Assessment of the Impact of Human Capital on the Gross Regional Product (for Example, the Udmurt Republic)

N N Pushina¹, N G Sokolova¹, V Likhachev¹
¹Kalashnikov Izhevsk State Technical University, Izhevsk, Russia

E-mail: pushina_nn@mail.ru, sokolova-ng@mail.ru, lihachevneh@mail.ru

Abstract. The authors focus on the measurement of the impact of human capital on economic growth because of negative trends in population, decreasing cash incomes, "brain - drain", decline in the quality of education and growing stratification in access by income level. It is pointed out that the existing tools of human capital valuation should be analyzed and tools for assessing the impact of human capital on economic growth have essential significant. Authors put forward a hypothesis that the growth of human capital drives to GDP growth or GRP growth is it about a region. The article provides raw data and calculations of indicators of efficiency of use of capital goods and human capital for the Russian Federation for 2014-2016 and for the Udmurt Republic for 2013-2017. Conclusions drawn from calculations formulating indicate that the hypothesis concerning direct correlation between cost of human capital and efficiency of use tangible and intangible assets is failure. Particularly it is showed that the increase in the cost of human capital went hand in hand with decreasing of the efficiency of use of tangible and intangible assets in 2014 and 2016.

1. Relevance of the study

Over the past decades, the negative trends are observed in Russia including a steady population decline, fall in cash income of men-in-the-street, quality of life, a decline in the quality of education and "brain drain" effect [1]. This indicates a negative change in the quantity as well as in the quality of "human capital". Since the end of the -1980th - and early 1990th of the XX century, models of economic growth involving human capital has been developed. Since that there is a need to assess the impact of human capital on economic growth, which in turn requires an analysis of the existing tools for the valuation of human capital and the development of tools to assess the impact of human capital on economic growth. The main hypothesis of the study is that the growth of human capital brought about a rise in GDP (or Gross Regional Product).

But to assess the impact of human capital on the country's GDP (or GRP of the region) it is necessary to consider the ways and tools of human capital valuation.

2. Review of methods of assessment of human capital

First, let us consider the existing ways of estimating of human capital.

The main indicator that evaluates the results of economic performance is the gross domestic product (GDP) and correspondingly at the regional level – gross regional product (GRP). GDP reflects the market value of the goods and services produced by a country's economy over a period of time [2]. One of the factors of formation and development of GDP in the country is human capital. Currently,
an increasing number of economists recognize that human capital is a strategic resource for progress, so that with no investment in human capital there will be no economic development. Human capital is the main productive force of society, the most important resource for the development of production. For modern growing economy, human capital is both a dragging force and an object of impact.

One thing is clear – human capital reflects the commercial approach to the human being, they must to ensure decent incomes, like any other resource. Consequently, the considered human capital has a certain reproductive cycle and preforms cycling. Based on these statements, “human capital” from the point of view of financial resources is an unlimited set of abilities, knowledge, acquired skills of citizens living and working in the country, regardless of citizenship, and it is bringing income to the state, expressed in the decline in the country's real GDP growth rate. But the next question is how to estimate human capital. The most well-known indicator of human capital estimation is the United Nations Development Programme's Human Development Index (HDI) [3]. The HDI is an integral indicator that is calculated annually by experts of the United Nations Development Programme together with a group of independent international experts for cross-country ranking purposes. HDI is based on the arithmetic mean of the three constituent indices:

- life expectancy at birth;
- level of education;
- GDP per capita at purchasing power parity.

The analysis of HDI values leads to the conclusion that there is no clear relationship between the overall economic performance and the human development process. Either option is possible, countries with the same level of HDI may have the opposite level of per capita income; countries with the same level of income may have different HDI values. If the country's ranking on the HDI is higher than the rating according to the GDP, then the conclusion can be occurred that this country has managed to transform the economic prosperity into promoting human capabilities to maximum advantage. If the growth rate of HDI is lower than the GDP growth rate, the economic prosperity in such a country has not led to a corresponding improvement in quality of life [4].

But many economists believe that this way of estimation of human capital is unacceptable, because, firstly, the measurement reduces the value of the individuals because they are being considered as a a financial asset, and secondly, the effect caused by improving the quality of the population can be seen after a long time, which makes it difficult-to-measure.

Measurements of human capital are generally inaccurate, but that is extremely essential. The world community is gradually becoming aware of the importance of the reciprocal influence of the human capital and the financial performance of a country or region where conventional valuation methods do not work at all.

Table 1. Classification of metrics to assess human capital at macro and micro levels.

| The estimates of human capital | Natural quantitative and categorical indicators of human capital (working age population, the duration of education, average life expectancy, proportion of the population with higher education, poverty level, etc.). |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Cost valuation (cost approach, income method, market value of human capital, etc.) |                                                                                                                                  |
| Integrated assessments (Human Development Index, Intellectual Development Index, Quality of Life Index, etc.) |                                                                                                                                  |
| Efficient use of human capital | Employment rate, labor productivity, return on human capital, ROI, internal rate of return, Kirkpatrick model, return on investment by Philips, innovation index, etc. |
Since the formation of human capital carries out at different levels: individual, micro - (enterprise level), meso- (region level), national (country level), therefore, and approaches to its management are different. L.A. Sharok [5] proposes the classification of existing approaches to the assessment of human capital.

Should be distinguished two main groups of methods, the first is aimed at assessing the value of human capital, the second is assessing how efficiently it is used.

One of the simplest methods of assessing human capital in the early 60-ies of XX century proposed the famous American economist T. Schultz. The essence of his proposal is to calculate the size of human capital in value terms, multiplying the cost of one year of study by the number of person-years of education that have been accumulated by the population at that time [6]. The development of this approach was the emergence of cost-effective and profitable methods of assessing human capital.

The cost approach is based on the summation of all investments in human capital, with two main ways. In the first case, the assessment of human capital takes into account the scale of funds budgeted for maintaining human performance. This approach was first applied in 1883 by Engel. He calculated the human capital as the sum of the family's expenses for the upbringing and support of children up to the age of 25, as it is to this age, according to E. Engel, basically completed the formation of personal qualities and abilities [7]. Kalabikhina I. E. believes that the cost of human capital includes full cost per person, including the cost of the physiological characteristics of man (food, clothing, housing and health care provision) and the costs of social adaptation (costs of education, cultural level), adjusted by the amount of expenses for relocation, by the amount of income lost by the parents, the value "infant mortality", etc [8]. The second variant of the cost approach takes into account the investment component, which increases the productive capacity of people, primarily as a result of training and advanced training [9].

Evaluation of human capital on the basis of income approaches involves its assessment from the point of view of the individual income. These approaches are beginning to be used by W. Petty and W. Farri, who were the first to sum up lifetime earnings. Petty W. in his works calculated the value of the population as a product of the average length of working lives, adopted equal to 20 years and average annual income. Farri W. used a slightly modified method, where at the initial stage he calculated labor income taking into account the deduction of the subsistence minimum, in fact – the net effect on the use of human capital, and then revealed the differences between life expectancy and age, at the end applying the procedure of discounting earnings-to-be [10]. Looking ahead, it should be noted that there is the complexity of the time factor due to the uncertainty of future income of the individual.

Anyway, cost-based and income-based approaches do not take into account personal, family and social values and moral attitudes, which are also components of human capital, so we can say that they shall have regard to the only part of human capital while it is evaluated. These shortcomings and pitfalls became the basis for the development of integrated assessment indicators, the main of which is the HDI. But it is these approaches that are more objective in assessing the impact of human capital on GDP of the country. In 1988, when assessing the contribution of human capital to the national economy, American economist R. Lucas, who followed the model of production function, suggested that the productivity of human capital is subject to the law of diminishing returns [11, 12, 13]. Mankiw G., Romer D. and Weil D. to assess the impact of economic growth factors used the same production function as for physical capital, and human capital, as consumption.

3. Proposed evaluation method
In this paper, the concepts used for the absolute, overall, economic efficiency of the use of non-financial assets in the production activities of the country to be calculated, are specified: costs and results; the methodology for calculating human capital has been justified.

Changing Russian over to the system of national accounts (SNA) enables a more complete assessment of production activities as "the activities of units-residents of the national economy for the production of goods and services..., both market and non-market, sold free of charge or at prices that have no economic value" to be assessed [14]. The main macroeconomic indicator in the SNA-2008
system is the gross domestic product (GDP), which expresses in market prices the value of all final products (goods and services) produced in the country. Account generation of income is a continuation of the account of expenses on total GDP. The annual country’s GDP at current market prices, is equal to the annual income (AI), which is received by all owners of capital (legal entities and individuals) including: government agencies, entrepreneurs and employees:
- employees receive income \( (EI) \), first, as payment for their work, and, secondly, in the form of the perks, health care provision and free of charges services providing by enterprises in education, security, public order and other social services;
- the revenue of entrepreneurs \( (ENR) \) accrues from the return on invested in the production of equity (net profit, including dividends and rewards), and, secondly, from free of charge above mentioned government services. In addition, if the entrepreneur is also an employee of the enterprise, he or she receives part of the \( EI \) income as payment for his labor;
- income received at the disposal of the state (or the budget) \( (ABI) \) accrues from the profit-making state property, as well as tax revenues. The income of \( A_B \), its accumulated and consumed part, belongs to the entire population of the country.

Therefore, the annual gross domestic income of the country, equal to GDP, can be expressed as follows:

\[
AI = EI + ABI + ENR. \tag{1}
\]

In the Russian Statistical Yearbook-2017, the income generation account is presented not by recipients of income employed in the country’s economy, but as the sum of various accounts used in the economic system. For example, table 12.4 [15] provides information on taxes on production and imports, while other taxes are included either in wages of employees or in gross profit. Therefore, to determine the revenue share of each entity, the recipient of the income \( (EI, ABI, ENR) \), it is necessary to carry out time-consuming special study. It is almost impossible to calculate indicators of economic efficiency on the basis of statistical information. Therefore, achieved in the reference year the economic results will measure in total income otherwise by GDP at market prices. Information on the income account is published in the Yearbook of Rosstat, there is also information on the amount of accumulated physical properties.

For the subsequent choice of the method of calculation of the human capital it is necessary to specify the concepts used further relating to capitalization of the employees’ income. Not all scientists recognize the scientific validity of this procedure. So, according to Alba A. Weinstein and V. N. Bogacheva, “in the case of evaluation of reproducible property for production purposes, the relevant parts of the company’s net income are subject to capitalization. Wages are also income, but ... for their economic purpose, it only covers the cost of reproduction of the labor force of the appropriate quality... Where is the net income of the working population, the capitalization of which gives the alleged amount of human capital?”[16]. Analyzing the advantages and disadvantages of the income approach, R. I. Kapelyushnikov cites the views of various researchers who assess human capital. At the same time, a number of researchers believe that operating costs, which appear as expenses for maintenance of people, should be deducted from gross income, while others, on the contrary, believe that consumption is not the means, but a goal of production and investment, and that therefore “gross earnings” are a more adequate basis for cost estimation of human capital than net income [17, p. 24].

Different opinions of scientists about the inclusion or exclusion of certain parts of income from the total amount arise due to the use of different interpretations of the term “capitalization” in the production, sale and use of items, as well as due to the need to reflect the different economic interests of the owners of capital in solving specific problems:

2. The term “capitalization” here means, firstly, the definition of the market price of tangible and intangible objects by the cost of money for their production and sale and, secondly, the calculation of the market price of these objects on the income in the sphere of their use or consumption. This understanding of the term “capitalization” meets the requirements of the
Federal Law on Valuation [18] and the current Federal Standards, which define the cost, income and comparative approach to the valuation of tangible and intangible assets.

The amount of annual income which is received by the employee, corresponds to the proportion of the capital value of one’s labor force, which is penetrated into the product throughout the year as well as transferred the annual share of capital cost of the material means of production, generating income $EI_{1} + EAI_{1}$. And the same, the capital of income that the owner may expend to obtain for this income during the planned time period can be fetched out from income $EI_{1} + EAI_{1}$ or $E_{NR} + ENRA$. Determined using the income approach a complete overhaul price $KPH_{1}$ of labour-force of the employee is equal to the sum of the annual gross income $ENR_{1} + ABIH_{1}$, discounted by year during the entire period of use $(TP)$ of human capital. Similarly, the total present value income of $ENR + ABI$ during the $TP$ can be used to calculate the full capital price of fixed and current assets of $K_{V}$ real objects belonging to the owners. The annual net income of the employee and the net income of the entrepreneur are part of the total gross income of the $TI$. The total income $TI$ is distributed between the entrepreneur and the employee in accordance with the laws, decrees, regulations and other restrictive documents in force in the country, and therefore, if these restrictions are changed, the income received either for the benefit of the entrepreneurs or for the benefit of the employees.

In order to calculate the minimum capital price of labour through the cost approach, the annual costs of the family and the state discounted by year due to the birth of a child before the child reaches the working age are summed up using the cost approach. The calculation of the annual minimum costs of the family is carried out in accordance with the norms of the subsistence minimum for the maintenance of children.

2. The economic evaluation subject of the effectiveness of social and economic activities can be distinguished in scale of their implementation and activities. To assess the effectiveness of the country’s development, comprehensive national economic indicators are used, which are calculated taking into account all the physical, human and natural capital of the country, regardless of the sources of funding, and all the gross income from this capital. When assessing the effectiveness of local facilities within a individual enterprise, industry, territorial region, local indicators are used such as self-supporting and national economic indicators. In the calculation of self-supporting indicators, the net income that the investors weight from investing their capital in any facilities are capitalized, and when calculating the local economic indicators all of the gross income generated at the local production facilities are capitalized.

The net capitalized income of an employee can be determined If all costs of his / her maintenance within the cost of living and other costs not yet included in this cost are deducted from his / her salary. Information on an employee’s net income may be interesting, for example, to the lender while the appropriateness of granting a loan to that employee are being assessed.

The state, entrepreneurs and employees are interested in getting the maximum income from investing their capital in tangible and intangible assets of the country. Therefore, information on net and gross income is essential to know in order to choose the most attractive destination for capital and align the interests of the state with the interests of entrepreneurs and employees. Capitalizing net and gross income at the expected rate of capitalization, ones get self-supporting and economic value of the estimated object. And when calculating the ratio of annual net or gross income to capital invested in any income-generating object, ones get various indicators of its economic efficiency, among which the most important are the ratio of the annual value of GDP to the capital value of non-financial assets of the national wealth of the country, including human capital, the calculation method of which should be chosen.

On the basis of the concept in 2009, a project of cross-country comparison of human capital was launched using the methodology developed on the basis of the Jorgenson-Fraumeni income approach [19].

The measurements were performed by summing up the lifetime earnings of workers categorized by age. Their education, gender factor, probability of their survival to age 75 years, employment rate and expected annual growth rate of their wages were taken into account. According to this method, R. I.
Kapelyushnikov had measured the human capital of Russia [20]. Kapelyushnikov R. I. studied the impact of these factors on the growth of human capital in Russia for the eight-year period from 2002 to 2010. He found that human capital increased by only 6% under the total influence of these factors, and the main engine for human capital to be increased is a pay increase which boosted up human capital by 117% [21, p. 24-26]. He also noted the various shortcomings of the proposed approach. Given these shortcomings of the Jorgenson–Fraumeni method, a number of studies show the possibility of combined use cost and income approaches [22].

In this paper, the convenient methodology of estimating the capital cost of labor on income produced in the accounting year is used. Capitalized income is represented as a series of annual revenues of the appraisal period, each of which is equal to income generated in that time. The capital consumption should be taken into account in the nominal value of annual gross income. In the years following the settlement, the annual income can only change if the value of the used assets changes, which would be reflected in the information of the next appraisal period and the same for the duration of the settlement period.

This method is taken as basis for human capital to be measure. In doing so the cost of human capital \( (CHR) \) is calculated by the formula (2), the effectiveness of the use of tangible and intangible assets of the country \( (EUA) \) is figured out by the formula (3), the interim results for the calculation by the formula (4) [22]:

\[
CHP = \frac{CT}{\left(\frac{AGDP}{AAI}\right)} - 1, 
\]

\[
EUA = \frac{AAI}{CT + CHP} = \frac{CFS + WE}{CHP}, 
\]

\[
CFS = (AAI - WE - BSP + ISP + PT) \cdot \frac{WE}{(BSP - PT - ISP) + WE}, 
\]

Here \( CT \) is the cost of capital goods, monetary unit; \( AAI \) - annual average income, monetary unit; \( WE \) - wages of employees (with no income tax), monetary unit, \( CFS \) - the cost of free services of the state, according to the current practice of assessing the value of the property on the average profitability of its use, monetary unit; \( BSP \) – balance sheet profit and gross mixed income in \( GDP \), monetary unit; \( PT \) – profit tax organizations, monetary unit; \( ISP \) – income from state property, monetary unit; \( AGDP \) - the annual \( GDP \) of the country, measured in market prices, monetary unit.

Note that the \( EUA \) indicator is actually an indicator of leverage both tangible capital and human capital.

4. Tasting of these approaches

Performed calculations (table. 2) according to statistics of the Russian Federation for 2014-2016 showed that, despite the annual growth of GDP in 2015 by 4.1% and in 2016 by 3.4% compared to the previous year, the intensity of return on income from real and human capital in 2015 increased by only 2.9%, and in 2016 decreased by 11.4%. The reasons for the decline in capital productivity is the increase in the growth rate of the cost of real and human capital compared with the growth rate of the \( GDP \) of the country, as well as due to the faster growth in the cost of human capital about real. If the increase in the cost of real capital was about 11.9% in 2016, the human capital increased by 20.5% this year. In the same year, the total real and human capital increased by 16.3%. The accumulation of expensive fixed capital and the growth of working capital reduces the economic efficiency of the country's national funds.
Table 2. Raw data and results of calculation of indicators of efficiency of use of real and human capital of the Russian Federation, 2014-2016, million rubles [23].

| Symbols | The value in million rubles. |
|---------|-----------------------------|
|         | 2014 | 2015 | 2016 |
| AAI     | 79919659 | 83232618 | 86043649 |
| CT      | 211632381 | 230700800 | 258220255 |
| We      | 33648458 | 34282307 | 36701360 |
| BSP     | 30808242 | 35868475 | 35851105 |
| PT      | 2375300 | 2599000 | 2770300 |
| ISP     | 612000 | 733000 | 775000 |
| CFS     | 10099704 | 8421347 | 9060829 |
| AAI     | 43748162 | 42703654 | 9060829 |
| CHP     | 255962531 | 24307227 | 293365434 |
| EUA     | 0.171 | 0.176 | 0.156 |

EUA(i) = EUA(i+1) / EUA(i) - 1

Note: i indicates the previous accounting year

Next, we go on to calculate an indicator on the example of Udmurtia. Calculations were made for the Udmurt Republic for the period 2013-2017 on the basis of national accounts data: NA.6.6., NA.12.3., NA.12.4., NA.12.22., NA.12.23 [24-26]. The calculation results are presented in table. 3.

Next, we can proceed straight to the assessment of the impact of human capital growth on the GRP of the region. To do this, it is available to compare the relative increase in GRP and the relative increase in the factors that caused it.

Table 3. Raw data and calculation of indicators of efficiency of use of capital goods and human capital of the Udmurt Republic for 2013-2017, mln. RUB.

| Denotation of the indicator | Period 2013. | 2014. | 2015. | 2016. | 2017. |
|-----------------------------|-------------|-------|-------|-------|-------|
| AGDP                        | 405126.40   | 450548.90 | 497685.00 | 540115.00 | 584100.00 |
| CT                          | 60034.60    | 64666.70 | 54999.00 | 54774.80 | 50978.80 |
| WE                          | 214069.90   | 240549.00 | 279956.90 | 312256.00 | 340359.04 |
| BSP                         | 60991.00    | 63927.00 | 66932.00 | 73564.00 | 78506.00 |
| PT                          | 905.00      | 868.00  | 764.00  | 748.00  | 938.00  |
| ISP                         | 37191.54    | 38420.92 | 37530.62 | 39109.20 | 42091.83 |
| CFS                         | 339776.00   | 385946.00 | 445262.00 | 434669.00 | 434229.00 |
| AAI                         | 38032.00    | 41221.00 | 40604.00 | 41266.00 | 34108.00 |
| CHR                         | 4.13        | 4.25    | 5.21    | 5.62    | 6.86    |

Increase/decrease
Do AGDP - +3.00% +22.35% +8.03% +22.07%
Increase/decrease
Do CHR - +1.08% -0.01% +1.02% -0.17%
On the basis of the analysis, several conclusions can be drawn. The outstanding growth of GRP was in 2014 and it was 11.21% and its lowest ratio was in 2017 where it decreased by 8.14%:

1) for the analyzed period the GRP of the Udmurt Republic annually increases;
2) the value of both capital goods and human capital for the period of 2014-2016 increased, but in 2017 it had been decreased;
3) at the same time, the efficiency of use of tangible and intangible assets for the entire period was growing. The most growth took place in 2015 and 2017.
4) but the most significant conclusion was jumped in implied from comparing the relative growth of GRP and the relative growth of human capital. Calculations show that in 2015 and 2017, the increase in the intensity of returns on capital goods and human capital leaves behind the growth of the Gross Regional Product of the Udmurt Republic. Thus, the increase in the efficiency of return on capital goods and human capital in 2015 amounted to 22.35% compared to 10.46% of Gross Regional Product growth, and in 2017 amounted to 22.07% compared to 8.14% of GRP growth. At the same time, in 2015 and 2017 there was a decrease in human capital by 0.01% and 0.17%, respectively. In 2014 and 2016, the situation is reversed – the relative growth of the Gross Regional Product outpaced the relative increase in the intensity of return on real and human capital, while there is an increase in human capital. In fact, it can be concluded that the hypothesis that the growth of human capital drives to an increase in the country's GDP (region's GRP) is not confirmed, on the contrary – with an increase in human capital, the increase in the efficiency of the use of tangible and intangible assets of the region is reduced. At least it was observed in 2014 and 2015.

And the highest growth of GRP took place, just in those periods in which the growth of human capital was minimal or there was a decrease in it, which is typical for 2015 and 2017.

In general, to assess the impact of human capital on GRP the following coefficient can be suggested for being used:

$$KI = \frac{EUA(i+1)/EUA(i)}{CHP(i+1)/CHP(i)}$$

In fact, this indicator is the coefficient of elasticity, which reflects how changes in one factor impact another factor [27] or a measure of the sensitivity of one variable to the change of another [28]. In this particular case, the coefficient reflects how GRP will change when the value of human capital changes by 1%. Data for the calculation and the final results of the formulaic calculation using equation (5) summarized in table 4.

| Table 4. Raw data and results of calculation of the coefficient of human capital impact on GRP of the Udmurt Republic |
|------------------------------------------|------------|----------|----------|----------|
| Table of symbols                        | Values     | 2014     | 2015     | 2016     | 2017     |
| EUA(i+1)/EUA(i)                         | +3.00%     | +22.35%  | +8.03%   | +22.07%  |
| CHP(i+1)/CHP(i)                         | +1.08%     | -0.01%   | +1.02%   | -0.17%   |
| Квл                                     | 2.78       | 22.57    | 7.87     | 26.59    |

Thus, the results do not give a clear conclusion about the impact of human capital on the region's GRP or the country's GDP. To further test the hypothesis, it seems reasonable to analyze a time lag, because of impact that human capital gives GDP growth could expose itself not immediately, but in the long term.

5. References
[1] Sokolova N G 2019 Marketing of the theritory: management of the quality of the people life Social and economic development and quality of life: history and modern times: materials of the
IX International scientific conference on March 15-16, 2019 (Prague: Vedecko vydavatelske centrum "Sociosfera-CZ") pp 32-34

[2] Order of the Federal Agency of State Statistics 81, dated 28 Feb. 2013 "On the approval of the methodology of the indicators “Proportion of hi-tech and scientific industries in GDP” and “Proportion of hi-tech and scientific industries in GRP of the region of the Russian Federation”

[3] Report on Human Beig Development 2004 Cultural Freedom in Mdnern World Publishing House «Ves mir» 328 p

[4] Kiritchnov M B 2010 Theories of Economic and Political Development of Brazil in XX century and in early XXI century (Voronezh: International Relationships Faculty) 191 p

[5] Sharok L 2007 Ways of effective human capital using HR Management 21 pp 53-56

[6] Theodore Schultz Wikipedia URL: https://en.wikipedia.org/wiki/Theodore_Schultz.

[7] Kalabikina I A 2011 Humans development: new dimension of social and economic progress estimating Textbook. Edt. Kolesov V P (Moscow: Publishing House: “Prava Cheloveka”)

[8] Davydov V 2011 Brazil – «tropical» gaint is rising (Moscow: ILI RSA) 122 p

[9] Paradoxes of the human capital measurement http://mirznanii.com/a/284882-5/paradoksy-izmereniya-chelovecheskogo-kapitala-5

[10] Robert Lucas Jr. Wikipedia. URL: https://en.wikipedia.org/wiki/Robert_Lucas_Jr

[11] Kramin T V, Grigoryev R A, Timiryasova A V, Vorontsova L V 2016 the contribution of the intellectual and social capital in economic growth of Russian regions Actual Problems of Economics and Law Vol 10 4

[12] Krisinevitch S A 2015 Efficiency of the human capital development: theoretical and methodological aspect Economic Bulletin of University Collection of Scientific Works of Scientists and Post-Graduated Students

[13] Russian Statistical Yearbook 2017 URL: www.gks.ru/free_doc/doc_2017/year/year17.pdf/

[14] Bogatchev V N 2006 National economies efficiency and cost mechanism (M.: Nauka) P 170

[15] Kapelushnikov R 2012 Russia’s human capital: what is its value? Working paper WP3/2012/06

[16] Federal Law 135-FZ dated 29 JUL 1998 “On Assessment Activities in the Russian Federation” URL: http://www.consultant.ru/document/cons_doc_LAW_19586/

[17] Jorgenson D W, Fraumeni B M 1989 The Accumulation of Human and Nonhuman Capital 1948-1984 R E Lipsey, H S Tice (Eds.) The Measurement of Savings, Investment and Wealth (Chicago: The University of Chicago Press)

[18] Jorgenson D W, Fraumeni B M 1992 The Output of the Education Sector Z Griliches (Eds.) Output Measurement in the Services Sector (Chicago: The University of Chicago Press)

[19] Soklakova A V, Likhachev V N 2017 Measurement of Economic Losses from Workforce Outflow to Abroad Bulletin of Kalashnikov ISTU Vol 20 2 pp123-127

[20] Likhachev V N, Pushina N N 2018 To Calculation of an Economic Efficiency Indicator of Non-Financial Asset Use to the Country National Wealth Bulletin of Kalashnikov ISTU Vol 21 3 pp 114-119

[21] Russian Statistical Yearbook 2017 URL: www.gks.ru/free_doc/doc_2017/year/year17.pdf/

[22] General government budget performance report (f. 0507021) URL: datamarts.roskazna.ru/infografika/ispolnenie-konsolidirovannogo_budjeta-2014-god/

[23] Regions of Russia Social and economic indicators 2017 URL: http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1138623506156

[24] Paul L Heyne, Peter J Boettke, David L Prychitko 2013 The Economic Way of Thinking: Pearson New International Edition ISBN 9781292053608 Pearson Education

[25] Elasticity (economics) Wikipedia URL: https://en.wikipedia.org/wiki/Elasticity_(economics)
Acknowledgments
This work is supported by the Kalashnikov Izhevsk State Technical University (Izhevsk, Russia) under grant 38.04.01/18GRA.