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INNOVATION AS A FACTOR OF REGIONAL ECONOMIC GROWTH: EVIDENCE FROM RUSSIA

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Abstract

The aim of this research is to determine which factors of innovation are relevant to generate economic growth at the regional level and which to reap the benefits. The new growth theories suggest that the source to increase returns may be agglomerations as geographical concentrations of knowledge. The paper analyses the concentrations of knowledge as agglomerations of expenditure on Research and Development, and on science and technology. It entails the number of scientists and engineers, scientific and technological personnel of innovation enterprises in the various Russian regions. The Exploratory Factor Analysis method is used to examine the structure of the innovation inputs and outputs. The paper empirically evaluates the impact of innovation factors on the economic growth in the regions and proposes a strategy to improve the efficiency of the regional innovation system.

Key words: innovation system, economic growth, regions of Russia

JEL Code: O32, O41, R12

Introduction

The Russian economy strongly depends on natural resources. Any changes in the world state of affairs put in jeopardy the stability of neither economic, nor social development. Change in conducted policy in the direction of innovation should fix this situation.

Russia has a significant scientific, research, innovative potential, efficient use of which will improve the competitiveness of the economy. Exactly this innovative development must be a key factor in the economic growth of the country, including regions. It is important to reveal which aspects of innovative development impact on the economy. How soon can appear the effect of R & D, of innovations' implementation, the aggregate of which innovative components allows to achieve maximum success in the economy.

The aim of the research is to determine which factors of innovation system are most relevant to generate economic growth at regional level and which factors are needed if regions are to reap the benefits of innovation system.

1 Theoretical background

The regional innovative potential is represented by resources, mobilized to achieve an innovative purpose, institutional mechanism. As a structural element of the economic potential it is close to the concept of "scientific and technical potential." His purposeful orientation is the production of new knowledge, ideas, discovering new technologies and search of ways for their implementation. Functional orientation of innovative potential consists in providing with conditions, under that other potentials: labor, natural resources, financial, information – could be realized in the most completely way.

Recent studies show that in the modern economy, based on the use of the achievements of STP, the formation of a sufficient innovative potential is the starting point for improving development effectiveness in the region. We can explain this relationship in the following way. In market conditions innovative technologies are in demand only in the presence of competition. It forces companies to create new competitive advantages, including related to innovations. Using the innovative potential can be compared with qualitative shift production possibility curve, as in this case real prospects for improving the quality of products arise, the rational use of human and material resources, improve productivity and efficiency in general.

F. Kvatraro attempt to supplement Schumpeter studies. He conducts an empirical analysis of changes in the development efficiency of the 20 Italian regions for the period 1981-2003. The analysis shows, that the efficiency depends on the regional transition to the knowledge-based economy. At the same time, scientist has discovered the following pattern. Early industrial territories are fully involved in the global movement towards an economy based on knowledge. In the late industrial regions due to slow expansion of production efficiency growth and active implementation of innovations occurs within the industrial economic sectors (Quatraro, 2009).

A. Skiba considers regional innovative development as the main direction of increase the efficiency. He analyzes the different views on the problem of determining the efficiency of scientific and technological progress (Skiba, 2008). B. Cherkovets thinks that socio-economic development of the national economy is determined by its efficiency. Efficiency, by

turn, depend on "... the height of productivity in the public material production. We can assume, that the main resource (or resources) of innovative economic development in the country lies in the sources and factors of labor productivity growth" (Cherkovets, 2009, p. 30).

Theoretical research on the geographic and economic dimension of innovation divided into some streams. The first stream of research considers the distribution of innovation activities and employment. A second stream of literature is papers about regional innovation complexes or clusters. The third one deals with the role of geographic agglomeration in technological innovation and economic development (table 1).

Tab. 1: Basic economics approaches deals with innovation and economic development

Theory	Authors
Differences in growth rates may result from increasing returns to knowledge	Romer,1986; Lucas, 1993; Grossman and Helpman, 1990
Convergence of countries depending on their steady-state level which in turn is conditional on savings, population growth and the production function. Diminishing returns to capital imply that in the absence of technological change, growth would stop. As empirically long-run growth does not stop, technological progress was assumed to be exogenous.	Solow, 1956; Swan, 1956
Technology is considered to be exogenous, it should be excluded from the models	Barro, 1997
Technology should be brought into the models through the inclusion of R&D theories	Romer, 1990; Grossman and Helpman, 1994; Barro and Sala-i-Martin, 1995
Holding constant expansion, in absence of technological progress, diminishing returns to scale will bring about convergence	Aghion and Howitt, 1998
Discoveries immediately spillover to the entire economy as knowledge is non-rival	Arrow, 1962; Sheshinski, 1967

The new growth theories suggest the source of increasing returns may be agglomerations as geographic concentrations of knowledge. The agglomerations of knowledge provide a means to facilitate information searches, increase search intensity and ease task coordination (Rastvortseva, 2014). Geographic location may provide knowledge

spillovers and the generation of innovation and yields higher rates of technological advance and economic growth (Feldman, 1999).

2 Geographic concentrations of innovations and economic growth

National competitiveness, by Porter, is determined as a result of the country's ability to innovate in order to achieve and preserve the advantageous position in comparison with other nations. The level of competitiveness and economic efficiency of the Russian regions development is different. So, in 2013, the maximum value of GDP per capita was in the Nenets Autonomous District - 4003 353.8 rubles per head, the minimum - in the Chechen Republic - 88 462.4 rubles per head (Fig. 1).

Fig. 1: GRP per head in Russia in 2013

Source: Calculations based on *Russian Federation Federal State Statistics Service*

To analyze the agglomerations of expenditure on research and development, expenditure on science and technology, amount of scientists and engineers, amount of scientific and technological personnel, output of innovation products, amount of innovation enterprises in Russian regions I am going to use Herfindahl-Hirschman index and Gini index (table 2).

Tab. 2: Methodological tools for assessment of the geographic concentration of innovations

Index	Calculation	Notation
Herfindahl-Hirschman index of innovation concentration (*HHI*)	$HHI = \sum_{i=1}^{n} x_i^2$	x_i is share of region *i* in total indicator of innovative development
Gini index (G)	$G = 1 - 2\sum_{i=1}^{k} dx_i dy_i^n + \sum_{i=1}^{k} dx_i dy_i$	where dx_i is share of group *i* in the total population size; dy_i is share of group *i* in the total feature size; dy_i^n is an accumulated share of group *i* in the total feature size.

Source: (Rastvortseva, 2014).

Internal costs on R & D - the actual cost of performing R & D within the country in monetary terms (including funded from abroad, but excluding the payments made abroad). Their assessment is based on the statistical accounting of costs for R & D on organizations' own forces during the reporting year independently by source of financing[15]. Let us consider the dynamics of internal expenditures on R & D in Russian regions in 2005-2013 by assessing Herfindahl-Hirschman index and Gini index (Fig. 2-3).

Fig.2: Dynamics of Herfindahl-Hirschman index on indicator for internal expenditures on R & D in Russian regions in 2005-2013

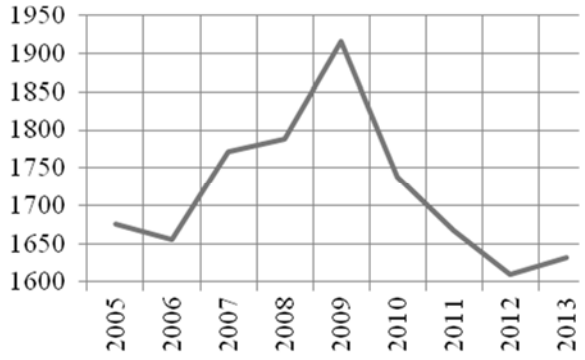
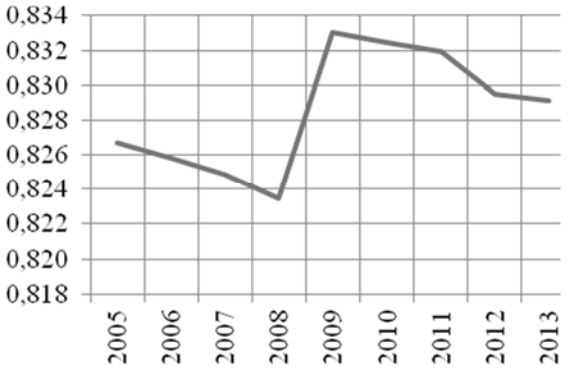


Fig.3: Dynamics of Gini index on indicator for internal expenditures on R & D in Russian regions in 2005-2013



Source: Calculations based on *Russian Federation Federal State Statistics Service*

[15] Methodological notes in *Regions of Russia. Economic and Social Performance*. 2014: Stat. book / Rosstat. - Moscow, 2014. - 900 p., p. 738

Fig. 2-3 show a high degree of concentration of expenditures on R & D in certain regions of Russia in 2009. In the same period maximum stratification of regions on this indicator was also observed (Fig. 2). In general, the graphics have a similar dynamics, except for the period 2006-2008 and 2012-2013. Let us note that in 2007, 2008 and 2013 there was an increase in the degree of concentration of R & D expenditures in the presence of the general decline in regional inequality in terms of similar indicator. Thus, in 2007 the shares of the Khanty-Mansi Autonomous District (with the growth of R & D expenditures by 2 times), the Krasnoyarsk Territory (by 1.62 times), Irkutsk region (by 1.61 times), Volgograd region (by 1.61 times), Republic of Bashkortostan (1.46 times) and some other regions have significantly increased.

Let us consider the dynamics of technological innovative (food, process) costs in Russian regions in 2005-2013 by assessing Herfindahl-Hirschman index and Gini index (Fig. 4-5). Expenditure on technological innovation - actual expenditures in monetary terms, related to the implementation of various kinds of innovative activity, carried out within the organization (branch, region, country). Current and capital expenditures are taken into account as part of the cost of technological innovation[16].

Fig. 4: Dynamics of Herfindahl-Hirschman index on indicator for technological innovative (food, process) costs in Russian regions in 2005-2013

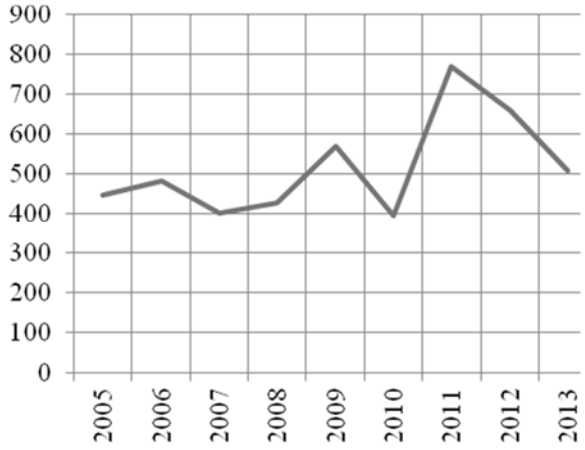
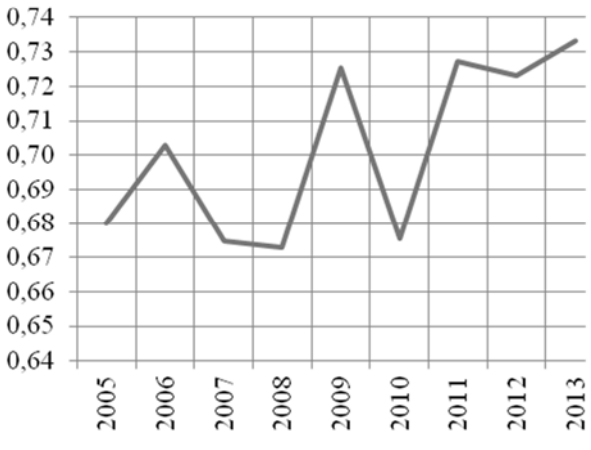


Fig.5: Dynamics of Gini index on indicator for technological innovative (food, process) costs in Russian regions in 2005-2013



Source: Calculations based on *Russian Federation Federal State Statistics Service*

The dynamics of the two indicators, which are shown in Figures 4-5, prove that the concentration of technological costs in certain regions of Russia is almost always

[16] Methodological notes in *Regions of Russia. Economic and Social Performance*. 2014: Stat. book / Rosstat. - Moscow, 2014. - 900 p., p. 738

accompanied by growth of divergence. The exception is 2008 (the growth of expenditure concentration was accompanied by a decrease of inequality) and 2013 (decrease of concentration took place amid growing Gini index). In general, the technological expenditures are less concentrated in the regions, than cost of R & D.

Let us consider the dynamics of R & D staff in Russian regions in 2005-2013 by assessing Herfindahl-Hirschman index and Gini index (Fig. 6-7).

Fig. 6: Dynamics of Herfindahl-Hirschman index on indicator for R & D staff in Russian regions in 2005-2013

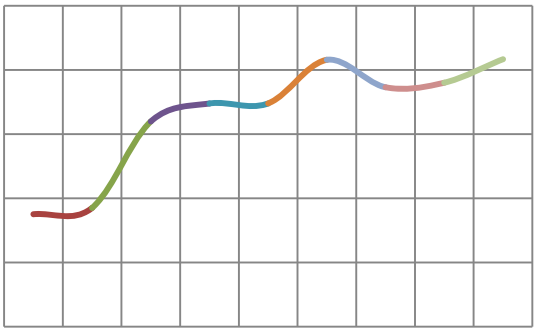
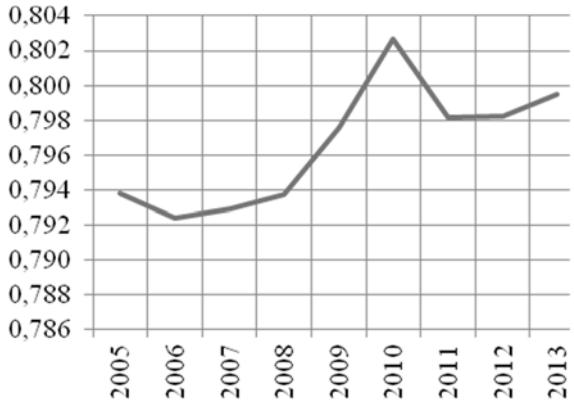


Fig.7: Dynamics of Gini index on indicator for R & D staff in Russian regions in 2005-2013



Source: Calculations based on *Russian Federation Federal State Statistics Service*

The concentration of R & D staff is high enough in the Russian regions and has a tendency to grow. 61% of all scientific staff works in the four leading regions on this indicator: Moscow (32.66% in 2013), Moscow region (11.81%), St. Petersburg (10.84%) and Nizhny Novgorod region (5.71%). Let us consider the dynamics of Herfindahl-Hirschman and Gini indices for the release of innovative goods and services in the regions of Russia in 2005-2013 (Fig. 8-9).

Fig. 8: Dynamics of Herfindahl-Hirschman index on indicator for innovative goods and services in Russian regions in 2005-2013

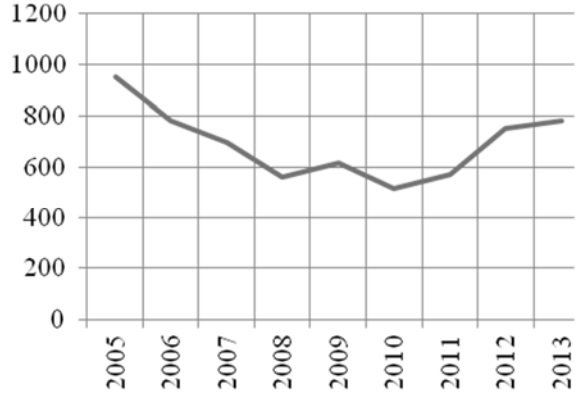
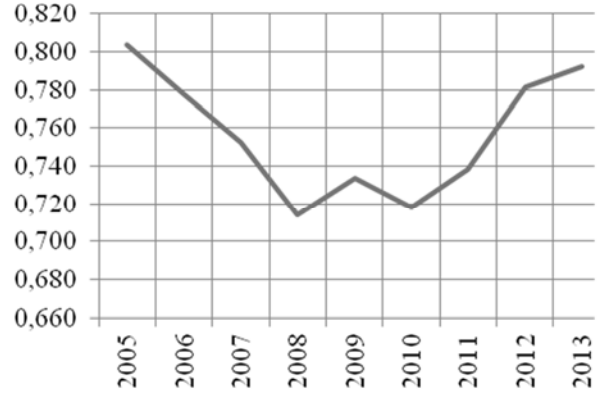


Fig.9: Dynamics of Gini index on indicator for innovative goods and services in Russian regions in 2005-2013



Source: Calculations based on *Russian Federation Federal State Statistics Service*

Another tendency is observed in the analysis of the concentration dynamics of the innovative goods and services' release. In the period up to 2008 and in 2010 there was a process of dispersal of production - peripheral regions have been actively involved in the production of innovative products. However, since 2010 production has been moving towards the central regions of the country, and increase in regional disparities on this indicator is observed.

3. The data and the estimation procedures

The data used in this study comes mainly from a Russian Federation Federal State Statistics Service, Statistical Data Book *Regions of Russia. Economic and Social Performance* for 2005-2014. The data has been collected in 83 regions, with the exception of the Republic of Crimea and Sevastopol.

To assess the impact of innovative factors on regional economic development, we will use a power-mode regression model with constant elasticity:

$$\hat{Y}_t = \alpha \prod_{i=1}^{m} x_{i,t-1}^{b_i}, \quad (1)$$

where $\hat{Y}_t$ is GRP, predicted in the time period *t*;

α is absolute term of equation;

x_i is innovative factors, included in the regression model;

b_i is equation parameters - regression coefficients, particular elasticity coefficient of GRP on investigated factors;

i is serial number of the factor;

m is number of factors, included in the model.

In linear representation the model looks in the following way:

$$\ln \hat{Y}_t = \ln \alpha + \sum_{i=1}^{m} b_i \ln x_{i,t-1} . \quad (2)$$

As a productive indicator we denote the gross regional product for 2013. Taking into account the fact, that the effect of innovative factors appears after a time, we consider the factor indicators for the previous period - 2012. In the course of the sample some emissions have been eliminated: in terms of internal expenditures on R&D - Moscow, the Moscow region, St. Petersburg, Nizhny Novgorod region; in terms of GRP - Khanty-Mansi Autonomous District, in terms of other indicators - the regions with their zero values due to limitations of the linearization of the power-mode model.

4. Empirical results

The results of the conducted analysis regarding modeling pair regression are presented in Tab.3.

Tab.3: The results of the empirical analysis-characteristic of pair regression models

	Internal expenditures on R & D	Expenditures on technological innovations	The number of staff engaged in R & D	The volume of innovative goods, works and services	Innovative activity of organizations
b	0,441*	0,394*	0,469*	0,227*	0,298
R^2	0,538	0,702	0,502	0,488	0,024
Adj R^2	0,532	0,698	0,496	0,481	0,011
F	85	172	73,7	69,7	1,8

* Significant at the 5% level

The results of the empirical analysis prove that the most significant factors for the development of the economy are the costs of technological innovations and internal costs of R & D. In order to determine the best combination of effective factors, we carry out a stepwise regression (Table.4).

Tab. 4: Results of the empirical analysis (stepwise regression)

	Model 1	Model 2	Model 3	Model 4
Internal expenditures on R & D	0,112	0,112	0,096	0,118
Expenditures on technological innovations	0,325*	0,325*	0,250*	0,270*
The number of staff engaged in R & D	–	-0,004	0,037	0,010
The volume of innovative goods, works and services	–	–	0,058	0,057
Innovative activity of organizations	–	–	–	-0,232
R^2	0,715	0,715	0,728	0,741
Adj R^2	0,707	0,703	0,713	0,722
F	90,3	59,4	46,9	39,5

* Significant at the 5% level

Results of the analysis, presented in the table, show that all innovative factors have a positive effect on the regional economic development (GRP), except for the innovative activity of enterprises, whose influence on the GRP is not statistically significant. Moreover, for a given volume of observations inclusion in the regression model the cost factor for technological innovations only is justified, while the inclusion of other factors is surplus. These results could be interpreted in two ways. On the one hand, the regions, spending more money on research and development and technological improvements, get great effects for economic growth. On the other hand, the more successful regions can afford themselves to spend more on the development of science and technology. We tend to keep the second position. In regions with a high level of competitiveness and economic efficiency the best conditions for the occurrence and development of modern technologies and innovative enterprises are created. This is confirmed by the negative influence of the factor *innovative activity of the companies* - in the more successful regions, the share of innovative active enterprises lower, because region does not develop due to them, but relying on industry, service sector and ... the extractive industry.

The study allowed us to identify positive trends in Russian regions' development. We conducted a similar analysis for the previous periods, what showed that the correlation between the innovation development and economic development indicators is very weak or non-existent. Thus, we see, that in 2012 appears a stable relationship between the development of innovative and economic sectors. We hope that this forebode the transition from the development of the Russian economy, based on the performance to the development, based on the innovative growth.

Conclusion

Growth of innovative resources concentration is not always accompanied by increase of inequality among regions on relevant indicators. It testifies the occurrence in certain regions in new centers of innovation. Innovations are being the most actively implemented in such regions as Moscow and St. Petersburg, Moscow region and Nizhny Novgorod region. The crisis impacts negative on the development of innovation in non-central regions. Consequently, only the stable development of the economy will contribute to the dispersal of innovations in all regions of Russia. The most significant factors for the development of the economy are the costs of technological innovations and internal costs of R & D. The more successful regions can afford themselves to spend more on the development of science and technology. A stable relationship between the development of innovative and economic sectors in Russian regions appears in 2012.

The findings of the article are useful for policy applications and policy-makers by providing them with a better understanding of the impact of key innovative determinants of regional growth, the length of time needed for these factors to generate growth and which combinations of factors are most successful.

References

Quatraro, F. (2009). Innovation, structural change and productivity growth: Evidence from Italian regions, 1980–2003. *Cambridge Journal of Economics*, 33, 1001 – 1022

Skiba, A. (2008, October 1). Economic development as a result of renovation. *The Economist*, 10, 50-56

Cherkovets, V. (2009, June 1). Innovative reproduction as a crisis resource. *The Economist*, 6, 30-34

How regions grow trends and analysis. (2009). Paris: OECD.

Lucas, R. (1993). Making a Miracle. *Econometrica*, 62, 251-251

Grossman, G., & Helpman, E. (1993). Endogenous Innovation in the Theory of Growth. *Journal of Economic Perspectives*, 8 (1), 23-44

Grossman, G., & Helpman, E. (1990). Trade, Innovation, and Growth. *The American Economic Review*, 2 (80), 86-91.

Barro, R., & Martin, X. (1995). *Economic Growth*. New York: McGraw-Hill.

Barro, R. (1998). *Determinants of economic growth a cross-country empirical study*. Cambridge, Mass.: MIT Press

Romer, P. (1990). Endogenous Technological Change. *Journal of Political Economy*, 99, 72-102

Aghion, P., & Howitt, P. (1998). *Endogenous growth theory*. Cambridge, Mass.: MIT Press.

Naydenov A.S. (2011, April 11-13). Influence of socio-economic consequences of World Economic Crisis on a Shadow Economy. Vulnerability, Uncertainty, and Risk. Analysis, modeling, and management. Proceeding of the ICVRAM 2011 and ISUMA 2011 Conference. Hyattsville, Maryland, 410-416.

Rastvortseva S. (2014, September 1-9). Analyses of regional specialization and geographical concentration of industry in Russia. SGEM2014 Conference on political sciences, law, finance, economics and tourism, 3, 25-32.

Feldman, M. (1999). The new economics of innovation, spillovers and agglomeration: a review of empirical studies. *Economics of Innovation and New Technology*, 8, 5-25

Krugman, P. (1991). Increasing Returns and Economic Geography. *Journal of Political Economy*, 99, 483-499

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