Development of Innovative Activity in Russia: Macroeconomic Aspect

Liudmila Guzikova

Abstract In today's world innovation is the key driver of economic development, growth and competition at both the micro and the macro-economy. Result of innovative activity, appearing at the microeconomic level, have an impact on macroeconomic fundamentals, which, in turn, determine the scope of the innovation. Improving the competitiveness of the Russian economy and its successful integration into the global economic system requires to enforce innovation. Therefore the identification and comprehension of interconnections and interdependencies between the fundamentals of the national economy and the parameters of the innovation is the important task to date. In the paper the innovative activity and its institutional structure in Russia are characterized; the system of innovation indicators for the national economy is determined; the trends of innovative development in Russia are identified on the base of numerical analysis of official statistics taking into account regional aspect; the current state, prospects and priorities for the development of innovative sphere in Russia are assessed.

Keywords Innovation • Innovative development • Innovation indicators • Macroeconomic fundamentals

1 Introduction

Innovation is the factor of competitiveness in the inner and in the international markets. In modern economy the innovation is diverse and complex process. The following features are now characteristic for innovation: the variety of forms and methods of innovative activity; shortening of the implementation period for new technological, organizational and managerial ideas to introduce into a working reality; the significant changes in the mass demand and its readiness to accept innovative products, works and services; the dissipation of innovation sources in the economy and society.

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Innovation can be divided into the following types: research and development; technological preparation and organization of production (purchase of equipment, changing procedures, methods, standards and quality control, the use of new technological processes, launch of new services); start of production in order to improve product and process, trial production; marketing a new product—market research output, its adaptation and advertising; acquisition of soft technologies in the form of patents, licenses, know-how, designs, patterns and technological services; acquisition of hard technologies—machines and equipment in order to implement product and process innovation; production planning—plans, drawings, specifications, performance characteristics for the creation, development, production and marketing of new products, processes and services (Dosi 2000; Antonelli 2003).

Though the innovation is often considered as the manifestation of entrepreneurial initiative of the microeconomic level it contributes to national economy's competitiveness when the innovative process is organized within the unified innovative system (Welfens 2011). The impact of innovation on economic productivity was analyzed in the range of aspects by Steil et al. (2002). Thompson and Stam (2010) analyzed the reverse impact and proved that the macroeconomic climate affects differently on all industries and in reality the firm and the industry innovativeness results in different effects from the macro-economy.

All mentioned above enables to raise the question about the interrelations between the indicators of innovative system and the macroeconomic fundamentals and about macroeconomic significance of innovation and to analyze it paying attention on specific features of the country. In our opinion these interrelations may vary not only by industries but also by regions if the country under consideration is large enough. As the ways of future development of national economy in Russia are tightly bound with the ways and forms of innovative activity the question raised in the paper is important and timed.

2 Methodology

Qualitative and quantitative analysis of the relationships and interdependencies between the main macroeconomic indicators of the Russian economy and the parameters of the innovation process in the country is undertaken in order to identify patterns and to use them subsequently in the management of the economy. The research methodology includes: analysis of theoretical and applied scientific publications on financial-economic aspects of innovation; analysis of state statistics and current media information on innovation in Russia. Regional and generalized characteristics of the innovation process and its results are compared with the main macroeconomic indicators and reviewed from the standpoint of economic theory.

The analysis of the structure of innovation expenditures is executed in terms of funding sources, regional distribution, institutional customers and functionality. Also the rate of change of the main macroeconomic fundamentals—GDP,

unemployment rate, labor productivity—is studied in comparison with the rate of change in the characteristics of innovation.

To find empirical regularities the econometric methods are usually applied. But it should be mentioned that the official statistics on innovation is conducted in Russia only since 2009 and due to the short time series this kind of methods can't work correctly. At the time of current study the data were available for 2012 on the site of the state statistics www.gks.ru.

3 Basic Positions and Results

3.1 Innovation in Russia: Funding and Institutions

In current circumstances innovation is not perceived as an individual act causing the effect limited in space and time but as a continuous and comprehensive managed process leading to irreversible changes in the socio-economic sphere. The exclusive role of the government in targeting of the innovative development vector and integral results of innovation process should be noted.

The innovation funding in Russia includes two main types of investment resources: (a) public investment resources (budgetary funds, extra-budgetary funds, government borrowing, shares, state property); (b) private investment resources including the financial resources of business entities, as well as public organizations, individuals, private resources of institutional investors, insurance companies, investment funds and companies, private pension funds. They also include companies' own funds and loans of commercial banks, other financial institutions and specially authorized government investment banks. The Fig. 1 shows the ratio of two types of resources mentioned above.

We can see that the volume of each source growth and the share of the volume of each source growth and the share of governmental funding has tendency to increase but is still less than 40 % of total volume. Total volume of the innovation funding constituted 680,063.8 million rubles in 2009 and grew up to 1,010,981.8 million rubles in 2012, i.e. by 48.66 %. Since 2009–2012 the volume of budget funding grew from 461,006.2 to 655,061.7 million rubles, i.e. by 42.09 %, while the volume of internal funding grew from 219,057.6 to 355,920.1 million rubles, i.e. by 62.48 %.

The percent of the federal expenditures channeled to innovation is rather small and did not exceed 3 % and constitutes less than 1 % of GDP (Table 1). The most part of governmental expenditures is assigned to applied research and its share has tendency to increase. By our opinion this fact reflects the intention to shorten the innovative cycle and to accelerate the commercialization. While the expenditures on fundamental research did not change noticeably, the expenditures on applied research increased almost twice in 4 years.

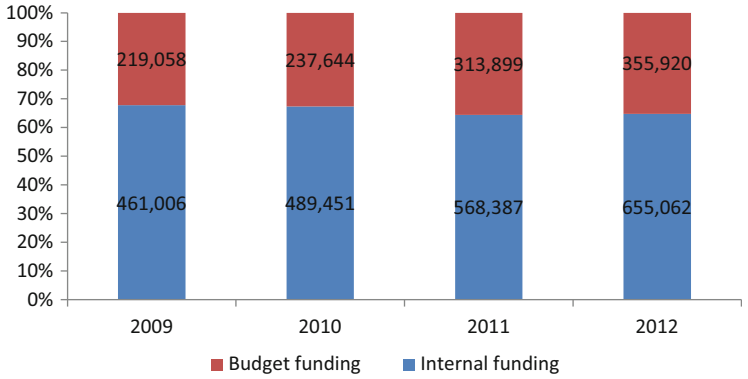

Fig. 1 The ratio of governmental and internal funding of innovation, million rub

Table 1 Governmental expenditures on R&D in 2009–2012, million rub

Indicator	2009	2010	2011	2012
Total expenditures of the Federal Government on civil science, million rub. including	219,057.6	237,644.0	313,899.3	355,920.1
Fundamental research	83,198.1	82,172.0	91,684.5	86,623.2
Applied research	135,859.5	155,472.0	222,214.8	269,296.9
The share of expenditures on applied research, %	62.02	65.42	70.79	75.66
Percent of federal budget expenditures, %	2.27	2.35	2.87	2.76
Percent to GDP, %	0.56	0.51	0.56	0.56

Source Composed by the author according to State Statistics data

According to the Program of Fundamental Scientific Research for long-term period (2013–2020) the volume of funding must increase from 83,184 million rub. in 2013 to 127,732 million rub. in 2020, i.e. by 52.5 % and the average annual growth should exceed 7 %.

Traditionally in Russia the State Academies are the centers of both fundamental and applied research while the universities' science played the secondary role. More than 75 % of funding is planned to allocate in State Academies while other grant holders including State Research Institute Kurchatov, Ministry of Health, Ministry of Education and Science, State Scientific Funds and subsidies to individual and legal entities get the rest. By our opinion the Program will not contribute to successful reformation of the higher education system and will not also allow the Russian universities to strengthen their positions in the world science.

The decrease tendency of the fundamental research funding appears also in the allocation of internal expenditures on scientific activity (Fig. 2). The share of research—both fundamental and applied—does not exceed 40 % of total amount.

Institutional environment in the national innovation system is a set of interrelated and interdependent legal, political, economic, legal and socio-cultural

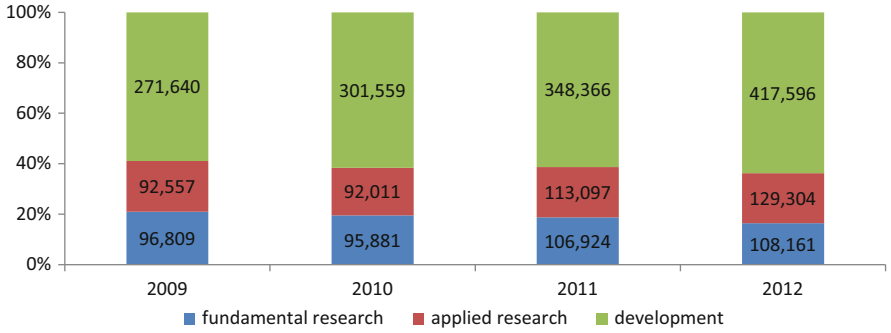

Fig. 2 The structure of internal R&D funding

institutions that underpin the incentives to innovate. Process of formation and development of innovative economy should proceed in parallel with the creation and development of relevant institutions. The institutional environment determines the type of economic growth, its quality and efficiency. It forms the basis of the conditions determining the sustainable socio-economic development of the country (Krutchankova and Bukhtiyarova 2013).

Macro level of the institutional environment of innovation can be specified as the level forming the institutions and determining the "rules of the game" (Valieva 2007): laws and regulations; contract law; property rights; enforcement (system of enforcing contracts); socio-cultural norms; institutional trust.

By the opinion of some Russian researchers shared by the author the now-days state of the main institutes necessary for successful innovative development is determined by so called institutional traps. The most crucial are the following (Malkina 2011):

- psychological immaturity as a range of psychological problems, such as skepticism and nihilism, or, conversely, satisfaction and complacency, risk aversion, change aversion, lack of understanding the problem and the ways of its solving, low level of mutual trust and respect for the rules and regulations;
- rent-seeking behavior—in countries rich in natural resources the assignment of natural resource rents become more effective short-term pattern of behavior than developing ways to increase the value added. Value added in the mineral extraction sector goes with less effort and less risk;
- trap of catch-up development and copying. As short-term behavioral pattern copying may be more efficient from the standpoint of economy than creating a new product, technology or organization improvement;
- reluctance of business to invest (both equity and debt) in its development. So that reproduction of the research base occurs insufficient. Innovation is related to investments in specific assets paying off over a long period and simultaneously to high-risk and uncertainty. More preferred is often an increase in personal income of business owners;

– trap of the public finance system—is a set of problems related to the low efficiency of production of public goods in modern Russia. In the context of innovative development these issues are of particular importance because in low private investment it is necessary to achieve high allocative efficiency in the allocation of governmental funds;
– imitation of innovation. This problem is directly related to the previous one, i.e. to inefficient control in public funding;
– the lack of the innovation environment organizational unity.

3.2 Innovation Indicators and Macroeconomic Fundamentals

The share of innovative products, works and services in GDP grew since 2008–2012 from 2.41 to 4.62 %. In Table 2 the rates of change of key macroeconomic indicators and indicators of innovation are presented. It is evident that dynamics of innovative indicators is much more intensive. It should be also mentioned that the most of indicators grew in 2011 rapidly than in the previous and the next years while the rate of GDP growth fell down from year to year.

According to economic theory innovation should increase labor productivity and simultaneously decrease the level of employment in short term period. But due to the small share of innovative products in GDP it is not possible to trace these connections surely. However in 2011 when the rate of innovation grew by 69.4 % the labor productivity increased by 3.8 % that is slightly more than in other years. Rather paradoxical observation is the growth of the employment rate by 1.9 % right in this period.

The technological innovation constitutes the most part of innovation in Russia. According to state statistics the expenditures on technological innovation include (a) research and development of new products, services and methods of production (transfer), new production processes; (b) production design and development and other (non-R&D) of new products, services and methods of production (transfer), new production processes; (c) purchase of machinery and equipment related to technological innovation; (d) purchase of new technologies; (e) purchase of software; (f) other pre-production means for new products, services and methods of

Table 2 The rate of change of macroeconomic indicators, %

Indicator	2010	2011	2012
GDP	4.5	4.3	3.4
Volume of innovative products, works and services	33.1	69.4	36.4
Share of innovative products, works and services in GDP	11.6	39.8	22.9
Employment rate	1.1	1.9	1.6
Labor productivity	3.2	3.8	3.1

Source Composed by the author according to State Statistics data

production (transfer), new production processes; (g) personnel training related to innovation; (h) marketing research; (i) other expenditures on technological innovation.

Among the total amount of expenditures to this type of innovation two large shares may be highlighted—R&D of new products, services and methods of production (transfer), new production processes which constitute 35.89 % and purchase of machinery and equipment related to the technological innovations which constitutes 42.08 % (Table 3). These shares reflect two main directions of innovative development of the country according to two strategies suggested by Russian scientists: modernization strategy—development of Russian economy through the modernization and adaptation of technologies developed and cultivated in foreign countries (Polterovich 2009): technological breakthrough strategy—the development priority of industry emerging sixth technological order (Glazyev 2009). Now the modernization strategy dominates as it is the shorter way to overcome the technological backwardness and to lead the economy to the now-days technological level.

3.3 Innovative Development: Territorial Aspect

The expenditures on innovation are unevenly allocated by regions of the country. The expenditures in Fig. 3 include both governmental and internal expenditures on technological innovation. The most part belongs to Central and Volga Federal Districts. In these regions the big number of R&D organizations is situated traditionally. The third position is occupied by Urals Federal District where

Table 3 Structure of expenditures to technological innovation in 2012

Objective of expenditures	Share, %
Research and development of new products, services and methods of production (transfer), new production processes	35.89
Production design and development and other (non-R&D) of new products, services and methods of production (transfer), new production processes	4.02
Purchase of machinery and equipment related to the technological innovations	42.08
Purchase of new technologies	1.64
Including rights to patents, licenses of the use of inventions, industrial samples, utility models	0.21
Purchase of software tools	1.57
Other pre-production to release new products, introduce new services or methods of production (transfer)	5.77
Personnel training related to innovation	0.50
Marketing research	0.31
Other expenditures on technological innovation	8.22

Source Composed by the author according to State Statistics data

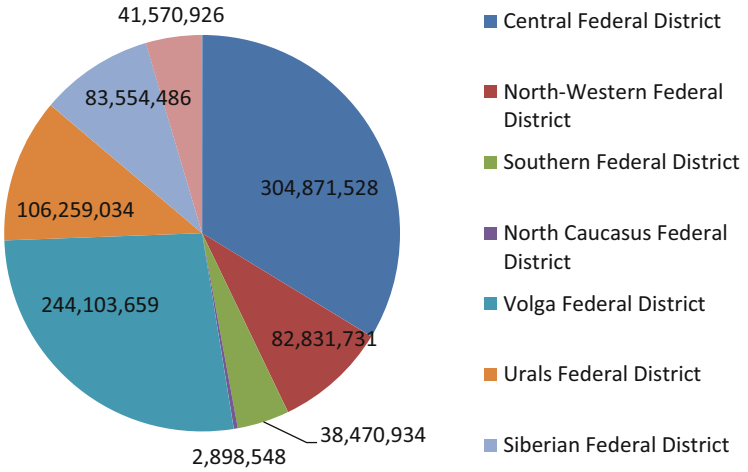

Fig. 3 Regional structure of expenditures on technological innovation in 2012, million rub (*Source* Composed by the author according to State Statistics data)

the large part of Russian heavy industry—metallurgy and machine building—is concentrated.

More detailed analysis showed that R&D expenditures oriented to new products exceed the expenditures on purchase of machinery only in Central Federal region and constitute 49.56 % of total amount. In other regions the expenditures on purchase of machinery and equipment connected to new technologies are significantly greater than expenditures on R&D. In Far Eastern Federal District the share of this kind of expenditures constitutes 83.11 %, in North Caucasus—60.82 %, in Southern Federal District—56.60 % and in Urals Federal District—55.24 %. Thus, it is confirmed that the modernization strategy now dominates on regional level and as the result—in the whole Russian economy.

The average share of innovative products, works and services constitutes 7.99 % and in five regions of the total eight the level of this indicator is lower (this values are highlighted in Table 4). It should be mentioned that in Table 4 the internal expenditures on all kinds of innovation are shown. We can also see exceptionally high share of the innovative products, works and services in Far Eastern Federal District for which the exceptionally high share of purchase of machinery and equipment is characteristic. One more time the short term efficiency of the purchase of machinery and equipment is approved as the efficiency indicators in Far Eastern Federal District are the highest.

In Table 5 some indicators of innovative productivity in Russia as the whole and in regions are presented: researchers' innovative productivity, innovative expenditures per researcher and index of innovative profitability. Researchers' innovative productivity was calculated by dividing of the total amount of shipped innovative products, works and services by the number of researchers. Average revenue of

Table 4 R&D regional revenue and internal expenditures in 2012

Region	Shipped products, works and services, million rub.	Shipped innovative products, works and services, million rub.	The number of researchers	Internal expenditures on innovation, million rub.	The share of innovative products, works and services, %
Russia	35,944,433.7	2,872,905.1	372,620	699,869.8	7.99
Central Federal District	972,759.5	938,153.2	194,890	369,069.5	10.23
North-Western Federal District	4,095,204.7	298,020.1	53,688	100,002.7	7.28
Southern Federal District	1,731,151.0	51,801.6	11,951	18,618.0	2.99
North Caucasus Federal District	347,998.3	27,010.1	4,736	3,448.1	7.76
Volga Federal District	7,458,276.8	950,604.8	52,121	109,155.0	12.75
Urals Federal District	7,239,168.9	148,696.2	21,417	40,420.2	2.05
Siberian Federal District	4,390,819.8	117,118.0	27,164	47,011.7	2.67
Far Eastern Federal District	1,509,054.7	341,501.1	6,653	12,144.6	22.63

Source Composed by the author according to State Statistics data

innovation for one researcher in Russia was equal to 7.7 million rubles. The maximal value was observed in Far Eastern Federal District—51.3 million rubles, the next is Volga Federal District with 18.2 million rubles. In other regions the indicator varies from 4.3 to 6.9 million rubles. So there is no pronounced relation between the dominating form of technological innovation and researchers' productivity.

Innovative expenditures per researcher were calculated by dividing of the total amount of innovative expenditures by the number of researcher. This indicator also has the maximal value in Far Eastern Federal District. The index of innovative profitability ranks the regions by the proportion of innovative revenue to innovative expenditures. The values of this indicator can be interpreted in the following way: (a) high innovative productivity of Far Eastern Federal District is explained by

Table 5 Innovative productivity in 2012

Region	Researchers' innovative productivity, million rub.	Innovative expenditures per researcher, million rub.	Index of innovative profitability
Russia	7.7	24	3.2
Central Federal District	4.8	1.6	3.1
North-Western Federal District	5.6	1.5	3.6
Southern Federal District	4.3	3.2	1.4
North Caucasus Federal District	5.7	0.6	9.3
Volga Federal District	18.2	4.7	3.9
Urals Federal District	6.9	5.0	1.4
Siberian Federal District	4.3	3.1	1.4
Far Eastern Federal District	51.3	6.2	8.2

Source Composed by the author according to State Statistics data

exclusive options of the region for the import of innovative machinery due to the border position; (b) high innovative productivity of North Caucasus Federal District can be explained by the fact that this region has options to import the productive technologies and the number of researchers is relatively small; (c) innovative productivity of Volga Federal District is related significantly with the innovation in oil production financing both by oil companies and the government; (d) Central and North-Western Federal Districts have combination of scientific and industrial potential which is realized in the relatively high values of the indicator; (e) regions with smaller scientific or industrial capability have the lower values of innovative productivity.

4 Conclusions

The research has led to the following conclusions.

The efficient innovation in Russia should combine the fundamental research as the base of long term development and future revenue and the technological modernization through purchase of modern machinery and equipment as the base of current improvements.

Creating a favorable long term institutional environment for innovation in the macroeconomic scale requires the formation of basic conditions for the entrepreneurship development, protection of property rights, support of fair competition,

anti-bureaucratic arbitrariness, improvement of innovation infrastructure and international cooperation in innovation.

The key macroeconomic fundamentals under influence of innovation are GDP, gross added value, labor productivity and employment level. The short period of statistic observations and very small contribution of innovation to national economy does not allow to trace the relationship of innovation indicators and macroeconomic fundamentals but the methodology of such study should be worked out in advance.

Three indicators of relative efficiency of innovation are proposed: the ratio of the revenue from innovative products, works and services to the number of researchers, the ratio of internal expenditures to the number of researchers, the ratio of the revenue from innovative products, works and services to innovative expenditures. In our opinion the indicators mentioned above can be used for special and time comparisons and allow to determine the directions of funding and the most appropriate objectives of innovation both in regional and in macroeconomic scale.

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