

## Models of Regional Development in Russia: Level of Industrialisation and Innovative Performance

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*The growth in the share of industry in the structure of Gross Domestic Product due to an increase in its competitiveness, causes a multiplier effect of accelerating economic growth, reducing unemployment and developing social and transport infrastructure. All these imperatives actualise the task of deepening the analysis of the level of industrialisation and innovative performance of the national economy and its regions. To achieve this goal, a theoretical analysis of the relationship between industrial growth and innovation activity was carried out, and the problems of industrial growth of the Russian economy were identified. The proposed toolkit is based on assessing the level of industrialization and innovative performance of the region. Based on their comparison, four models of industrial and innovative development are distinguished: model of non-industrial development, model of post-industrial development, model of neo-industrial development, and model of industrial development. According to the results of the study, the structure of Russian regions by the type of industrial-innovative development model is relatively stable and insufficiently progressive. Only a third of the regions have high innovative performance. The lack of the required balance between the development of industrial potential and the innovative productivity of Russian regions is associated with the low efficiency of the applied industrial policy measures. The research results can be useful for assessing the quality of industrial growth of regions in countries with transitional economies.*

**Keywords:** *Regional Development; Industrial Growth; The Share of Innovative Products in Industrial Output, Innovative Performance; Post-Industrial Development; Neo-Industrial Development; Non-Industrial Development; Industrial Development.*

### Introduction

It has long been established that the accelerated economic growth of developed countries depends on industrial revolutions. Criticism of the post-industrial economic development paradigm resulting from the loss of jobs and competitive advantages in high-tech industries is accompanied by ideas regarding the need to achieve innovative growth through modernisation and reindustrialisation. The neo-industrialization (reindustrialization) model received theoretical justification in the second half of the 20th century (Galbraith, 1967), however, it began to be applied only when developed countries exhausted opportunities for growth through previous instruments. It is currently being implemented as a part of the concept of the fourth industrial revolution (4IR), that is based on the growing convergence of different emerging technology domains (digital production technologies, nanotechnologies, biotechnologies and new materials) and their complementarity in production.

Currently, there are many factors that scientists attribute to the possibility of accelerating economic growth. This includes an influx of skilled labour (Tipayalai, 2020) and even just population growth (Madsen *et al.*, 2010). Some studies, particularly regarding the example of the dynamics of European Integration (Kallioras & Petrakos, 2010), reveal the negative impact of excessive consolidation of various economies on industrial growth. However, according to the results of other studies, the unification of innovation-weaker countries leads to the faster growth of

their innovation dynamics (Krajco *et al.*, 2019). Along with this, the highest degree of convergence as a result of economic integration of countries is achieved in growth rates of real output in all groups of economies (Oplotnik *et al.*, 2011).

Scientists also note the need for digitalization of not only production, but also human capital, and organizational capital (Schneider, 2018). An interesting conclusion shows that the longer the distance to the high level of industrial development of the territory in the past, the higher the level of its economic development at the present time. This gives hope to regions with low industrial potential to expect high economic results in the future (Ozak, 2018). However, naturally, there must be some prerequisites for such progress.

One of the lessons we can take from the Great Recession is that countries with a higher share of industry in their GDP were less affected by the crisis. Therefore, we agree with the statement that one of the most significant factors of economic growth is the innovative development of industry (Jungmittag, 2004). On the one hand, the criterion for the effectiveness of the transition to a new stage of technological development is considered to be such a level of development of the manufacturing industry, which not only meets the needs of the home territory, but also has a high export component. On the other hand, the need for innovative development of extractive industries has also been proven by scientists (Litvinenko & Sergeev, 2019).

So, despite the multiplicity of sources of economic growth, the most significant source of growth in the context of the instability of the global economy and the vulnerability of national economic systems is neo-industrialization, which provides a qualitatively new level of industrial development based on innovations.

The logic of the article's presentation assumes, first of all, identification of aspects of the relationship between industrial growth and innovative development in world studies, and secondly, consideration of theoretical prerequisites of neo-industrialisation in Russia and substantiation of the importance of industrial growth supported by innovations. The third part of the article presents the research methodology that allows not only to determine the degree of connection between industrial development and the innovative performance of Russian regions, but also to establish the type of territorial model of industrial and innovative development used. The fourth part of the article contains the results of the analysis of industrial and innovative development of Russian regions and their discussion. In the final part, conclusions are given and directions for further research are formulated.

### **Theoretical Foundations of the Relationship between Industrial Growth and Innovative Development**

Our analysis of publications on the topic of this study shows that the relationship between industrial growth and innovative development of regions is confirmed by researchers from different countries of the world. It was found that the relationship between industrial growth and innovation activity occurs in different areas, namely:

1. Sustainable development. The neo-industrialization of regional economic systems is viewed in the context of sustainable industrial development, which predetermines the focus of innovation on environmental protection and the efficient use of non-renewable resources (Ulbrich, 2020), as well as on the search for ways to overcome the industrial crisis in our post-Covid 19 societies (Ferrannini *et al.*, 2020).

2. Organizational and technological improvement of regional enterprises. The consolidation of Chinese manufacturing companies through international expansion and M&As abroad leads to an increase in the country's innovative potential (Petti *et al.*, 2019). European studies of neo-industrialization deal with the problem of stabilizing the global value chain based on innovative vectors aimed at reducing dependence on imports, accelerating the transition to a digital and low-carbon economy, increasing the transparency of interactions between participants in the chain (Mateus & Martins, 2020). The organizational aspect is also showed in the study of industrial clusters, the geographical proximity of enterprises in which contributes to the development of proximity in other dimensions: social, competence and innovative (Lis, 2020). With the advent of the Fourth Industrial Revolution, the issues of introducing innovations into the business models of enterprises through digital transformation are relevant (van Tonder *et al.*, 2020). Everywhere and in Asian countries, in particular, technological innovations are considered as the basis for updating and adapting the business processes of manufacturing companies to the challenges of the digital economy (Li *et al.*, 2020).

3. Formation of human capital. India's experience demonstrates the high importance of improving the quality of higher education in order to form a qualified technical workforce to increase the share of industrial production in GDP and enhance its innovative content (Hariharan & Biswas, 2020). The importance of developing digital skills of the workforce for ensuring the sustainability of economic development in the context of Industry 4.0, based on the digitalization of production processes, is highlighted in an article by European scientists (Habanik *et al.*, 2019). Researchers from China and Pakistan state the crucial importance of intellectual capital and innovation policy for manufacturing companies in the context of the fourth industrial revolution (Li *et al.*, 2021). Improving human capital contributes to the growth of the effectiveness of technological innovation, strengthening the link between technological innovation and spillovers (Hu, 2021). Improving the quality of human capital and technological innovation, as well as continuous investment in R&D, make the production sector and the national economy more productive (Gu *et al.*, 2021).

4. Interaction with subjects of the innovation environment. The industrial strategy of the UK emphasizes the key role of the interaction of universities with industrial enterprises (Johnston & Wells, 2020). The expediency of cooperation with universities is confirmed by studies that have shown a more developed ability of university business incubators to create innovations of global novelty compared to technology incubators, which tend to create local innovations (Goraczowska, 2020). It is proved that innovations not only of large corporations, but also of anchor entrepreneurs play a significant role in the origin and development of agglomerations and clusters. Anchor entrepreneurs are a dynamic force and catalyst for new industrial formations (Ferriani *et al.*, 2020). Based on the example of regional studies carried out in Poland, it is substantiated that the stimulation of innovative cooperation for the development of industry is advisable in advanced territories. In underdeveloped regions, it is necessary to stimulate innovation as such. (Swiadek & Goraczowska, 2020).

5. Export. A study of data from Chinese industrial companies over a seven-year period showed that market size affects the innovation activity of enterprises in the region less than their export activities (Cai *et al.*, 2020). The inverse relationship between these parameters is also confirmed: the activation of innovations, especially in terms of marketing, contributes to an increase in the export activity of regional enterprises in Uruguay (Horta *et al.*, 2020).

Despite the existence of many points of contact between industrial development and innovation, we believe that their relationship is most strongly manifested in the creation of innovative products. The relationship between the effectiveness of innovation and the development of the industrial sector of the economy is emphasized, for example, by H. Kroll, P. Neuhausler, who substantiated the need to match the technological development of industry with the effectiveness of economic activity, expressed, among other things, in the growth of innovative productivity (Kroll & Neuhausler, 2020). In this regard, further research is carried out in the context of determining the innovative performance of the industrial development of Russian

regions. However, before proceeding to a methodological description of the proposed research tools, we consider it necessary to describe the main problems of the industrial development of Russian regions.

### Problems of Industrial Development in Russia

Neo-industrialisation as a global trend and imperative of the innovation trajectory of national economies postulates the key role of industry, and especially its part related to the use of advanced technologies, for achieving competitive economic growth. The need to understand at a state-level the importance for Russia (as well as for other transition economies) of industrial development, supported by the growth of output of innovative products, is due to several theses emphasised in various studies (Klyuev, 2018; Kornev *et al.*, 2015; Kaneva, 2017; Benini & Czyzewski, 2007; Doroshenko *et al.*, 2016):

1. The property of any industrial revolution is the unevenness of its translation into the world space. Scientific ideas and developments change the economic landscape only if there is a technological restructuring of economic systems and a multiple increase in the use of the achievements of the industrial revolution. That is why it is important to level the industrial development of regional economies within the country and ensure their compliance with innovative transformations.

2. According to the Industrial Development Report 2020<sup>1</sup>, Russia is among the 50 economies actively developing and implementing advanced digital technologies (ADP), however, not as a leader, but as a follower. It should also be noted that the introduction of advanced digital production continues to have limitations in developing countries. Therefore, in fast-growing economies, industrial growth is accompanied by increased productivity, while in developing countries productivity remains low even as industrial production grows.

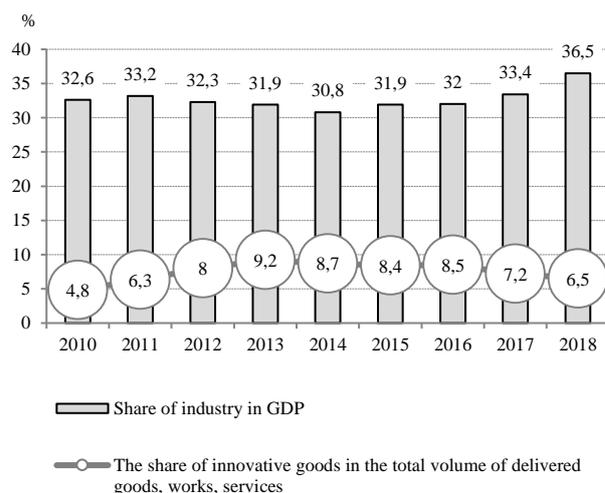
3. Re-industrialisation implemented after de-industrialisation is considered to be more complicated than early industrialisation. Increasing the share of industrial production in the country's GDP and in the total number of employed people in the economy in the 21st century requires much more effort than before.

4. The opportunities to effectively eliminate the disparity in the innovative and industrial development of Russian regions are associated with the spread of positive experience of using the agglomeration effect in the capital.

5. Spending on technological innovations and the quality of institutions in Russia have the most significant positive impact on the level of economic activity and economic growth in the regions.

The development of the industrial sector determines the speed and quality of economic growth. Although against the background of global statistics Russian industrialisation indicators generally correspond to general trends<sup>2</sup>, the qualitative component of Russia's industrial sector is largely

inferior to developed countries due to the lack of significant growth in the manufacturing industry. The weak dynamics of the industrial production index of the Russian Federation in 2015 – 99.2 %, in 2016 – 102.2 %, in 2017 – 102.1 %, in 2018 – 102.9 %) is mainly due to a positive trend in mining. At the same time, in Germany this indicator was 111, 112, 116, 117 in 2015, 2016, 2017, 2018 respectively, in the USA - 111, 108, 111, 115, in India - 114, 120, 124, 130<sup>3</sup>. Russia's development dynamics are characterised by a qualitative improvement of the industrial component only in the period from 2011 to 2014, and further growth of the industrial sector's contribution to Gross Domestic Product was accompanied by a decrease in the level of innovativeness of products (Fig. 1).



**Figure 1.** The Dynamics of Industrial and Innovative Development of the Russian Federation

The explanation of the dynamics given in Fig. 1 is the fact that Russia, with its historically developed export-raw material model of the economy, maintains high profitability of production and the export of raw materials while at the same time low profitability of the manufacturing industry. Overcoming the stagnation of development characterised by the increase of the financial sector, trade, and services, is possible only if the outstripping growth of mechanical engineering, electronic industry and construction in relation to GDP growth is achieved. The formula for development in Russia is considered to be vertical integration plus neo-industrialisation (Gubanov, 2017). Experts note that in order to accelerate the appearance of signs of the fourth industrial revolution in Russia, it is important to increase the contribution of the manufacturing industry to added value, to increase the level of commercialization of innovations, to intensify the participation of small businesses in the innovation process, to improve models of interaction between the high-tech sector and the subjects of the innovation environment. (Schetina *et al.*, 2014; Doroshenko *et al.*, 2019).

<sup>1</sup> Industrial Development Report 2020. Industrializing in the digital age Overview. Available from the Internet: [https://www.unido.org/sites/default/files/files/2019-11/UNIDO\\_IDR2020-English\\_overview.pdf](https://www.unido.org/sites/default/files/files/2019-11/UNIDO_IDR2020-English_overview.pdf).

<sup>2</sup> List of Countries by GDP Sector Composition. Available from the Internet: <http://statisticstimes.com/economy/countries-by-gdp-sector-composition.php>.

<sup>3</sup> Federal State Statistic Service. Available from the Internet: <https://www.gks.ru/incomparisons>.

As a result of the theoretical analysis of the scientific problem, we can state that there is no congruence between external challenges and the state of the industrial base of the Russian economy, which underlines the urgency of the problem of studying the industrial potential of Russian regions in the context of the ability to create an innovative product.

**Research method**

The methodology of the proposed analysis is based on assessing whether the level of industrialization of regions determines their ability to produce innovative goods. Regression equations and correlation coefficients are used as analysis tools. They make it possible to identify the nature and degree of the relationship between the level of industrialization and the innovative performance of the region. The procedure for calculating the level of industrialization and innovative performance of the region is given in table. 1.

Table 1

**Indicators to Analyse the Relationship between Industrial Development and Innovative Efficiency of Russian Regions**

Indicator	Interpretation	Calculation
Level of industrialisation	contribution of all industry sectors to the Gross Regional Product	sum of the gross value added in the extractive and manufacturing industries
Innovative performance	share of innovative products in industrial output	volume of innovative goods produced in the region, correlated with the volume of output of domestically produced goods

*Note: Indicators are calculated on the basis of Rosstat data.*

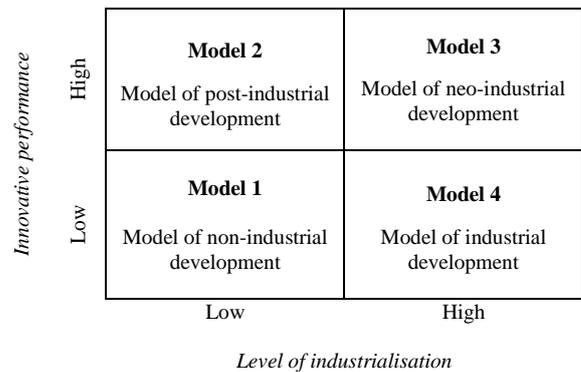
Comparison of the level of industrialization and innovative performance of the region allows us to determine the type of model of industrial and innovative development used in the region (Fig. 2).

In addition, data analysis within the framework of the proposed methodological approach allows us to determine the type of industrial and innovative development model used in the region.

The critical value that defines the middle of each axis in the matrix is the average value of the indicator for the Russian Federation.

Models of regional industrial and innovative development (MRIID) may be given the following characteristics:

1. The model of non-industrial development is typical for regions with a relatively low level of industrialisation and a small share of innovative production in industrial output. These are mainly regions with agricultural or service specialisation.



**Figure. 2.** Models of regional industrial and innovative development

*Composed by the author*

2. The model of post-industrial development occurs in regions with relatively low levels of industrialisation and a high share of innovative products in industrial output. The economic structure of these regions is in line with the ideology of the post-industrial economy (the contribution of the services sector to Gross Regional Product is high); however, the industrial sector in these regions is mainly of a high-tech nature, and this makes it possible to produce a relatively high percentage of innovative products.

3. The model of neo-industrial development highlights the regions that are the reference points for innovative development in the context of the fourth industrial revolution, as they demonstrate a relatively high contribution of industry to Gross Regional Product, which is accompanied by a relatively large share of innovative products in total industrial output.

4. The model of industrial development is typical for old industrial regions, which use low and medium-tech industries and are slow to implement technological modernisation programmes, which, as a result, complicates the growth of their industrial output of innovative products.

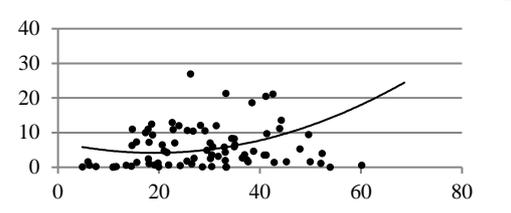
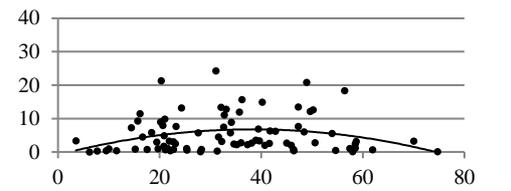
**Research Results and Discussion**

Estimation of the relationship between the level of industrialisation and innovative performance by all subjects of the Russian Federation for 2014 and 2018. (Table 2) shows that the relationship between the studied parameters becomes less determined and the nature of the relationship changes (from direct to inverse).

On the one hand, this proves that it is difficult to achieve innovative performance by developing the industrial sector without corresponding modernisation of the research base and innovation infrastructure. On the other hand, the analysis highlights the slowdown in the innovation processes of the Russian regions' economies: while in 2014 the correlation between the level of industrialisation and the innovation performance was weak, in 2018 it is completely absent

Table 2

**Relationship between the Level of Industrialisation (Axis x) and the Innovative Performance (axis y) in the Subjects of the Russian Federation**

Year	Scatter graph	Regression equation	Determination coefficient	Correlation coefficient
2014		$y = 0.008x^2 - 0.317x + 7.182$	0.164	0.334
2018		$y = -0.005x^2 + 0.399x - 0.885$	0.075	0.058

Composed by the author

It can be stated that for 2018 in the Russian regions there was no stable and deterministic relationship between the level of industrialization and innovative performance.

A summary of the statistical data and the results for determining the type of innovation development model used are presented in Table 3.

Table 3

**Defining the Model of Industrial and Innovative Development of Russian Regions in 2014 and 2018**

The subject of the Russian Federation	2014		2018		MRIID -2014	MRIID -2018
	Level of industrialisation	Innovative performance	Level of industrialisation	Innovative performance		
Voronezh Region	18	7.2	18.4	5.9	1	1
Rostov Region	22.8	10.9	27.6	5.8	2	1
Novosibirsk Region	17.3	10	20.9	4.9	2	1
Tver Region	25.5	1.8	31.6	4.5	1	1
Sevastopol	24.2	0.5	16.6	4.5	1	1
Republic of Kalmykia	4.8	0.1	3.5	3.4	1	1
Bryansk Region	20.6	6.5	21.9	3.3	1	1
Kurgan Region	26.9	2.6	32.2	3.2	1	1
Pskov Region	19.1	0.7	22.7	3.1	1	1
Moscow	14.7	11	19.4	3	2	1
Altai Krai	21.6	4.3	23.1	2.5	1	1
Jewish Autonomous Oblast	13.5	0.6	20.8	1.8	1	1
Kamchatka Krai	19.8	1.2	25.3	1.1	1	1
Amur Region	21	4.7	21.6	1.1	1	1
Orel Region	18	1	19.7	1	1	1
Altai Republic	7.5	0.2	10	1	1	1
Kabardino-Balkarian Republic	17.9	2.4	15.2	0.9	1	1
Murmansk Region	30.4	3.6	28.2	0.8	1	1
Republic of Crimea	21.9	0.7	17.5	0.8	1	1
Zabaykalsky Krai	15.5	7.3	22.7	0.8	1	1
The Republic of Buryatia	25.6	10.6	21.1	0.7	2	1

Continuation of Table 3

The subject of the Russian Federation	2014		2018		MRIID -2014	MRIID -2018
	Level of industrialisation	Innovative performance	Level of industrialisation	Innovative performance		
Ivanovo Region	26.5	0.9	25.4	0.6	1	1
The Republic of Ingushetia	11.5	0.2	11.5	0.4	1	1
The Karachay-Cherkess Republic	19.9	0.1	22.1	0.4	1	1
The Republic of North Ossetia – Alania	11	0.1	9.5	0.4	1	1
Kaliningrad Region	33.3	0.1	31.3	0.3	4	1
The Republic of Dagestan	6.2	0.6	7.7	0.3	1	1
The Tyva Republic	10.9	0	28	0.1	1	1
The Chechen Republic	5.9	1.6	6.2	0	1	1
The Republic of Mordovia	26.2	26.9	31.1	24.3	2	2
Khabarovsk Krai	18.5	12.5	20.3	21.3	2	2
Ulyanovsk Region	31.3	12	32.1	13.4	3	2
Moscow Region	22.6	12.9	24.3	13.2	2	2
Yaroslavlskaya Oblast	29.1	10.5	33.1	12.8	2	2
Krasnodar Krai	15.6	1.4	16.1	11.5	1	2
The Chuvash Republic - Chuvashia	28.2	12.1	32.7	11.1	2	2
Saint Petersburg	23.9	12	21	9.9	2	2
Tambov Region	14.6	6.3	15.7	9.3	1	2
Stavropol Krai	17.8	11	20.2	9	2	2
The Republic of Adygea	18.7	9.3	20.6	8	2	2
Penza Region	23.1	7	23.2	7.7	1	2
Kostroma Region	33.1	2	32.6	7.5	4	2
Primorsky Krai	14.5	0.3	14.4	7.3	1	2
The Republic of Tatarstan	41.1	20.5	48.9	20.9	3	3
Perm Krai	49.6	9.4	56.4	18.4	3	3
Nizhny Novgorod Region	33.2	21.3	36.2	15.7	3	3
Belgorod Region	33.1	4.4	40.2	14.9	4	3
Samara Region	42.5	21.1	47.3	13.5	3	3
The Udmurt Republic	43.9	11.2	50.2	12.6	3	3
Tula Region	41.3	9.7	49.6	12.2	3	3
Kursk Region	35	6.5	35.7	12	4	3
Kirov Region	30.1	7	34.1	8.9	1	3
Lipetsk Region	44.2	13.6	47.3	7.7	3	3
Sverdlovsk Region	32.9	5.8	39.4	6.9	4	4
The Republic of Bashkortostan	34.9	8.2	41.7	6.3	4	4
Chelyabinsk Region	38.7	4.6	42.8	6.2	4	4
Irkutsk Region	37.6	1.6	48.4	6.1	4	4
Ryazan Region	31.7	3.2	33.9	5.8	4	4
Arhangelsk Region	42.8	1.4	53.9	5.6	4	4
Vladimir Region	34.4	8.3	38.9	3.6	4	4
Omsk Region	40.8	3.5	39.6	3.4	4	4
Tyumen Region	60.1	0.6	70	3.3	4	4

End of Table 3

The subject of the Russian Federation	2014		2018		MRIID -2014	MRIID -2018
	Level of industrialisation	Innovative performance	Level of industrialisation	Innovative performance		
Orenburg Region	52	1.1	58.7	3.2	4	4
The Mari El Republic	26.7	10.4	36	2.8	2	4
The Republic of Khakassia	33.3	0	50.6	2.8	4	4
Kaluga Region	36.5	2.7	45	2.7	4	4
Leningrad Region	34.9	5.9	38.1	2.7	4	4
The Republic of Karelia	30.4	0.2	41.6	2.6	1	4
Saratov Region	30.2	2.5	34.6	2.4	1	4
Kemerovo Region	45.2	1.6	58.5	2.4	4	4
Smolensk Region	30.6	5.9	35.2	2.2	1	4
Volgograd Region	37.4	2.1	37.3	2.2	4	4
Vologda Region	38.4	18.6	45.9	2	3	4
Novgorod Region	36.9	3.6	40.7	2	4	4
The Komi Republic	47.9	5.3	58.5	1.2	4	4
The Republic of Sakha (Yakutia)	49.9	1.6	57.4	1.1	4	4
Tomsk Region	41.2	3.5	46.3	0.8	4	4
Krasnoyarsk Krai	52.3	4	61.9	0.7	4	4
Chukotka Autonomous Okrug	53.9	0	54.6	0.5	4	4
Magadan Region	28.6	0.1	46.4	0.4	1	4
Astrakhan Region	29.5	4.9	58	0.1	1	4
Sakhalin Region	68.6	60.1	74.7	0.1	3	4

Source: Rosstat data [Electronic resource]. URL: [http://www.gks.ru/wps/wcm/connect/rosstat\\_main/rosstat/ru/statistics/accounts/#](http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/accounts/#), Russian regions. Socio-economic indicators. (2018) Collected papers / Rosstat. M. P. 1162, Regions of Russia. Socio-economic indicators. (2015) Collected papers / Rosstat. M. P. 1266, and authors calculations.

The assessment showed that practically in all regions of Russia there was no “revolutionary” growth in the level of industrialization (such as to exceed the average Russian level). Only seven subjects of the Russian Federation (Kostroma, Tambov, Belgorod, Kursk, Kirov regions, Krasnodar & Primorsky Krai) demonstrated in 2014–2018 increase in innovative performance, indicating a transition to a more progressive model of regional development. During the same period, only seven subject of the Russian Federation (the Republic of Karelia and Mari-El, Astrakhan, Kirov, Magadan, Saratov, Smolensk regions) showed an increase in the level of industrialization, which allowed them to move to the zones of the matrix of models of

industrial and innovative development, indicating an increase in the efficiency of the regional politicians. Note that the level of industrialization of regions producing a high share of innovative products in the volume of industrial output is in the range from 14.4 to 56.4 % (for all Russian regions this interval is 3.5–74.7).

A correlation-regression analysis (Table 4) has been conducted for the identified models, which establishes the highest level of determination and correlation ratio between the investigated parameters in the regions implementing the industrial development model and the neo-industrial development model.

Table 4

**Relationship between the Level of Industrialisation (axis x) and the Innovative Performance (axis y) in the Subjects of the Russian Federation with Different Types of MRIID in 2018**

MRIID type	Regression equation	Determination coefficient	Correlation coefficient
1	$y = 0.045x + 1.031$	0.037	0.194
2	$y = 3.036x^{0.41}$	0.107	0.287
3	$y = 0.014x^2 - 1.076x + 32.3$	0.161	0.367
4	$y = -0.000x^2 + 0.008x + 4.574$	0.182	-0.424

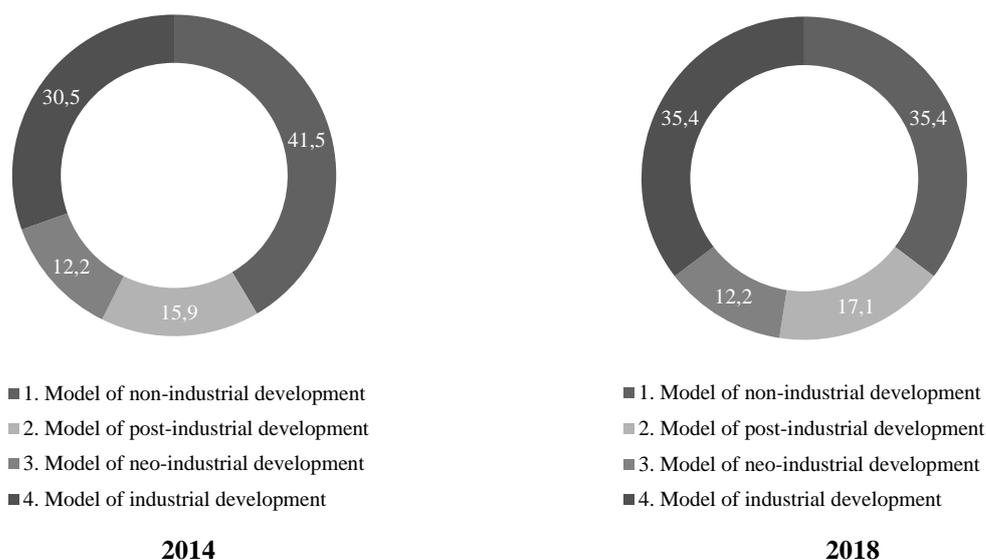
It is necessary to emphasise that the model of neo-industrial development is characterised by a direct relationship between the level of industrialization and the innovative performance of the region, while the model of industrial development is characterised by an inverse relationship between these parameters. The transition of regions implementing the model of industrial development to the model of neo-industrial development is possible on the basis of the reduction and modernization of low-tech industries, an increase in the innovative activity of

companies and the opening of new innovative technological sites.

A further increase in the level of industrialisation within the framework of the existing policy of technological modernisation in the regions implementing model 3 will strengthen the established direct correlation ratio between the level of industrialisation and the innovative performance. Regions implementing models 1 and 2 require government support for their industrial growth and competitiveness.

It should be noted that during the analysed period the regional structure of the Russian Federation, considered

through the prism of the models proposed in the article, has improved (Fig. 3).



**Figure 3.** Regional Structure of the Russian Federation According to the type of Industrial and Innovative Development Model

The share of regions with a high contribution of innovative products to industrial output (models 2 and 3) expanded from 28.1 % in 2014 to 29.3 % in 2018, which positively characterizes the industrial policy being implemented in them.

In 2018, a post-industrial development model is being formed in 17.1 % of Russian regions, and only 12.2 % of Russian regions have a neo-industrial development model. According to the data of 2018, it can be stated that 70.7 % of Russian regions have a level of innovative performance below the average for the Russian Federation, of which: 35.4 % of the subject of the Russian Federation implement the model of non-industrial development, 35.4 % of Russian regions use the model of industrial development.

A positive trend is that the share of regions implementing the model of non-industrial development has decreased, while the share of subjects of the Russian Federation using the model of neo-industrial development and the model of industrial development has increased. The share of regions with a relatively higher level of industrialization (models 1 and 4) has grown from 42.7 % in 2014 to 47.6 % in 2018.

### Conclusions

With the crisis of the post-industrial doctrine and the exhaustion of the former sources of economic growth, the difficulty of overcoming the consequences of de-industrialisation is seen as the main factor constraining economic development. Intensive restoration of the role of industry in ensuring sustainable economic dynamics is implemented in the format of industrial policy of neo-industrialisation and is identified as a priority task of state and regional management of economic development in the context of prolonged stagnation and technological lag.

A theoretical analysis of the world experience in researching the problem outlined in the article showed that industrial development and innovative activity have points

of contact in many aspects, namely: achieving sustainable development, organizational and technological improvement of business, improving the quality of human capital, interaction with the subjects of the innovative environment, and development of export activities. We support the idea that in the context of the fourth industrial revolution, the strongest relationship between industrial development and innovation is demonstrated in the creation of innovative products.

The solution of the problems of industrial development of Russian regions in modern conditions is illusory without an increase in the level of industrialization of the regions, supported by innovative performance. The proposed methodological approach is based on assessing the relationship between the level of industrialization and innovative performance, and the calculation algorithm for it is presented in the article. Comparison of regions according to these parameters allows us to distinguish four models of regional development: non-industrial, post-industrial, neo-industrial, and industrial development.

The analysis of Russian regions shows that there is no required balance between the development of industrial potential and innovative performance: the level of industrialization and the share of innovative products in the industrial output of Russian regions have weak determinism and correlation. At the same time, there is a positive dynamic shift in the structure of regional development models. The share of regions with relatively higher innovative productivity increased from 28.1 % in 2014 to 29.3 % in 2018. The share of regions with a relatively higher level of industrialization increased from 42.7 % in 2014 to 47.6 % in 2018. These trends positively characterize the programs for the development of industry and innovations being implemented in the Russian regions.

The article empirically proved the impossibility of transition to a new type of economy without increasing the level of its industrialization at a new technological level.

The proposed classification of models of industrial and innovative development of regions makes it possible to assess the acceptability of the industrial policy pursued in the region from the point of view of its compliance with the challenges of the fourth industrial revolution. The

theoretical and methodological provisions and practical conclusions presented in the article can serve as a basis for further research on the quality of industrial growth in the range of countries with transition economies.

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