ISSN 2518-1467 (Online),
ISSN 1991-3494 (Print)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫНЫҢ

Х А Б А Р Ш Ы С Ы

ВЕСТНИК

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН

THE BULLETIN

THE NATIONAL ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN

PUBLISHED SINCE 1944

1

JANUARY – FEBRUARY 2019

ALMATY, NAS RK

NAS RK is pleased to announce that Bulletin of NAS RK scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of Bulletin of NAS RK in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential multidiscipline content to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы "ҚР ҰҒА Хабаршысы" ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Web of Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабаршысының Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді мультидисциплинарлы контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Вестник НАН РК» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Вестника НАН РК в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному мультидисциплинарному контенту для нашего сообщества.

«Қазақстан Республикасы Ұлттық ғылым академиясының Хабаршысы».
ISSN 2518-1467 (Online),
ISSN 1991-3494 (Print)
Меншіктенуші: «Қазақстан Республикасының Ұлттық ғылым академиясы»РҚБ (Алматы қ.)
Қазақстан республикасының Мәдениет пен ақпарат министрлігінің Ақпарат және мұрағат комитетінде 01.06.2006 ж. берілген **№5551-Ж** мерзімдік басылым тіркеуіне қойылу туралы куәлік

Мерзімділігі: жылына 6 рет.
Тиражы: 2000 дана.

Редакцияның мекенжайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., 220, тел.: 272-13-19, 272-13-18,
http://www.bulletin-science.kz/index.php/en/

Типографияның мекенжайы: «Аруна» ЖК, Алматы қ., Муратбаева көш., 75.

«Вестник Национальной академии наук Республики Казахстан».
ISSN 2518-1467 (Online),
ISSN 1991-3494 (Print)
Собственник: РОО «Национальная академия наук Республики Казахстан» (г. Алматы)
Свидетельство о постановке на учет периодического печатного издания в Комитете информации и архивов Министерства культуры и информации Республики Казахстан **№5551-Ж**, выданное 01.06.2006 г.

Периодичность: 6 раз в год
Тираж: 2000 экземпляров

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, ком. 219, 220, тел. 272-13-19, 272-13-18.
www: nauka-nanrk.kz, bulletin-science.kz

Адрес типографии: ИП «Аруна», г. Алматы, ул. Муратбаева, 75

Bulletin of the National Academy of Sciences of the Republic of Kazakhstan.
ISSN 2518-1467 (Online),
ISSN 1991-3494 (Print)
Owner: RPA "National Academy of Sciences of the Republic of Kazakhstan" (Almaty)
The certificate of registration of a periodic printed publication in the Committee of Information and Archives of the Ministry of Culture and Information of the Republic of Kazakhstan N 5551-Ж, issued 01.06.2006

Periodicity: 6 times a year
Circulation: 2000 copies

Editorial address: 28, Shevchenko str., of. 219, 220, Almaty, 050010, tel. 272-13-19, 272-13-18,
http://nauka-nanrk.kz /, http://bulletin-science.kz

Address of printing house: ST "Aruna", 75, Muratbayev str, Almaty

BULLETIN OF NATIONAL ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
ISSN 1991-3494
Volume 1, Number 377 (2019), 162 – 174 **https://doi.org/10.32014/2019.2518-1467.19**

UDC 330.5

O. V. Pogharnitskaya[1, 2], E. G. Matyugina[2, 3], G. Y. Boyarko[1], A. A. Mitsel[1, 2], E.V. Vaganova[3]

[1]Tomsk Polytechnic University, Tomsk, Russia,
[2]Tomsk University control systems and radio electronics, Tomsk, Russia,
[3]Tomsk State University, Tomsk, Russia.
E-mail: pov@tpu.ru; emk512542@mail.ru; gub@tpu.ru; maa@usu.tusur.ru; hailun@mail.ru

IS WELFARE THE CORRELATION UNITY OR THE STRUGGLE OF ITS COMPONENTS? (Based on the data of the countries of the former soviet union)

Abstract. The article is to present such welfare components as human development index, *economic growth*, energy consumption, ecological condition. The object of the research is the dynamics of the welfare of countries from the former Soviet Union. For evaluation a set of such criteria as gross domestic product per capita, human development index and energy consumption per capita have been used. In addition such indicators as gross domestic product per unit of energy use; emissions of CO_2, methane and greenhouse gases per capita, and area of forests have also been investigated.

Factual data for the period 1997-2015 have been used. The research is related to the common stages of the transformation and parameters of the development of countries from the former Soviet Union over a certain period of time. Nevertheless, countries that have a common past have demonstrated a significant variation in the dependencies of the studied indicators. Based on the results of the correlation analysis, a group of countries showing a high dependence on all the welfare criteria on the factors considered (Russia, Armenia, Azerbaijan, Belarus) has been chosen.

A positive correlation of human development index has been found in codependency of human development index and gross domestic product per unit of energy use. A positive correlation of gross domestic product per capita indicator has been found in codependency of gross domestic product per capita and gross domestic product per unit of energy use; gross domestic product per capita and CH4 per capita (exception Ukraine). A study of dependencies allows us to equate economic growth and welfare. It is common for the countries from the former Soviet Union (correlation coefficient for most countries is 0.95) between economic growth rates and energy consumption, as well as energy consumption and CO^2 emissions (correlation coefficient 0.85–0.997).

All countries show an obvious dependence of economic growth on energy consumed. A slightly weaker correlation has been noticed in Kyrgyzstan and Kazakhstan. A negative correlation between energy consumption per person and gross domestic product per unit of energy use has been found in Uzbekistan. The reason is the growth of the population in spite of the decrease in energy consumption. A negative correlation between the gross domestic product per capita and the forest area is common for Kazakhstan, Kyrgyzstan and Tajikistan, which have a small forest fund.

The data obtained allowed us to classify countries according to the level of energy consumption and dependence on the sources of natural resources. Energy consumption as a welfare criterion has its own specific number of dependencies. It is this criterion that has the maximum number of dependencies with a strong negative correlation for countries from the former Soviet Union. That lays the groundwork for expanding the list of correlating factors in future research.

Key words: welfare, human development index, economic growth, energy consumption, CO_2 emissions.

Introduction. The growth of welfare as a key strategic priority acquires special significance in the conditions of limited resources. The maintenance of the required rates of economic growth with the predicted depletion of traditional energy resources, providing the functioning of the world economy as a whole and of an individual state in particular. The inclusion of various spheres of life in the formation of the level of welfare makes the study of approaches to its assessment through various criteria with the

elaboration of each related component, relevant. The complexity of a problem is connected with a broad differentiation of levels of social and economic development of the countries. Thus, about a quarter of the population of the planet live in the countries with an average consumption of food considerably exceeding physiological requirements, a low child mortality, a high life span and almost 100% literacy. The 4/5 of the commercial energy consumed annually accounts for the population of the most developed countries. The rest of the 3/4 are mostly illiterate or semiliterate, their life span is three decades shorter. The countries of the former Soviet Union occupy an absolutely unique niche. It is caused by reforming of the approaches to the economic management (refusal of the planned economy), transition to energy efficient economy in a very short time amidst the significant increase in welfare. It constitutes the choice of an object of the present research. A wide range of approaches to the assessment of welfare reflects his versatility. It allows to identify the most significant aspects of their correlation interdependence and interaction.

The considerable number of initiative projects confirms the importance of criterion of welfare. For example, The "Beyond GDP" Conference (2007), Stiglitz/Sen/Fitoussi (2009), etc. European Statistical System Committee (ESSC) has created a group responsible for the development of set of the indicators corresponding to contents of the message of "GDP and Beyond". Other international organizations make considerable efforts in the field, especially within an initiative project "Better Life: Measurement of Welfare and Progress". A number of researchers (L. Liu, T. Chen and Y.Yin, J.G. Lambert, C. A. Hall, S. Balogh, A. Gupta, M. Arnold, C. Pasten, J. C. Santamarina) [1-3] hold to the opinion regarding the existence of communication between the quality of life and energy consumption. Rahman, Huq claim the accurate correlation between consumption of energy and the general economic conditions [4]. Hoque sees energy production as an indicator of physical quality of life. Meanwhile Forrester uses the criteria of pollution, population density, consumption of food and resources [5]. Nicholas Apergis with his research team (2010) investigated the cause-and-effect relationship between CO_2, energy consumption, including the renewable energy, and economic growth for a number of the developed and developing countries [6, 7].

There is a wide range of approaches to assessment of the cause-and-effect relationship between the economic growth and energy consumption – from denial of any dependence to the mutually causing influence of these parameters, including the unidirectional influence of only one factor (for example, the increase of energy consumption causes economic growth, however the feedback effect is absent).

So, Kraft (1978) [8] has proved the influence of economic development on the energy consumption growth; Akarca, Long (1980) claimed about the lack of cause-and-effect relationship between GDP and consumption of primary energy resources [9]; The Stern (1993) adhered to the opposite point of view and subsequently (in 2000) he proved the existence of the economical and energy interaction [10].

Some researchers have identified the particular characteristics of different counties in this interaction. On the basis of the analysis of indicators of the countries of the Organization for Economic Co-operation and Development (30 countries) and the countries, not included in it (78 countries), Asafu-Adjaye (2000) [11], J. Chentanavat with coauthors (2008) have defined that the relation between energy consumption and GDP is very common only for highlydeveloped countries[12].

Russian scientists M.M. Alibegov and L.M. Grigoriev claim that electricity rates have to be considered as a significant indicator of the consumption level of primary energy resources [13]: the higher electricity rates in the country are, the lower the rate of primary energy resources consumption per GDP. The opponents of that point of view are V.A. Volkonsky and A.I. Kuzovkin, A.P. Parshev, G.P. Litvintseva [14-16].

Thus, comparison of results of assessment of welfare on the basis of various criteria with the detailed elaboration by means of allocation of the set of factors is of interest.

Research methods. There is a wide range of the indicators reflecting economic and social progress of society, supplementing, partially duplicating each other or even confrontational. As a result of definition of multicomponent indexes of progress in order to complete or replace gross domestic product (GDP) indicator, human development index (HDI), Index of steady economic welfare, Indicator of original progress as a criterion of welfare of society have been offered. The limitation of GDP indicator is his focus on the assessment of economic activity without taking into account other indicators of living standards, including subjective ones. For example, Germany has one of the highest GDP per capita and at the same time the widest gender gap in labor compensation (2011). It must be noted that GDP is connected

with welfare from a position of the provision of population with material wealth. This indicator is cross functional, well-timed and easy to use. Michael Spence claims that in order to reach necessary welfare, the countries should show such rates of economic growth which will provide both social integration, and ecological sustainability [17]. GDP indicator can be replaced by the characteristic of welfare through power consumption assessment per capita of the main segment of the population meeting vital needs. These expenses can significantly vary depending on countries and segments of the population of each state. The existence of a wide range of criteria of welfare causes probability of different results of its assessment, including the opposite ones [18].

Such criteria as HDI (as symbiosis of progress of economic and social fields), GDP per capita (economic growth) and energy consumption per capita (energy efficiency of economy) are of research interest. In this context the material of the countries of the former Soviet Union with emphasis on oppositely directed tendencies has been investigated.

Detailed elaboration of the resulting indicators (GDP per capita in US dollars, HDI and energy consumption per capita) has allowed to allocate a number of the factors correlating with them:

- GDP per energy use unit (in fixed prices 2005, parity of purchasing power in USD for a kilogram of oil equivalent);
- emissions of CO_2 per capita;
- emissions of methane per capita in metric tons of an equivalent of CO_2;
- emissions of greenhouse gases per capita (in metric tons of an equivalent of CO_2);
- area of the woods (% of the total area of lands).

A number of ecological factors is not mentioned directly in the HDI, but they are indirectly reflected in such criteria as «the expected lifetime». Taking into use such factor as «the area of woods» is connected with consideration of the woods as an instrument of compensation of technology-related pressure upon the environmental conditions, health and working ability of the population, their participation in a recreation. Panel International Energy Agency [19], the United Nations [20], Organisation for Economic Co-operation and Development [21], The Word Bank [22], United Nations Development Programme [23] have formed factual base of the study. The period of the studied indicators is 16 years (from 1997 to 2012). The significance of the received correlation has been checked by means of Student statistic [24].

$$t_{pac} = \frac{|r|}{\sqrt{1-r^2}}\sqrt{n-2},$$

where r – correlation coefficient; n – period of time, year (n = 16). If $t_{pac} \geq t_{kr}$ then the correlation is recognized as statistically significant.

At significance value 0,05 critical value is t_{kr} = 2,14 [25]. With rare exception the correlation between the studied indicators was significant.

Results. First of all, the dynamics of the chosen criteria of welfare must be characterized (figure 1, 2).

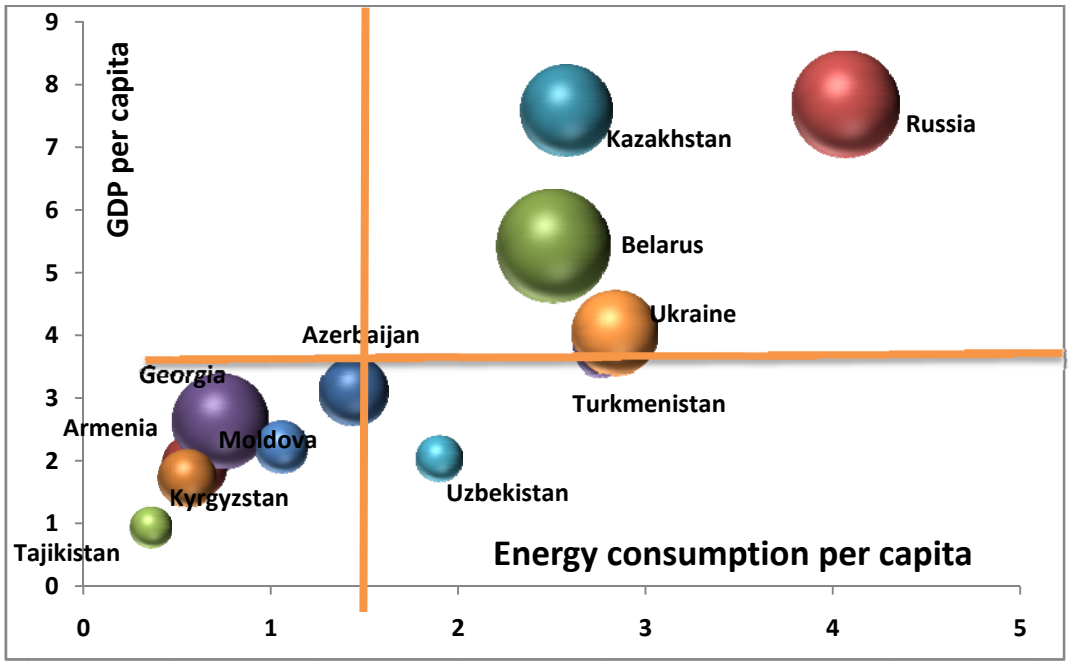


Figure 1 – Economic Growth, Energy Consumption and the HDI (1997):
** diameter of a tag reflects the level of HDI (the more diameter, the higher the rating of the country);*
** horizontal and vertical lines of the section – by average values of parameters.*

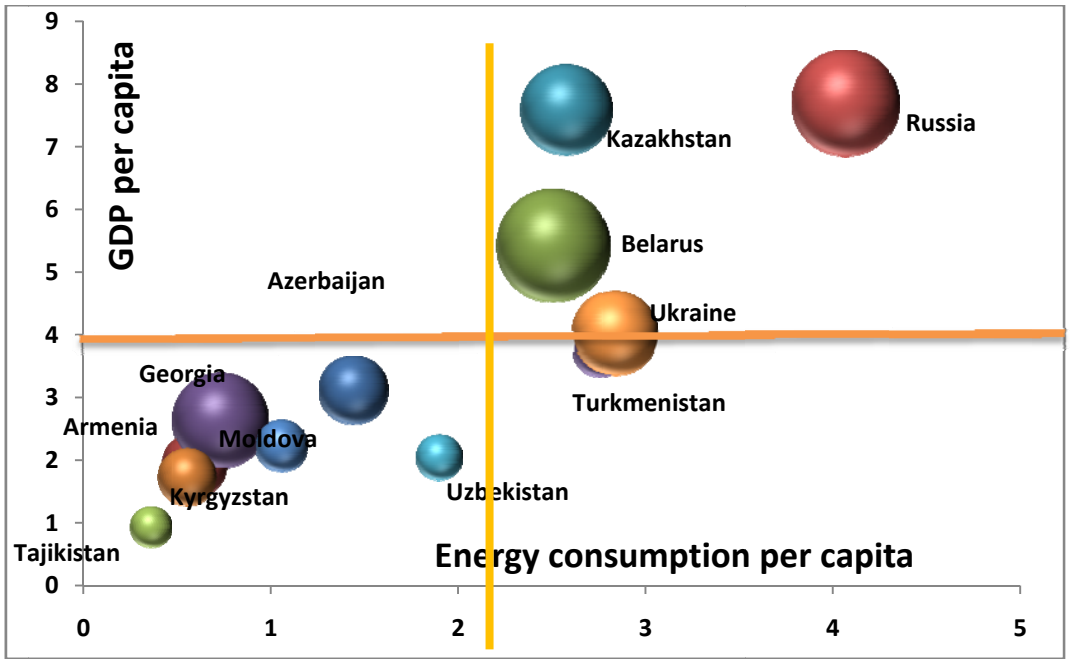


Figure 2 – Economic growth, energy consumption and HDI 2013:
** diameter of a tag reflects the level of HDI (the more diameter, the higher the rating of the country);*
** horizontal and vertical lines of the section – by average values of parameters.*

The investigated data show high dependence of economies of the countries on energy consumption. It has been found in their conditional division into two groups:

- the countries with low GDP and low energy consumption per capita;
- the countries with high GDP and high energy consumption per capita.

In 2013 the group of the countries on the quadrants has practically remained. Some countries have improved the situation (Russia, Azerbaijan, Kazakhstan, Turkmenistan, etc.), in Ukraine GDP has fallen. It must be noted that in 2013 the first group includes the countries with a low and average level of HDI (low level - Kyrgyzstan, Tajikistan), the second group includes the countries with high human development index (Russia, Belarus). The exception of the second group is Turkmenistan with a low human development index. That can be partly explainable by a low level of GDP per capita. However the country sticks to the status of the "vice-leader" in energy consumption per capita. Based on the statistical data of these 11 countries, the parameters have both positive and negative correlation:

For an indicator of HDI the positive correlation is revealed in the following dependences:

• HDI and GDP per unit of energy use;

• HDI and CH_4 per capita (an exception is Ukraine);

The closeness of correlation between HDI and GDP per unit of energy use is 0,73–0,998.

For an indicator of GDP the positive correlation is revealed in the following dependences:

• GDP per capita and GDP per unit of energy use;

• GDP per capita and CH_4 per capita (an exception is Ukraine).

For an indicator of energy use per capita the positive correlation is revealed in the following dependences:

• energy use per capita and CO_2 per capita;

• energy use per capita and greenhouse gas emissions per capita.

To the countries of the former Soviet Union are likely to have close positive connection (correlation coefficient for the majority of the countries is 0,95) between the rates of economic growth and energy consumption, as well as the energy use and emissions of CO_2 (coefficient of correlation 0,85–0,997).

The received results correspond to results of the empirical research conducted earlier for other countries. In fact, the economic growth has led to increase of consumption of energy, what in turn, has caused increase of emissions of CO_2. Partly it is caused by insufficiently high rates of implementation of energy efficient technologies, and insufficient investments. We will consider the criteria of welfare, energy consumption and economic growth, focusing on the negative correlation of the allocated parameters.

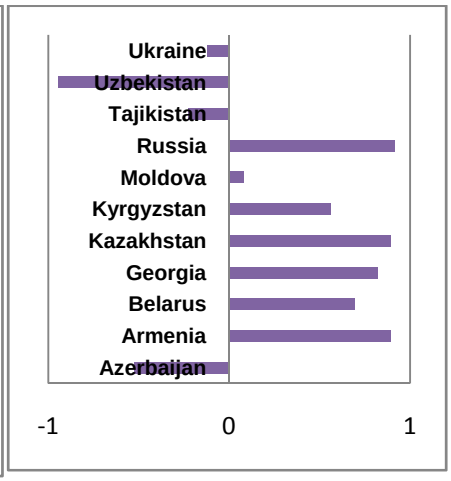
Correlation relationship of HDI (figure 3). All of the countries investigated have shown a rather close connection between HDI and GDP per energy use unit. That indicates that the welfare is based on energy consumption. The negative correlation observed concerns three countries – Uzbekistan, Ukraine and Azerbaijan regarding the parameter of the greenhouse gases per capita, in particular emissions of carbon dioxide and methane. This fact can be connected with the decrease of power consumption in the period of 1996-2014. Thus, Azerbaijan has reduced power consumption by 5 times, Uzbekistan by 3 times, Ukraine by 2,1 times. It is also connected with development of alternative and nuclear power engineering. Thus, in Uzbekistan it has increased by 82%, in Ukraine by 59%. Uzbekistan has raised positions by 6 points concerning the index of human development, Azerbaijan by 2 points correspondingly.

Correlation relationship of GDP per capita (figure 4). The unambiguous dependence of economic growth on the consumed energy is common for all countries, the weaker correlation has been observed in Kyrgyzstan and Kazakhstan. Uzbekistan shows the negative correlation between energy consumption per capita and GDP per unit of energy use (0,893). The reason for that is the growth of the population of the country at the time of decrease in energy consumption by 25%. GDP per unit of energy use (in fixed prices 2005, parity of purchasing power in USD for a kilogram of oil equivalent) has grown almost by 3 times.

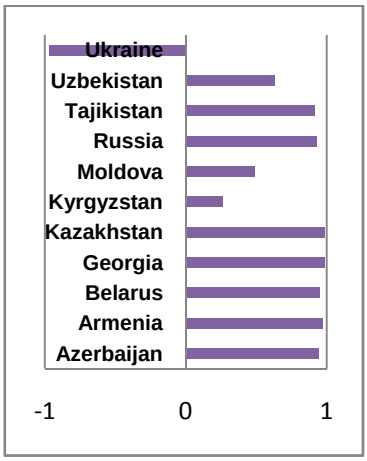
The negative correlation between GDP per capita and the area of the woods defines Kazakhstan, Kyrgyzstan and Tajikistan, which have insignificant forest area.

Correlation relationship of energy consumption per capita (figure 5). The whole picture concerning energy consumption and emissions of CO_2 and greenhouse gases (an exception: only Russia) is common for all countries. The negative correlation concerning energy consumption per capita and GDP per unit of energy use; energy consumption per capita and CH_4 per capita is observed in Uzbekistan. First of all it is connected with the growth of population by 27% (1997-2013) with increase in GDP. The emissions of methane have increased only by 5%. Negative correlation between energy consumption per capita and forest area in Kazakhstan, Kyrgyzstan and Tajikistan are connected with an insignificant share of forest area in the total area of all lands – 1,2%, 3,3% and 2,9% correspondingly (besides, in Kyrgyzstan the forest area has reduced by 24%).

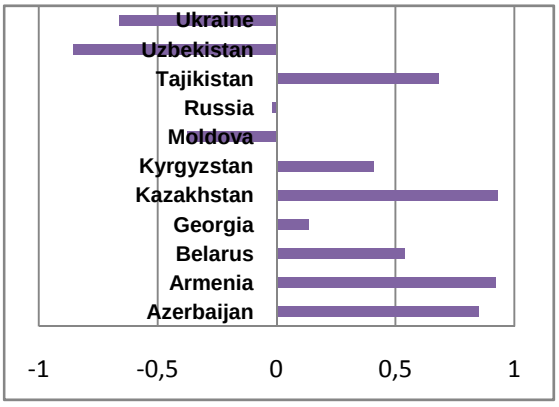
correlation coefficients of the HDI and the ratio of GDP to energy



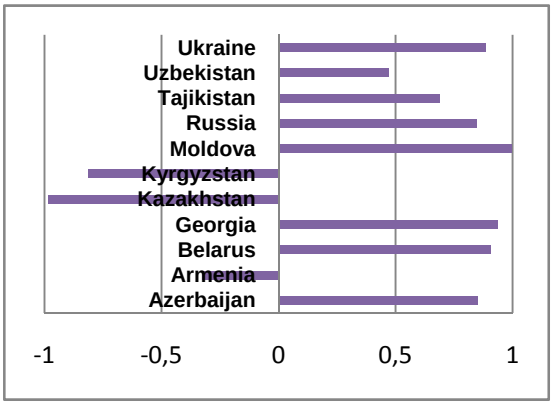
correlation coefficients of HDI and CO_2 per capita



correlation coefficients of HDI and CH_4 per capita

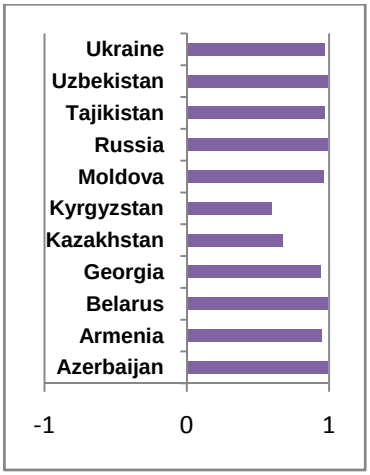


correlation coefficients of the HDI and greenhouse gases per capita

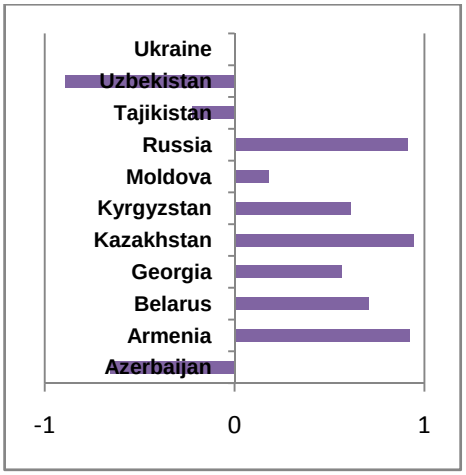


correlation coefficients of HDI and forest area

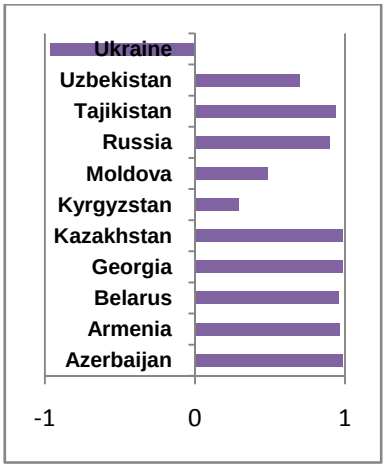
Figure 3 – Correlation relationship of HDI



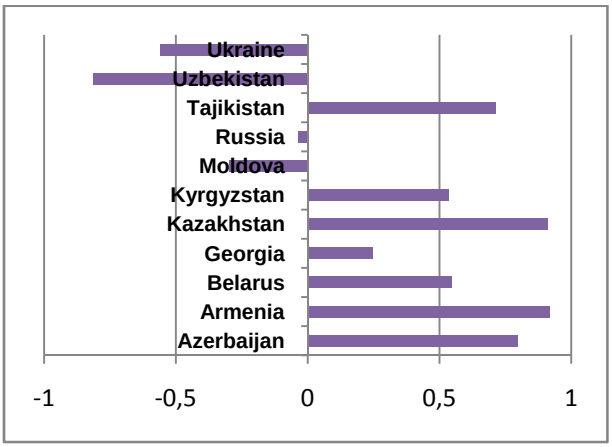
correlation coefficients of GDP per capita and GDP per unit of energy use



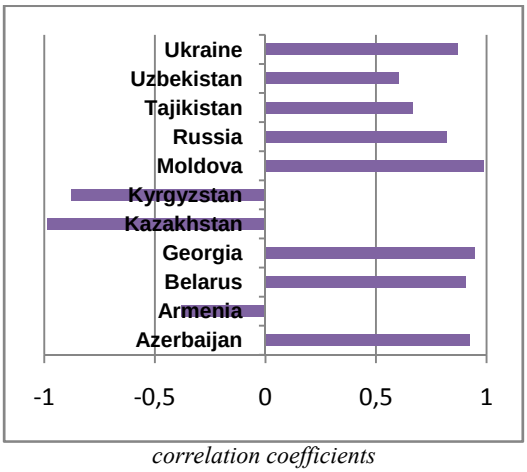
correlation coefficients of GDP per capita and CO_2 per capita



correlation coefficients of GDP per capita and CH_4 per capita

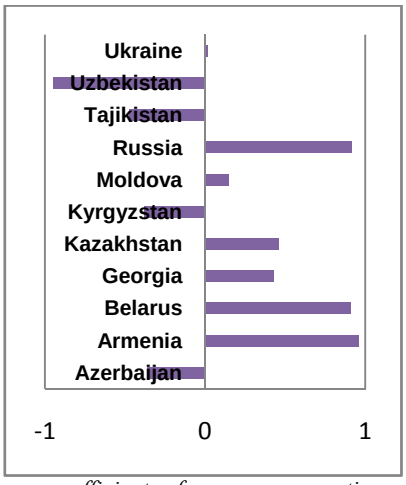


correlation coefficients of GDP per capita and greenhouse gases per capita

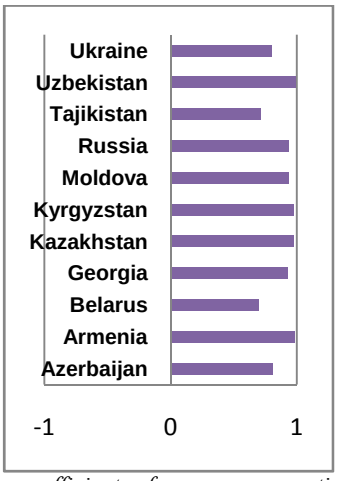


correlation coefficients of GDP per capita and forest area

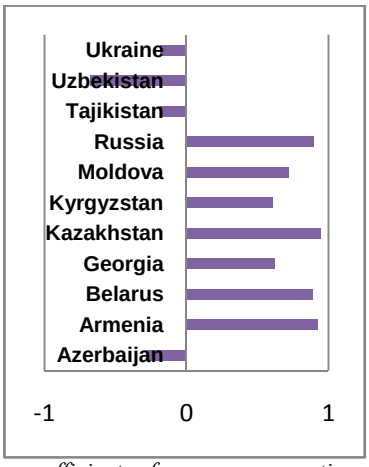
Figure 4 – Correlation relationship of GDP per capita



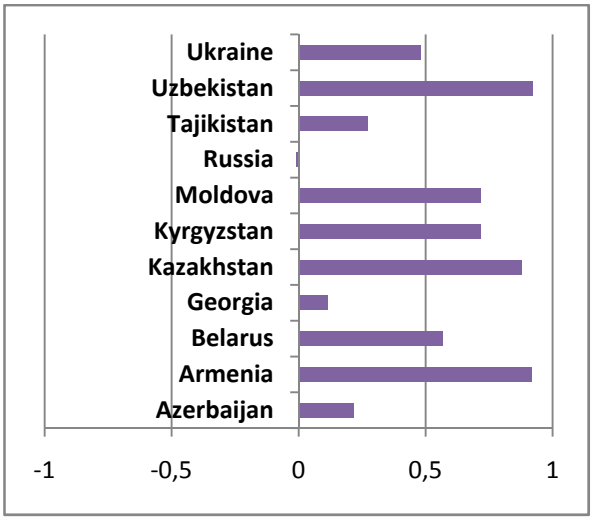
coefficients of energy consumption per capita and GDP per unit of energy use



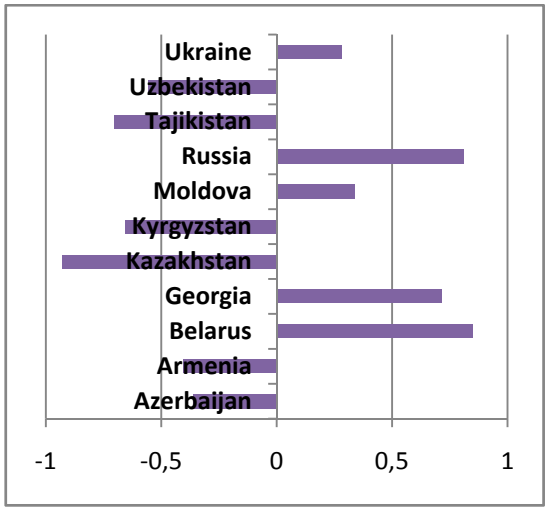
coefficients of energy consumption per capita and CO_2 per capita



coefficients of energy consumption per person and CH_4 per capita



correlation coefficients of energy consumption per capita and greenhouse gases per capita



correlation coefficients of energy consumption per capita and forest area

Figure 5 – Correlation relationship of energy consumption per capita

For elaboration of this criterion we will compare consumption of energy of extractable resources and the level of energy consumption and GDP (figure 6).

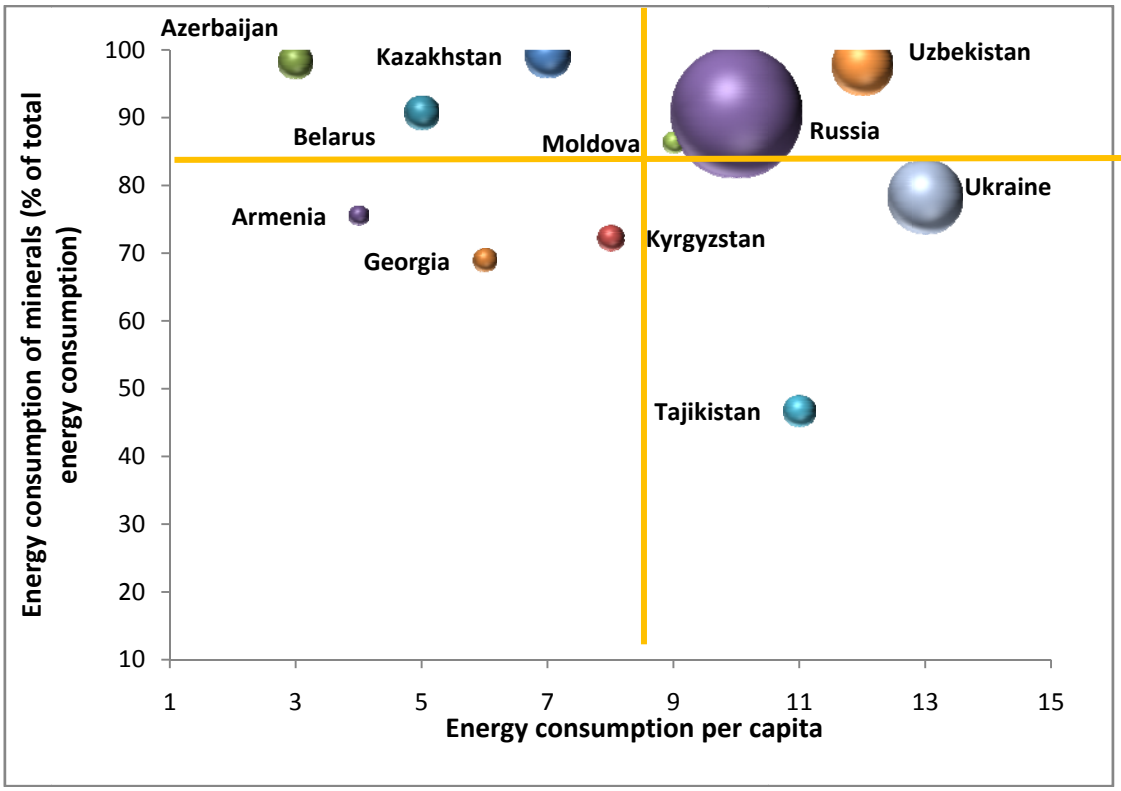


Figure 6 – Consumption of mineral energy and energy intensity of the economies of the post-Soviet countries:
** Diameter of a circle is positively associated to the population of the country*
** Horizontal and vertical lines of the section – by average values of parameters.*

The obtained data can be divided into 4 groups of the countries:

- the countries with rather low power consumption and with average dependence on power sources of extractable resources (Armenia, Georgia, Tajikistan);
- the countries with rather low power consumption and with high dependence on power sources of extractable resources (Azerbaijan, Belarus);
- the countries with average power consumption and with medium high dependence on power sources of extractable resources (Kyrgyzstan, Ukraine);
- the countries with medium high power consumption and with high dependence on power sources of extractable resources (Russia, Kazakhstan, Uzbekistan).

The following data regarding the first group can also be provided:

- Tajikistan: the share of the renewable electric power from the total production of the electric power is 99% (generally hydraulic power), consumption of renewable energy is 50% of the general final energy consumption;
- Georgia: a share of development of the renewable electric power from total production of the electric power is 80%, consumption of renewable energy is 32% of the general final energy consumption;
- Armenia ranks No. 3 among the considered countries;
- The most dependent country among the considered ones on the use of power sources of extractable resources is Uzbekistan, generally on natural gas (80% in the structure of primary power sources, oil – about 16%, coal and hydroelectric power - the rest). Uzbekistan ranks № 11 in the world in extraction of natural gas, ranks № 10 on its consumption, ranks № 34 on consumption of primary energy [26].

We will distinguish the countries with a close positive correlation (close to 1) (table 1).

Table 1 – Grouping of countries by positive correlation

Factors	Criteria		
	HDI	**GDP per capita**	**Energy consumption per capita**
GDP per unit of energy use	Ukraine, Uzbekistan, Tajikistan, Kazakhstan, Russia, Moldova, Georgia, Belarus, Armenia, Azerbaijan	Ukraine, Uzbekistan, Tajikistan, Russia, Moldova, Georgia, Belarus, Armenia, Azerbaijan	Russia, Belarus, Armenia
CO_2 per capita	Russia, Kazakhstan, Georgia, Armenia	Russia, Kazakhstan, Armenia, Belarus	Ukraine, Uzbekistan, Russia, Moldova, Kyrgyzstan, Kazakhstan, Georgia, Armenia, Azerbaijan, Belarus, Tajikistan
CH_4 per capita	Tajikistan, Kazakhstan, Russia, Georgia, Belarus, Armenia, Azerbaijan	Tajikistan, Russia, Kazakhstan, Georgia, Belarus, Armenia, Azerbaijan	Russia, Kazakhstan, Armenia, Belarus, Moldova
Greenhouse gases per capita	Kazakhstan, Armenia, Azerbaijan	Kazakhstan, Armenia, Azerbaijan, Tajikistan	Uzbekistan, Kazakhstan, Armenia, Kyrgyzstan, Moldova
Forest area	Ukraine, Russia, Moldova, Georgia, Belarus, Azerbaijan	Ukraine, Russia, Moldova, Georgia, Belarus, Azerbaijan	Russia, Belarus, Georgia

Thus, the countries which have shown high dependence on the considered factors by all criteria of welfare are Russia, Armenia, Azerbaijan, Belarus.

Each of the countries mentioned has defining characteristics:

• Russia has high GDP and energy consumption per capita (figures 1, 2) with essential dependence on conventional energy sources (fig. 18);

• Armenia has a low level of GDP and energy consumption per capita (figures 1, 2), and is less dependent on conventional energy sources;

• Azerbaijan is the country with high GDP and low energy consumption with high dependence on conventional energy sources;

• Belarus is the country with high GDP and average energy consumption with high dependence on conventional energy sources.

A number of the countries shows negative correlation regarding the following dependences (table 2).

Table 2 – Grouping of countries by negative correlation

Factors	Criteria		
	HDI	**GDP per capita**	**Energy consumption per capita**
GDP per unit of energy use			Azerbaijan
CO_2 per capita	Azerbaijan	Azerbaijan	
CH_4 per capita			Azerbaijan
Greenhouse gases per capita	Russia	Russia	Russia
Forest area	Armenia	Armenia	Azerbaijan, Armenia, Tajikistan

In Russia the negative correlation of all criteria of welfare and a factor Greenhouse gases per capita has been revealed. In Azerbaijan the prevalence of negative correlation of energy consumption per capita with practically all factors has been noticed (4 of 5).

Thus, the conducted research predetermine the extension study of welfare of these countries, perhaps, at extension of the list of factors and/or allocation of factors of the second level.

Discussion. Comparison of the provided data has revealed almost full identity of dependences of welfare: HDI and economic growth (GDP per capita). In the context of studied dependences it allows to equate the economic growth and welfare. Partly it is explained by the high importance of meeting material needs of the investigated countries, connected with the leap of standards of well-being after the transformation of the economic system. In Russia GDP has per capita changed from $2 641,77 (1996) to $14 467,79 (2013). Energy consumption has its own specific "set" of dependences, creating prerequisites of extension of the list of the correlating factors in future researches. This criterion has the maximum quantity of dependences with strong negative correlation. It makes necessary to elaborate both the criterion, and factors, correlating with it. It seems also reasonable to specify energy consumption by industries, discuss institutional aspects of the problem, structure the consumed energy resources. Such countries as Russia, Armenia, Azerbaijan (table 2) can be taken as objects of investigation.

Conclusion. The presented research doesn't pretend to completeness. It is unlikely to close the chapter on choosing the criterion of welfare, especially taking into account flexible specific characteristics. Nevertheless, the result is: integrated character of the assessment received when applying such indicator HDI and GDP per capita for the countries of the former Soviet Union has been established. The factor of energy consumption per capita has to be investigated more deeply on the basis of the obtained data. Perhaps, additional allocated factors will allow to define new aspects of criteria per capita. That does not mean the refusal of such indicators as HDI and FGP.

О. В. Пожарницкая[1, 2], Э. Г. Матюгина[2, 3], Г. Ю. Боярко[1], А. А. Мицель[1, 2], Е. В. Ваганова[3]

[1]Томск политехникалық университеті, Томск, Ресей,
[2]Томск мемлекеттік басқару жүйесі және радиоэлектроника университеті, Томск, Ресей,
[3]Томск мемлекеттік университеті, Томск, Ресей.

АУҚАТТЫЛЫҚ – КОРРЕЛЯЦИЯЛЫҚ БІРЛІК НЕМЕСЕ ҚҰРАМДАС БӨЛІКТЕРДІҢ ТАЛАСЫ (Посткеңестік елдердің материалдары негізінде)

Аннотация. Көрсетілген мақалада зерттеу нәтижесіне сәйкес кеңес өкіметін құраған мемлекеттердің 1997-2015 жылдар аралығындағы әртүрлі белгілерді қолданумен (ЖІӨ халықтың жан басына шаққандағы, АӘДИ және халықтың жан басына шаққандағы энергияны тұтыну) әл-ауқатын зерттеудің нәтижелері келтірілген.

Обьектілердің зерттеуі постсоветстық кеңістіктегі беделді динамикадан туындады. Бағалау үшін критерийлер жиынтығы пайдаланылды: жан басына шаққанда ЖІӨ, АӘДИ және адам басына шаққанда энергияны тұтыну. Энергияны пайдалану бірлігіне ЖІӨ, CO_2 қалдықтары, метан және парниктік газдар,орман алаңы бөлшек факторлары ретінде анықталды.

Зерттеудің ерекшелігі трансформацияның ортақ кезеңдеріне, бұрынғы Кеңес Одақ елдерінің белгілі бір уақыт кезеңінде ұлттық экономиканың даму көрсеткіштеріне байланысты. Дегенмен, ортақ өткені бар елдер, зерттелген көрсеткіштердің тәуелділіктеріндегі айтарлықтай шашыраңқылықты көрсетті. Корреляциялық талдаудың нәтижелері бойынша барлық әл-ауқат критерийлерінде жоғары тәуелділік танытқан елдер тобы анықталды. (Ресей, Армения, Әзірбайжан, Белорусия). АӘДИ көрсеткіштері үшін АӘДИ және ЖІӨ тәуелділігіне қатысты энергияны пайдалану бірлігіне байланысты оң корреляция анықталды.

Жан басына шаққандағы ЖІӨ көрсеткіші үшін тәуелділіктерге қатысты оң корреляция анықталды: жан басына шаққанда ЖІӨ және энергияны пайдалану бірлігіне ЖІӨ; жан басына шаққандағы ЖІӨ, адамға шаққандағы CH_4 (Украинадан басқа). Бұл зерттелген тәуелділіктер шегінде экономикалық даму мен әл ауқат арасында теңдік белгісін қоюға мүмкіндік берді. Посткеңестік кеңістіктегі елдерге экономикалық даму мен энергия тұтыну (көп елдер үшін корреляция коэффициенті 0,95) және энергия тұтыну мен CO_2 қалдықтар арасындағы (корреляция коэффициенті 0,85-0,997) тығыз оң қатынастар тән.

Барлық елдер экономикалық дамудың тұтынылатын энергияға тәуелділігін көрсетеді, Қырғызстан мен Қазақстан үшін корреляция біршама төмен. Өзбекстан үшін энергияны тұтыну және энергияны пайдалану бірлігіне шаққанда ЖІӨ арасындағы теріс корреляция белгіленді. Оған себеп - энергия тұтыну көлемінің азаюында ел халқының өсуі. Жан басына шаққандағы ЖІӨ мен орман алқабының арасындағы теріс кор-

реляция шамалы орман қоры бар Қазақстан, Қырғызстан және Тәжікстанмен сипатталады. Алынған мәліметтерге сәйкес елдерді энергосыйымдылық деңгейі мен пайдалы қазбалардан энергия көздерінің тәуелділіктері "байланысы" бойынша топтастыруға мүмкіндік берді.

Энергия тұтынуға әл ауқаты критериясы сияқты өзіндік нақты тәуелділіктер "жиынтығы" тән. Сонымен қатар, посткеңестік кеңістіктегі елдер үшін бұл критерий ең күшті теріс корреляциялық байланыспен тәуелділігі максималды санға ие. Бұл болашақ зерттеулерге корреляциялық факторлардың тізімін кеңейтудің алғышарттарын құрайды.

Түйін сөздер: әл-ауқаты, адам әлеуетінің даму индексі, экономикалық өсу, энергия тұтыну, CO_2 шығарындылары.

О. В. Пожарницкая[1, 2], Э. Г. Матюгина[2, 3], Г. Ю. Боярко[1], А. А. Мицель[1, 2], Е. В. Ваганова[3]

[1]Томский политехнический университет, Томск, Россия,
[2]Томский государственный университет систем управления и радиоэлектроники, Томск, Россия,
[3]Томский государственный университет, Томск, Россия.

БЛАГОСОСТОЯНИЕ – КОРРЕЛЯЦИОННОЕ ЕДИНСТВО ИЛИ БОРЬБА СОСТАВЛЯЮЩИХ? (На материале стран постсоветского пространства)

Аннотация. В представленной статье проведено исследование таких значимых компонент благосостояния как индекс человеческого развития (ИЧР), экономический рост, энергопотребление, экологическая составляющая.

Объектом исследования выступила динамика благосостояния стран постсоветского пространства. Для оценки использована совокупность критериев: ВВП на душу населения, ИЧР и энергопотребление на душу населения. В качестве детализирующих факторов определены - ВВП на единицу использования энергии; выбросы CO_2, метана и парниковых газов на душу населения; площадь лесов.

Использованы фактологические данные за период 1997-2015 гг. Специфика исследования связана с общностью этапов трансформации, параметров развития национальных хозяйств бывших стран Советского Союза в течение определённого периода времени. Тем не менее, страны, имеющие общее прошлое, продемонстрировали существенный разброс зависимостей исследуемых показателей.

По результатам корреляционного анализа выделена группа стран, продемонстрировавших высокую зависимость по всем критериям благосостояния от рассмотренных факторов (Россия, Армения, Азербайджан, Белоруссия). Для показателя ИЧР положительная корреляция выявлена в отношении зависимостей ИЧР и ВВП на единицу использования энергии. Для показателя ВВП на душу населения положительная корреляция выявлена в отношении зависимостей: ВВП на душу населения и ВВП на единицу использования энергии; ВВП на душу населения и CH_4 на чел. (исключение Украина).

Это позволило в рамках исследуемых зависимостей поставить знак равенства между экономическим ростом и благосостоянием. Странам постсоветского пространства характерна тесная положительная связь (коэффициент корреляции для большинства стран 0,95) между темпами экономического роста и энергопотреблением, а так же потреблением энергии и выбросами CO_2 (коэффициент корреляции 0,85–0,997). Однозначную зависимость экономического роста от потребляемой энергии демонстрируют все страны, чуть более слабая корреляция – для Киргизии и Казахстана. Отрицательная корреляция между энергопотреблением на человека и ВВП на единицу использования энергии установлена для Узбекистана. Причина тому - рост населения страны при снижении энергопотребления. Отрицательная корреляция между ВВП на душу населения и площадью лесов характеризует Казахстан, Киргизию и Таджикистан, имеющие незначительный лесной фонд.

Полученные данные позволили провести классификацию стран по «связке» уровня энергоемкости и зависимости от источников энергии полезных ископаемых. Энергопотреблению как критерию благосостояния характерен собственный специфический «набор» зависимостей. Более того, именно данный критерий имеет максимальное количество зависимостей с сильной отрицательной корреляционной связью для стран постсоветского пространства. Это создает предпосылки расширения перечня коррелирующих факторов в будущих исследованиях.

Ключевые слова: благосостояние, индекс развития человеческого потенциала, экономический рост, энергопотребление, выбросы CO_2.

Сведения об авторах:

Пожарницкая Ольга Вячеславовна – кандидат эконом. наук, доцент ШИП, НИ ТПУ, доцент кафедры экономики ТУСУР, Томск; Россия; pov@tpu.ru; https://orcid.org/0000-0002-2975-379X; Researcher ID: P–4950–2017

Матюгина Элеонора Григорьевна – доктор эконом. наук, профессор кафедры управления инновациями, НИ ТГУ, профессор кафедры менеджмента, ТУСУР, Томск, Россия; emk512542@mail.ru; https://orcid.org/0000-0001-5532-1141

Боярко Григорий Юрьевич – доктор эконом. наук, профессор ИШПР, НИ ТПУ, Томск, Россия; gub@tpu.ru; https://orcid.org 0000-0002-0715-7807

Мицель Артур Александрович – доктор техн. наук, профессор кафедры автоматизированных систем управления, ТУСУР, академик МАН ВШ, профессор НИ ТПУ, Томск, Россия; maa@usu.tusur.ru; https://orcid.org/0000-0002-2624-4383

Ваганова Елена Владимировна – ст. преподаватель кафедры управления качеством, НИ ТГУ, Томск, Россия; hailun@mail.ru; https://orcid.org/0000-0001-5081-3200

REFERENCES

[1] Liu L., Chen T., Yin Y. (2016). Energy Consumption and Quality of Life: Energy Efficiency Index // Energy Procedia. 88: 224-229. DOI org/10.1016/j.egypro.2016.06.152.

[2] Lambert J.G., Hall C.A., Balogh S., Gupta A., Arnold M. (2014). Energy, EROI and quality of life // Energy Policy. 64: 153-167. DOI org/10.1016/j.enpol.2013.07.001.

[3] Pasten C., Santamarina J.C. (2012). Energy and quality of life // Energy Policy. 49: 468-476. DOI org/10.1016/j.enpol.2012.06.051.

[4] Hoque A., Rahman S.F., Huq A.M.Z. (1980). Rural Energy in Bangladesh, Proceedings of the International Seminar on Agriculture to Industry: The Role of Engineering. Inst. of Engineers, Bangladesh. P. 134.

[5] Forrester J.W. (1971). World Dynamics. Wright Allen Press, Boston, MA. 176 p.

[6] Apergis N., Payne J.E. (2010 b.). Renewable energy consumption and growth in Eurasia // Energy Economics. 32 (6): 1392-1397. DOI org/10.1016/j.eneco.2010.06.001.

[7] Apergis N., Payne J.E. (2009). CO_2 emissions, energy usage, and output in Central America // Energy Policy, 37: 3282-3286. DOI: org/10.1016/j.enpol.2009.03.048.

[8] Kraft J., Kraft A. (1978). On the relationship between energy and GNP // Journal of Energy and Developmen. 3: 401-403. URL: http://www.jstor.org/stable/24806805.

[9] Akarca AT., Long T.V. (1980). On the relationship between energy and GNP: a reexamination // Journal of Energy Development. 5: 326-331. URL: http://www.jstor.org/stable/24806899.

[10] Stern D.I. (2000). A multivariate cointegration analysis of the role of energy in the US macroeconomy // Energy Economics. 22: 267-283. DOI org/10.1016/S0140-9883(99)00028-6.

[11] Asafu-Adjaye J. (2000). The Relationship between Energy Consumption, Energy Prices and Economic Growth: Time Series Evidence from Asian Developing Countries // Energy Economics. 22 (6): 615-625. DOI org/10.1016/S0140-9883(00)00050-5.

[12] Chentanavat J., Hunt LC, Pierce R. (2008). Does energy consumption cause economic grows?: Evidence from a systematic study of over more 100 countries, Journal of policy modeling, 30: 209-220. DOI org/10.1016/j.jpolmod.2006.10.003.

[13] Alibegov M.M., Grigoriev L.M. (2003). Energy consumption and energy charge [Jenergopotreblenie i tarify na jelektrojenergiju] // *Economics and mathematical methods*, 39(4): 59-71. (In Rus.)

[14] Volkonsky V.A., Kuzovkin A.I. (2006) .Analysis and forecast of the energy intensity of the Russian economy [Analiz i prognoz energoemkosti ekonomiki Rossii] // Problems of forecasting. 1: 53-61. (In Rus.).

[15] Parshev A.P. (2001). Why Russia is not America [Pochemu Rossiya ne Amerika], M.: the Crimean bridge-9D, Forum: 416. (In Rus.).

[16] Litvintseva G.P. (2006). The investment crisis as a result of the imbalance between the structural and technological parameters of the economy and its institutional arrangement [Krizis investitsii kak rezul'tat nesootvetstviya strukturno-tekhnologicheskikh kharakteristik ekonomiki ee institutsional'nomu ustroistvu] // Problems of forecasting, 6: 23-40. (In Rus.)

[17] Improving life does not necessarily require high GDP. [A high gross domestic product is not an indispensable prerequisite for life improvement (In Russ.)]. Available at: http://www.vestifinance.ru/articles/57904 (accessed 24.08.2017).

[18] Taspenova G.A., Smailova Zh.P., Meshkov V.R. (2018). Socio-economic indicators of living standards in the Republic of Kazakhstan // Bulletin of National Academy of Sciences of The Republic of Kazakhstan. 2(372): 204-211. https://doi.org/10.32014/2018.2518-1467.

[19] International Energy Agency. URL: http://www.iea.org (accessed 23.05.2017).

[20] United nations. URL: http://www.un.org (accessed 13.04.2017).

[21] Organisation for Economic Co-operation and Development. URL: http://www.oecd.org/ (accessed 18.05.2017).

[22] The word bank. URL: http://www.worldbank.org/ accessed 18.05.2017).

[23] UNDP, "Human Development Report," UNDP, New York, 1990-2015. URL: http://hdr.undp.org (accessed 18.06.2017).

[24] Kobzar' A.I. (2012). Applied mathematical statistics. For engineers and scientists [Prikladnaya matematicheskaya statistika. Dlya inzhenerov i nauchnykh rabotnikov] *FIZMATLIT*: 816. (In Rus.).

[25] Belov A.A., Ballod B.A., Elizarova N.N. (2008). The theory of probability and mathematical statistics [Teoriya veroyatnostei i matematicheskaya statistika]. Rostov-on-Don, Feniks: 318. (In Rus.).

[26] Oil, gas and energy of Uzbekistan. Available at: http://neftegaz.ru/analisis/view/8429-Neft-gaz-i-energetika-Uzbekistana (accessed 18.05.2017). (In Rus.).

[27] Fang C., Wang S., Li G. (2015). Changing urban forms and carbon dioxide emissions in China: A case study of 30 provincial cities // Applied Energy. 158: 519-531. DOI org/10.1016/j.apenergy.2015.08.095.

[28] Azar E., Nikolopoulou C., Papadopoulos S. (2016). Integrating and optimizing metrics of sustainable building performance using human-focused agent-based modeling // Applied Energy. 183: 926-937. DOI org/10.1016/j.apenergy.2016.09.022.

[29] Yu E.Sh., Jin J.C. (1992). Co-integration tests of energy consumption, income, and employment // Resources and Energy. 14: 259-266. DOI org/10.1016/0165-0572(92)90010-E.

[30] Edgerton J.D., Roberts L.W., Below S.V. (2011). Education and Quality of Life // In Handbook of Social Indicators and Quality of Life Research. Springer Netherlands: 265-296. ISBN 978-94-007-2420-4.

[31] Matyugina E.G., Pogharnitskaya O.V., Dmitrieva N.V., Grinkevich L.S., Selenchuk Z.O., Strelnikova A.B. (2016). Evaluating perspectives of economy “decarbonation”// IOP Conference Series: Earth and Environmental Science, 43: 1-6. DOI 10.1088/1755-1315/43/1/012042.

[32] Liu L., Chen T., Yin Y. (2016). Energy Consumption and Quality of Life: Energy Efficiency Index/ Energy Procedia, 88: 224–229. DOI org/10.1016/j.egypro.2016.06.152.

[33] Stern D.A. (2000). A multivariate cointegration analysis of the role of energy in the US macro economy // Energy Economics. 22(2): 267-283. DOI org/10.1016/S0140-9883(99)00028-6.

[34] Tsibulnikova M.R., Pogharnitskaya O.V., Adam A.M. (2016). Effective Management of Recreation Resources for Human Capital Increase // The 27th International Business Information Management Association Conference: Proceedings IBIMA. Milano, May 4-5, Norristown: IBIMA: 579-585. DOI doi:10.2991/itsmssm-16.2016.36.

[35] Vazim A., Tretyakov K., Khloptsov Dm., Lemeshko E. (2016) Energy efficiency, low-carbon energy and economic growth in the Arctic countries - the exporters of hydrocarbons // III International Scientific Conference ‘Information Technologies in Science, Management, Social Sphere and Medicine’ (ITSMSSM). Tomsk, Russian Federation. DOI http://dx.doi.org/10.2991/itsmssm-16.2016.37.

[36] Zhussupova Zh.M., El-Hodiri M.A. Comparative analysis of the Kazakhstani companies’ performance before and after implementation of the norms of corporate governance // Bulletin of the National Academy of Sciences of the Republic of Kazakhstan. 2018. Vol. 4, N 371. P. 171-179 // http://dx.doi.org/10.32014/2018.2518-1467 (in Eng.). ISSN 2518-1467 (Online), ISSN 1991-3494 (Print).

Publication Ethics and Publication Malpractice
in the journals of the National Academy of Sciences of the Republic of Kazakhstan

For information on Ethics in publishing and Ethical guidelines for journal publication see http://www.elsevier.com/publishingethics and http://www.elsevier.com/journal-authors/ethics.

Submission of an article to the National Academy of Sciences of the Republic of Kazakhstan implies that the described work has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis or as an electronic preprint, see http://www.elsevier.com/postingpolicy), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, including electronically without the written consent of the copyright-holder. In particular, translations into English of papers already published in another language are not accepted.

No other forms of scientific misconduct are allowed, such as plagiarism, falsification, fraudulent data, incorrect interpretation of other works, incorrect citations, etc. The National Academy of Sciences of the Republic of Kazakhstan follows the Code of Conduct of the Committee on Publication Ethics (COPE), and follows the COPE Flowcharts for Resolving Cases of Suspected Misconduct (http://publicationethics.org/files/u2/New_Code.pdf). To verify originality, your article may be checked by the Cross Check originality detection service http://www.elsevier.com/editors/plagdetect.

The authors are obliged to participate in peer review process and be ready to provide corrections, clarifications, retractions and apologies when needed. All authors of a paper should have significantly contributed to the research.

The reviewers should provide objective judgments and should point out relevant published works which are not yet cited. Reviewed articles should be treated confidentially. The reviewers will be chosen in such a way that there is no conflict of interests with respect to the research, the authors and/or the research funders.

The editors have complete responsibility and authority to reject or accept a paper, and they will only accept a paper when reasonably certain. They will preserve anonymity of reviewers and promote publication of corrections, clarifications, retractions and apologies when needed. The acceptance of a paper automatically implies the copyright transfer to the National Academy of Sciences of the Republic of Kazakhstan.

The Editorial Board of the National Academy of Sciences of the Republic of Kazakhstan will monitor and safeguard publishing ethics.

Правила оформления статьи для публикации в журнале смотреть на сайте:

www:nauka-nanrk.kz

ISSN 2518-1467 (Online), ISSN 1991-3494 (Print)

http://www.bulletin-science.kz/index.php/en/

Редакторы *М. С. Ахметова, Т. М. Апендиев, Д. С. Аленов*
Верстка на компьютере *Д. Н. Калкабековой*

Подписано в печать 11.02.2019.
Формат 60x881/8. Бумага офсетная. Печать – ризограф.
19,2 п.л. Тираж 500. Заказ 1.

Национальная академия наук РК
050010, Алматы, ул. Шевченко, 28, т. 272-13-18, 272-13-19