveness considering the innovation component is the most important part of national administration. In the article the research of the question of multi-factor assessment and regional classification the quality of the country population`s life is carried out in the following logical sequence: theoretical analysis of categories of living standards and quality of life; development of the statistical indicators system at the regional level for assessing the quality of life of the population; distribution of the entire system of indicators for certain economic categories; receiving indexes for each region by each category; realization of regional clustering with the received system of indexes. The methodical tools of the research were general scientific methods: analysis (conducted analysis of definitions for concepts of the standard of living and quality of life); synthesis (combination of separate research methods into a unified methodology of regional differentiation by the quality of life); deduction (initially it is analyzed all the proposed systems of indicators in general, and then they are divided into economic categories); abstraction (separation of a significant indicators system for the implementation of regional differentiation in terms of innovation development of the living standard of the population from the entire statistical information), specification (revealing specific characteristics of the received categories and clusters); comparison (comparison of regions according to the indicators of the population`s life quality level), classification (grouping of individual indicators into economic categories); generalization (with the help of which conclusions were drawn). There were also used some special methods: cluster methods (the tree clustering method and k-means clustering of the regions of Ukraine by the basic indicators of population`s living standards), the method of the main components (for the development of regional indexes for each category). The research was carried out for the data of 2017 year as the last year, for which statistical information is available with most indicators in a regional context. The object of the study is Ukraine and its 24 regions. The city of Kyiv was highlighted as the capital.

The article presents the results of the empirical analysis of the level and quality of population`s life indicators, which allowed to allocate five clusters and a set of indicators for regional differentiation. The study empirically confirms the presence of regional clusters in the category of living standards and theoretically proposes a methodology for its implementation in conditions of innovative development. The results of the study can be useful for analyzing various scenarios for the implementation of social policy aimed at financial and economic protection of the population ensuring. It was shown that for certain regions the quality of population`s life should be considered as a task of their innovative growth.

JEL classification: A1, C1, C5, C6, C8

Keywords: innovative growth, innovation development, living standards of the population, quality of population`s life, regional differentiation, regional clusterization

Received: 20.05.2020 Accepted: 25.06.2020

[1] Donetsk National University after VasylStus, Faculty of Economics, Ukraine, ORCID: 0000-0003-2993-5128.

[2] Donetsk National University after VasylStus, Faculty of Economics, Ukraine, ORCID: 0000-0002-8515-6674.

[3] Academia JS w Gorzowie Wielkopolskim, Poland, ORCID: 0000-0001-9161-6967.

[4] Varna Free Univeristy, Bulgaria, ORCID: 0000-0002-5966-5125.

Introduction

The modern concept of human development, which covers the most important problems of society`s development (economic growth, employment, distribution of benefits, social protection, etc.), places a person at the center of the potential and strategic development of the state. At the same time, man is a decisive component of national wealth. In recent years, the concept of human development has substantially meaningfully enriched and transformed into a real basis for the long-term strategy of socio-economic development of most countries. At the same time, the level of socio-economic development of the country is largely determined by the quality of its population`s life. The concept of „quality of life" covers all spheres of human existence and society`s, considers both objective and subjective factors of living conditions.

Raising the population`s living standard is the main goal of every progressive society. In modern conditions, quality of life becomes the main strategy of socio-economic policy of the country, a criterion for the successful work of all spheres and levels of government, and its consistent improvement in many countries is a national idea. The main strategy in many countries is to increase the expenses for human development. The quality of life is determined by a system of indicators that characterize the general welfare of people, satisfying their vital needs. Indicators of the quality of life and development of person are increasingly becoming the criterion for decision-making in the field of economic and social policy. At the same time, by these indicators Ukraine is progressively lagging the rest of the developed countries.

The quality of life influences both the essential circumstances of human life and the level of production and technology development. While formulating the requirements for the quality of life, one can stimulate the development of the economy towards more complete satisfaction of the corresponding human needs. Proceeding from the modern society`s growing need in knowledge, which is both a component of quality of life and a condition for economic development, it is logical to conclude that the vital importance of improving the measures of life quality for innovative development of the economy, and quality of life regarded as an instrument of innovation development.

Questions of the quality of life assessment arise when solving various socio-economic problems. Most often such tasks are comparing socio-economic development of certain territories or groups of population, assessing the effectiveness of the state`s socio-economic policy, developing indicators for such policies, etc.

Literature review

It is believed that the term „quality of life" was first applied in 1920 by A. Pigu in the „Economic Theory of Welfare". The widespread use of this term is associated with the name of the American economist J. Gelbright, who published in 1958 the book „Society of Abundance" and although the category „quality of life of the population" develops under the influence of the supporters` views of the theory of well-being, the sociologists have no less importance in the elaboration of this category (Galbraith, 1998). Due to sociological works, this category was disclosed as a social concept. At the same time, the subjective aspect of people's assessment of the level and quality of their own lives was the methodological basis for determining the content and the next quantification.

The quality of life is a complex category, in contrast to the concept of „quality", which is described in international ISO standards. Despite the long history of studying this problem, both in foreign and domestic literature, it has still not been possible to concretize the very concept of „quality of life" and thereby effectively use its indicators in the practice of state statistics. The category „quality of life" is synthetic, combines various aspects of human life and human perception of life. In addition, this category is latent, not directly measurable. The breadth of this concept goes beyond the limits of the partial concept of „standard of living", or other partial concepts that are associated with the assessment of human development. The quality of life reflects a variety of living conditions, and the standard of living is only one of the most important components of the quality of life.

With all the richness of the concepts of quality of life, there is no single universal definition of this category. The concept of „quality of life" in the modern scientific sphere is used by various sciences: philosophy, economics, sociology, political science, social ecology, geography, medicine, etc. In the paper „Analysis of the quality and lifestyle of the population" (Ayvazyan, 2012) highlights four basic concepts of quality of life. The first is the concept of economic well-being and considers quality of life as a wealth. This concept is rather narrow and limited in the

modern sense. The second is Utilitarian and it defines the quality of life through the concept of usefulness acquired by human throughout life. This concept is used within the limits of subjectivist measurement of life quality. The third is the expansion of human capabilities and it examines the process of human development and improving the quality of life as an extension of people's ability to choose areas of activity, ways of self-realization, access to knowledge, etc., such a concept is most recognized and demanded today in the practical and scientific spheres. The fourth is pragmatic and it evaluates the quality of life as depending on the level on which a person at Maslow's hierarchy of behavioral motivation is and depending on the specific application of life quality indicators.

Thus, quality of life is a complex, multicomponent phenomenon, which depends both on objective and subjective factors that reflect the basic preconditions and the level of realization of human development, the degree of priority of human development in the civilization process, as well as the self-perception of man, one's self-identification and state of the environment (Prystupa & Keurysh, 2010).

Although the problem of assessing the life quality was posed from ancient times, various subjects offer measuring means for life quality only several decades. The modern tool for measuring the quality of life is very wide and solves different tasks. The lack of a single interpretation of the „quality of life" is significantly reflected both in the allocation of indicators and parameters, and on the methods of its evaluation. In practice, it is manifested in the fact that some scientists determine the quality of life from the standpoint of the objective nature its indicators (Forrester, 1978; Bell, 1999), or through subjective people`s feelings (Michel, Logottegi & Cantor). Many researchers use both objective and subjective indicators to evaluate both. We are impressed with the idea expressed by Ayvazyan S.A., who proposes to allocate: macro-approach (objectivist), which is based on the analysis of statistical indicators characterizing conglomerates of the population in this synthetic category (empirically based on macroeconomic data); and a micro-approach (subjectivist) that is based on the analysis and processing of the results of special questionnaire surveys of population aimed at researching the synthetic category (empirically based on microeconomic data) (Libanova et al., 2013).

The current world experience of life quality measuring includes such an arsenal of methods based on the analysis of statistical macroeconomic indicators: income-based indicators; indicators based on anthropometric indicators of children; „Green pure national product"; the index of true progress (development); index of economic prosperity; index of physical quality of life; human development index; social health index; Johnston's (1988) Quality of Life Index; international index of living conditions; integral social index of Michalis; Social progress index of Estes. In addition, it is possible to distinguish such methods of evaluation that are based on the analysis of microeconomic data: assessment of life quality after Ferrens and Powers; Eurobarometer; Swedish ULF system; analysis of the state`s population life quality; consumer`s index of confidence; quality of life, based on health assessment; Quality of life index by the World Health Organization; Philippine analysis of the social climate. There are also methods that cover these two approaches: the indicator of the magazine „Money Magazine"; Myers Trend Indicator; basic and improved quality indicators of Diner life; Cummins` comprehensive indicator of the life quality; Ruth Wehenhoven indicator of the happily lived life; German system of social indicators; Dutch index of living conditions.

There are different approaches of assessing the population life`s quality in the statistical theory and practice, but still the question of building a single aggregate indicator of living standards continues to be controversial. A rational way of combining indicators of the level and quality of life to obtain a comprehensive generalization index that objectively, reliably and realistic reflects the level and quality of population`s life hasn`t been found yet.

We propose a method, based on an objectivist approach to indicator analysis for assessing the quality of life in terms of regions. The advantages of this method are saving resources for conducting primary statistical observations, which is associated with the use of official statistics. This method also has several disadvantages that are mainly related with questions of trust for the official statistics data.

Previously unresolved issues as a part of the general problem to which this article is devoted: An analysis of the existing theoretical ideas about the nature and assessment of the life`s quality made it possible to conclude that despite the waking researcher`s interest in this problem, the unambiguous category and methodology that would be accepted by all definitions for life`s quality evaluation has not been formulated yet. It is very important to know which indicators quality and standard of living depend on,

therefore the necessity of identifying and analyzing the components of the population`s life quality determines the relevance of this research and its practical significance.

The article's purpose: The aim of the study is to develop a multi-factor assessment method and a regional classification of the population's living standards.

In accordance with this goal, the following research objectives were set:

1) to study the quality of life of the population as the most important form of expression of economic growth in modern conditions of innovative development;

2) to identify the main theoretical approaches to the study of the categories of „standard of living" and „quality of life";

3) to form a system of indicators of quality of life for its use in conditions of innovative development;

4) to analyze the state of the regions and carry out regional differentiation according to the proposed system of indicators of quality of life.

Methodology and research methods: To study the living standards in Ukraine and conduct regional comparisons, we will define the terminological basis of the study. It is necessary to emphasize several features, while characterizing the quality of life as a socio-economic category. The category „standard of living" is defined in a narrow and broad sense: in the narrow sense through the characteristics of the level of consumption of the population and the degree of satisfaction of needs (measuring income, expenses and consumption of goods and services); in the broad sense through the characterization of the level of human development (health and ability to supply needs) and living conditions of the population (the state of the environment and safety).

Thus, in the narrow sense of the word, the standard of living is expressed as the ratio of income level to the cost of living. In a broader sense, the standard of living is no longer limited to its value estimates but is closer to the concepts of „lifestyle" and „quality of life". The study and synthesis of existing theoretical approaches to the study of the quality of life as an economic category has allowed substantiating the conclusion that the system-forming basis of them „living standard" concept are different human`s needs which arise and which are realized in the sphere of consumption. The limitation of the research`s field in the sphere of consumption represents an important constructive difference with the definition of „quality of life" as a category of higher order. Quality of life is the most important social category that characterizes the structure of human needs and the ability to meet them.

Some researchers focus their attention on the economic side, material security of population`s life while determining the concept of „quality of life". There is also the opposite view, according to which quality of life is the most integrated social indicator. Level and quality of life are used by researchers to develop mechanisms for state regulation of population`s life. So, O. Melnichenko (Melnychenko, 2008) and V. Mandybura (Mandybura, 1999) offered their mechanisms which are based on the conducted analysis of these concepts and their main components.

At present, there are many methods for assessing the quality of population`s life. But the main disadvantage of existing methods is the use of the expert estimation method, which does not allow guaranteeing the validity of the weight of the criteria based on which the quality of life is calculated. Thus, attention should be paid to the method of assessing the quality of the population`s life, which does not use the expert estimation method.

We analyzed different foreign researches to people differentiation and found out some approaches. The methodology of the Canadian Index of Wellbeing is represented by the set of eight indicators, the researcher Erikson R. describes the Swedish Approach to Welfare (Erikson, 1993). European Foundation for the Improvement of Living and Working Conditions propose the methodology used for monitoring quality of life in Europe, the UK Government developed the strategy with the local quality of life indicators, supporting local communities to become sustainable (QofL, 2005). We need to underline that foreign methodologies can be applied for Ukraine only in particular cases because of the difference in the set of indicators, which are available on the state level.

Some regional aspects of the life quality were considered by different researches. Among them A. Vlasuk (Vlasyuk & Yacenko, 2005), Z. Herasimchuk (Herasimchuk, 2002), I. Gukalova (Gukalova, 2007), L. Petkova (2006), N. Kelley-Gillespie (Kelley-Gillespie, 2009) and others. They research different factors of influence on the quality of life in the regions, regional inequality of the level of life, tools of Realization of Regional Strategic Development, but they are not concerned the regional classification methodology of the population`s quality of life under innovation development.

In this study, we propose to combine the disparate indicators of the level and quality of life using the method of factor analysis. The set of factor analysis methods is quite large: the method of the main components, simple methods of factor analysis, approximating methods of factor analysis. The method of the main components has some advantage over the simple methods of factor analysis that is the ability to identify sufficient characteristic factors in the analysis of life quality. The advantage of using the method of the main components before the group method is that it does not require the prior selection of elementary group characteristics, which allows making the analysis easier.

The method of the main components detects k-component factors, which explain the entire variance of output k random variables; at the same time components are being built in order of decreasing the proportion of the total output quantities` dispersion that often allows extending several first components. The first main component of F1 defines such a direction in the space of the outgoing attributes, according to which the set of objects has the largest variance.

The second main component F2 is constructed so, that its direction is orthogonal to the direction F1 and it explains the residual dispersion as much as possible, and so on, to the K`s main component of Fk. Since the selection of the main components occurs in a descending order in terms of the dispersion, so the features included in the first major component with large coefficients have the maximum effect on the differentiation of the objects under study. Since it has been absent the consistent presumptive indicator which characterizes the population`s standard of living, several statistical indicators reflecting different sides of this category are calculated for its analysis. As a result of the study the content of the life quality, were proposed a system of criteria and indicators, which were grouped into blocks.

The block of indicators that are related to environmental protection is one of the factors of people`s comfortable life. The health and well-being of the population depend at first on the state of the environment in which it lives. For Ukraine, as well as for many other countries, major problems are that ones, which are related to environmental pollution. Therefore, while characterizing the quality of population`s life authors could not ignore such aspects of environmental state`s analysis, which is associated with indicators of health, and indicators of comfort of life, and with other aspects of human development. It is known that absolute indicators characterize the phenomena less qualitatively than relative ones. Because I-IV hazard grade waste products are usually generated by industrial enterprises, it was decided to calculate the above figures for 1 million UAH of industrial output sold in order to obtain the final coefficients of environmental protection in the regions. This unit includes the following indicators:

X_{11} - expenses for protection of the environment for 1 million UAH of industrial products sold;

X_{12} - the volume of waste of I-IV classes of danger for 1 million UAH of sold industrial products.

The social situation is largely determined by the possibility of the population in meeting the requirements including health. Health indicators can also characterize the social situation, which is a complex and multicomponent concept. I propose the following indicators of this block:

X_{21} - number of hospitals;

X_{22} - the number of hospital beds per 10 000 of population;

X_{23} - the number of doctors of all specialties per 10 000 of population;

X_{24} - number of medical staffs per 10 000 of population;

X_{25} - the number of newly registered cases of diseases per 100 000 of population.

The block of indicators of education reflects the indicators that demonstrate the sustainable development of human potential. It is education of a corresponding level that prepares a person for the realization of professional and social ambitions, provides freedom of choice the alternatives and confrontation with the challenges of life. The indicators t was proposed to be included to this block cover all levels of education, except for preschool, namely:

X_{31} - the number of students of colleges, technical schools, schools per 10,000 people;

X_{32} - number of students of universities, academies, institutes per 10,000 of population;

X_{33} - the number of students of general education institutions per 10,000 of population;

X_{34} - the number of students of vocational education institutions per 10,000 of population.

The unit of indicators of well-being reflects the material basis of society's development. The significance of the indicators of this unit follows from the fact that welfare

is a factor in the life expectancy, level of education, the realization of labor activity and various human ambitions. Gross regional product is one of the most important indicators of the region's economic development, it is also an economic basis for raising the level of incomes and accordingly for improving its level of well-being. Population`s income reflects the material basis of welfare and human development. Expenses - indicate the volume of needs satisfaction (material and spiritual). The following indicators are displayed in this block:

X_{41} - money income (average per month per household, UAH);

X_{42} - non-monetary income (average per month per household, UAH);

X_{43} - consumer cash expenditures (on average per month per household, UAH);

X_{44} - non-consumer money expenses (average per month per household, UAH);

X_{45} – GRP per capita (UAH).

Innovation is the commissioning of any new or significantly improved product or process, a new marketing method or a new organizational method in the enterprise, organization of workplaces or external relations. Indicators of the number of postgraduate students and doctoral students reflect the intellectual potential of scientific and innovative development. The volume of innovative products that were sold shows the result of innovation activity. Indicators of expenses for research and innovation activities reflect the material basis for the development of innovation. The section of innovative development indicators includes:

X_{51} - the number of post-graduate students per 10,000 of population;

X_{52} - the number of doctoral students per 10,000 of population;

X_{53} - internal running costs for research and development on 10,000 people;

X_{54} - total expenditures on innovative activities per 10,000 of population;

X_{55} - the volume of innovative products that were realized per 10,000 of population.

The population is the main driving force of social development. In this case, the birth rate accumulates the influence of a wide range of factors: socio-psychological, economic, socio-cultural, and others. Indicators of mortality and life expectancy accumulate the influence of the state of medical and social well-being, working conditions, ecological situation, etc. To the block of indicators on population reproduction, it was proposed to include the following indicators:

X_{61} - average life expectancy aborning (indicator of health status, living conditions and work of the population);

X_{62} - the total fertility rate (indicator of the level of childbearing activity and the process of replacement of generations);

X_{63} - total mortality rate;

X_{64} - the total coefficient of population growth.

Employment, as the main form of realization of economic activity of the population and a means to ensure its welfare, is one of the main characteristics of human development in the region. The level of employment characterizes the degree of use of working population in the field of socially useful labor and serves as an indicator of incentives for human development in the workplace. The unemployment rate of the population (according to the ILO methodology) is calculated as the ratio of the number of unemployed people aged 15-70 to the economically active population of the specified age. It characterizes the possibilities of satisfying the supply of labor, points to the level of implementation of labor potential and the degree of the inclusion problem in employment relations. This indicator can be an indicator of negative processes in the labor market and in the socio-economic field. The block of labor indicators contains two indicators:

X_{71} - employment level, %;

X_{72} - unemployment rate, %.

The block of indicators of crime can speak for the social tensions in society, which often appears because of decrease of people`s economic well-being. This block is represented by indicators:

X_{81} - number of detected crimes;

X_{82} -number of convicted on proofs that came into force.

It should be admitted that the data indicators of the blocks are interrelated.

In order to calculate the quality criteria for each group, here were considered the statistical indicators provided by the State Statistics Service in 2017, all indicators were processed in the application package of Statistics Enterprise 10.0 (Yankovoi, 2002).The purpose of the analysis was to identify clusters of Ukraine regions, as

the most significant features based on a complete sample, which includes all 24 regions of Ukraine and the capital (Kyivcity).

It was identified the main components on the ground of the component analysis of selected 29 indicators` system that characterize the quality of population`s life. Received numbers (Eigenvalue) served for criterion for selecting the size of main components. Those components that had an actual number of more than 1 were selected for further analysis. There were seven of such components. Together they provide almost 85% variations of all 29 variables. Their factor coordinates based on correlations are shown in Table 1.

The most significant factors that have an impact on the components were identified for each integrant. They are highlighted in the table as a bold. It can also be admitted that the last component despite having its own number more than one, does not contain a very significant coefficient of influence for all factors. The maximum coefficient for the seventh factor is 0.34 <0.5. Therefore, the last integrant is not essential for regional differentiation. The analysis of the obtained integrants and their main components made it possible to conclude that not all the proposed factors are included in the structure of at least one integrant. This made it possible to remove some of the factors for further research. These were the

Table 1: Weights of the main components of 29 quality of population`s life factors

Factor	F1	F2	F3	F4	F5	F6	F7
X_{11}	-0.15	-0.32	0.47	0.13	0.30	-0.27	0.00
X_{12}	0.08	-0.30	-0.10	-0.23	-0.29	**0.72**	0.10
X_{21}	-0.73	-0.26	0.08	0.05	-0.35	-0.05	0.38
X_{22}	-0.66	-0.33	-0.47	0.10	-0.14	0.10	-0.09
X_{23}	-0.82	0.29	-0.23	0.21	-0.08	-0.10	0.17
X_{24}	-0.18	0.43	**-0.66**	0.12	-0.24	0.02	-0.33
X_{25}	0.39	0.55	0.15	0.06	-0.35	0.03	0.32
X_{31}	-0.25	0.33	-0.16	**-0.68**	-0.14	0.05	-0.11
X_{32}	**-0.96**	0.09	-0.10	-0.08	-0.01	-0.07	-0.12
X_{33}	-0.08	0,50	0.31	**-0.73**	0.10	-0.01	-0.04
X_{34}	0.17	0.29	-0.14	**-0.77**	-0.02	0.11	0.03
X_{41}	-0.60	**0.59**	0.17	0.07	0.11	0.08	0.25
X_{42}	0.43	**0.61**	-0.47	-0.05	-0.07	-0.22	-0.04
X_{43}	-0.45	**0.69**	-0.12	-0.01	0.11	0.00	0.33
X_{44}	0.25	0.08	**-0.67**	-0.06	0.35	-0.09	0.30
X_{45}	**-0.88**	-0.15	0.00	-0.08	-0.02	0.02	-0.23
X_{51}	**-0.96**	0.08	-0.07	0.02	0.00	-0.03	-0.18
X_{52}	**-0.96**	0.04	-0.12	0.04	0.06	-0.04	-0.19
X_{53}	**-0.94**	-0.18	-0.02	-0.02	0.04	0.06	-0.06
X_{54}	-0.54	-0.45	-0.26	-0.20	0.37	0.36	0.07
X_{55}	-0.19	-0.43	-0.20	-0.05	**0.66**	0.16	0.24
X_{61}	-0.46	**0.59**	-0.47	0.19	-0.04	-0.19	0.19
X_{62}	-0.29	**0.68**	0.52	0.15	0.11	0.22	-0.21
X_{63}	0.48	**-0.76**	-0.26	-0.17	-0.09	-0.16	-0.09
X_{64}	-0.41	**0.76**	0.39	0.16	0.10	0.19	-0.04
X_{71}	-0.44	**-0.67**	0.12	-0.23	-0.09	-0.40	-0.01
X_{72}	0.56	0.00	-0.24	**0.55**	0.06	0.42	-0.20
X_{81}	**-0.87**	-0.36	0.13	0.03	-0.07	0.09	-0.02
X_{82}	-0.37	**-0.61**	0.16	0.06	-0.37	0.13	0.34

Source: Calculated by the authors

three indicators of health care - the number of hospitals (X21), the number of hospital beds per 10,000 population (X22), the number of doctors of all specialties per 10 000 population (X23) and the indicator of innovations - the total expenditures for innovation activities (X54). In fact, another indicator is also in this category, which is not very significant - the cost of environmental protection for 1 million UAH sold industrial products, but it was decided to leave a minimum of 2 indicators in each category for consideration of each category from different sides.

Thus, the system of indicators left 25 factors for which the factor analysis was repeatedly carried out using the principal component method, which allowed the identification of 6 main components, which given in Table 2.

The first component is mainly characterized by indicators of innovation activity: the number of postgraduate students per 10,000 of population, the number of doctoral students per 10,000 of population, the internal running costs for research and development, and the educational indicator - the number of university students: universities, academies, institutions per 10,000 of population and the indicator of well-being – GRP per capita. Therefore, this first and most important component can be considered as innovative and educational. That emphasizes again the importance of innovations in improving the quality of population`s life.

As appears from the obtained data about weighted coefficients, the second main component characterizes the integral demographic indicators - the average life expectancy at birth and the overall fertility, mortality and natural growth rates; welfare indicators - non-cash income and consumer cash expenditures, as well as the level of employment and the number of sentenced convicts of the

Table 2: Weights of the main components of 25 factors of quality of life of the population

Factor	F1	F2	F3	F4	F5	F6
X_{11}	0.13	-0.38	0.46	-0.02	**0.44**	-0.15
X_{12}	-0.16	-0.23	-0.06	0.22	**-0.66**	0.38
X_{24}	0.18	0.45	**-0.58**	-0.27	-0.26	-0.30
X_{25}	-0.30	0.59	0.23	0.04	-0.20	-0.13
X_{31}	0.30	0.30	-0.35	**0.61**	-0.17	0.06
X_{32}	**0.96**	-0.06	-0.22	0.00	-0.02	-0.06
X_{33}	0.21	0.47	0.14	**0.76**	0.14	0.05
X_{34}	-0.12	0.36	-0.27	**0.70**	-0.05	0.07
X_{41}	0.69	0.49	0.18	-0.06	0.09	0.22
X_{42}	-0.38	**0.70**	-0.40	-0.04	0.11	-0.25
X_{43}	0.54	**0.63**	-0.10	-0.06	0.15	0.22
X_{44}	-0.29	0.17	**-0.62**	-0.12	0.32	0.35
X_{45}	**0.85**	-0.29	-0.12	0.03	-0.10	-0.08
X_{51}	**0.96**	-0.07	-0.16	-0.09	-0.05	-0.08
X_{52}	**0.95**	-0.10	-0.20	-0.13	-0.01	-0.04
X_{53}	**0.89**	-0.32	-0.11	-0.04	-0.07	0.05
X_{55}	0.10	-0.42	-0.21	-0.07	0.37	**0.61**
X_{61}	0.48	**0.54**	-0.43	-0.31	0.10	-0.09
X_{62}	0.45	**0.58**	**0.57**	-0.05	-0.07	0.05
X_{63}	-0.60	**-0.67**	-0.31	0.13	0.02	-0.12
X_{64}	0.55	**0.66**	0.44	-0.10	-0.04	0.09
X_{71}	0.36	**-0.75**	-0.09	0.25	0.18	-0.27
X_{72}	-0.57	0.10	-0.01	**-0.59**	-0.30	0.22
X_{81}	0.83	-0.49	0.03	-0.04	-0.15	0.06
X_{82}	0.25	**-0.66**	0.09	0.00	-0.32	0.06

Source: Calculated by the authors

legally enforceable courts. Thus, the second component corresponds to socio-demographic indicators.

The third component is characterized by the allocation a greater number of less significant factors. Nevertheless, the categories of positive and negative significant indicators are substantially determined. Negative indicators are the number of average medical personnel per 10 000 of population and non-expendable costs, and positive - the total fertility and natural growth rates, as well as the environmental expenses. This indicator is called the indicator of demographic health.

The fourth component corresponds to the indicators of education and labor and includes the sign plus the factors for higher education: the number of students in colleges, technical schools, schools per 10,000 of population, the number of students in general education institutions per 10,000 of population and the number of students of vocational training schools per 10,000 of population, which are set to a negative indicator - the unemployment rate. The subcomponents of this component are responsible for the level of intellectual capital growth. Therefore, let's call it intellectual.

The fifth component combines the main factors of environmental protection, with the costs for environmental protection for 1 million UAH of sold industrial products is included in the component with a minus sign, and the volume of I-IV classes hazard waste for 1 million UAH of realized industrial products - with a plus sign. Let's consider this component as ecological.

The sixth component, that is the last, emphasizes once again the importance of innovations in improving the quality of population`s life and contains the volume of realized innovative products per 10,000 of population as the main influencing factor. Therefore, let's call this component an innovative one.

Thus, the number of indicators was reduced from 29 factors to 6 main components, which characterize the quality of the Ukrainian population`s life. Region`s factor coordinates are based on correlations that are given in table 3.

The obtained indicators are characterized by apparent heterogeneity in the regions of Ukraine and show it clearly that the regions are significantly notable for quality of life and for terms of innovative activity. It was carried out regional differentiation and break down the regions of the world into groups in order to determine their characteristics and to identify more homogeneous groups of regions in terms of living standards for the further study and modeling of factors influencing the country's economic development. For realizing this purpose, it was used methods of cluster analysis. To determine the optimal number of homogeneous groups for the selected set of factors it was used the cluster method joining with the Euclidean metric by the Ward's method and it was built a tree clustering, that is given in Fig. 1. The received dendrogram confirms the presence of regional groups in terms of quality of life and clearly distinguishes five optimal homogeneous groups.

As a result of the cluster analysis using the k-medium algorithm, the regions of the country were divided into five homogeneous clusters with the characteristics that are presented in Fig. 2

Representatives of clusters among the regions were distributed as the following:

Cluster 1 represents individually the capital of Ukraine - Kyiv city.

Cluster 2 combines the following regions: Vinnytsya, Donetsk, Zhitomir, Kirovograd, Lugansk, Poltava, Khmelnitsky, Cherkassy, and Chernihiv.

Cluster 3 includes Volyn, Transcarpathian, and Rivne regions.

Cluster 4 is Ivano-Frankivsk, Lviv, Ternopil, Chernivtsi regions.

Cluster 5 is formed with Dnipropetrovsk, Zaporizhya, Kyiv, Mykolaiv, Odessa, Kharkiv, Kherson regions.

Results: The Cluster 1, represented by the city of Kyiv, distinguishes itself significantly after the main innovation and educational indicator. It is of extremely importance in comparison with the other areas. As Table 3 shows, F1 (Kyiv) = 11.84, while in other regions this indicator varies from 1.83 in the Donetsk region to 2.49 in Kharkiv. Indeed, in 2017, in Kyiv were 31.78 postgraduate students per 10,000 of people (the closest to it is the Kharkiv region with 11.81, and all other regions from 0.6 in Donetsk region to 8.12 in Lviv region). The situation is similar with the doctoral students: Kyiv has 2.23 per 10,000 of population, Kharkiv - 0.79, all the others from 0.05 - Donetsk to 0.53 - Lviv). The internal running costs for the implementation of researches and development are also significantly different in Kyiv (Internal current expenditure for R & D).Thus, it was amounted to 18395.35 thousand UAH in Kyiv in 2017, Kharkiv region cashed up 8093.04 thousand UAH, Dnipropetrovsk – 6902.17 thousand

Table 3: Factor coordinates of regions based on correlations

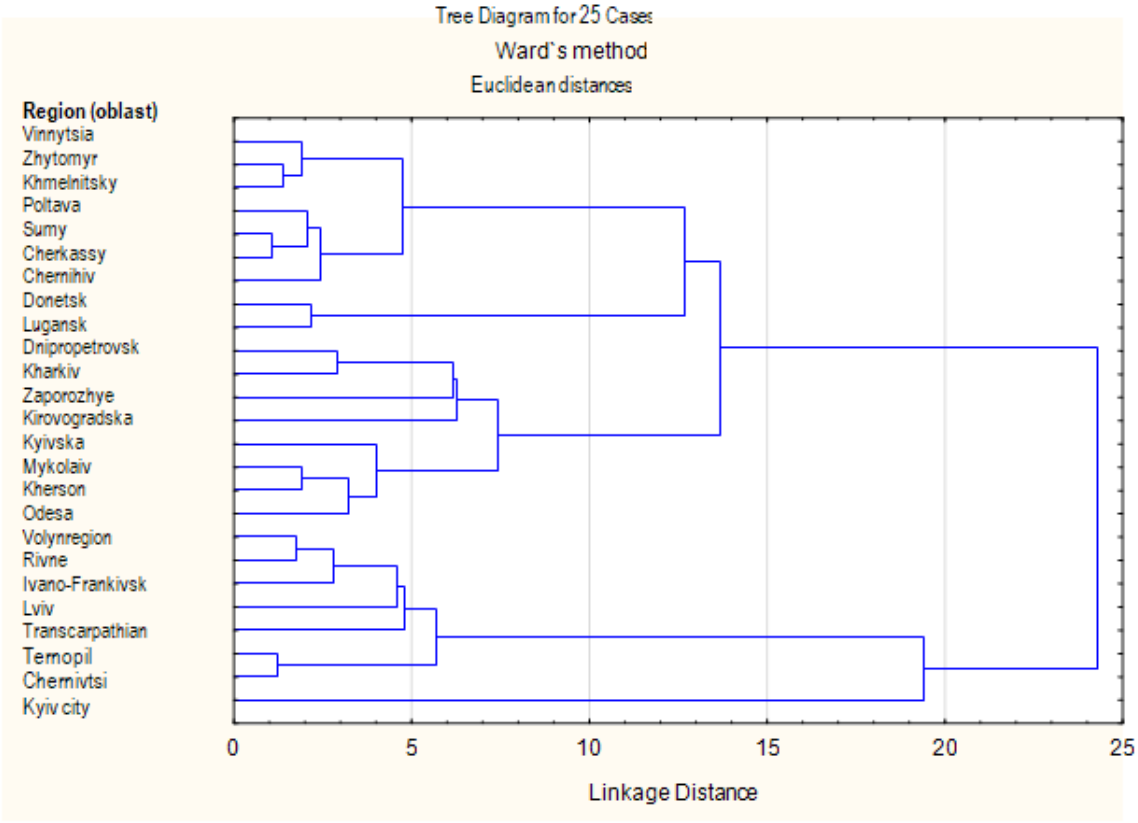
Region	F1	F2	F3	F4	F5	F6
Vinnytsia	-0.88	0.99	-1,19	0.47	-0.14	-0.16
Volyn region	-0.68	3.27	0.47	0.48	-0.45	0.10
Dnipropetrovsk	0.90	-3.24	0.61	1.47	-1,80	0.32
Donetsk	-1.83	-1.63	1.31	-3.82	-1.18	0.66
Zhytomyr	-1.70	0.05	-0.55	1.07	-0.82	-0.93
Transcarpathian	0.42	3.10	3.16	-0.67	1.05	1.58
Zaporozhye	0.35	-3.03	-1,60	-0.16	2.09	3.17
Ivano-Frankivsk	0.22	4.04	-0.07	-0.45	0.51	-0.63
Kyivska	-0.12	-2.92	2.88	0.99	2.19	-1.21
Kirovogradska	-2.23	-1.45	-0.46	1.30	-3.07	1.91
Lugansk	-2.91	-1.18	1.03	-4.56	-0.19	-0.66
Lviv	2.26	1.48	-0.31	0.76	0.11	-0.14
Mykolaiv	-0.64	-1.55	1.22	1.35	1.36	0.47
Odesa	1.68	-0.87	2.27	1.13	0.22	-0.08
Poltava	-0.80	-1.30	-1.00	-0.05	-0.80	-0.51
Rivne	-0.67	3.47	1.88	0.83	-1,19	-0.50
Sumy	-1.31	-0.76	-2.16	0.07	0.65	-1.25
Ternopil	-0.30	3.42	-2.17	-0.33	0.32	0.77
Kharkiv	2.49	-3.17	-0.51	0.77	-0.01	-0.74
Kherson	-0.86	-0.71	1.00	1.10	-0.25	0.09
Khmelnitsky	-1.30	0.61	-0.05	0.30	-0.16	-1.32
Cherkassy	-1.25	-0.69	-1.24	-0.05	0.45	-0.77
Chernivtsi	-0.38	3.79	-1.33	0.32	0.77	0.79
Chernihiv	-2.29	-1.58	-2.43	-0.64	1.03	-0.65
Kyiv city	11.84	-0.13	-0.77	-1.67	-0.69	-0.30

Source: Calculated by the authors

UAH, Zaporizhzhya– 4947.14 thousand UAH, Mykolaiv – 2867.07 thousand UAH, and all other regions from 31.43 thousand UAH (Donetsk) to 1615.06 thousand UAH in Kyiv region. It is logical that the educational component which corresponds to the number of students in institutions of higher education, universities, academies and institutes per 10,000 of population has been added to the innovation component. In the year 2017 in Kyiv studied 1217.79 students per 10,000 of population. Kharkiv region has this indicator at the level of 574.87 and all other regions from 57.82 in Donetsk to 432.65 in Lviv region.

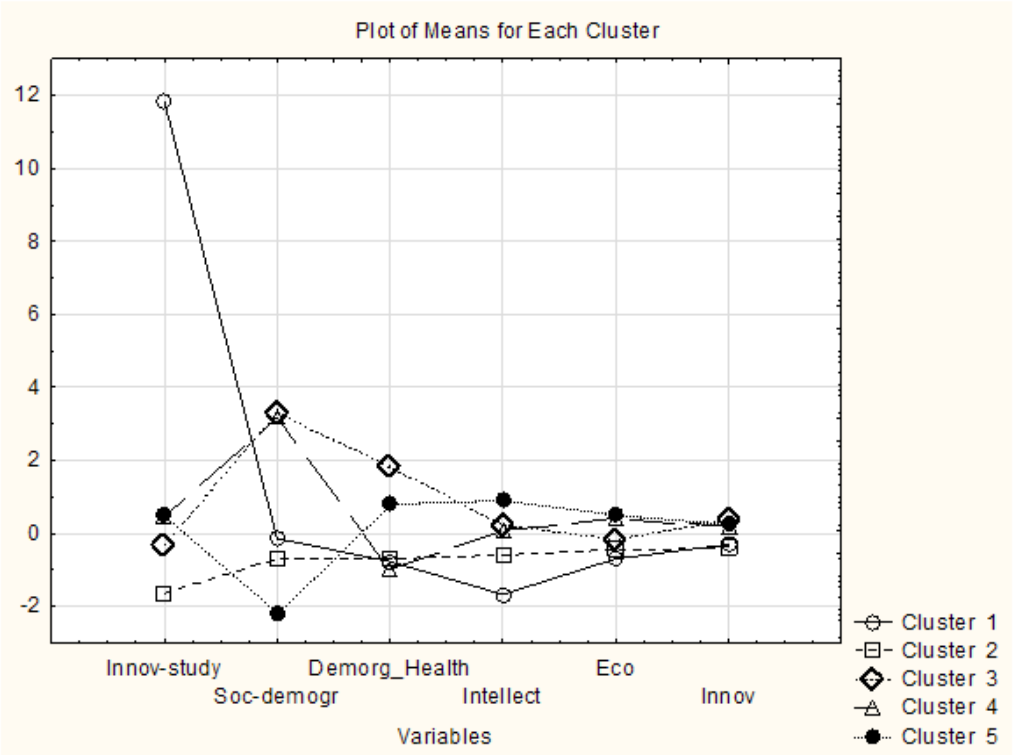
Thus, Kyiv distinguishes with an extremely powerful potential in innovation sphere and has a very large, almost inaccessible innovation and educational index. However, according to Fig. 2 all other indicators in the first cluster, unfortunately, do not have the same large range. It is very interesting that the last component F6, which also characterizes the innovative component of living standards for the first cluster, has the least value with the second cluster. This component mainly analyzes the impact of the realized innovative products volume per 10,000 of population. According to Table 3, F6 (Kyiv) = - 0.3. The negative value of the obtained indicator underlines the ineffectiveness of the current extremely powerful scientific and innovative potential implementation, which was identified in the main component F1, relative to the volume of realized innovative products per 10,000 of population. Indeed, in the year 2017 in Kyiv it was sold innovation products in the amount of 3530.64 thousand UAH per 10,000 of population. As a comparison, Kharkiv region had this indicator at the level of 4874.34 thousand UAH. The Donetsk region, which had the lowest rates for all the potential factors of the first cluster, had implemented innovation product in the amount of 5338.77 thousand

Figure 1: Dendrogram of regional differentiation in Ukraine upon the indicators of the population`s life quality (2017)



Source: Calculated by the authors

Figure 2: The living standards clusters of Ukrainian population



Source: Calculated by the authors

UAH per 10,000 of population. Zaporizhia region is the leader in branch with the value of 21947.21 thousand UAH per 10,000 of population.

The second cluster is characterized by low values for all selected components, and for some of them it even has the lowest values. This is particularly clearly seen in the indicators of innovation. The first major innovation and educational component for the second cluster is very low towards to the values for the other clusters. However, the effectiveness of the innovation potential for the second cluster is the highest unlike the first cluster, which is clearly confirmed in Fig.2, there is a growing curve from the first to the sixth component for the second cluster. The most characteristic for this cluster is Donetsk region, which was characterized by the innovative components earlier. Thus, the second cluster includes areas that have not very strong innovative and educational potential.

The third cluster included regions characterized by the highest indicators for the second and third main components. The second socio-demographic component on the background of a rather low level of crime and employment, emphasizes rather high demographic indicators and well-being indicators. The third main component of demographic health emphasizes once again the important high demographic indicators for this cluster against the background of the normal (middle level) ecology, but less significant values of welfare indicators (with a focus on non-consumer costs) and partially indicators of education and innovation. It includes three regions: Volyn, Transcarpathian and Rivne.

The fourth and fifth clusters are similar in many respects: high innovation indicators, (except of those in Kyiv city), the best ratio for the first and sixth innovative components in comparison with the ratio in Kyiv city, so with the best innovative performance in terms of the implemented innovation products` volume per 10,000 of population. The fifth and fourth main components are high environmental and intellectual indicators, but they significantly differ in terms of socio-demographic components and components of demographic health.

The fourth cluster is characterized by high indicators for the second, but low values for the third main integrants. The second socio-demographic component, as well as for the third cluster, highlights the rather high demographic indicators and indicators of well-being on the background of a rather low level of crime and employment. The third main component of demographic health emphasizes once again the importance of sufficiently high demographic indicators for this cluster but compares them to even higher welfare index and to the indicators of education and innovation. Thus, there is a good demographic situation for the regions of the fourth cluster, which includes Ivano-Frankivsk, Lviv, Ternopil, and Chernivtsi regions, on the background of even better financial climate of well-being, supported by high-quality educational and innovative environment.

The fifth cluster formed Dnipropetrovsk, Zaporizhzya, Kyiv, Mykolayiv, Odessa, Kharkiv and Kherson regions. Unlike the fourth cluster, these regions are characterized by a low range of the second main integrant and by the high value of the third main integrant. The second component is characterized by a poor demographic situation, but also by a favorable situation on the labor market. And there are relatively slight values of well-being indicators for the third integrant. However, regions of these clusters differ by the fourth intellectual component. According to Fig.2, the second cluster has the highest values for this indicator. Indeed, these regions have a low level of unemployment and enough children who have a high level of education: students of colleges, technical colleges, students of general educational institutions, students of vocational training schools for 10,000 of population.

Conclusions from this study and prospects for further development of this area: In this research the authors used statistical and mathematical methods part way through constructing a system of „quality of life" indicators. To assess the quality of life in the region, authors propose a method that is based on an objectivistic approach to indicators analysis - to combine the disparate indicators of the level and quality of life it was used the method of factor analysis. Quality of life is considered as a dynamic, integrated concept that reflects the subjective and objective satisfaction degree of the entire complex of human vital requirements (indicators of environmental protection, health, education, welfare, innovation, demographic indicators, labor and crime indicators). It is carried out the component analysis of indicators, including data about available resources, with considering the indicators of Ukrainian population`s quality of life. It is discovered the structure of the Ukrainian regions` clusters, which characterize the state of society as a whole and socio-economic relations that take place in it.

The studied summation of regions was divided into quite distinct groups - five major clusters. An analysis of

the main trends in the level and quality of life, which is based on the system-information approach, allowed us not only to give a general description of the quality of life, but also to identify the main trends in the studied area.

It is important to note that the result, which was obtained with the cluster analysis is one of the possible results. This result should be compared with similar results obtained with using other metric combinations, union-find algorithms, etc., as well as with the results of the other data analysis methods.

Author Contributions: idea, T. F.; conceptualization N. B.; methodology, T. F. and N. B.; writing, N. B., T. F., J. S. and K. S.; theoretical research, T. F.; the development of a system of statistical indicators at the regional level for assessing the quality of life of the population, T. F.; statistical data, T. F.; statistical analysis, T. F., J. S.; mathematical analysis, N. B., K. S.; visualization, N.B., T. F., R. S. and K. S.; review and editing, N.B., J. S. and K. S.; methodology, N.B. and T. F.; software, N. B. and K. S.

References

Ayvazyan, S.A. (2012). *Analysis of the Quality and Life Style of the Population.* Central Economics and Mathematical Institute of the Russian Academy of Sciences. Moscow: Nauka [in Russian].

Bell, D. (1999). *Gryadushhee postyndustryalnoe obshhestvo. Opitsocyalnogo prognozyrovany. [The emerging post - industrial society. The Experience of Social Forecasting. Moscow:* Academia. [In Russian]

Canadian Index of Wellbeing. https://uwaterloo.ca/canadian-index-wellbeing. Retrieved from: https://uwaterloo.ca/canadian-index-wellbeing/our-products/domains

Erikson, R. (1993). *Descriptions of Inequality: The Swedish Approach to Welfare Research.* In: M.Nussbaum, A.Sen (eds.), 1993.

Fahey, T., Nolan, B. & Whelan, C. (2003). *Monitoring quality of life in Europe, European Foundation for the Improvement of Living and Working Conditions,* Publications of the European Communities, Luxembourg.

Forrester, J. (1978). *Myrovaya dynamyka.[World dynamics]*. Moscow: Progress [In Russian].

Galbraith, J.K. (1998). *The Affluent Society.* Rev .ed. Boston: Houghton Mifflin.

Gukalova, I.V. (2007). Potencial faktoriv vplyvunaumovy zhyttya i stannaselennya v regionax Ukrayiny. [Potential factors of influence on the conditions of life and status of the population in the regions of Ukraine].Chasopys socialno-ekonomichnoy I geografiyi – *Journal of Social and Economic Geography.* Kharkov, 3, 176-184 [In Ukrainian].

Herasymchuk, Z.V. (2002). *Organizacijno-ekonomichnyj mexanizm formuvannyata realizaciyi strategiy i rozvytku regionu: Monografiya [Organizational and Economic Mechanism for the Formation and Implementation of the Regional Development Strategy: Monograph].* Lutsk: LDUU. [In Ukrainian].

Karmazina, O.O. (2018). Dovkillya Ukrayiny za 2017 rik. Statystychnyj zbirnyk [Environment in Ukraine for the 2017 year. Statistical Compilation]. Kyiv: Derzhavna sluzhba statystyky Ukrayiny. Retrieved from: http://www.ukrstat.gov.ua/druk/publicat/kat_u/2018/zb/11/zb_du2017.pdf) [In Ukrainian].

Karmazina, O.O. (2018). *Zaklady okhorony zdorovya tazakhvoryuvanistna selennya Ukrayiny` u 2017 roci. Statystychny zbirnyk. [Agencies of health care and population diseases in Ukraine in 2017 year. Statistical Collection].*Kyiv: Derzhavna sluzhba statystyky Ukrayiny. Retrieved from: http://www.ukrstat.gov.ua/druk/publicat/kat_u/2018/zb/06/zb_zoz_17.pdf) [In Ukrainian].

Karmazina, O.O. (2018). *Vyshhaosvita v Ukrayini u 2017 roci. Statystychny zbirnyk.[Higher education in Ukraine in 2017 year. Statistical Collection].* Kyiv: Derzhavna sluzhba statystyky Ukrayiny [In Ukrainian].

Karmazina, O.O. (2018). *Zagalnoosvitnita profesijno-tekhnichninavchalni zaklady Ukrayiny. Statystychnyj zbirnyk. [Secondary and vocational training establishments of Ukraine. Statistical Collection].* Kyiv: Derzhavna sluzhba statystyky Ukrayiny [In Ukrainian].

Karmazina O.O. (2018). *Naukovata innovacijna diyalnist Ukrayiny. Statystychnyj zbirnyk [Scientifi can dinnovative activity of Ukraine].* Kyiv: Derzhavna sluzhba statystyky Ukrayiny. Retrieved from: http://www.ukrstat.gov.ua/druk/publicat/kat_u/2018/zb/09/zb_nauka_2017.pdf [In Ukrainian].

Kelley-Gillespie, N. (2009). An Integrated Conceptual model of Quality of Life for Older Adults Based on a Synthesis of the

Literature. *Applied Research Quality Life.* Vol. 3, 259–282.

Libanova, E.M., Gladun O.M. &Lisogor L.S. (2013).Measuring the quality of life in Ukraine, Analytical report. Kyiv.

Local quality of life indicators – supporting local communities to become sustainable. A guide to local monitoring to complement the indicators in the UK.

Government Sustainable Development Strategy. http://www.auditcommission.gov.uk/Retrieved from: http://www.auditcommission.gov.uk/

Mandybura, V.O. (1999). *Rivenzhyt tyanaselen nyata mexanizmyj ogoregulyuvannya.[The level of life of the population and the mechanisms of its regulation]*. Extended abstract of Doctor's thesis. Kyiv: NAS of Ukraine. [in Ukrainian]

Melnychenko, O.A. (2008). *Pidvyshhennya rivny atayakosti zhytty anaselennya: mexanizm derzhavnogo regulyuvannya: monografiya [Improving the Level and Quality of Life of the Population: the Mechanism of State Regulation: a monograph].* Kharkiv: KRI NAPA „Magister". [In Ukrainian]

Osypova, I.I. (2018). *Vytraty i resursy domogospodarstv Ukrayiny u 2017 roci. Statystychnyj zbirnyk. [The Costs and Resources of Households of Ukraine in 2017 year. Statistical Compilation]*. Kyiv: Derzhavna sluzhba statystyky Ukrayiny. Retrieved from: http://www.ukrstat.gov.ua/druk/publicat/kat_u/2018/zb/07/zb_vrdu2017_pdf.pdf [In Ukrainian].

Petkova, L.O. (2006). *Teoretyko-metodologichni zasady ekonomichnogo zrostannya v Ukrayini: regionalni aspekty [Theoretical and Methodological Principles of Economic Growth in Ukraine: Regional Aspects].* Extended abstract of Doctor's thesis. Kyiv [In Ukrainian]

Prystupa, Ye, Keurysh, N. (2010). *Yakist `zhytty alyudyny: kategoriyi, komponenty tayihvy miryuvannya [Quality of Life of Humans, Category, Ingredients and their Measurement].* Fizychna aktyvnist, zdorov'ya i sport # 2 –Physical activity, health and sport No. 2) (pp. 54-63) [In Ukrainian].

Senyk, I.V. (2018). *Ekonomichna aktyvnist naselennya Ukrayiny 2017.Statystychnyj zbirnyk [Economic Activity of the Population of Ukraine for 2017 year]*. Kyiv: Derzhavna sluzhba statystyky Ukrayiny. Retrieved from:http://www.ukrstat.gov.ua/druk/publicat/kat_u/2018/zb/07/zb_EAN_2017.pdf[In Ukrainian].

Timonina, M.B. (2018). *Naselennya Ukrayinyza 2017 rik. Demografichnyj shhorichnyk [Population of Ukraine in 2017 year].* Kyiv: Derzhavna sluzhba statystyky Ukrayiny. Retrieved from: http://www.ukrstat.gov.ua/druk/publicat/kat_u/2018/zb/11/zb_dy_2017.pdf [In Ukrainian].

Vernera, I.Ye. (2018). *Statystychnyj shhorichnyk Ukrayiny za 2017 rik. [Statistical Yearbook of Ukraine for 2017 year].* Kyiv: Derzhavna sluzhba statystyky Ukrayiny. Retrieved from: http://www.ukrstat.gov.ua/druk/publicat/kat_u/2018/zb/11/zb_seu2017_u.pdf [In Ukrainian].

Vernera, I.Ye. (2018). *Statystychnyj zbirnyk «Regiony`Ukrayiny». Chastyna I [Statistical collection "Regions of Ukraine". Part 1].* Kyiv: Derzhavna sluzhba statystyky Ukrayiny. Retrieved from: http://www.ukrstat.gov.ua/druk/publicat/kat_u/2018/zb/11/zb_ru1ch2018.pdf [In Ukrainian].

Vernera, I. Ye. (2018). *Statystychnyj zbirnyk «Regiony Ukrayiny». Chastyna II [Statistical collection "Regions of Ukraine". Part 2].* Kyiv: Derzhavna sluzhba statystyky Ukrayiny. Retrieved from: http://www.ukrstat.gov.ua/druk/publicat/kat_u/2018/zb/11/zb_ru2ch2018.pdf [In Ukrainian].

Vlasyuk, A.S., Yacenko L.D (2005). Regyonal noeneraven stvourovnya zhyzny [Regional Inequality in the Level of Life]. Teorya I praktyka upravlenyya – *Theory and Practice of Management,* 5, 7-13 [In Russian].

Yankovoi, A.G. (2002). *Multivariate analysis in STATISTICA.* Odessa: Optimum, Issue 2.

Zherebyn, V.M. (2012). *Indykatoryka chestva zhyznina selenya. [Indicators of quality of life of the population].*Voprosy statistiki # 3 – Questions of statistics #3 [In Russian].