EQUILIBRIUM
Quarterly Journal of Economics and Economic Policy
Volume 13 Issue 3 September 2018
p-ISSN 1689-765X, e-ISSN 2353-3293
www.economic-policy.pl

ORIGINAL PAPER

Citation: Spitsin, V., Mikhalchuk, A., Chistyakova, N., Spitsyna, L., & Pavlova, I. (2018). Development of innovative industries in Russia under unfavourable external environment. *Equilibrium. Quarterly Journal of Economics and Economic Policy, 13*(3), 467–485. doi: 10.24136/eq.2018.023

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Received: 28 August 2017; Revised: 14 June 2018; Accepted: 14 July 2018

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Development of innovative industries in Russia under unfavourable external environment

JEL Classification: *R11; O31; L60; C12*

Keywords: *innovative sector; innovative development; manufacturing industry; Russian regions; efficiency assessment*

Abstract
Research background: Innovative development of industries and regions in Russia during the period 2005–2011 has not brought significant positive results. Innovative activity of regions and industries remained at a low level. After a relatively stable 2012–2013, the Russian economy faced the geopolitical crisis and economic sanctions in 2014–2015.

Purpose of the article: The primary purpose of this study is to investigate the innovative development patterns of industrial sectors in selected Russian regions in the years 2012–2015, which include the period of negative external environment (2014–2015) for the national economy.
Methods: The study enhances the analysis of statistical data and applies quantitative analysis methods (analysis of variance). The research focuses on 14 regions of Russia, members of the Association of Innovative Regions of Russia (AIRR) and 2 specific industries: section D «Manufacturing» and subsection DL «Manufacture of electrical and optical equipment» which usually manifest high level of innovative economic activity.
Findings & Value added: The research results show that the crisis period of 2014–2015 has not stimulated the increased innovative activities for both industries. The innovative sector (section D) grew faster than the non-innovative one in 2013, but this advantage became insignificant in 2014–2015. Some signs of revival for innovative enterprises in subsection DL were observed during the crises beginning in 2014, but this trend was not retained in 2015. The analysis of structural indicators (proportions) of the innovative sector shows that only a few AIRR regions have values comparable to the leading European countries. Most of the AIRR regions lag behind the leading foreign countries specifically on the «Share of enterprises engaged in technological innovation» and «Share of new or significantly improved products» Indicators. The study did not reveal the statistically significant positive dynamics of these indicators in the AIRR regions over the period 2013–2015.

Introduction

Innovative development of industries and regions in Russia is undergoing a turbulent development. After a short, but rather stable period of early 2000s, Russia entered an unstable period of 2005–2011, which did not manifest significant positive results. Innovative activities across regions and industries remained at a low level and innovation activity indicators varied considerably from year to year. In 2014, the Russian economy faced a geo-economic and geopolitical crisis resulting into a completely different economic environment, with a crucial decline of oil prices, economic sanctions, lower demand and weakened national currency. The influence of such an unfavourable external environment on industries' innovative sector in the Russian regions is becoming a critical issue for scientific research.

This study focuses on the impact of the crisis in the Russian economy and the negative external environment in 2014–2015 on the industries in the regions which are considered innovative on the national scale. These regions form the Association of the Innovative Regions of Russia (AIRR) and are closely monitored on behalf of the Russian governmental agencies for advanced economic activities. We explore the innovative sector of two industry branches (Section D «Manufacturing» and Subsection DL «Manufacture of electrical and optical equipment») at the level of Russian regions and identify the patterns, trends and results of its development in the period

2013–2015, which includes the period of negative external environment in 2014–2015.

The primary purpose of this research is to investigate the development patterns of the Russian innovative economic sectors in the period unfavourable external environment, i.e. economic crisis and imposed sanctions. Specific objectives of the study are (1) to compare indicators dynamics of the innovative and non-innovative sectors of the economy to identify whether the innovative sector has advantages during the crisis; (2) to compare the optimality of proportions of the Russian innovative sector with foreign countries; (3) to identify development challenges and disproportions of the innovative sector to formulate recommendations stimulating economic activities of the industries under research. The authors of this research evaluate performance of the regional innovation system's key components which are large and medium-sized innovative industrial enterprises. These economic agents mainly contribute to the output of innovative activities (innovative products). Authors use the analysis of variance (ANOVA) as the quantitative method applied to the sample of the AIRR regions. The structure of the article consists of introduction, literature review, research methodology, results, discussion and conclusion.

Literature review

Innovative processes have a local nature, and their stimulation and development are required at the regional and local levels (Zemtsov & Barinova, 2016, pp. 65–81). Innovative activities are seen as a source of competitive advantage and, therefore, providing stimuli at the regional level is one of governmental priorities (see Asheim *et al*., 2011, pp. 875–891; Wang *et al*., 2015, pp. 140–152; Zemtsov & Barinova, 2016, pp. 65–81; Lurie, 2008, pp. 96–109; Shchepina, 2015, pp. 58–65). Although Asheim *et al.* (2011, pp. 875–891) stress the concerns for regional innovation systems (RIS) literature about the boundaries of industrial districts, clusters and regional innovation systems themselves, they relate to the central role of knowledge and learning in clusters and regional innovation systems with the need for new policies to address regional inequalities and divergence. Moreover, it is necessary to consider the scale of the cluster which should be growing in the future due to the possibility to include more companies in the industrial sector, open structure of the cluster, which can cross over not only the territory where the cluster is mostly concentrated, but also the borders of the country (Jurene & Jureniene, 2017, pp. 214–233). Overall, the RIS concept is built on the following research pillars: (1) RIS structure and RIS typology (Asheim *et al*., 2011, pp. 875–891; Lurie, 2008, pp. 96–109; Shchepina, 2015, pp. 58–65); (2) RIS individual components and processes (Hashi & Stojcic, 2013, pp. 353–366; Friesenbichler & Peneder, 2016; Golichenko & Balycheva, 2013, pp. 46–53); (3) RIS performance evaluation through various approaches and techniques (Bajmócy, 2012, pp. 69–84; Dzemydaitė e*t al*., 2016, pp. 83–89; Xie & Liu, 2015, pp. 169–176). Geographic proximity is a very important localization factor enabling innovative activities and collaboration of locally-embedded companies (Boschma *et al*., 2013, pp. 29–51). On regional and local levels, a quantitative evaluation of RIS and clusters' performance specifically is attempted through different multi-criteria evaluation methods (Tvaronavičienė & Razminienė, 2017, pp. 133–147). A comparative research on RIS elements development on the forefront of the digital economy, both at national and regional levels, can employ the TOPSIS method with application of generalized distance measure GDM (Balcerzak & Pietrzak, 2017a, pp. 21–28) or multiple-criteria decision analysis (Balcerzak & Pietrzak, 2017b, pp. 5–18).

Numerous recent studies are devoted to the innovative enterprises of industries and territories (countries, regions and local areas) (Hashi & Stojcic, 2013, pp. 353–366; Sachpazidu-Wójcicka, 2017; Friesenbichler & Peneder, 2016; Stojcic & Hashi, 2014, pp. 121–146; Archibugi *et al*., 2013a, pp. 303–314; Archibugi *et al*., 2013b, pp. 1247–1260; Pohulak-Żołędowska, 2016). In these studies, the researches make efforts to identify the patterns, trends and development results. The sectorial and regional analysis is usually based on enterprise survey data that allow to reveal innovative and non-innovative businesses performance. This monitoring is conducted by state statistical agencies, consulting agencies or academic institutions. For example, Community Innovation Survey is held by Eurostat every two years for the EU countries. The aggregate data are open-source and publicly available on Eurostat's website under the "Science and Technology[1]" section. The data may be retrieved, disaggregated by countries, industry branches, innovative or non-innovative sectors, firm size and types of innovation. Some indicators correspond to the Statistical Form #4 of the Russian Innovation Statistics Survey, which allows to compare innovative activity between Russia and European countries across innovative and non-innovative sectors and industry branches.

Based on the data of this or similar surveys, researchers investigate the innovative and non-innovative sectors to identify patterns and differences in strategies, as well as factors that stimulate innovation processes. For

[1] Eurostat. Science and Technology / Community Innovation Survey (2016-2017). Retrieved form http://epp.eurostat.ec.europa.eu/portal/page/portal/statist ics/search_database. (24.04.2017).

example, the impact of innovation on productivity growth and competitiveness of innovative sector can be assessed through the CDM model and correlation to explore the impact of innovative decision on the output of enterprises (Friesenbichler & Peneder, 2016; Stojcic & Hashi, 2014, pp. 121–146; Van Leeuwen, 2002). Numerous organizational and structural factors such as firm size, industry characteristics, infrastructure can impact innovation processes (Hashi & Stojcic, 2010; Hashi & Stojcic, 2013, pp. 353–366).

There are many articles where authors study of the economic crisis (2007–2009) and its influence and effects on the innovative development (Archibugi *et al*., 2013a, pp. 303–314; Archibugi *et al*., 2013b, pp. 1247–1260; Archibugi & Filippetti, 2011, pp. 1153–1182; Ranga & Etzkowitz, 2012, pp. 1429–1438). Archibugi *et al.* (2013a, pp. 303–314) describe several challenges for innovative enterprises during the crisis (decreasing willingness to invest in innovation and so on), while at the same time, a few innovation-active companies received benefits. During crises period the gap between the leading countries and countries-outsiders becomes more obvious (Archibugi *et al*., 2013b, pp.1247–1260). Some publications focus on innovative development patterns of enterprises during the crisis and provide recommendations for regulation of innovative processes (Archibugi & Filippetti, 2011, pp. 1153–1182; Ranga & Etzkowitz, 2012, pp. 1429–1438). According to Ranga and Etzkowitz (2012, pp. 1429–1438), after the crisis of 2007–2008 there is a growing call for a government intervention to spur economic growth through innovation-based solutions on a long-term basis, e.g. targeted and integrated innovation policies as an essential complement to the structural and financial adjustments or public and private investments necessary for the growth of new industries with high job creation potential. In this instance, regional policies aiming at boosting economic activities and creating growth generators should consider potential positive and negative effects of public aid measures on the polarization of regional economic space (Godlewska-Majkowska *et al*., 2016, pp. 189–212).

Research methodology

In this study we approach innovative and non-innovative industries with the following hypotheses:

H1 – *During the crisis period the innovative sector demonstrates better dynamics than the non-innovative sector*;

H2 – *The innovative sector of the innovation-intensive subsection DL manifests better results for the innovative proportions as compared to the innovative sector of the section D.*

We consider an innovative sector of the industry in accordance with the official statistics criteria, i.e. expenditures on innovation over the current year.

The investigated industries include the section D «Manufacturing» and the subsection DL «Manufacture of electrical and optical equipment». Here and further in the study we use the Russian official statistics classifier OKVED OK 029–2007[2] (corresponds to NACE Rev. 1.1, Eurostat[3]) and Statistical Classification of Economic Activities in the European Community, Rev. 1.1 2002 on the EU statistics.

The section D in Russia is characterized by medium or low technology intensity. On the contrary, the DL subsection of the section D comprises high-tech and medium-tech industries (see Gokhberg, 2016).

The sample of regions consists of Russian regions, members of the Association of Innovative Regions of Russia[4]. These regions position themselves as leaders in the innovative development of Russia and provide a significant contribution in the share of industrial manufacturing (over 25%).

The analysis for 2012–2015 is based on statistical data of the Federal State Statistics Service of the Russian Federation (Rosstat, 2017), UniSIS (UniSIS 2017), and data obtained in Rosstat on a special request. We also use Eurostat data to compare the innovative proportions of Russia and leading European countries (Eurostat, 2017).

The Authors employ the ANOVA as the quantitative method applied to the sample of the AIRR regions with the use of Statistica software. The ANOVA method allows to evaluate the static and dynamic comparison of two panels with the breakdown of indicators corresponding to the mean value (Hill & Lewicki, 2007; Spitsin *et al*., 2018). This study also relies on the Authors' method to comprehensive assessment of innovative development efficiency (Spitsin *et al*., 2016, pp. 48–57). The method is based on a systemic approach and measures efficiency in three domains: (1) effec-

[2] OK 029–2007. Russian Classification of Economic Activities (2015). Retrieved from: http://www.consultant.ru/document/cons_doc_LAW_77392/ (23.08.2017).

[3] Statistical classification of economic activities in the European Community. Rev. 1.1 (2002). Retrieved from http://ec.europa.eu/eurostat/ramon/nomenclatures/index.cfm? TargetUrl=LST_NOM_DTL&StrNom=NACE_1_1&StrLanguageCode=EN&IntPcKey=&StrLayoutCode=HIERARCHIC (23.08.2017).

[4] Association of Innovative Regions of Russia website (2017). Retrieved from http://www.i-regions.org/en/ (23.08.2017).

tiveness to assess the systemic results, e.g. growth rates and compliance with innovative development goals; (2) optimality to evaluate proportions improvement and internal structure of an innovation system; (3) economy to estimate the ratio innovation cost-output.

This study deals with the first two domains (effectiveness and optimality) to comprehensively assess the innovative development of the industries. Effectiveness is assessed through resulting indicators growth. We calculate the annual growth rates for three initial indicators: value of shipped products, investment in fixed assets, number of employees. Then we compare the growth rates for each indicator and year between innovative and non-innovative sectors and between D and DL industry branches. Optimality is the structural proportions characteristic of regional innovation systems and their innovative sector. Here, three indicators are calculated and analyzed: the share of shipped products of innovative sector in the total shipped products, the share of new or significantly improved products in shipped products of the innovative sector, the share of enterprises engaged in technological innovation. We compare these proportions across Russian AIRR regions and leading European countries as well as across D and DL industry branches. The ANOVA is applied to distinguish the differences.

Results

Testing hypotheses of the differences in the average growth rates between innovative and non-innovative sectors in D and DL for the AIRR regions of Russia

To correctly apply ANOVA, we test the hypothesis regarding the normal distribution of indicators by means of Pearson's $\chi 2$-test (Fig. 1).

Testing hypotheses about the normal distribution of growth rates, we found strongly significant differences from the normal distribution for 2013/2012 (significance level of $0.0005 < p \approx 0.0016 < 0.0050$), statistically significant for 2014/2013 (significance level of $0.005 < p \approx 0.019 < 0.050$) and for 2015/2014 (significance level of $0.005 < p \approx 0.009 < 0.050$) and weakly significant for 2015/2012 ($0.05 < p \approx 0.09 < 0.10$).

The purpose of ANOVA is to test the significant differences between means of groups (samples). In the case of the F-test, the dependent variable should be normally distributed within groups. However, the F-test is remarkably robust to deviations from normality.

The Kruskal-Wallis test assumes that the variable under consideration is continuous and that it was measured on at least an ordinal (rank order) scale. The interpretation of the Kruskal-Wallis test is basically identical to that of the parametric one-way ANOVA, except that it is based on ranks rather than means.

The growth rates for indicator "Value of shipped products" are shown in Fig. 2.

Due to the small sample sizes of "Value of shipped products" indicator and violation of the normal distribution in samples, we apply for hypothesis testing both the parametric F-test ($p_F \approx 0.028$) and non-parametric (rank) Kruskal-Wallis test ($p_{K\text{-}W} \approx 0.002$). In case of disputes, the results of nonparametric test were considered a priority. Statistically significant differences in the growth rates are shown in Table 1.

Testing hypotheses about the normal distribution of Pearson's $\chi 2$-test of growth rates for indicators "Investment in fixed assets" and "Number of employees", we obtained the following results:

– highly significant differences from the normal distribution (significance level of $p < 0.0005$) were found for indicator "Investment in fixed assets";
– insignificant differences from the normal distribution for 2013/2012 (significance level of $0.10 < p \approx 0.19$), statistically significant for 2015/2014 (significance level of $0.005 < p \approx 0.007 < 0.050$) and for 2015/2012 (significance level of $0.005 < p \approx 0.0096 < 0.050$) and highly significant for 2014/2013 ($p < 0.0005$) were identified for indicator "Number of employees". Statistically significant differences by rank Kruskal-Wallis test are shown in Table 2.

For the period of the beginning of the crisis in 2014, we found some positive trends in the innovative sector of the subsection DL and, on the contrary, slowing the growth of innovative sector of the section D. However, further deepening of the crisis in 2015 led to the fact that non-innovative sectors of D and DL began to show the higher growth rates. The obtained results are generally consistent with the findings of international researchers about the possible adverse impact of the crisis and instability on the innovative economic development (Archibugi *et al*., 2013b, pp. 1247–1260).

Testing hypotheses of the differences in structural indicators (proportions, optimality) of the innovative sector in 2013–2015

Testing hypotheses about the normal distribution of Pearson's $\chi 2$-test for "Share of new or significantly improved products in shipped products of the innovative sector", "Share of shipped products of innovative sector" and "Share of enterprises engaged in technological innovation" indicators, we found highly significant differences from the normal distribution (significance level of $p < 0.0005$).

Box plots of “Share of new or significantly improved products in shipped products of the innovative sector” and “Share of shipped products of innovative sector” structural indicators are shown in Fig. 3 and Fig. 4. In Fig. 3-4 and further on, the cross in the box is the mean value, the line in the box is the median, the box is the quarterly range of 25% to 75%, the “whiskers” are the full range without emissions (extreme values).

Analysis of the first two indicators (Fig. 3, 4) did not reveal statistically significant differences in their mean values which indicate the absence of their positive or negative dynamics during the study period. Visually, some deterioration in the “Share of shipped products of innovative sector indicator” is observed for the separate regions in 2015 compared to 2014 in D and DL. It is surprising that there are no statistically significant differences on the first two indicators between the high-medium-tech subsection DL and the section D, where low-tech industries “Coke and petroleum products”, “Manufacture of basic metals and fabricated metal products”, “Food Industry” prevail in the national economy of Russia.

Box plot and value of $p_{K\text{-}W}$ test for the indicator “Share of enterprises engaged in technological innovation” are shown in Fig. 5 and Table 3.

The third indicator “Share of enterprises engaged in technological innovation” (Fig. 5, Table 3) shows that the average value of the subsection DL is statistically significantly higher than the average value of the section D for all three years of 2013–2015 ($p_{K\text{-}W} < 0.050$ in Table 3). However, here we also observe no positive or negative dynamics for this period.

International comparisons show that indicators “Share of new or significantly improved products in shipped products of the innovative sector” and “Share of enterprises engaged in technological innovation” in the Russian regions are considerably (by 2–4 times) lower than in Germany and France (Eurostat, 2017).

Discussion

Our hypothesis that during the crisis period the innovative sector demonstrates better dynamics than the non-innovative sector (H1) is partially confirmed. DL demonstrates better dynamics in the beginning of the crisis, but later DL loses this advantage. The hypothesis that the innovative sector of the innovation-intensive subsection DL manifests better results for the innovative proportions as compared to the innovative sector of the section D (H2) is also confirmed partially. Here, we observe significant differences only in the share of innovative enterprises with no significant differences on other indicators.

The crisis period 2014–2015 did not lead to a revival of innovation activity in the regions of the AIRR both in the manufacturing industry and its high-medium-tech subsection DL. Furthermore, the above problems are typical not only for the AIRR regions, but also for other regions of Russia. The Strategy of Innovative Development of Russia, adopted in 2011, assumes that there is a need for a substantial increase in the values of “Share of new or significantly improved products in shipped products of the innovative sector” and “Share of enterprises engaged in technological innovation” indicators (see Strategy, 2011). However, the statistical data for 2012–2015 do not allow us to identify positive changes in these indicators’ behavior. Consequently, the adopted Strategy was not supported by effective measures to stimulate innovation processes at industrial enterprises during this period.

Russian scientists also explore the innovative sector at the regional level (Golichenko *et al.*, 2013; Golichenko & Balycheva, 2013, pp. 46–53). Basing on the results cluster analysis, Shchepina (2012) identifies four types of innovative behavior in the regions: concentrated innovation in a small core, active diffusers, low-concentrated innovation activity, active innovators. However, these studies are carried out at the regional level with the selection of the innovation sector without differentiation by types of economic activity. Since the industrial structure of Russian regions and their innovative proportions vary greatly, lack of analysis across industries by type of economic activity can distort final research results. Moreover, Russian studies rarely address the period of unfavourable external environment of 2014–2015. Yur’ev and Dybok (2017, pp. 51–59) apply methods of mathematical statistics cluster analysis to study the factors influencing innovative development in Russian regions, but also without differentiation by types of economic activity. The study of Spitsin and Monastirniy (2011, pp. 93–100) have previously explored some problems of the innovative sector in the crisis period of 2008–2009, specifically for the manufacturing industry in the Tomsk region. This study closes the gap of Russian innovative industries analysis by types of economic activities under unfavourable external environment in 2014–2015.

Conclusions

Basing on the results of our research, we can make the following conclusions about the innovative development of industries in the AIRR regions under unfavourable external environment:

1. The effectiveness of innovative development. The innovative manufacturing sector (section D) grew faster than the non-innovative one in 2013, but this advantage was lost in 2014–2015. Some revival of innovation activity in subsection DL was established at the beginning of the crisis in 2014, but this trend was not retained in 2015. On the contrary, at deepening crisis in 2015, non-innovative sectors of D and DL began to show better performance than innovative sectors. Findings of our study confirm that crisis and instability negatively influence innovative development of the economy.
2. The optimality of the innovative sector proportions. There were no statistically significant positive or negative dynamics on the following structural "Share of shipped products of innovative sector", "Share of new or significantly improved products in shipped products of the innovative sector" and "Share of enterprises engaged in technological innovation" indicators during the period 2013–2015. It was found that most of the AIRR regions lag far behind leading European countries by last two indicators and this gap is not being diminished. Only a few regions of the AIRR have the values of structural indicators comparable to the leading European countries.
3. The innovative sector in most regions of the AIRR is small (it consists of a small number of large enterprises), and can be called innovative rather conventionally because its ability to generate new products is low. These facts lead to the instability of the innovative performance at the regional level.

From a policy perspective, it is necessary to enhance the stimulation of innovative processes at the regional level in the current unfavourable external environment. Incentive measures should provide certain advantages of innovative enterprises and stimulate innovative processes such as (1) stimulating innovative processes and benefiting from innovations at the level of medium-sized innovative and non-innovative enterprises; (2) increasing the intensity of innovative processes, e.g. creation of product innovations by the largest innovative enterprises. Effective incentive measures will help to reduce the gap between Russia regions and leading European countries by the structural indicators as well as to provide the advanced development of innovative sector compared to the non-innovative sector.

The current study has certain limitations concerning the availability of statistical data. The Authors evaluate the performance of all the AIRR regions (14 regions) and, despite the fact that the AIRR regions contribute significantly to industrial production (more than 25%), they still make up only a small part of all Russian regions (85 regions total). It is quite possible to overcome this obstacle if accounting statements of enterprises included the indicator of expenditures on technological innovations. This could significantly facilitate research at the enterprise level and enlarge the size of the samples. The ANOVA enables researchers to assess the differences significance between the groups of enterprises and also in the dynamics. However, it does not allow to quantify the strength of a factor influence (for example, innovative activity) on the indicators studied.

In future studies, the Authors will focus on researching the impact of a protracted crisis and related factors (currency exchange rate, the price of oil, etc.) on the indicators of the innovation sector, innovation-intensive and high-tech industries. We plan to substantially expand the sample of regions and generate panel data for the study for an increasing time period (2013–2018). The application of regression analysis to panel data will allow to make quantitative assessments of the influence of various factors and characteristics on the studied indicators.

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Acknowledgements

The research is conducted with financial support from Russian Foundation for Basic Research (RFBR) in the frames of scientific and research project of RFBR named “Investigation of the processes of natural formation of regional clusters”, project №18-410-700006

Annex

Table 1. Statistically significant differences in the growth rates of the shipped products by rank Kruskal-Wallis test and parametric F-test

Significant differences in average growth rates of the shipped products	Values of $p_{K\text{-}W}$	Values of p_F
Average growth rate of DI is higher than DNI in 2013	0.004	0.013
Average growth rate of DI is higher than DLI in 2013	0.026	0.054
Average growth rate of DI in 2013 is higher than in 2014	0.020	0.055
Average growth rate of DLI is higher than DLNI in 2014	0.057	0.087
Average growth rate of DLI is lower than DLNI in 2015	0.074	0.055
Average growth rate of DLNI in 2015 is higher than in 2013	0.065	0.380
Average growth rate of DLNI in 2015 is higher than in 2014	0.011	0.006

Source: own calculations based on Rosstat (2017), UniSIS (2017).

Table 2. Statistically significant differences in the growth rates of indicators "Investment in fixed assets" and "Number of employees" by rank Kruskal-Wallis test

Significant differences in average growth rates	Values of pK-W
Average growth rate for indicator "Investment in fixed assets" of DI is higher than DNI in 2013	0,026
Average growth rate for indicator "Investment in fixed assets" of DLI is higher than DLNI in 2014	0,071
Average growth rate for indicator "Investment in fixed assets" of DI is lower than DNI in 2015	0,061
Average growth rate for indicator "Number of employees" of DI is higher than DNI in 2013	0,002
Average growth rate for indicator "Number of employees" of DI in 2014 is lower than in 2013	0,004
Average growth rate for indicator "Number of employees" of DLI is higher than DI in 2014	0,014
Average growth rate for indicator "Number of employees" of DI in 2015 is lower than in 2013	0,003
Average growth rate for indicator "Number of employees" of DLI in 2015 is lower than in 2014	0,049

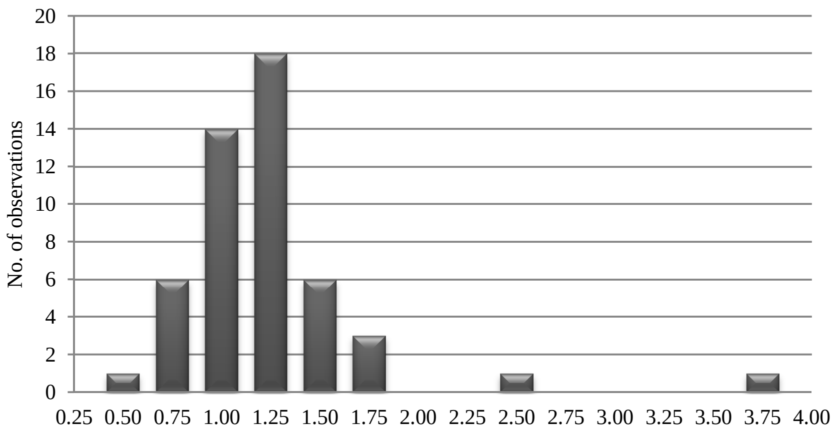
Source: own calculations based on Rosstat (2017), UniSIS (2017).

Table 3. The significant of differences for indicator "Share of enterprises engaged in technological innovation" by rank Kruskal-Wallis test

	D13	**D14**	**D15**	**DL13**	**DL14**	**DL15**
D13		0,58	0,65	**0,005**	**0,009**	**0,015**
D14	0,58		0,70	**0,002**	**0,004**	**0,010**
D15	0,65	0,70		**0,002**	**0,005**	**0,015**
DL13	**0,005**	**0,002**	**0,002**		0, 82	0,57
DL14	**0,009**	**0,004**	**0,005**	0,82		0,90
DL15	**0,015**	**0,010**	**0,015**	0,57	0,90	

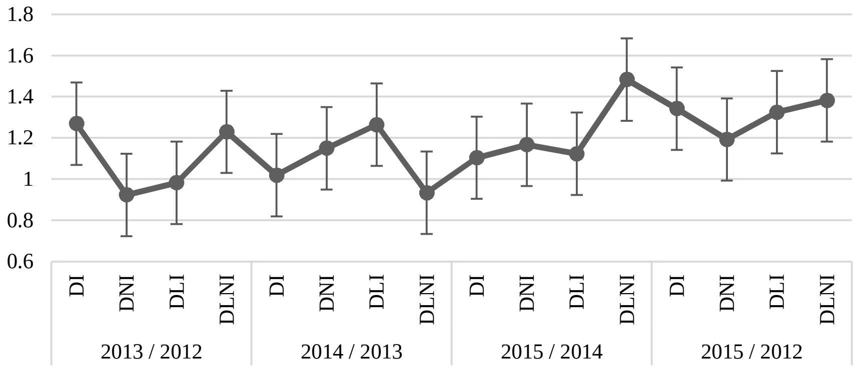
Source: own calculations based on Rosstat (2017), UniSIS (2017).

Figure 1. Distribution of growth rates for the indicator “Value of shipped products” 2013/2012 by Pearson's $\chi 2$-test



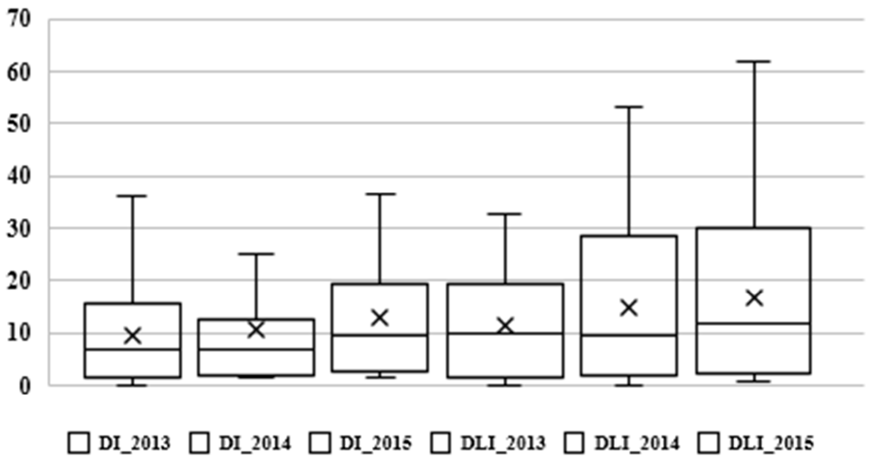
Source: own calculations based on Rosstat (2017), UniSIS (2017).

Figure 2. Means values of growth rates with 95% confidence interval for the indicator "Value of shipped products" in innovative (I) and non-innovative (NI) sectors of D and DL for AIRR regions of Russia in 2012–2015



Source: own calculations based on Rosstat (2017), UniSIS (2017).

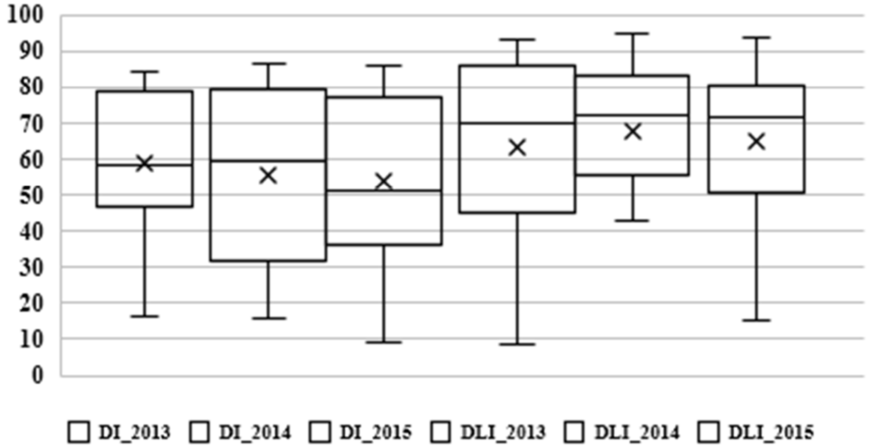
Figure 3. Share of new or significantly improved products in shipped products of the innovative sector, % *



* - The cross in the box is the mean value, the line in the box is the median, the box is the quarterly range of 25% to 75%, the "whiskers" are the full range without emissions (extreme values).

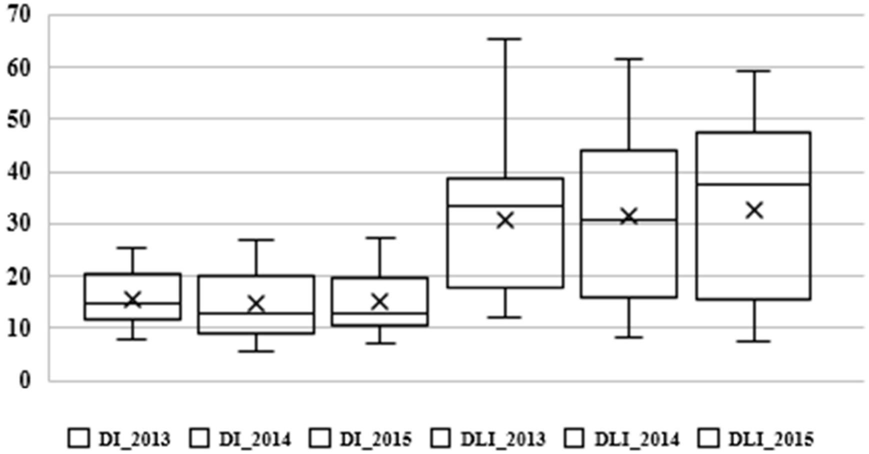
Source: own calculations based on Rosstat (2017), UniSIS (2017).

Figure 4. Share of shipped products of innovative sector in total shipped products of the branch of industry, %



Source: own calculations based on Rosstat (2017), UniSIS (2017).

Figure 5. Share of enterprises engaged in technological innovation, %



Source: own calculations based on Rosstat (2017), UniSIS (2017).