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Small innovation enterprises: Russian data

МАЛЫЕ ИННОВАЦИОННЫЕ ПРЕДПРИЯТИЯ: ДАННЫЕ РОССИИ

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Abstract

Increasing the innovation activity of small enterprises is an urgent problem in Russia and its regions. Innovations include both the production of new or improved products (goods and services) that are significantly different from previously produced products, and the introduction of new or more advanced production processes in enterprises that are significantly different from those that were previously used. The aim of the study was to assess the levels of innovation use based on the specific weight of small innovative enterprises in the total number of small enterprises in the regions of Russia. The study used mathematical modeling of empirical data for all regions and the construction of the corresponding density functions of the normal distribution. The official information of the Federal State Statistics Service for 2015, 2017 and 2019 was considered as the initial empirical data. The study included the study of indicators that characterize the share of small innovative enterprises. The average values of the indicators were determined, as well as the ranges of their changes in the regions of Russia. The conclusions of the study, which contain scientific novelty and originality, are as follows: it is proposed to use economic and mathematical models to evaluate the values of indicators that characterize the innovation activity of small enterprises; it is shown that almost every twentieth small enterprise in Russia showed a certain innovation activity during the period under review; it is shown that the values of the specific weights of small innovative enterprises in the total number of small enterprises were significantly

Аннотация

Повышение инновационной активности малых предприятий является актуальной проблемой в России и ее регионах. К инновациям относятся как выпуск новой или усовершенствованной продукции (товаров и услуг), которые существенно отличаются от производимой ранее продукции, так и внедрение в предприятиях новых или более совершенных процессов производства, существенно отличающихся от тех, которые применялись ранее. Целью исследования являлась оценка уровней использования инноваций на основе учета удельного веса малых инновационных предприятий в общей численности малых предприятий по регионам России. В процессе исследования использовалось математическое моделирование эмпирических данных по всем регионам и построение соответствующих функций плотности нормального распределения. В качестве исходных эмпирических данных рассматривалась официальная информация Федеральной службы государственной статистики за 2015, 2017 и 2019 годы. Исследование включало изучение показателей, характеризующих долю малых инновационных предприятий. Были определены средние значения показателей, а также диапазоны их изменения по регионам России. Выводы исследования, содержащие научную новизну и оригинальность, заключаются в следующем: предложено использовать для оценки значений показателей, характеризующих инновационную активность малых предприятий экономико-математические модели; показано, что почти

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differentiated by region; the regions with the maximum and minimum values of the specific weights of small innovative enterprises are identified.

Keywords: innovations, small innovative enterprises, regions of Russia, functions of normal distribution, assessment of the use of innovations.

Introduction

Small businesses are constantly faced with the problems of selling manufactured goods and services due to the growing demands of customers, the need to ensure competitiveness in the markets, and the desire to improve the efficiency of their activities.

To solve these problems, enterprises need to improve and update their products; modernize with new equipment and tools; develop specialization; use better raw materials and components; introduce advanced technological processes; improve the functions and management methods performed; improve the competencies of employees; improve logistics and marketing strategies; improve the environmental friendliness of their production (Mompo & Redoli, 2009; Gunday et al., 2011; Slack et al., 2015).

It should be noted that previously, innovative activity was described in research as scientific, research, industrial or technological activity. At present, this innovative activity combines a comprehensive, holistic system of activities carried out at enterprises in order to increase their efficiency (Putera & Jannah, 2012). Significantly, in addition to economic goals, it seeks to address issues of increasing employee income, firm sustainability, and improving socialization (Geels, 2004).

It is important for innovation activities to take into account the characteristics of enterprises specializing in various types of economic activities (Mazzucato & Penna, 2016). This approach should take into account the exchange of technology between different industries and increase macroeconomic stability by stimulating firm activity (Hausman & Rodrik, 2003). It should be noted that innovation should extend not only to high-tech activities (for example,

каждое двадцатое малое предприятие в России проявляло за рассматриваемый период определенную инновационную активность; показано, что значения удельных весов малых инновационных предприятий в общей численности малых предприятий были существенно дифференцированы по регионам; выявлены регионы с максимальными и минимальными значениями удельных весов малых инновационных предприятий.

Ключевые слова: инновации, малые инновационные предприятия, регионы России, функции нормального распределения, оценка использования инноваций.

manufacturing), but also to all sectors of national economies (Martin, 2013), including trade, services (Benaim & Tether, 2016), as well as social activities (Van der Have & Rubalcaba, 2016).

When implementing innovations, it is necessary to take into account five main elements (Fagerberg, 2017):

- knowledge that is formed by state research organizations and universities, as well as supplemented by their own developments of various firms;
- skills, both highly specialized and general, that are formed in educational processes, including professional training of people;
- availability of demand for innovative solutions by creating appropriate markets, as well as using public procurement;
- state financing of innovative initiatives of small enterprises and individual entrepreneurs, as well as reducing the tax burden on these categories of actors;
- improving the institutional support of economic processes based on the promotion of innovation in legislative and regulatory acts, based on the needs of the business community.

In recent years, small business in Russia has generated significant economic growth, an increase in gross domestic product, the creation of new jobs and the reduction of poverty (Kiseleva et al., 2019; Pinkovetskaia et al., 2019; Pinkovetskaia et al., 2020a; Pinkovetskaia et al., 2020b). Russia has formed high expectations for the growth of innovation in the economy. Based on the introduction of innovations, it is planned to move to more technological and efficient forms and methods of enterprise activity, including small enterprises. In Russia,

innovation activity is currently defined by the provisions set out in Presidential Decree (Presidential Decree No. 204, 2018). This document provides for an increase in the number of organizations that have implemented technological innovations to fifty percent of their total number. The problem of increasing innovation activity is relevant in modern conditions. At the same time, it seems logical to develop innovations in all regions of Russia.

Literature review

Scientific research examines innovations related to changes in existing knowledge, technological processes, the use of new technology and other opportunities and resources in various types of economic activities (Fagerberg et al., 2010), including low-tech and high-tech (Tunzelmann & Acha, 2004), in the service sector (Rubalcaba et al., 2012).

In recent years, the study of the characteristics of innovative enterprises has become particularly relevant and has included the analysis of factors that affect their effectiveness (Liu & White, 2001; Smits & Kuhlmann, 2004). Since 1991, the countries of the European Union have been collecting information describing not only the innovation activities of firms, but also the factors influencing them (Smith, 2004). It should be noted that the processes of mutual influence of the elements of national innovation systems in most cases are stable, despite the changes occurring in the regions (Pierson, 2000).

A number of scientific publications are devoted to the problem of innovation activity in Russia. Let's look at the most interesting of them, which were published in 2019-2020. A brief description of these publications is given in table 1.

Table 1.
Scientific publications on innovation in Russia.

Authors	Studied questions	Period, years	Objects of innovation	Type of indicators
1	2	3	4	5
Petrikov (2019)	Analysis of the directions of innovation activity, priority for individual regions	2016-2017	Regions of the Central Federal District	indices
Podsolonko et al. (2019)	Analysis of the transfer of innovative technologies by type of economic activity	2010-2016	Russia	indices
Arkhipova et al. (2019)	Assessment of the volume of innovative goods produced and services rendered and work performed by small businesses	2016	Russian regions	absolute
Zhuravlev (2020)	Assessment of the degree of readiness of the regional economic complex for innovation based on regression analysis	2007-2017	Regions of the Central and North-Western Federal Districts	absolute
Belemaeva & Kalimullin (2020)	Increase in the market capitalization of a company that regularly innovated	2001-2012	One company	absolute
Deputatova & Perelman (2020)	Analysis of innovative technologies and methods for attracting buyers	2015-2018	Trade sector in Russia	absolute
Yezhov (2020)	Dynamics of changes in innovative activity of enterprises. Business participation in scientific developments. Barriers to innovation	2014-2018	Russia	absolute, specific
Kudryavtseva (2020)	Institutional aspects of state support for innovations in production technologies	2012-2015	Countries	indices
Lipovka & Arnautova (2020)	Innovative development based on information technologies	2015-2018	Gypermarket	absolute
Smirnova (2020)	Dynamics of changes in the share of innovative enterprises. Factors that reduce the effectiveness of innovation implementation	2000-2014	Russia	specific

Source: Achieved by the authors

Based on the information given in Table 1, it can be stated that the problem of studying regional innovation activity is relevant in Russia. At the same time, in theoretical and applied research to date, unjustifiably little attention has been paid to the comparative analysis of the activities of small enterprises that carried out technological innovations in the regions of Russia. In the same works where such an analysis was available, the absolute values of innovation activity were compared, as a rule, which is not always logical, since regions differ significantly in the number of economic entities, population, size and location.

Methodology and design

The purpose of our study was to assess the levels of innovation use based on the share of small innovative enterprises in the total number of small enterprises operating in the regions of Russia.

To date, the main aspects of innovation activities of organizations are presented in detail in the document (OECD, 2018). At the same time, innovations are understood as the production of new or improved products (goods and services) that differ significantly from previously produced products, as well as the introduction of new or more advanced production processes in enterprises that differ significantly from those that were previously used. Accordingly, innovations can be of two types. The first type of innovation involves better products and services, and the second type is associated with changes in production processes. Both of these types of innovations are united by such a concept as technological innovation. It should be noted that innovations aimed at creating new or improving existing production processes, in turn, are divided into the following subspecies:

- changes in production technologies and the creation of new products (goods and services) in various industries;
- changes in logistics, transport, and distribution operations related to the supply of organizations and the sale of finished products;
- improving the technology and organization of information processes;
- use of more effective methods of conducting and managing production activities, including accounting and control issues;
- development of interaction of organizations with the external environment;
- improving the effectiveness of personnel policy;

- improvement of methods and forms of marketing and pricing.

An analysis of previous studies, including those presented in Table 1, has led to the conclusion that it is advisable to use the share of innovative small enterprises in the total number of such enterprises in each of the regions of Russia as an indicator of the level of innovation activity in the regions.

The research process included three stages. At the first stage, the initial empirical data describing the share of innovative small enterprises in the total number of small enterprises operating in the regions of Russia were formed. At the second stage, the distribution of specific innovation values across the country's regions was evaluated. At the third stage, a comparative analysis was carried out, during which the regions of the country were established, in which the minimum and maximum values of specific innovations were noted.

As initial information, the study used official statistics for 2015-2019 on the share of innovative organizations in the total number of organizations in 82 regions of Russia (Federal State Statistics Service, 2021).

In the economic and mathematical modeling used to estimate the distribution of specific innovation values across the country's regions, the normal distribution function was used. The author's paper (Pinkovetskaia & Slepova, 2018) present a methodological approach to the development and use of such a function to determine the average value of the indicator for the considered regions, as well as the range of its variation.

The study included testing the following three hypotheses:

- hypothesis 1 - average values of indicators characterizing the share of Russian small enterprises that implemented technological innovations did not change significantly over the period from 2017 to 2019;
- hypothesis 2 - values of the share of innovative small enterprises in their total number have a significant differentiation across different regions;
- hypothesis 3 - territorial location of regions does not significantly affect the share of innovative small enterprises.

Results of research

In the course of the computational experiment, economic and mathematical modeling was carried out on the basis of empirical data. The models that describe the distribution of the three indicators for different years across 82 regions of Russia are shown below:

- the share of innovative small enterprises in the total number of small enterprises by region in 2015, %

$$y_1(x_1) = \frac{206.29}{3.01 \times \sqrt{2\pi}} \cdot e^{-\frac{(x_1-4.54)^2}{2 \times 3.01 \times 3.01}} ; (1)$$

- the share of innovative small enterprises in the total number of small enterprises by region in 2017, %

$$y_2(x_2) = \frac{206.28}{2.69 \times \sqrt{2\pi}} \cdot e^{-\frac{(x_2-4.88)^2}{2 \times 2.69 \times 2.69}} ; (2)$$

- the share of innovative small enterprises in the total number of small enterprises by region in 2019, %

$$y_3(x_3) = \frac{152.09}{2.77 \times \sqrt{2\pi}} \cdot e^{-\frac{(x_3-5.50)^2}{2 \times 2.77 \times 2.77}} ; (3)$$

The high quality of functions (1)-(3) was confirmed in the testing process according to the Shapiro-Wilk, Pearson, and Kolmogorov-Smirnov criteria.

Discussion

At the next stage of the study, patterns were identified that characterize the distribution of the considered indicators. Column 2 (Table 2) shows the data describing the average values of the indicators. The ranges in which the values of the indicators for most countries are shown in the third column of the table.

Table 2.

Values of indicators of the share of innovative small enterprises, %

Indicator	Average values	Values for most regions
1	2	3
share of innovative small enterprises in the total number of small enterprises by region in 2015	4.54	1.53-7.55
share of innovative small enterprises in the total number of small enterprises by region in 2017	4.88	2.19-7.57
share of innovative small enterprises in the total number of small enterprises by region in 2019	5.50	2.73-8.27

Source: The calculations are carried out by the author on the basis of functions (1)-(3).

The data shown in Table 2 show that the average values of the share of innovative small enterprises in the total number of small enterprises operating in the regions were in the range from 4.54% to 5.50% in 2015-2019. That is, on average, in the regions under consideration, only one in twenty small enterprises participated in innovation activities. It should be noted that during this period, no significant changes were observed, both in the average values and in the values typical for most regions. The first hypothesis was confirmed.

To test hypothesis 2 on the differentiation of indicators by region, the analysis of the range of variation of each of the indicators presented in Table 2 was carried out. The coefficients of variation (the ratio of the mean square deviations

to the average values of the indicators) were: for the first indicator – 66%, for the second indicator – 55%, for the third indicator – 50%. Thus, the analysis showed a significant differentiation in the considered regions of the values of each of the three indicators. Therefore, hypothesis 2 was confirmed.

At the next stage, the regions where the maximum and minimum values of each of the indicators were noted in 2019 were identified. At the same time, the maximum and minimum values are those that correspondingly exceed the upper limits of the ranges shown in the third column of Table 2 and are smaller than the lower limits of the ranges. The results of this analysis are shown in Table 3. Along with the lists of regions, this table also shows the division of the

identified regions by their geographical location and the specific weights of small innovative

enterprises in the regions, which are given in parentheses.

Table 3.
Regions with maximum and minimum values of indicators.

Indicator	Maximum values	Minimum values
1	2	3
the share of small innovative enterprises in the total number of small enterprises by region in 2019	<p>Kurgan area (8.5%), Voronezh area (8.67%), Krasnoyarsk territory (8.86%), Penza area (8.87%), Vologda area (9.03%), Republic of Mari El (9.35%), Republic of Crimea (9.4%), Udmurtia (9.69%), Republic of Mordovia (10.17%), Oryol area (10.2%), Belgorod area (10.53%), Moscow city (11.03%), Lipetsk area (13.04%), Altai territory (13.2%).</p> <p>Located in the Central (five regions), North-West (one region), the Volga (four regions), southern (single region), Siberian (two regions) Federal districts.</p>	<p>Sakhalin area (0.96%), Republic of Adygea (1.41%), Kaliningrad area (1.57%), Republic of Karelia (1.59%), Republic of North Ossetia (1.82%), Zabaikal territory (2.08%), Stavropol territory (2.18%), Amur area (2.27%), Tyumen area (2.52%), Tver area (2.65%).</p> <p>They are located in the Northwestern (two regions), Central (one region), North Caucasus (three regions), Siberian (three regions), Ural (one region), and Far Eastern (three regions) federal districts.</p>

Source: Developed by the author on the basis of data from Table 1 and official statistical information.

Table 3 provides information on the territorial location of the regions with the maximum (column 2) and minimum (column 3) values of the share of small innovative enterprises in 2019. The analysis of this information showed that there was no correlation between the values of the indicators for the regions and their territorial location. Thus, we can state the confirmation of the third hypothesis.

It should be noted that even the regions with the largest share of small innovative enterprises (the city of Moscow, the Lipetsk region and the Altai Territory) have not yet reached the level defined in the Presidential Decree (Presidential Decree No. 204, 2018).

Conclusions

The purpose of the study, which was to assess the levels of innovation use based on taking into account the share of small innovative enterprises in the total number of small enterprises in the regions of Russia for 2015, 2017 and 2019, was achieved. The conclusions that have scientific novelty and originality include:

1. The article presents a methodology for assessing the share of small innovative enterprises in the total number of small enterprises in the regions of Russia.
2. Modeling of the distribution of indicators based on data for 2015, 2017, and 2019 was carried out.
3. It is proved that the values of the share of small innovative enterprises in the total

number of small enterprises have not changed significantly over the years considered.

4. It is shown that almost every twentieth small enterprise in Russia showed a certain innovative activity during the period under review.
5. It is shown that the values of the specific weights of small innovative enterprises in the total number of small enterprises were significantly differentiated by region.
6. The regions with the maximum and minimum values of the specific weights of small innovative enterprises in the total number of small enterprises are identified.
7. It is proved that there is no influence of the territorial location of the regions on the minimum and maximum values of the considered indicators.

The results of our work have a certain theoretical and practical significance. The methodological approach presented in the article to estimate the share of small innovative enterprises in the total number of small enterprises in the regions of Russia can be used in further research. Namely, when monitoring the share of innovative small enterprises in the regions and municipalities of Russia. The results of the work can be applied in the current activities of state structures and public organizations, when justifying measures to support innovation activities in accordance to Presidential Decree (2018). In addition, the information obtained can be used to solve problems of increasing the share of innovative small enterprises in regions where such

enterprises are not widely developed. The results of the work are of interest to leasing companies that ensure the introduction of new equipment and advanced technologies. The new knowledge gained is of interest and can be used in the educational process at universities.

Further research can be carried out to assess the industry characteristics characteristic of innovative small enterprises.

In the course of the study, there were no restrictions on empirical data, since information was considered for all 82 regions of Russia.

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