A.A. Priemyshev, M.V. Arysheva, Z.I. Lavrova

ANALYSIS OF THE HUMAN DEVELOPMENT INDEX CALCULATION. COMPARISON OF THE OLD AND THE NEW METHODS

А.А. Приемышев, М.В. Арышева, З.И. Лаврова

АНАЛИЗ РАСЧЕТА ИНДЕКСА РАЗВИТИЯ ЧЕЛОВЕЧЕСКОГО ПОТЕНЦИАЛА. СРАВНЕНИЕ СТАРОЙ И ОБНОВЛЕННОЙ МЕТОДИК

The article examines the population life quality as one of the most important indicators that reflect the level of development of any country, and its evaluation. The intricacy of the problem of life quality assessment is due to a large number of indicators on hand. The authors presented the basic theoretical concepts of life quality and methodological approaches to measuring and assessing life quality (objectivist and subjectivist). Particular attention is devoted to one of the main indicators of life quality — Human development index. Presented is the analysis of its calculation by the old technique, which was used until 2010, and by the new one, currently adopted. The main purpose of using the human development index is to draw up the inter-regional ranking of countries with a view to assess the population life quality dynamics and to compare it with other territories. 75 countries with high, average and low values of HDI were chosen for the analysis. The correlation coefficient is counted, proving the linear dependence between final values of the HDI, made by means of the old and the new methods for different countries. Calculation of the Russian Federation HDI is made using the Federal State Statistics Service data. The result differs from the RF HDI in the global HDI ranking presented by the UN report, which could be explained by using statistic data for calculating from different sources.

LIFE QUALITY; HUMAN DEVELOPMENT INDEX; THE OLD AND THE NEW CALCULATING METHODS; MAXIMUM AND MINIMUM VALUES OF INDICES; HDI COUNTRIES RANKING.

Рассматриваются вопросы качества жизни населения как одного из важнейших показателей, отражающих уровень развития любой страны, и его оценки. Сложность задачи оценки качества жизни связана с большим количеством существующих индикаторов. Приведены основные теоретические концепции качества жизни и методологические подходы к измерению и оценке качества жизни (объективистский и субъективистский). Особое внимание посвящено одному из основных показателей качества жизни населения — индексу развития человека. Понятие «индекс развития человеческого потенциала» (ИРЧП) формируется на международном уровне в конце 1980-х гг., а с 1990 г. данные о величине ИРЧП по странам, входящим в ООН появляются в публикациях. Проведен анализ расчета ИРЧП по старой методике, используемой до 2010 г., и новой, принятой в настоящее время. Основной целью использования индекса развития человеческого потенциала, или индекса человеческого развития, является составление межрегиональных рейтингов стран с целью оценки динамики качества жизни населения и сравнения показателей с другими территориями. Для анализа выбрано 75 стран с высоким, средним и низким значениями индекса развития человеческого потенциала. Определен коэффициент корреляции, подтверждающий линейную зависимость между итоговыми значения ИРЧП, рассчитанными по старой и новой методикам для разных стран. Проведен расчет индекса развития человеческого потенциала России на основании данных Федеральной службы государственной статистики. Полученный результат отличается от значения данного показателя в общемировом рейтинге стран по ИРЧП, представленном в докладе ООН, что объясняется, вероятно, использованием для расчета статистических данных из других источников.

КАЧЕСТВО ЖИЗНИ НАСЕЛЕНИЯ; ИНДЕКС РАЗВИТИЯ ЧЕЛОВЕКА; СТАРАЯ И НОВАЯ МЕТОДИКИ РАСЧЕТА; МАКСИМАЛЬНЫЕ И МИНИМАЛЬНЫЕ ЗНАЧЕНИЯ ПОКАЗАТЕЛЕЙ; РЕЙТИНГ СТРАН ПО ИРЧП.

Quality of life is the level of satisfaction of the material, spiritual and social needs of the human being; the subjective assessment of the level of material and spiritual need satisfaction [1]. Quality of life is one of the most important indicators adopted by the UN, which reflects the

level of the country development. Determining quality of life plays an important role in the process of socio-economic management and the country development. The relevance of this issue is emphasized by the fact, that with proper measurements, based on objective statistical indicators, we gain the ability to define a strategy of social development, the level of economic well-being of the population, as well as determine the human potential (capabilities), which is especially important during the transition to the post-industrial economics and society.

This period is characterized by significant changes: development of market economy, changes in the character of labor and the organization of the work process as a whole [2]. Such changes have a clear impact on quality of life: falling living standards, dramatically increasing income inequality. Economic situation characterized by crisis, caused by unresolved problems of the transition from planned economy to developed market economy, gives the special relevance to the analysis of methods to measure quality of life [3].

Measuring quality of life is a challenging task. Primarily, this is due to the fact that there are many indicators that can be used to assess quality of life. It is worth mentioning, that there are many theoretical concepts of quality of life that imply a different approach to the assessment of QoL (quality of life). The main theoretical concepts are called: the economic welfare theory, the utilitarian concept and the capabilities approach.

In addition to theoretical concepts there are two distinguished methodological approaches to measuring and evaluating quality of life: objectivist (based on the theory that the leading role in society is given to social structures) and subjective (based on the theory that the individual takes the main role. In this case, the assessment of QoL is reduced to the individual's assessment of his/her conditions). In this article the evaluation of quality of life is based on the objectivist approach and the analysis of statistical indicators and aggregate indicators that measure quality of life and characterize the population of the country as a whole. When speaking about the measurement of synthetic indicators of quality of life [4] it should be considered, that the measurement and interpretation methodology of aggregate indicators of quality of life must

comply with a certain type of tasks. In this work the authors are interested in the analysis of the Human Development Index calculation. The objective of such an index is to make inter-regional ranking of countries to assess the population life quality dynamics and compare it with other territories.

There are many indexes associated with the measurement of quality of life. These include the Gross National Happiness, the Happy Planet Index (HPI), the Quality-of-life, the Physical quality of life index, life satisfaction, the Genuine Progress Indicator (GPI).

One of the main indicators of quality of life is the Human Development Index (HDI). The Human Development Index (HDI) − is a measure of human development, a country's statistics in three dimensions: longevity and health, education and GNI per capita. The value of HDI is calculated as the geometric mean of all indices. This index was developed in the late XX century by a group of economists led by Mahbub ul Haq, a scientist from Pakistan. However, it should be noted that the conceptual framework of quality of life was created due to the works of Amartya Sen, who received a Nobel Prize in Economics in 1998. The investigation of this index was carried out within the UN Development Program and was first made public in 1990 in the Human Development Report of the United Nations [5].

The structure of the Human Development Index:

• GNI (gross national income per capita), adjusted in accordance with the purchasing power parity (PPP).

• Life expectancy at birth.

• *Expected years of schooling.*

• *Mean years of schooling.* The last two indicators form composite index of education.

A comparison of the old and the new methods

The first step in the HDI calculation is to create sub-indices for each measurement. To convert indicators into indices on a scale from 0 to 1. It is necessary to establish the minimum and maximum values.

The maximum values are assigned to the actually observed highest country indicators values of the time series, i. e. for the period 1980−2010. Minimum values will affect the

evaluation, that's why certain values are used as cost of living or «natural» zero [6].

$$\text{Index measurement} = \frac{D_{\text{fact}} - D_{\text{min}}}{D_{\text{max}} - D_{\text{min}}} \quad (1)$$

Shown below are the necessary for the calculation minimum and maximum values of the indicators.

Table 1

Values of indicators for the HDI, the old method, 2010

Measurement	Maximum value	Minimum value
Life expectancy at birth	85	25
Literacy	100	0
Percentage of students	100	0
GNI per capita (PPP US)	5448 (UAE, 1980)	100

The calculation method used until 2010 is different from the one currently in use. The resulting value was the average of the three indices (life expectancy at birth, Literacy Rate, Gross Enrollment ration, GNI per capita) [5] according to formula (2) [6].

$$\text{HDI} = \frac{I_{\text{life}} + I_{\text{education}} + I_{\text{income}}}{3}. \quad (2)$$

Tab. 2 shows the extreme values for calculating the HDI, the new method.

Table 2

Values of indicators for the HDI, the new method, 2010

Measurement	Maximum value	Minimum value
Life expectancy at birth	83.2 (Japan, 2010)	20.0
Mean years of schooling	13.2	0
Expected years of schooling	20.6 (Australia, 2002)	0
The composite index of education	0.951 (New Zealand, 2010)	
GNI per capita (PPP US $)	108211 (UAE, 2010)	163 (Zimbabwe, 2008)

Under the new methodology, developed and adopted by the UN in 2010, the total value is the geometric mean of three indices (life expectancy at birth, education index, income index). In addition to the changes in the formula to calculate the final result, there were made the changes in the education index calculation. Now it includes two components: the Expected Years of Schooling Index and the Mean Years of Schooling index. The maximum and minimum values used in the calculation of indicators were also changed in 2010. The income index is particularly interesting for the research [7].

The minimum value for this indicator − the GNI per capita. Some economists use the new value − $ 163 for the calculation, referring to the fact, that this is the minimum value of the GNI per capita recorded in Zimbabwe in 2008 [8]. To us, the use of this amount seems unjustified, because if we consider Zimbabwe and calculate its income index, the actual value and the minimum one will be equal, hence the numerator and the income index as a whole will be zero. In this case, the calculations cannot be considered valid, as the human development index also takes a value of zero, and with such a result we cannot trace the dynamics of changes in the values of the indices included in the HDI calculation for the country where the minimum value of the GNI per capita was used for the annual calculation of the HDI. Thus, it seems appropriate to use the old minimum value, a constant value of $ 100.

The differences in the calculation of the education index by the old and the new methods

The calculation of the Education Index (the old method):
- Percentage of students.
- Literacy Index.

$$I_{ed} = 1/3 \cdot i_{st} + 2/3 \cdot i_l. \quad (3)$$

The calculation of the Education Index (the new method):
- Mean Years of Schooling Index.
- Expected Years of Schooling Index.

$$I = \frac{\sqrt{\text{mean\_years} + \text{expected\_years}} - D_{\text{min}}}{D_{\text{max}} - D_{\text{min}}}. \quad (4)$$

The main difference in calculations using the old and the new methods is the final stage: according to the old methodology it was calculated by taking the arithmetic mean of all indicators [9]:

$$HDI = \frac{I_{life} + I_{education} + I_{income}}{3}. \quad (5)$$

The new method weights each component of the index differently, a weighting factor of 1/3 is assigned to the average life expectancy, per capita GDP has a coefficient of 1/3, Gross enrollment index − 1/9, Adult literacy Index is weighted as 2/9, so the formula will look like all the components have a weighting factor of 1/3, hence the formula will look like a geometric mean [10]:

$$HDI = \sqrt[3]{I_{life} I_{education} I_{income}}. \quad (6)$$

Whether or not those changes are justifiable can be viewed in different ways, but in general, the fact that proposed by the authors weights are not reasonable can be seen as a major flaw, which casts doubt on the objectivity of the evaluation. There was the same disadvantage in the old calculation method. Though it is worth tracing the world dynamics on this issue, whatever insufficient the grounds.

In order to compare the old and the new method`s results of calculating the Human Development index, we have compared the ranking of countries on the list of Human Development Index, made using this methods.

Comparative analysis of HDI results using the old and the new methods

In this article, a comparative analysis of old and new methods of calculating the HDI was done. For the study purposes, there were 75 countries (15 countries from three groups in terms of HDI for low HDI − 30 countries) selected from the list. In Fig. 1−3 shown are the HDI values for the old and the new methods [10]. Based on the data a correlation analysis was performed.
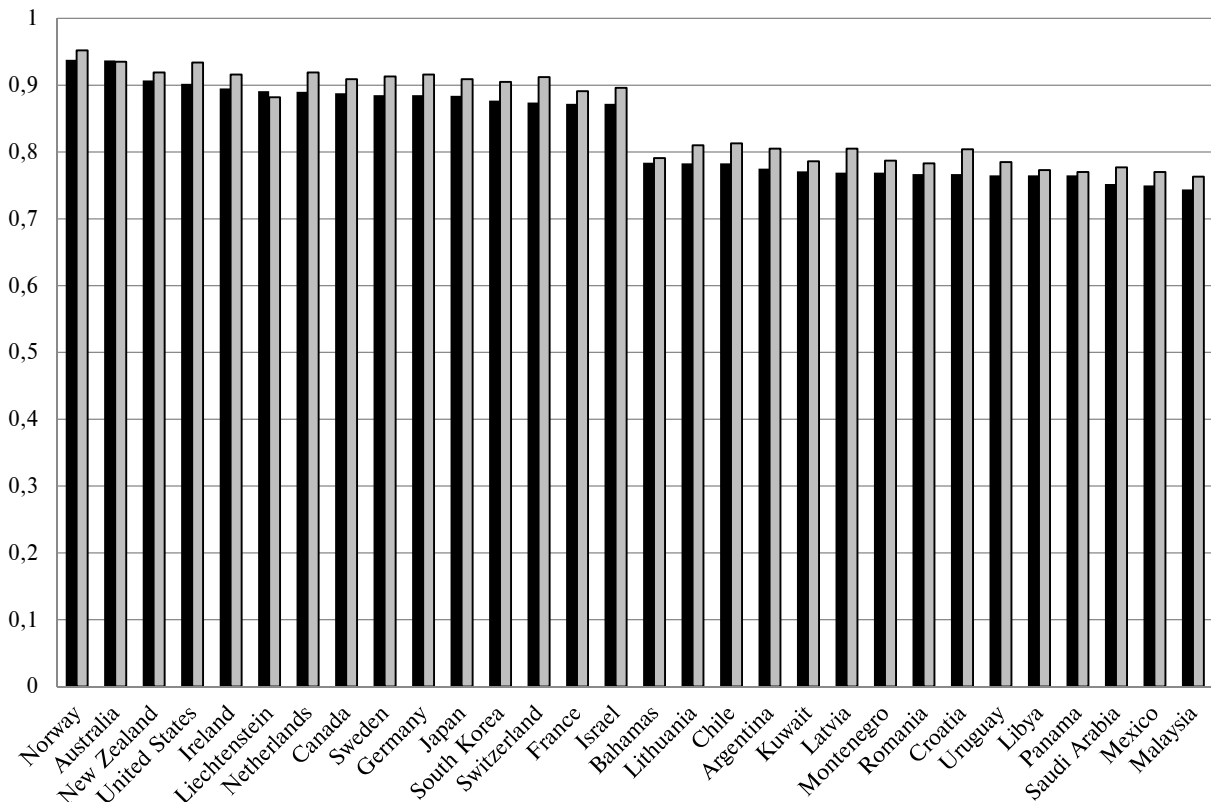

Fig. 1. HDI values for the countries with a very high and high development level of human potential
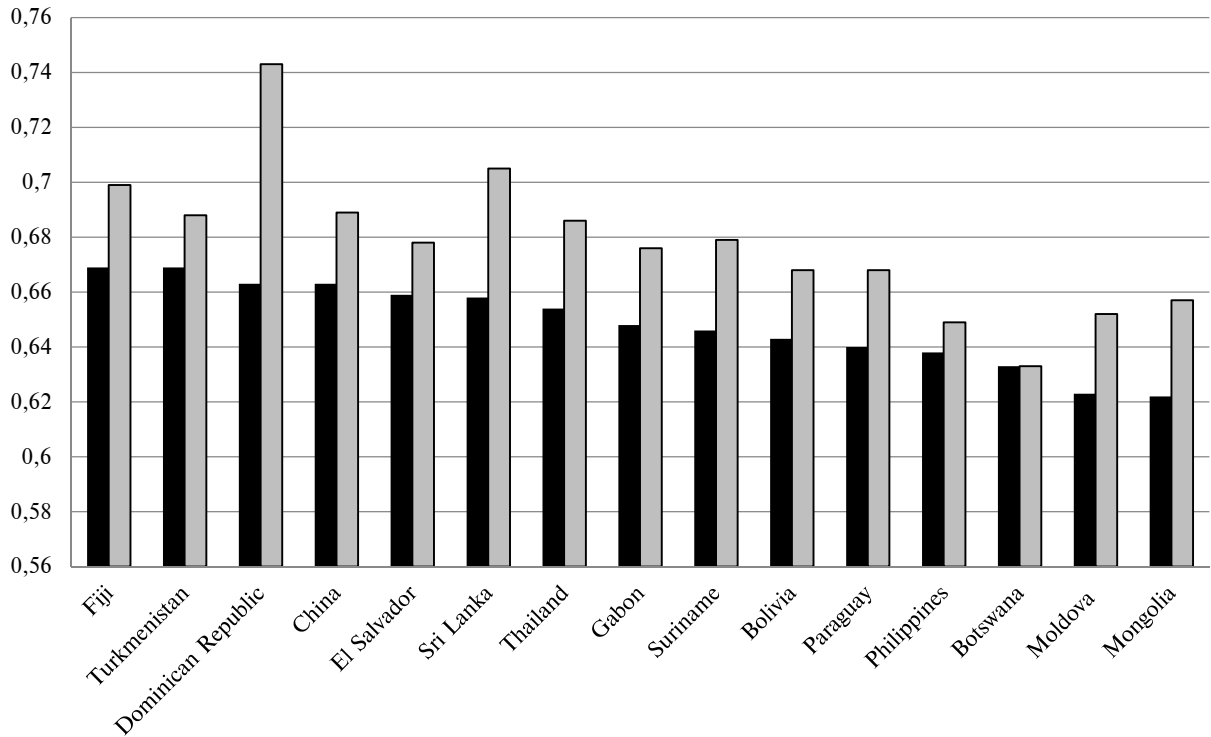
(■) − new method; (□) − old method

Fig. 2. HDI values for the countries with an average development level of human potential
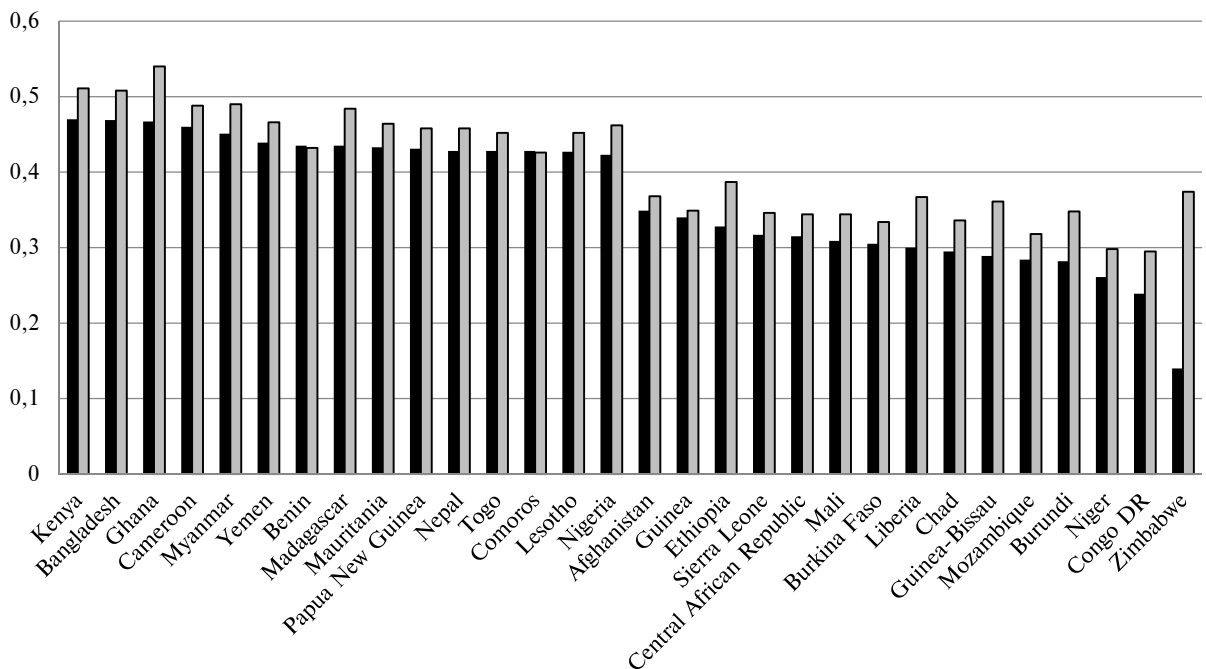
(■) − new method; (□) − old method

Fig. 3. HDI values f the countries with a low development level of human potential
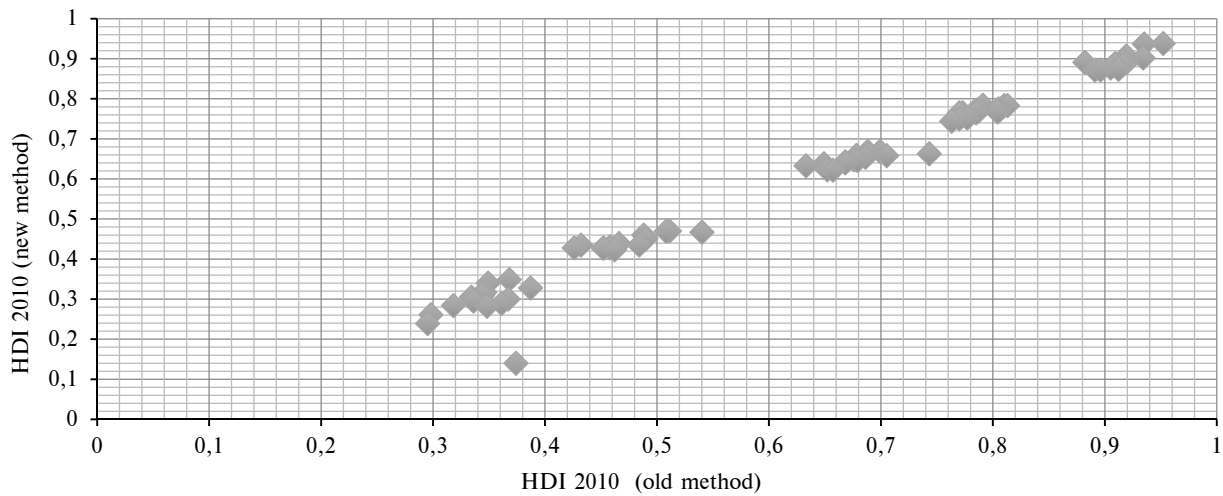
(■) − new method; (□) − old method

Fig. 4. The dependence between the values of the HDI for 2010, calculated according to the old and the new methods

Pearson's formula was used to calculate the correlation coefficient [11]:

$$r = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum (x_i - \bar{x})^2 \sum (y_i - \bar{y})^2}} = 0.99. \quad (7)$$

The calculation was made using the similar function in Excel.

The calculations show that the relationship is very close, as the correlation coefficient is in the range of 0.9−1. This suggests a direct relationship between the final values of HDI of the countries, calculated according to the old method and the values of the HDI calculated using the new method. The resulting value of the correlation coefficient suggests that the relationship between these parameters is linear. This means, that by conducting the more detailed and wider study with a large enough sample, you can build a regression model and track how much the 1 point alteration in the HDI by using the old methodology will change the HDI calculated using the new method. The results of this computation are shown in the correlation field:

Position change in the global ranking of countries after application of the new method

Particularly interesting is the way the countries changed their position after the application of the new method. These data are presented in Tab. 3:

Table 3

Comparative analysis of the values of the HDI countries done by the old and the new methods

Rank	The old method		The new method		Changes	New rank
1	0.952	Norway	0.938	Norway	0	1
2	0.935	Australia	0.937	Australia	0	2
3	0.934	USA	0.907	New Zealand	+2	3
4	0.919	Netherlands	0.902	United States Of America	−1	4
5	0.919	New Zealand	0.895	Ireland	+2	5
6	0.916	Germany	0.891	Liechtenstein	+9	6
7	0.916	Ireland	0.89	Netherlands	−3	7
8	0.913	Sweden	0.888	Canada	+2	8
9	0.912	Switzerland	0.885	Sweden	−1	9
10	0.909	Canada	0.885	Germany	−4	10
11	0.909	Japan	0.884	Japan	0	11
12	0.905	South Korea	0.877	South Korea	0	12
13	0.896	Israel	0.874	Switzerland	−4	13
14	0.891	France	0.872	France	0	14
15	0.882	Liechtenstein	0.872	Israel	−2	15

F o r E x a m p l e :

1) The HDI value of 0.952 in Norway under the old methodology (1st place) has changed in accordance with the new method to 0.938 (the first line in Tab. 1). Nevertheless, the position in the ranking has not changed and Norway remained at the first place.

2) The HDI value of 0.882 in Liechtenstein under the old methodology (15th place) has increased in accordance with the new method to 0.891. This allowed Liechtenstein to go 9 positions up (+9) and get the 6th place.

3) The HDI value of 0.919 in the Netherlands under the old methodology (4th place) dropped in accordance with the new method to 0.89. After changing the ranking position the Netherlands was on the 7th place (−3 position).

Calculation of the Russian Federation HDI using the new method

The authors calculated the human development index based on the data supplied by the Federal State Statistics Service [12]. This result does not correspond to the value of this indicator in the global ranking of countries by HDI presented in the UN report [13]. The results are presented in Tab. 4.

T a b l e 4

Comparison of the results of the HDI index calculation

Method of calculating	Value	Place in the UN ranking
The old methodology	0.719	65
The new methodology	0.78	55
The author's calculations	0.809	44

The data presented in Tab. 4 show a discrepancy between the results of calculation and, accordingly, ranking of the UN. Primarily, this is due to the fact that the statistics cannot always be collatable due to the fact that the data used for the analysis are from different sources. It is worth noting that for the analysis of the life quality in a region that is inextricably linked with the level of quality of life of the country population, there are more commonly used indicators, such as the population change dynamics, indicators of the economically active population and unemployment, the structure of educational institutions, the number of hospital beds and the number of doctors, and the personal incomes [14].

Changes in the methodology for calculating the HDI and the introduction of new indicators have led to significant changes. By applying the geometric mean, we get the most accurate result of the averaging that allows us to find a value that would be qualitatively equidistant from both maximum and minimum values of the attribute, which is a positive moment. There is also a negative effect of using the geometric mean, associated with greater unpredictability of results than in the calculation using the arithmetic mean. It is also worth mentioning that the weights of the index components are a target for criticism by numerous Russian and European scientists, including S.A. Ayvazyan, who cites I. Numbler's criticisms [15]. B.V. Kornejchuk and N.G. Ivanova also subjected the index to the critical assessment, because it is difficult to use it as a full measure of human capital [16].

In addition to the adjustment of indices the new method is supposed to calculate several new indicators: the human development index, adjusted for socio-economic inequality, the gender inequality index, and the multidimensional poverty index. A wider range of indicators allows to analyze a wider range of indicators that affect quality of life of the population. In addition to the approved indicators, it would be appropriate to add indicators, influencing quality of life, that take into account:

- the environmental factor,
- the political system stability,
- the social tension in the society,
- the corruption level in the country.

In conclusion, it should be added, that in accordance with both the old and the new methodology, the main indicator of the population's income is the GNI per capita, which in its essence does not reflect the exact level of income, but it is highly weighted when calculating the HDI using the new method, which on the second thought shows certain reassessment of the importance of this criterion.

Thus, by analyzing the old and the new methodology for calculating the human development index it is worth mentioning that the new method has a number of positive aspects as well as some negative ones that have been criticized by economists and need some improvement. Nevertheless, the majority of

scientists recognize that the main task of the calculation of such index as the index of human development — development of the inter-regional system of countries ranking with the aim to assess the population life quality dynamics and compare it with other areas — is performed quite well, while remaining understandable enough for the general public.

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PRIEMYSHEV Artem A. — St. Petersburg State University of Economics.
191023. Sadovaya str. 21. St. Petersburg. Russia. E-mail: ginzart@bk.ru

ПРИЕМЫШЕВ Артем Андреевич — студент Санкт-Петербургского государственного экономического университета.
191023, ул. Садовая, д. 21, Санкт-Петербург, Россия. E-mail: ginzart@bk.ru

ARYSHEVA Marina V. — St. Petersburg State University of Economics.
191023. Sadovaya str. 21. St. Petersburg. Russia. E-mail: aryschewa.marina@gmail.com

АРЫШЕВА Марина Витальевна — студент Санкт-Петербургского государственного экономического университета.
191023, ул. Садовая, д. 21, Санкт-Петербург, Россия. E-mail: aryschewa.marina@gmail.com

LAVROVA Zoia I. — St. Petersburg State University of Economics.
191023. Sadovaya str. 21. St. Petersburg. Russia. E-mail: ZoyaL@yandex.ru

ЛАВРОВА Зоя Игоревна — доцент Санкт-Петербургского государственного экономического университета, кандидат технических наук.
191023, ул. Садовая, д. 21, Санкт-Петербург, Россия. E-mail: ZoyaL@yandex.ru