Author's regional dimension in the process of new industrialization of the knowledge intensity of the invested capital

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***Abstract*—One of the most important trends in the social development of the twentieth century, which changed the face of the world economy, was the emergence of «new industrial countries» among developing countries. Dynamically developing, they were able to provide industrial products not only to domestic markets, but also took an active position in the global division of labor. New industrial countries have only their own characteristics. Export-oriented manufacturing has become the leading industry in almost all newly industrialized countries. To increase the efficiency of economic development, Russia should take into account the experience of these countries. In order to increase the pace of economic development, it is necessary first to study the impact of the level of knowledge intensity of the invested capital on economic efficiency. The article deals with the analysis of the knowledge intensity of the invested capital. Knowledge intensity is an important parameter for determining the efficiency of the economy. The author introduced into scientific circulation indicators: knowledge intensity of invested capital, science intensity of gross regional product and investment return of gross regional product. The article reveals the influence of factors influencing the change in the knowledge intensity of invested capital and gives the author's methodological approaches to its calculation (the author's methods of factor analysis). The article presents the author's analytical, systematic statistical material for the analysis of key indicators revealing the impact on the change in the knowledge intensity of invested capital. The article is executed in the framework of scientific project Inc SB RAS № XI.174.1.4 «Activation of internal potential of development of regions of resource specialization».**

Keywords—factor analysis; deviation; investment intensity; gross regional product; internal current expenditure on research and development; investment in fixed capital.

I. INTRODUCTION

In modern conditions of rapidly developing markets of high-tech products and innovative technologies, russian manufacturers face numerous challenges from the international community, affecting the competitiveness of domestic industry and the economy as a whole (Grosheva, P. Yu., 2017).

In this regard, a key activity of companies, ensuring the preservation of the existing market niche and the possibility of creating new markets, is to stimulate their innovation activity through the intensive development of innovative potential, which requires companies to invest in innovative projects for the production of high-tech products and increase their investment attractiveness (Piven', A. V., 2007).

Knowledge intensity is one of the indicators characterizing the technology and reflecting the degree of its connection with research and development. Therefore, knowledge intensity is one of the leading factors in the competitiveness of products. This is due to the activity of innovation. As a result, science has become not only a resource, but also a key factor in economic growth.

II. RESEARCH QUESTION

General issues of innovation management, life cycle innovation and product innovation are studied by such scientists, as: B. N. Avdonin, N. V. Berezina, D. Burchell, V. V. Bokov, E. Bruce, V. I. Degtyarenko, N. V. Kazakova, F. Kotler, A. A. Kolobov, S. A. Osmolovsky, A. V. Fomina, A. O. SHeremet'ev, etc., with details not studying the features of control creation and production of high-tech products taking into account specificity of individual sectors of the economy.

In the 90-ies of XX century there were fundamental changes in the russian economic system: not only the constitutional structure of the Strada, but also the principles and methods of management of the national industry. They caused a violation of the mechanism of financing of expanded reproduction in the country; destabilization of the growth rate of gross domestic product and national income; preservation of the outdated macro-technological structure of material production; the fall in the knowledge intensity of national industry, etc. As a result, the dependence of the national economy on the potential of extractive industries exporting raw materials has increased, and the macro – technological structure of material production-on the import of equipment and scientific and technical documentation. This situation is

compounded by the significant potential of idle capacity and the huge amount of morally and physically worn-out equipment, the decline in the production of high-tech industries, the reduction of highly skilled professionals, the reduction in value added in industry and the fall in the share of material production in the gross domestic product of the country. Meanwhile, the main vector of modern competition lies in the field of dynamically changing national priorities based on scientific and technological achievements and innovations (Antyufeev, G. V., 2006).

Thus, it remains very important to solve the problems of increasing the knowledge intensity of the macro-technological structure of the national industry, which can provide a long and sustainable economic growth in the country, a multiple increase in GDP, as well as reducing the sensitivity of the Russian industry to fluctuations in oil prices and exchange rates. Only in this case the significant internal mechanisms and factors of development of industrial enterprises of innovative impulses and own investment basis will increase (Belousova, O., 2008; Cepelev, O. A., 2007; Kuz'menko, T. V., 2006; Penyugalova, A. V., & Mal'sagov R. M., 2006; Samogorodskaya, M. I., 2002).

In this regard, the urgent need in both scientific and practical terms is the development of theoretical and methodological issues related to the laws of the formation of a knowledge-based macro-technological structure in a structurally unbalanced russian industry, the lack of incentives for industrial enterprises to innovate, as well as the lack of necessary sources of its financing, the stagnation of industries that determine scientific and technological progress, and the increasing dependence of industrial production on external price factors (Antyufeev, G. V., 2006).

All these problems predetermined the relevance of the research topic.

III. MATERIALS AND METHODS

Three indicators were used for the factor analysis of the knowledge intensity of the invested capital: gross regional product (GRP), internal current expenditure on research and development, and investment in fixed capital. The growth of the GRP of the Irkutsk region of the Russian Federation seemed to show stable growth, but this artificial growth, since the main reason for such a stable growth lies in the high volatility of the Russian currency.

Further, on the basis of the methods of deterministic (functional) factor analysis developed by the author (Filatov, E. A., 2018b), we estimate the impact of two factors on the change of the invested capital of the Irkutsk region of the Russian Federation.

The initial data for the alternative factor analysis of the knowledge intensity of the invested capital of the Irkutsk region of the Russian Federation are presented in table 1.

TABLE I. BASELINE DATA FOR THE FACTOR ANALYSIS

No.	Indicators	No. factor's	2014 (0) *	2015 (I) **	Deviation (Δ) ***
1	***VRP*** – gross regional product (GRP), million rub.		916 317.5	1 013 542.3	+97224.8
2	***VTZN*** – internal current expenditure on research and development, million rub.		4 549.6	4 215.8	-333.8
3	***IOK*** – investments in the fixed assets, million rub.		214 422	206 075	-8347.0
4	***NE_{IK}*** – **science intensity of the invested capital** (2 / 3) = (5 * 6)		0.021218	0.020458	**-0.000760**
5	***NE_{VRP}*** – science intensity of GRP (2/1)	***F_1***	0.004965	0.004159	-0.000806
6	***IO_{VRP}*** – investment return of GRP (1/3)	***F_2***	4.273430	4.918318	0.644887

where: * **0** - past (basic) period (year), taken as reference base; ** **I** - reported (current) period (year); *** **Δ** - change for the period, calculated as the difference between the fact and the plan (**I** - **0**).

The author introduced into scientific circulation the indicator of knowledge intensity of the invested capital (***NE_{IK}***), which is calculated as the ratio of internal current expenditures on research and development (***VTZN***) to the size of investments in fixed capital (***IOK***).

The science intensity of invested capital consists of the product of two factors: the science intensity of GRP and the investment return of GRP.

The initial formula for factor analysis of the science intensity of invested capital (***NE_{IK}***) will be as follows (formula 1):

$$NE_{IK} = \frac{VTZN}{VRP} * \frac{VRP}{IOK} = F_1 * F_2 \quad (1)$$

The author introduced into scientific circulation the indicator of science intensity of GRP (***NE_{VRP}***), which is calculated as the ratio of internal current costs for research and development (***VTZN***) to the size of the gross regional product (***VRP***). If in 2014 the science intensity of GRP of the Irkutsk region of the Russian Federation was 0.50%, in 2015 it decreased to 0.42%.

The author introduced the indicator of investment return of GRP (***IO_{VRP}***), which is calculated as the ratio of GRP (***VRP***) to the amount of investment in fixed capital (***IOK***). This indicator characterizes the efficiency of investment in fixed capital. If in 2014 INVESTICIONNAJA GRP Irkutsk region of Russia amounted to 4.27, then in 2015 it has increased to 4.92.

The total deviation of the resulting indicator (ΔNE_{IK}) is determined by the formula 2:

$$\Delta NE_{IK} = \sum_{n=1}^{2} \Delta NE_{IK}(F_n) = \Delta NE_{IK}(F_1) + \Delta NE_{IK}(F_2) \quad (2)$$

Auxiliary data on the comparative coefficients for the factor analysis are presented in the table 2.

TABLE II. MULTIPLE COMPARATIVE COEFFICIENTS BY ONE FACTOR

Comparison of factors	Signs for the comparative coefficients	Value	The product of the coefficients (value)
$F_{1\,(I)}$ / $F_{1\,(0)}$	A_1	0.837743	1.00
$F_{1\,(0)}$/ $F_{1\,(I)}$	A_2	1.193683	
$F_{2\,(I)}$ / $F_{2\,(0)}$	A_3	1.150906	1.00
$F_{2\,(0)}$ / $F_{2\,(I)}$	A_4	0.868881	

The author's (alternative) methods of factor analysis are presented in the table 3.

Method No. 1.1 (formulas 1.1-1.3 in the table 3) is based on the difference between the effective planned indicators, which are adjusted on the comparative coefficients (A_1).

Method No. 1.2 (formulas 1.1-1.3 in the table 3) is based on the difference between the effective actual indicators, which is adjusted on the comparative coefficients (A_4).

Method No. 2.1 (formulas 3.1-3.3 in the table 3) is based on the ratio of the departure of the original factor to the original plan factor multiplied by the planned performance indicator, which is adjusted on the comparative coefficient (A_1).

Method No. 2.2 (formulas 4.1-4.3, in the table 3) is based on the ratio of the departure of the original factor to the original actual factor multiplied by the actual performance indicator, which is adjusted on the comparative coefficient (A_4).

Method No. 3.1 (formulas 5.1-5.3 in the table 3) is based on the difference between the effective actual and planned indicators, which is adjusted on the comparative coefficients (A_1).

Method No. 3.2 (formulas 6.1-6.3 in the table 3) is based on the difference between the effective actual and planned indicators, which is adjusted on the comparative coefficients (A_4).

Method No. 4.1 (formulas 7.1-7.3 in the table 3) is based on the ratio of deviation of the effective factor to the difference between the effective actual and planned factors, which is adjusted on the comparative coefficient (A_1).

Method No. 4.2 (formulas 8.1-8.3 in the table 3) is based on the ratio of deviation of the effective factor to the difference between the effective actual and planned factors, which is adjusted on the comparative coefficients (A_4).

Method No. 5.1 (formulas 9.1-9.3 in the table 3) is based on the ratio of deviation of the effective factor to the difference between the actual performance factors, which is adjusted on the comparative coefficients (A_1).

Method No. 5.2 (formulas 10.1-10.3 in the table 3) is based on the ratio of deviation of the effective factor to the difference between the planned performance factors, which is adjusted on the comparative coefficients (A_4).

TABLE III. METHODS OF THE ALTERNATIVE FACTOR ANALYSIS USING THE COMPARATIVE COEFFICIENTS

Formula number	Formulas / calculations	
	Main part of the formula	Correction factors
1.1	$\Delta NE_{IK}(F_1) = NE_{IK\,0}*(A_1) - NE_{IK\,0}$	–
1.2	$\Delta NE_{IK}(F_2) = (NE_{IK\,0}*(A_3) - NE_{IK\,0})*$	A_1
2.1	$\Delta NE_{IK}(F_1) = (NE_{IK\,1} - NE_{IK\,1}*(A_2))*$	A_4
2.2	$\Delta NE_{IK}(F_2) = (NE_{IK\,1} - NE_{IK\,1}*(A_4))*$	–
3.1	$\Delta NE_{IK}(F_1) = (\Delta F_1 / F_{1\,0}) * NE_{IK\,0}$	–
3.2	$\Delta NE_{IK}(F_2) = (\Delta F_2 / F_{2\,0}) * NE_{IK\,0})*$	A_1
4.1	$\Delta NE_{IK}(F_1) = ((\Delta F_1 / F_{1\,1}) * NE_{IK\,1})*$	A_4
4.2	$\Delta NE_{IK}(F_2) = (\Delta F_2 / F_{2\,1}) * NE_{IK\,1}$	–
5.1	$\Delta NE_{IK}(F_1) = (NE_{IK\,1}*A_4) - NE_{IK\,0}$	–
5.2	$\Delta NE_{IK}(F_2) = ((NE_{IK\,1}*A_2) - NE_{IK\,0})*$	A_1
6.1	$\Delta NE_{IK}(F_1) = (NE_{IK\,1} - (NE_{IK\,0}*A_3))*$	A_4
6.2	$\Delta NE_{IK}(F_2) = NE_{IK\,1} - (NE_{IK\,0}*A_1)$	–
7.1	$\Delta NE_{IK}(F_1) = \Delta NE_{IK} - (NE_{IK\,1} - (NE_{IK\,0}*A_1)$	–
7.2	$\Delta NE_{IK}(F_2) = \Delta NE_{IK} - (NE_{IK\,1} - (NE_{IK\,0}*A_3))*$	A_1
8.1	$\Delta NE_{IK}(F_1) = \Delta NE_{IK} - ((NE_{IK\,1}*A_2) - NE_{IK\,0})*$	A_4
8.2	$\Delta NE_{IK}(F_2) = \Delta NE_{IK} - ((NE_{IK\,1}*A_4) - NE_{IK\,0})$	–
9.1	$\Delta NE_{IK}(F_1) = \Delta NE_{IK} - (NE_{IK\,1} - (NE_{IK\,1}*A_4))$	–
9.2	$\Delta NE_{IK}(F_2) = \Delta NE_{IK} - (NE_{IK\,1} - (NE_{IK\,1}*A_2))$	A_1
10.1	$\Delta NE_{IK}(F_1) = \Delta NE_{IK} - ((NE_{IK\,0}*A_3) - NE_{IK\,0})*$	A_4
10.2	$\Delta NE_{IK}(F_2) = \Delta NE_{IK} - ((NE_{IK\,0}*A_1) - NE_{IK\,0})$	–

IV. RESULTS

The result by the methods 1.1, 2.1, 3.1, 4.1, 5.1 is presented in the table 4, the result by the methods 1.2, 2.2, 3.2, 4.2, 5.2 is presented in the table 5.

TABLE IV. RESULT BY THE METHODS 1.1, 2.1, 3.1, 4.1, 5.1

No.	Main part of the formula	Correction coefficients		Result
1	ΔNE_{IK} (F_1) = -0.003442	–		-0.003442
2	ΔNE_{IK} (F_2) = 0.003202	0.837743	A_1	0.002682
	-0.000240			**-0.000760**

TABLE V. RESULT BY THE METHODS 1.2, 2.2, 3.2, 4.2, 5.2

No.	Main part of the formula	Correction coefficients		Result
1	ΔNE_{IK} (F_1) = -0.003962	0.868881	A_4	-0.003442
2	ΔNE_{IK} (F_2) = 0.002682	–		0.002682
	-0.001280			**-0.000760**

Factor analysis allows us to obtain a quantitative assessment of the influence of deviations of factors on the deviation of the value of the studied indicator. As can be seen from the final result of tables 1, 4, 5 the purpose of the analysis is achieved – the determination of the influence of

factors is disclosed without deviations.

According to the results of the analysis, the following factors influenced the change in the science intensity of the invested capital (ΔNE_{IK}) of the Irkutsk region of the Russian Federation in the amount of -0.076%:

- reduction-tech GRP in Irkutsk region of the Russian Federation (F_1) on -0.000806 reduced the analyzed indicator -0.3442%;

- increase of the investment GRP Irkutsk region of the Russian Federation (F_2) on 0.644887 increased study rate +0.2682%.

According to the results of the analysis, it is clear that in 2015 compared to 2014 there was a slight (almost zero) decrease in the knowledge intensity of the economy of the Irkutsk region of the Russian Federation. This, in turn, suggests that no economic recovery in 2015 after the financial crisis in Russia and, in particular, in the Irkutsk region is not observed.

V. DISCUSSION

Economic growth and investment activity are interdependent processes, so the issues of investment management have a huge role for individual economic entities, regions and the country as a whole (Davydova, L. V., & Il'minskaya, S. V., 2007).

The low volume of investments in science in Russia and, in particular, in the Irkutsk region forms insignificant indicators of the knowledge intensity of the invested capital.

Inflation according to the Federal state statistics service of the Russian Federation in the Irkutsk region in 2015 amounted to 12.2%, and GRP increased by only 10.6%.

High inflation rates in Russia reduce the rate of innovative development of industries and enterprises and reduce the competitiveness of the economy as a whole. As a result, this leads to a significant increase in the cost of new equipment and advanced technologies, leading to an increase in the production costs of innovative high-tech products and, as a consequence, to a reduction in the resource potential of enterprises.

In Russia, there is an inefficient mechanism to support innovation. Of the 83 trillion rubles in Russian banks, only 1.5 trillion rubles is spent on investment in real production, while in countries with developed economies at least one third of the banks ' funds is directed to innovative development.

Monitoring the processes of revitalization in the already studied settlements would allow to assess the stability of the existing models and to determine the factors that have the strongest impact on their institutional transformation (Tarasova, O. V., & Rudneva, V. A., 2018).

VI. CONCLUSION

Innovative type of economic development is a necessary condition for sustainable economic growth. Therefore, an innovative type of economic development is a necessary condition for sustainable growth and exit from stagnation. To form an innovative type of economic development it is necessary to create a clear strategy of innovative development of the country (Filatov, E. A., 2018a).

For example, the formation of motivation for the development of man-made raw materials requires state coordination of all russian participants in the process of development of man-made deposits, a centralized approach to the problem at the federal and regional levels (Kuz'min, M. I., & Kuznetsova, A. N., 2018).

For the long-term growth of the country's economy, such intangible factors as education and science are becoming increasingly important. Significant changes are taking place in the commodity and energy markets, and they mainly relate to the trajectory of decline in demand for traditional Russian exports.

At the turn of the XX-XXI centuries it became obvious that the theoretical and practical experience of Western countries in the field of neoeconomics contains a lot of useful that can be used creatively in Russia. But significant differences in the legal field, in the traditions of state regulation in different countries are very wide and are primarily due to historical conditions, constitutional traditions, forms of government and management, the specifics of the organization of structural relations in the real sector of the economy, the degree of development of the knowledge-intensive sector of the national economy, etc. In this regard, there is a problem of adaptation of foreign theoretical and practical experience to Russian conditions (Antyufeev, G. V., 2006; Heuzler, H., 1996).

The way out of the economic crisis is possible due to an accelerated increase in the knowledge intensity of modern industrial production and an increase in the knowledge-intensive segment of the national industry at a rate exceeding the macroeconomic dynamics.

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