SCIENCE AND EDUCATION IMPACT ON ECONOMIC GROWTH AND ASSESSMENT METHODOLOGY OF INNOVATIVE POTENTIAL

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1. Scientific-educational system and economic growth

Indisputably in the 20th century, now and in the future, economic development is mostly based on innovations, especially in advanced technological solutions. In this case, the assessment of the economic consequences of knowledge and education is an extremely significant and contemporary scientific issue. The latter, being a relatively new area of research is sourced from the classical works of economics (A. Smith, A. Marshall, etc.). Conceptual issues of innovative development have been considered especially in the works of J. Schumpeter[1].

Qualitative and quantitative assessments of the impact of scientific-educational system have significant importance among economic development issues and are brought to the attention of many researchers. Several applied research studies conducted by samples of different countries and carried out in several directions are dedicated to these issues. In particular, the question of the effectiveness of investments in scientific-educational system has been studied[2]. These investments are important components of the economic policy of any country and the approaches on this matter vary significantly in various countries. The principles of assessing correlation between a scientific-educational system and economic development are distinctive in each country[3]. Expenditures on science are considerable especially in South Korea and Sweden, which are more than 4% and 3% of GDP respectively and make up 1200-1300 U.S. dollar per capita. In absolute value, expenditures on science are large in the USA and China. An interesting fact is that some countries not having much economic development level, such as Slovenia, Estonia, Iceland, in this regard invest heavily in the science in order not to fall behind the aforementioned countries by expecting high economic efficiency in the future.

Remarkable investigations have been conducted by various countries, which discovered so-called economic efficiency between education and science. These studies reveal a useful experience in system development in this or that country. There

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[1] Шумпетер Й., История экономического анализа в 3 тт. - СПб.: Экономическая школа, 2004.

[2] Julia Lane Jason Owen-Smith Rebecca Rosen Bruce Weinberg, (2014) New Linked Data on Research Investments: Scientific Workforce, Productivity, and Public Value No. 8556 October 2014

[3] See more details about this in Suvaryan Yu., Harutyunyan V., Khachatryan V. (2011). “Scientific-educational system and economic development”, Yerevan: Science, pp. 10-20.

are numerous studies concerning the education impact on the economy. The latter have been assessed from different perspectives. For instance, the impact of education has been calculated not only on the income of individual dynamics but also on the macroeconomic indicators of countries. The experience of South Korea is noteworthy in terms of discovering economic efficiency of science, where in the last few decates structural changes in GDP in favor of spendings on science brought about 5-6 times unprecedented growth of GDP per capita[4].

The study of the issue is important for those countries, which are on the way to improve the scientific-educational system in order to record sustainable economic growth. The Republic of Armenia (RA) is among these countries. The further economic development of our country also depends on investments in science and education. The RA doesn`t have rich natural resources and geopolitical location contributing to economic advancement. Therefore, economic advancement can mostly be based on the new scientific-technological solutions and information technologies.

During independence statehood (post communist period), the scientific-educational system of our country has passed certain challenges and currently stands on the improvement path. In order to develop a strategy for the further advancement of the RA scientific-educational system, it`s especially important to evaluate correlation between system and economy for the period of our modern history.

The assessment methodology of science and education impact on the economic growth and development is based on extensive international experience of the investigation on the issue.

To assess the impact of science and education on the GDP volume and growth rate, a direct impact of changes in the volume of scientific works and educational services of the public importance (state, private, funded) of these spheres on the economic development has been calculated. Additionally, an impact of scientific-technical advancement and education as factors of economic dynamics have been observed.

Investments in innovation, scientific research and human resources, additionally expansion of grant programs financed by international organizations as well as investments in the developments of corporate nature innovation and scientific-structural developments are essential for GDP growth. The investments simply increase GDP volume and growth rate, as a factor of expanding the volume of educational and scientific and technical services. The results of scientific-educational activities financed by the state budget, private financing and by grant programs are reflected in the GDP of a country as scientific-educational services bought by the entities (including the state) operating in the market. Accordingly, the contribution ($\Delta P_{(S+E)}$) of the scientific-

4 World Bank (2004): *World Development Indicators* 2004. World Bank, Washington DC.

educational system on the GDP (G∆P) growth rate (P) has been calculated by the following formula:

$$\Delta P_{(S+E)} = \frac{(S_t - S_{t-1}) + (E_t - E_{t-1})}{G\Delta P_{(t-1)}} * 100,$$

$$\Delta P_{(S)} = \frac{S_{t-1}}{G\Delta P_{(t-1)}} * 100,$$

$$\Delta P_{(E)} = \frac{E_t - E_{(t-1)}}{G\Delta P_{(t-1)}} * 100$$

where S and E reflect the volume of scientific-technical and educational services in the periods t and t-1 accordingly.

The long-term impact on GDP growth is manifested through the creation and investment of new technics, preparation of qualified professionals, and through the enhancement of the country`s competitiveness. Economic-mathematical models accepted in international practice have been used for the assessment of such impact.

Based on the calculations, the direct combined impact of science and education on GDP dynamics on average made up 0.23% in 1995-2013, while the average annual growth rate of GDP made up 7% in that period. By the way, the impact of education was 0.25%, while that of science 0.03% (See table).

The impact of science and education on GDP volume and growth was evaluated as stated with the use of economic-mathematical methods together with the factors of capital and labor in 1995-2013.

The economic-mathematical model has been built on the methodology of the production function, because the international experience of similar studies as well as the situational analysis show that to assess the most realistic impact of education, science and other factors on GDP, it's important to include capital and labor in the model as the main factors forming GDP. In this regard, it`s appropriate to rely on the logic of Kobe-Douglas function and to define the correlation between mentioned factors by the exponential model. In this case, the calculated model will present also the coefficients of elasticity factors as a reasonable basis for conclusions.

Based on the above, the following dependent and independent variables have been chosen for the construction of the model:

GDP - GDP in current prices (billion AMD),

K - Gross accumulation of fixed assets (billion AMD),

L - The average annual number of employed (thousand person),

E - The volume of educational services (billion AMD),

S - The volume of scientific-technical works (billion AMD)

DIRECT INVESTMENT OF SCIENCE AND EDUCATION ON THE GDP GROWTH RATE

	GDP (bln AMD)	GDP growth %	Volume of research works (bln AMD)	Share of science in GDP %	Impact of science on GDP growth, %	Education (bln AMD)	Share of education in GDP, %	Impact of education on GDP, %	Impact of science and education on GDP, %
1995	522,3	6,9	2,0	0,38	–	26,9	5,15	–	–
1996	661,2	5,9	2,0	0.30	0.00	27.9	4.22	0.19	0.19
1997	804,3	3,3	2,1	0.26	0.02	29.0	3.61	0.17	0.18
1998	955,4	7,3	2,7	0.28	0.07	30.2	3.16	0.15	0.22
1999	987,4	3,3	2,2	0.22	-0.05	38.4	3.89	0.86	0.81
2000	1031,3	5,9	2,6	0.25	0.04	39.5	3.83	0.11	0.15
2001	1175,9	9,6	3,1	0.26	0.05	42.9	3.65	0.33	0.38
2002	1362,5	13,2	4,2	0.31	0.09	49.8	3.66	0.59	0.68
2003	1624,5	14,0	5,0	0.31	0.06	56.6	3.48	0.50	0.56
2004	1907,9	10,5	4,9	0.26	-0.01	57.6	3.02	0.06	.0.06
2005	2242,9	13,9	5,9	0.26	0.05	63.6	2.84	0.31	0.37
2006	2656,2	13,2	6,5	0.24	0.03	74.7	2.81	0.49	0.52
2007	3149,3	13,7	7,0	0.22	0.02	89.1	2.83	0.54	0.56
2008	3568,1	6,9	7,8	0.22	0.03	96.9	2.72	0.25	0.27
2009	3141,7	14,1	9,4	0.30	0.04	113.4	3.61	0.46	0.51
2010	3460,2	2,2	8,7	0.25	-0.02	120.9	3.49	0.24	0.22
2011	3777,9	4,7	9,2	0.24	0.01	120.7	3.19	-0.01	0.01
2012	4000,7	7,2	9,7	0.24	0.01	125.8	3.14	0.13	0.15
2013	4272,9	3,5	10,2	0.24	0.01	129.9	3.04	0.10	0.11
Average annual rate	–	7.0	–	–	0.03	–	–	0.25	0.23

To assess the integral impact of education and science on GDP, the effect of the following 3 variables on GDP has been built:

K - Gross accumulation of fixed assets (billion AMD),
L - The average annual number of employed (thousand person),
E+S - The sum of scientific-educational services (billion AMD),

Taking into account the nature of multilateral indirect and long-term impact of science and education on economic development as well as the behavior of presented numerical series, a preference has been given to exponential correlation between education and science of GDP, in other words to the version of production function supplemented with new factors. Considering the fact that scientific-educational system influences the economic development not directly, but with a certain lag, a triennial lag was applied in the model. The following model was obtained:

$$GDP=194K_t^{0.35} L_{(t)}^{-0.28} \quad (S+E)_{t-3}^{\ 0.54} \qquad R=0.992183 \ (1)$$

With the same approach the impact of combinations capital-work-science-education, capital-work-education, capital-work-science on GDP volume and progress has been calculated.

To assess the impact of science and education on GDP, the impact of the following 4 variables on GDP has been evaluated:

K - Gross accumulation of fixed assets (billion AMD),

L - The average annual number of employed (thousand person),

E - The volume of educational services (billion AMD),

S - The volume of scientific-technical works (billion AMD)

In a result of calculations, the following coefficients of elasticity have been determined:

$$GDP_{(t)=}4123\text{-}K_{(t)}^{0.28}L_{(t)}^{-0.58}\ S_{(t-3)}^{0.27}.E_{(t-3)}^{0.33} \qquad R=0.993052\ (2)$$

According to model (1), elasticity coefficient of capital is 0.35, that of work -0.28 and that of education and science cummulative indicator 0.54. As the number of empoyed people during the investigated period from 1995-2013 declined from 1476.4 to 1163.8 thousand people, therefore, the elasticity ceofficient of that factor obtained an appropriate meaning.

A model of similiar nature was solved for the periods 1995-2008 and 1995-2010. Based on the calculations the elasticity coefficient of capital was made up 0.47 and 0.4 correspondingly, and that of education and science cummulative indicator 0.17 and 0.3. In 2011-2013 the gross accumulation of fixed assets showed a downward trend because of reductions of investments compared with the previous period, in a result of which, the elasticity coefficient for scientific-educational system was increased based on the last model, while that for the capital declined. Therefore, it can be concluded that with the involvement of different years, calculated average elasticity coefficient for scientific-educational system varies from 0.2-0.3. Thus, according to the results obtained, 20-30% of GDP annual volume in 1995-2016 was due to science and education.

An individual impact of education and science on GDP growth has also been observed (second model). Elasticity coefficients accordingly made up 0.33 for education and 0.27 for science. In general, in all model calculations the importance of science in GDP dynamics is relatively low.

This phenomenon proves that scientific-educational system especially scientific works are not aimed at innovative development, the connection between science and production is weak, fundamental scientific achievements are neither applied in the results of practical scientific-structural developments nor become types of the new technologies and product, the commercialization of which should be followed.

The above-mentioned indicators prove the state of the accomplishments in science and education, in particular, the conversion of knowledg into the value and national wealth. However, the calculations show that in short-term and in long-term phases that processes significantly fall behind the realities of the developed countries.

The analyses have made apparent that a gap arose between achievements of science, creation of scientific concepts and their application and commercialization processes. The same refers to education: highly qualified specialists are prepared and some of them seek jobs in foreign countries, a so-called “brain-drain” phenomenon takes place and thus created scientific potential does not fully serve to the socio-economic interests of the country. In this respect, definitely the most important issue is the strengthening relations between science and production, which is possible, if:

− Partial order and partnership principles are involved in the system financing science,

− Science management system is aimed at innovative development, provision of strong relations between science and production.

2. Innovation potential assessment methodology

In the current conditions of rapid scientific and technical progress, the innovative activity, as stated above, has an obvious impact on economic advancement. Therefore, it`s important to evaluate that influence and the innovative potential. Currently, various and sometimes even contradictory approaches exist for solving the problem. The reason probably is that in different countries and in various economic systems, management of innovative activities is carried out by different models and in this sense, it`s impossible to apply a uniform methodology.

The assessment of innovative potential, first of all, is based on the interpretation of innovative potential. The concept of innovative potential or innovative capacity in economics literature is explained by a variety of approaches.

In some sources[5], the entity of different types of resources necessary to carry out an innovative activity is presented as an innovative potential or capacity. This interpretation by its nature is presented as a resource based approach. The definitions used by the proponents of this approach, are directed only towards estimation of potential and opportunities of the economic system. In another interpretation[6] an innovative potential is considered in terms of results of innovative activity, i.e. actual product, which was obtained in a result of innovative process. In this case, innovative capacity is presented as possible and future innovation product to be created.

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[5] www.finam.ru

[6] Кравченко С. И., Кладченко И. С. Исследование сущности инновационного потенциала, Науч. труды Донецкого национального технического университета. Сер.: экономическая. Вып. 68. Донецк: ДонНТУ, 2003.

A point of view can be found in the literature of economics, according to which an innovative capacity should be identified together with scientific-technical or intellectual and creative capacities. This approach is not justified, because according to that opinion innovative activity should be considered only within the given capacities.

Many authors, who study the quantitative assessments of innovative capacity of the economic system, present innovative potential as an integration of resources, infrastructures and results during innovative capacity calculations. With this approach the innovative potential is defined as a system combining its 3 elements: resources, inner and outcome, which are in interaction and depend on each other[7].

Innovative capacity is a parameter, which allows the region to evaluate the possibilities of its innovative activity and decide innovative development strategy. With this approach, some authors suggest identifying so-called “hidden” resources or possibilities of the country for integrating and implementing them in the future in the innovative system. Indeed, this approach is justified, however, it does not reveal the current situation[8]. In some sources[9], innovation for the region is measured based on „own“ and acquired innovation. Comprehensive assessment of innovative capacity assumes, first of all, the existance of scientifically proved system of indicators and second the existance of a statistical base. Research on the assessment of innovative potential has been most actively conducted only in the last 15 years. There are a lot of problems which are under active discussions.

The main problem of assessing the potential is the identification of a primary principle or model, based on which evaluation factors will be presented. Two approaches are distinguished: from science to innovation and from market to innovation.

Taking into account the first approach, innovative activity is directly based on scientific potential. In those countries, where scientific potential is significant, innovative activity is more active. The most important question here is whether innovative idea is generated in scientific-research field or it`s more a business initiative. Perhaps, it can be stated that two models exist. In one case, scientific research activity can be a source for innovation; in another case, business activity or market can generate an innovative problem or innovative request. In fact, science out of the economic field or without innovation could be, however, innovation without economic consequences could not be imagined.

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7 Кокурин Д. И., Инновационная деятельность, Москва, 2001.

8 Чекулина Т. А., Тамахина Е. А., Инновационный потенциал региона: содержательные особенности и теоретические аспекты исследования / Т. А. Чекулина, Е. А. Тамахина // Вестник ТГУ. 2011. № 2 (94), стр. 65-70

9 Nauwelaers C., A. Reid Methodologies for the evaluation of regional innovation potential / Claire Nauwelaers, A. Reid// Scientometrics. 2005. Volume 34. Number 3. pp. 497-511.

Kalcsú Zoltán, Magyar Dániel. Regional Situation Analysis on the Innovative potential of the West - Transdanubian Region. / South East Europe Transnational Cooperation Programme «Jointly for our common future» Project FIDIBE - «Development of Innovative Business Parks to Foster Innovation and Entrepreneurship in the SEE Area». Written by Pannon Novum Nonprofit Ltd. on behalf of West Pannon Regional Development Company. November 2009.

One of the main issues is whether science and innovation are significantly different activities, which should be managed by different models or which should be supported by various means, or these two areas should be considered as interdependent and as a united system. According to some approaches, scientific research resources undoubtedly play a significant role in business innovation, however, a successful innovation requires knowledge, ability and initiation. Moreover, there is no clear path from successful research to innovation.

Discussions focus on the so-called „innovative chain", according to which any research leads to innovation. It`s rather complicated to evaluate the results of research, which have not become a market product yet. It should be stated that an innovative chain is not „measurable". On the other hand, the process from research to innovation shows that this model provides insufficient description of the relation between research and innovation because of several reasons. A considerable part of innovation originates from the idea of the market. As already stated above, innovation is not a sole application of scientific principle. It includes knowledge from many other sources and the difficulty in an innovation system is in ensuring proper balance between science and business.

It`s also important to evaluate so-called „innovative" area in the economy. Based on some approaches, innovation is apparent in the field of high technologies. According to some sources, the main innovative area of the US economy is the computer technologies, but in some countries these areas could vary. Some sources state that economic development can not merely be attributed by a sector called „high technologies"[10]. Innovative policy should contribute innovation in all areas and not only focus on the high technologies. An approach can be considered as a basis that each country can measure its innovative potential based on the characteristics of the industry that is more developed and makes a country more developed.

Another issue is the time lag between „science-innovation-business". Definitely, scientific result can not directly become a market product. It especially refers to fundamental scientific research. Here also there cannot be one common standard. This also causes problems in terms of assessing innovation potential.

Based on the analyses conducted, the possible models or solutions for assessing the RA existing innovative development potential are observed below.

First of all, several knowledge-based fields and fields having innovative potential should be distinguished in the economy. The priority should be given to the IT sector, but several other sectors of our country deserve attention too, such as instrument making and pharmaceutics. The innovative potential in the RA could be estimated for an individual sector or in macro level, as no systematic data exist for individual enterprises. Currently the RA state statistical service provides some indicators, which describe the scientific research field (research and development costs, the number of research

[10] Lennart Elg., Innovations and new technology - *what is the role of research? Implications for public policy,* VINNOVA Analysis VA 2014:05, Swedish Governmental Agency for Innovation Systems April 2014.

companies and their staff, etc.), patent statistics, scientific publications data as well as macro-parameters concerning the financial-economic and technological environment. It`s obvious that the effectiveness assessment of innovation is restricted, because in general, these parameters do not give the complete picture of the scale, results and quality of an innovative activity.

Summarizing the studies of current approaches concerning the assessment of innovative potentional in the economic system, it`s possible to separate the entity of those main indicators, which can describe the development level of the innovative system in a macro level. These are indicators of scientific-technical development level, qualitative indicators of market institutions and legislation development, educational level of the workforce, financial indicators, indicators of knowledge transfer and use, as well as quantitative and qualitative indicators of economic growth.

To evaluate the innovative potential, complex or integral indicators are usually used, which could be useful for the development of the innovative strategy of a country and a region[11]. Integral indicator includes several factors, which can vary based on the specificities of a region or a country. For each factor included in the integral indicator, certain weighted factors should be applied, which derived from experimental (empiric) methods. With such weights, the indicators can be calculated by different methods, particularly by weighted average method. To calculate the integral indicator, three approaches are suggested.

I. Based on the above experience of calculating integral indicators described above, in order to assess the RA innovative potential, a weighted method could be applied. Simultaneously, with the growth indices of different factors, a dynamic analysis of the RA innovative potential could also be conducted. Basically, both absolute and relative values of factors could be considered. Usually, relative indicators are considered as a basis for calculations[12]. Before integrating indicators, weights should be set for each indicator based on the empiric approach with consideration of the following condition:

$$0,1 <= k_i <= 0.9$$

$$\sum_{i=1}^{n} (k_i) = 1$$

where k_i – is the weight of the indicator i

n - the number of indicators observed

Integral indicator could be defined as follows:

$$I = (k_1 * C_1) + (k_2 * C_2) + \ldots\ldots + (k_n * C_n)$$

where C_i - is the relative value of an indicator i

[11] Узяков М. Н., Сапова Н. Н., Херсонский А. А., Инструментарий макроструктурного регионального прогнозирования: методические подходы и результаты расчетов, Проблемы прогнозирования, 2010, № 2.

[12] The logic in presenting relative values as a basis in in presenting values of different quality or dimention in comparable view and dimention (from 0 to 1).

Indicator "I" is calculated for each year. By calculating the growth rate of the series of integral indicators for every year and by averaging the latter (by applying geometric average), it`s possible to get an insight about the innovative development dynamics of a country or a region:

$$D=\sqrt[m]{t1 * t2 * \cdots . tm}$$

where D – is an indicator of innovative potential dynamic

$t1 * t2 * \cdots . tm$ – is the growth rate of an integral indicator (I) per year.

The main advantage of this approach is in the simplicity of calculations. Proximity of weights of the indicators can be stated as a drawback, which would lead to inaccurate results.

II. Geometric average of relative indicators is calculated, while empiric weights are not applied in this case.

$$I = \sqrt[n]{C1 * C2 * \cdots * Cn}$$

where C_i – is a relative value of an indicator i

n - is the number of indicators observed.

According to this approach, the components of innovative potential of a region (C_i) are brought to a comparable appearance (relative indicators are observed). This method is applied to identity the rating of the region among several other regions[13]. Based on the above stated method, it`s possible to calculate the innovative development dynamics (like in the 1st approach).

III. By this approach the impact of different factors is evaluated by econometric methods, through pair regression coefficients. First of all, it`s needed to distinguish the most significant statistical indicators (as an outcome indicator) among prescribed ones describing innovative potential of our country, which mainly reflect on the innovative activity of the country. Based on our analyses those indicators are the volumes of "innovative" sectors of the industry and production and services of information technologies as separately as in combination. The selection of this indicator is stipulated by the fact that it warrants attention and the "outcome" of innovative activity is important for those areas of the economy which are most likely to "absorb" innovation. That is, in those sectors of economy where such products were produced and services provided, which were exposed to technological changes of different degrees over the past five years. The calculated indicator is presented together with other indicators in the table 1.

Absolute and relative values of indicators, characterizing innovation potential are also presented in the table 1. The pair regression coefficient matrix has been built for those indicators. Based on that matrix, those indicators, which are significantly correlated with outcome factor will be defined, i.e. the most significant indicators, which will be merged into the integral indictor will be identified.

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[13] Алексеев С. Г., Экономические проблемы регионо и отраслевых комплексов, Проблемы современной экономики, N 2 (30), 2009.

Table 1

Absolute and relative values of indicators expressing innovative potential (2010-2015)

	2010	2011	2012	2013	2014	2015
The number of scientific-technical companies carrying out scientific and technological works, unit (SI)	81	72	72	62	66	70
The share of companies engaged in scientific-technical works among existing organizations, % (SIR)	0.540072	0.449607	0.444637	0.381492	0.404759	0.415603
Domestic costs on the research and development (R&D), mln AMD (SE)	7987.9	9276.6	9713.2	9355.7	10912	11929.9
The share of domestic costs on R&D in GDP, % (SER)	2.30850638	2.455462	2.276641	2.053653	2.259856	2.370765
The number of research specialists holding scientific degree and carrying out scientific-technical activities, thousand people (SP)	2.2	2	2	1.9	2.1	2
The share of research specialists holding scientific degree among employed, % (SPR)	0.18562268	0.170198	0.170532	0.163258	0.185267	0.186463
The number of companies with post-graduate studies, unit (AS)	51	47	47	55	62	59
The share of companies with post-graduate studies, % (ASR)	0.34004534	0.293493	0.290249	0.33842	0.380228	0.350294
The number of patents issued, unit (PT)	187	188	182	172	181	170
The number of patents issued per 10000 capita employed, unit (PTR)	0.15777928	0.159986	0.155184	0.147792	0.159682	0.158493
Gross accumulation of fixed capital, mln AMD (CP)	1156732	985877.2	1006835	966365.3	965486.6	1045047
The share of gross accumulated fixed capital in GDP, % (CPR)	33.4295878	26.09559	23.59884	21.21251	19.99506	20.76766
Information and communication technologies (volume in mln AMD) (IT)	196717.3	198739.8	213906.9	234416.1	233830.3	235423.0
Share of ICT products and services in GDP, % (ITR)	5.68513804	5.260526	5.013685	5.145626	4.842584	4.678435
The total volume of “innovative” sectors of industry (ID) *(mln AMD)*	20780.2	22168.7	22673.9	24437.5	24623.4	26825.3
The share of products and services of “innovative” sectors of industry in GDP, % (IDR)	0.60054863	0.586792	0.531445	0.536423	0.509946	0.533085
The volume of ICT and innovative product and services, mln AMD, (IN)	217497.5	220908.5	236580.8	258853.6	258453.7	262248.3
The share of ICT and innovative product and services in GDP, % (INR)	6.2857	5.8473	5.5451	5.682	5.3525	5.2115

The matrix of pair correlation coefficients has been built for the relative values of integrated indicators. Based on the pair correlation coefficients, it`s possible to evaluate the weights of factors with the following approach:

$$K_i = \frac{R_i}{\sum_{i=1}^{m} R_i}$$

where K_i – is the weight of the indicator i,

R_i – is the value of indicator i (pair coefficient of correlation),

m – is the number of significant indicators

The value of the weight K_i is calculated for all significant indicators from 1 to m. Indicators with negative or insignificant correlation coefficients are not included in the list of significant coefficients.

First of all, according to the conducted correlation analysis, significant factors affecting the innovative potential are included within the dynamic context in a particular case during the last 6 years.

Four factors are significant for the share of industrial innovative product and services in GDP (IDR): *the share of companies engaged in scientific-technical works among existing organizations, % (SIR), the share of domestic costs on R&D in GDP, % (SER), the number of patents issued per 10000 capita employed (PTR) and the share of gross accumulated fixed capital in GDP, % (CPR).* Indeed, the correlation for PTR is rather low, therefore, it will be integrated in the overall indicator correspondingly.

Having the above stated overall picture, it`s appropriate to consider the share of industrial innovative products and services in GDP (%) (IDR) as an outcome, as the number of factors is 4, that is the maximum. With a second approach through geometric average it`s possible to calculate the RA innovative potential (INNP) for 2010-2015.

$$INNP_T == \sqrt[4]{C_{SIR} * C_{SER} * C_{PTR} * C_{CPR}} = 0{,}49$$

According to results, innovative potential is evaluated 0.49 from the range 0 to 1. However, this figure does not reflect the overall picture. Therefore, the weights of four indicators observed are calculated and their dynamics are emphasized.

Based on the correlation coefficients calculated, the weights of factors could be estimated by the following formula:

$$K_i \frac{R_i}{\sum_{i=1}^{m} R_i}$$

where K_i - is the weight of the indicator i,

R_i - is the value of indicator i (pair coefficient of correlation),

m - is the number of significant indicators

The value of the weight K_i is calculated for all significant indicators from 1 to m. Indicators with negative or insignificant correlation coefficients are not included in the list of significant coefficients.

After calculating the weights, the integral indicator can be calculated according to the first approach.

In our case the weights of 4 significant indicators have been calculated based on the suggested method:

K_{SIR}=0.8/(0.8+0.4+0.2+0.9)=0.35

K_{SER}=0.4/(0.8+0.4+0.2+0.9)=0.17

K_{PTR}=0.2/(0.8+0.4+0.2+0.9)=0.09

K_{CPR}=0.9/(0.8+0.4+0.2+0.9)=0.39

Taking into account the weights calculated, it`s possible to calculate the innovative potential for each year and see the dynamics of the potential. The dynamics of an innovative potential has been calculated for every year ($INNP_i$) (table 2).

Table 2

Weighted values of indicator, integral indicator and growth rate of an integral indicator

	weights	2010	2011	2012	2013	2014	2015
The share of companies engaged in scientific-technical works among existing organizations, % (SIR)	0,35	0.1890252	0.1573625	0.1556230	0.1335222	0.1416657	0.145461
The share of domestic costs on R&D in GDP, % (SER)	0,17	0.3924461	0.4174285	0.3870290	0.3491210	0.3841755	0.40303
The number of patents issued per 10000 capita employed, unit (PTR)	0,09	0.0142001	0.0143987	0.0139666	0.0133013	0.0143714	0.014264
The share of gross accumulated fixed capital in GDP, % (CPR)	0,39	13.0375392	10.1772801	9.2035476	8.2728789	7.7980734	8.099387
Integral indicator of an innovative potential, $INNP_i$		0.34233157	0.31322749	0.2966303	0.2676208	0.2794602	0.286878
Growth rate of an integral indicator of an innovative potential			91.4982763	94.701224	90.220335	104.42395	102.6543

As calculations showed, the dynamics of an innovative potential had no significant trend in the last 5 years, however, there was a certain declining tendency. In 2014-2015, it had a positive growth rate.

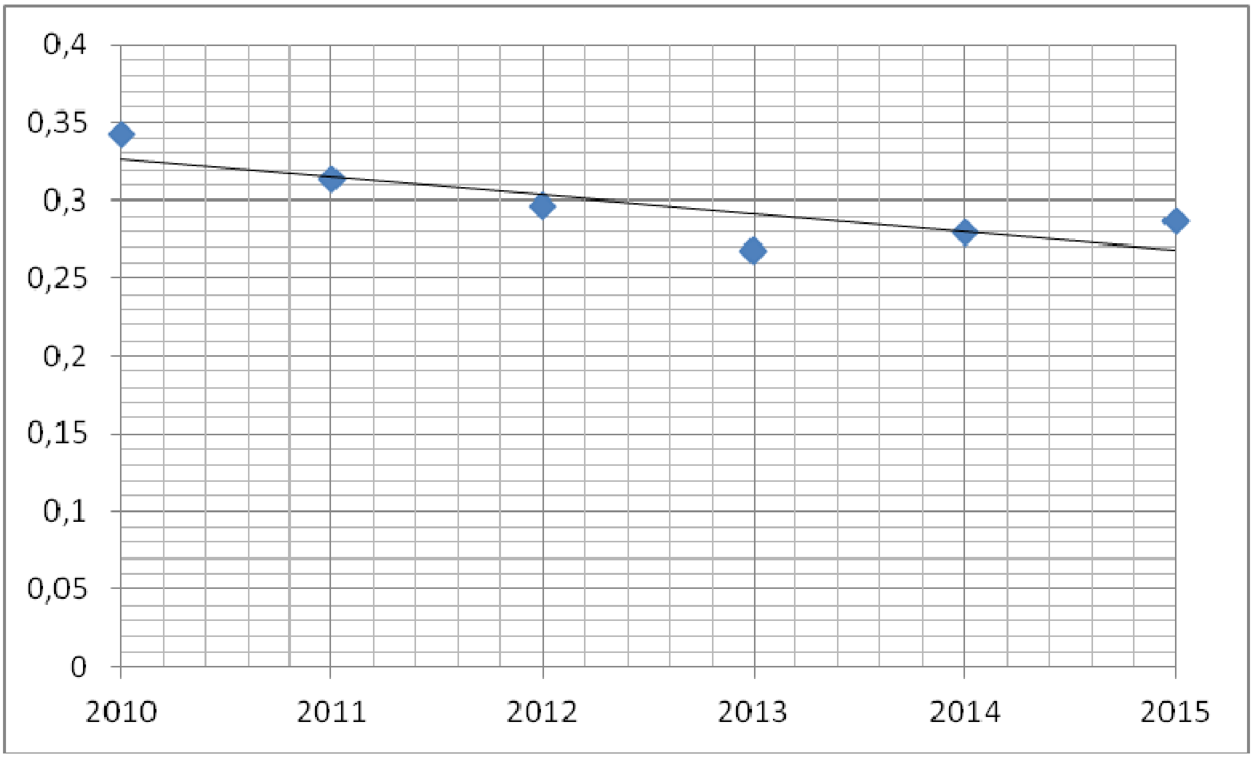

Figure 1. The dynamics of an innovative potential integral indicator ($INNP_i$) in 2010-2015

Average growth rate has been calculated by geometric average method and equals to 96.5. This means that no growth was detected in the last 5 years. This phenomenon in our country is explained by the gap between scientific and technical result and its commercialization stated above, which means that in order to enhance innovative potential, it`s necessary to activate market investments together with the scientific component.