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Identification of clustered points of growth by analyzing the innovation development of industry

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Abstract

The efficient clustering processes in the state provide sustainable development of the economy in general. The basis for the creation of effective clusters is the high level of development of the innovation system. In this article, the authors proposed a new approach to identifying point cluster growth through analysis of innovative development of the industry. This article contains the analysis of innovative development of manufacturing industries and assesses the impact of their innovation development at the GDP. A result of the research authors identified industries that are the points of cluster growth in the state economy.

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Keywords: innovation; innovative development; clusters; industries; manufacturing industry; processes clusterization.

1. Introduction

Prospects for the social and economic development of the state is significantly depend on the cluster development. The most effective clustering process is carried out in the innovative developed industries. The effective cluster policy of the state enhances competitiveness and innovative capacity. Therefore, the cluster state policy should be based on the industries that are the most innovative developed and have high growth potential.

The purpose of the study is to develop a method of taxonomic evaluation of innovative development of industries in order to identify the points of cluster growth. We will use this method to investigate the industries of Russian

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economy and to identify the most innovative developed ones. We will also evaluate the impact of innovative development of industries at the GDP.

We used the variety of theoretical and empirical research methods, including the literature review, the author's taxonomic method of estimation of innovative development industries, as well as methods of stochastic analysis.

2. Body

The first description of the innovation processes were presented at the beginning of the XX century by Austrian economist Schumpeter, who analyzed the "new combinations" of changes in the development of economic systems (1912). Issues of innovation development of economic systems are widely covered in the works of such well-known foreign scientists as Ansoff (1979), Drucker (1985), Vodachek (1989), Bruce (2010), Wahren (2004) et al. Among domestic scientists involved in the study issues of evaluation of innovative development, we can highlight the work of Zavlin (1998), Vasilenko (2003), Yakovets, (2003), Prigojin (1989), Molchanov (1994), Lapin (2008), Baburin (2010), Kiselev (2010), Vertakova, Plotnikov (2013), Grechenyuk, Grechenyuk (2014) et al.

A result of study different approaches to assessing the effectiveness of innovation, we found that most of the authors focus on the assessment of the innovative potential of the region. However, this is not enough. We need to use an integrated system of indicators, including also the assessment of innovative activity and effectiveness of innovation processes in the Russian economy. With regard to the industry analysis of innovative development of the necessary methodological framework is not currently developed. Therefore, we have developed a system of indicators characterizing the degree of innovation development of the Russian economy.

For this purpose, we selected indicators that can be calculated according to official statistics. We have grouped our proposed indicators in two main blocks. The first block of indicators characterizes the industry innovation activity. The second block reflects the effectiveness of innovation processes in the industries. The system of indicators characterizing the level of industry innovation activity (the first block), includes three indicators:

1. The coefficient of the total innovation activity of organizations in the industry. It is calculated as the ratio of the number of organizations implementing technological, organizational and marketing innovations in the industry to the total number of organizations in the industry. It characterizes the level of innovative activity in the industry in general, by all kinds of implemented innovation.

2. The coefficient of technological innovation activity of organizations in the industry. It is calculated as the ratio of the number of organizations implementing technological innovation in general in the industry to the total number of organizations in the industry. It characterizes the level of technological innovation activity of industry.

3. The coefficient of the intensity use of innovations. It is calculated as the ratio of the number newly acquired advanced production technologies (APT) in the industry to the number of used in the industry. It shows how much the industry has to newly acquired APT to the number already used APT. The higher this ratio, the more intense the flow update process used innovations.

To assess the effectiveness of innovation across industries, we have developed the following system indicators (the second block):

1. The coefficient intensity of creation new advanced production technologies (APT). It is calculated as the ratio of the number of fundamentally new APT, has no analogues either in Russia or abroad, to the total number of APT developed in the industry. Accordingly, if the value of this coefficient is high, the industry and the economy as a whole are more competitive.

2. The share of innovative goods, works and services in the total volume of shipped goods, works and services. It is calculated as the ratio of innovative goods, works and services sector to the total volume of goods sold, works and services in the industry. This indicator shows the amount of production and sales of innovative products in the total volume of produced and sold products industry.

3. The coefficient of innovation effectiveness of the industry. It is defined as the ratio of innovative goods, works and services, re-introduced or exposed to significant technological changes over the last three years to the total volume of innovative products in the industry.

However, we understand that due to heterogeneity of economic and innovative development of Russian industries results of developed indicators can be very different. The resulting values of these coefficients may vary greatly: leaders in one direction of the study may be underdogs in others (Vertakova, Grechenyuk, 2015a). So we have come

to realize the need to develop the integral indicator that will allow revealing leading and lagging industries of the totality of the calculated indicators.

For the integrated assessment of innovative development by industries, we have developed a taxonomic efficiency indicator of innovation processes in the industry (TEIIP). By calculating this indicator, we can rank the industries in order of magnitude TEIIP and identify the most innovative developed industries in the totality of indicators proposed earlier (Vertakova Yu. V., Grechenyuk O.N. (2015b)).

On the basis of the calculated TPEIPs values we will do ranking industries in order of decreasing efficiency of innovative activity. Industries with the highest values TPEIPs will be considered as the most innovative developed and we will consider them as desired point of cluster growth. Industries with the highest values TPEIPs will be considered as the most innovative developed and we will consider them as desired point of cluster growth. On the basis of them the creation innovative industry cluster will be most effective.

At present the manufacturing industry in Russia is one of the main sectors of the economy. The manufacturing industry takes approximately two-thirds of all products shipped industrial production in the country (Plotnikov, Vertakova, 2014.). Therefore, it is in this industry, we need to concentrate on the development of innovation and the ability to create industrial clusters.

Using the proposed method, we researched the innovative development of the manufacturing industries in 2013 and represented the values obtained in Table 1.

Table 1. The coefficients of innovation activity in the manufacturing industry in 2013

Industries	The coefficient of the total innovation activity of organizations in the industry	The coefficient of technological innovation activity of organizations in the industry	The coefficient of the intensity use of innovations
The average value for the industry in general	0,101	0,089	0,172
Manufacture of food products, beverages and tobacco	0,110	0,090	0,038
Textile and clothing manufacture	0,085	0,070	0,034
Manufacture of leather, leather products and footwear	0,115	0,108	0,301
Processing of wood and manufacture of wood products	0,068	0,051	0,027
Pulp and paper industry; publishing and printing activities	0,037	0,032	0,043
Chemical manufacture	0,250	0,230	0,137
Manufacture of rubber and plastic products	0,117	0,100	0,022
Manufacture of other non-metallic mineral products	0,100	0,082	0,076
Metallurgical manufacture and production of metal goods	0,148	0,130	0,058
Manufacture of machinery and equipment	0,159	0,149	0,078
Manufacture of electrical and optical equipment	0,269	0,259	0,123
Manufacture of vehicles and equipment	0,215	0,204	0,084

The maximum value of the coefficient of the total innovation activity of organizations in the industry in 2013 was found in the manufacture of electrical and optical equipment - 0.269. It says that almost 27% of all organizations involved in these activities, carried out various kinds of innovations. Chemical manufacture is slightly inferior to it - 0.25. In the manufacture of vehicles and equipment this figure is 0.215; in the manufacture of machinery and equipment - 0.159. The value of the coefficient reached 0.148 in metallurgical manufacture. The value of the coefficient in other industries is below the industry average (0.133). The coefficient of the total innovation activity of organizations in the industries such as food processing, leather, leather products and footwear, rubber and plastic products and other non-metallic mineral products is 0.1-0.2. Even lower values of the coefficient are in activities such as the textile and clothing industry (0,085), wood processing and manufacture of wood products (0,068). The outsider of the study is the pulp and paper industry; publishing and printing activities - 0,037. The highest value of the coefficient of technological innovation activities in 2013 in manufacturing industry as well as the coefficient of the total innovation activity of organizations in the industry, we identified in the manufacture of electrical and optical equipment - 0.259. Consequently, 26% of organizations engaged in this activity, carried out technological innovation. Chemical manufacture is slightly inferior to the leader, where the value coefficient is 0.23. In third place we find the manufacture of vehicles and equipment - 0,204.

The average values are observed in the metallurgical manufacture and the manufacture of machinery and equipment - 0.13 and 0.15, respectively. The level of technological innovation activity of organizations engaged in the manufacture of leather, leather products and footwear, as well as in the manufacture of rubber and plastic products in 2013, below the industry average and the value is 0.1. Outsiders of the study proved to be the manufactures of food, textile and clothing, woodworking, pulp and paper industry; publishing and printing activities, manufacture of other non-metallic mineral products. The values of these coefficients aren't exceeding the threshold of 0.1. In the present conditions of the economy, we need to use only the latest innovative technologies that meet modern requirements of competitiveness, so it is important to study the intensity of use of innovations. The highest result of the coefficient of the intensity use of innovations in 2013 we have identified in the manufacture of leather, leather products and footwear - 0.301. This is surprising, especially given that the values of its previous indicators were below the industry average. Consequently, the 30 newly acquired advanced production technologies (APTs) are used by organizations in the production per 100 APTs. It's certainly not a very high figure, but compared to other ones, it is quite noticeably. We consider that this is due to the desire of organizations to increase the comparatively low innovation activity due to a significant acquisition of new APT.

With a significant lag of it there is the chemical manufacture - 0,137, and manufacture of electrical and optical equipment - 0,123, where the number of newly acquired APT per 100 already in use APTs is 14 and 12, respectively. The industry average this ratio is low value - 0,082, i.e. the organization of the industry in 2013 acquired only 8 per APT 100 used by APT. The value of this coefficient is slightly higher in the manufacture of vehicles and equipment - 0,084. Just below the value of the coefficient in the manufacture of machinery and equipment and other non-metallic mineral products - 0.078 and 0.076. In metallurgical production it has only 0,058. In other industries upgrade processes used by APTs (manufacture of food products; rubber and plastic products, wood processing and manufacture of wood products, textile and clothing, pulp and paper production, publishing and printing activities) proceed very sluggishly (0.02-0.04).

Next, we will examine the effectiveness of innovative activity in the manufacturing industry by economic activity (Table 2).

Table 2. The coefficients of innovation effectiveness in manufacturing industry in 2013

Industries	The coefficient intensity of creation new advanced production technologies (APTs)	The share of innovative goods, works and services in the total volume of shipped goods, works and services.	The coefficient of innovation effectiveness of the industry
The average value for the industry in general	0,107	0,092	0,689
Manufacture of food products, beverages and tobacco	0,200	0,039	0,029

Textile and clothing manufacture	0,000	0,024	0,832
Manufacture of leather, leather products and footwear	0,000	0,016	0,270
Processing of wood and manufacture of wood products	0,000	0,030	0,198
Pulp and paper industry; publishing and printing activities	0,143	0,032	0,957
Chemical manufacture	0,000	0,096	0,589
Manufacture of rubber and plastic products	0,000	0,092	0,521
Manufacture of other non-metallic mineral products	0,000	0,041	0,651
Metallurgical manufacture and production of metal goods	0,012	0,075	0,670
Manufacture of machinery and equipment	0,031	0,062	0,683
Manufacture of electrical and optical equipment	0,092	0,107	0,640
Manufacture of vehicles and equipment	0,075	0,281	0,704

Analysis of the intensity of the creation of new APTs in 2013 in the manufacturing industry by economic activity led to the following conclusions. The highest value of the coefficient intensity of creation new APTs was revealed in food industry - 0.2. This shows that among the 100 APTs that were developed in 2013, 20 APTs were principally new, having no analogues either in Russia or abroad. Pulp and paper industry; publishing and printing activities ranked second (0,143). The level of the coefficient in the manufacture of electrical and optical equipment and transport equipment is much lower, but higher than the industry average - 0.092, 0.031, respectively. In metallurgical production its value is even lower - 0.012. In the remaining activities of the manufacturing industry (textile and clothing manufacture, production of leather, leather products and footwear, wood processing and manufacture of wood products, chemicals, rubber and plastic products, other non-metallic mineral products) principally new APTs in 2013 did not were created. An analysis of the share of innovative goods, works and services in the total volume of shipped goods, works and services in 2013 in the manufacturing industry by economic activity revealed that the leader of this indicator is the production of vehicles and equipment - 0.281, i.e. is 28% of all produced and sold products (works, services) is an innovative. All other manufacturing industries are inferior him a more than twice, and do not reach the average level (0.116). The level of the indicator in the manufacture of electrical and optical equipment, rubber and plastics and chemical manufacture in 2013 was 0.1, i.e. only 10% of produced and sold products were innovative. In metallurgical manufacture and manufacture of machinery and equipment it was - 7.5% and 6.2%, respectively. In the remaining activities of the manufacturing industry (manufacture of foodstuff, textile and clothing, leather and leather products, wood processing and manufacture of wood products, pulp and paper production, publishing and printing, production of other non-metallic mineral products) value of the indicator has not reached even 0.05, i.e. less than 5% of all manufactured products were innovative. Consequently in most manufacturing industries there is a very low efficiency of use of innovations.

The coefficient of innovation effectiveness of the industry revealed that the maximum value of the indicator observed in the pulp and paper industry; publishing and printing (0.957). This shows that 96% of the total volume innovative products were a newly introduced or exposed to significant technological changes over the last three years. In the textile and clothing manufacture the value of this coefficient was 0.832. In the manufacture of vehicles and equipment the figure was (0.704), it was slightly above the average value (0.696).The coefficient was slightly less in the manufacture of machinery and equipment (0.683), metallurgical manufacture (0.67), manufacture of other non-metallic mineral products (0.651), electrical and optical equipment (0.64). In the chemical industry and the

manufacture of rubber and plastic products the value of the indicator amounted to 0.589 and 0.521, respectively. In the remaining manufacturing industries (food, leather and wood), the coefficient was not reached 0.3.

Results of the study proved very different. For each coefficient the dispersion of values was quite high and the leaders of the research in the same direction were outsiders in another. Therefore, we calculated the taxonomic efficiency indicator of innovation processes in the manufacturing industry (TPEIP) developed by us (Figure 1).

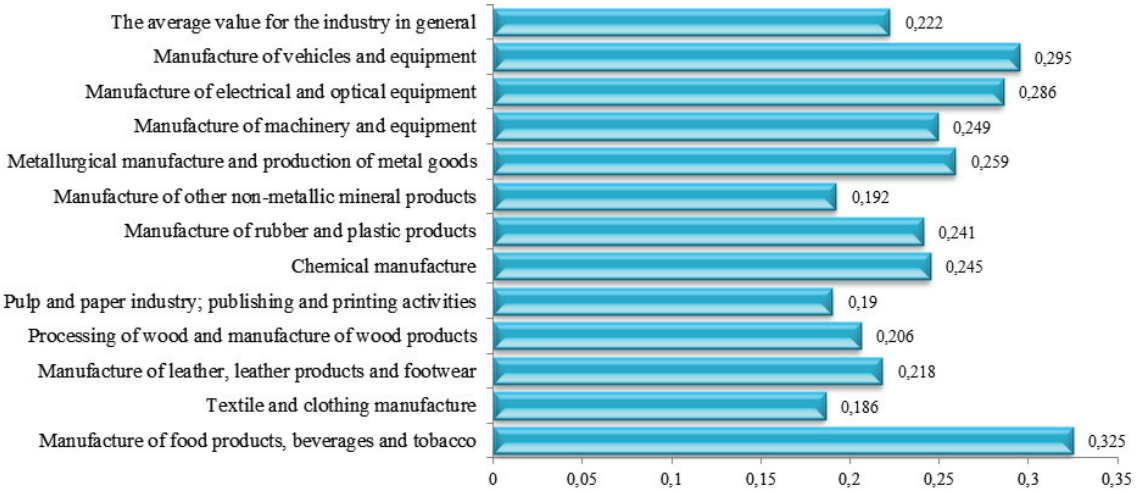


Fig. 1. Taxonomic efficiency indicator of innovation processes (TEIIP) in 2013 in the manufacturing industry

On the basis of the calculated values TEIIP in the manufacturing industry we will make their ranking according to the degree of diminishing the effectiveness of innovation process (Table 3).

Table 3. Ranking of the manufacturing industries according to the degree decreasing the effectiveness of innovative processes

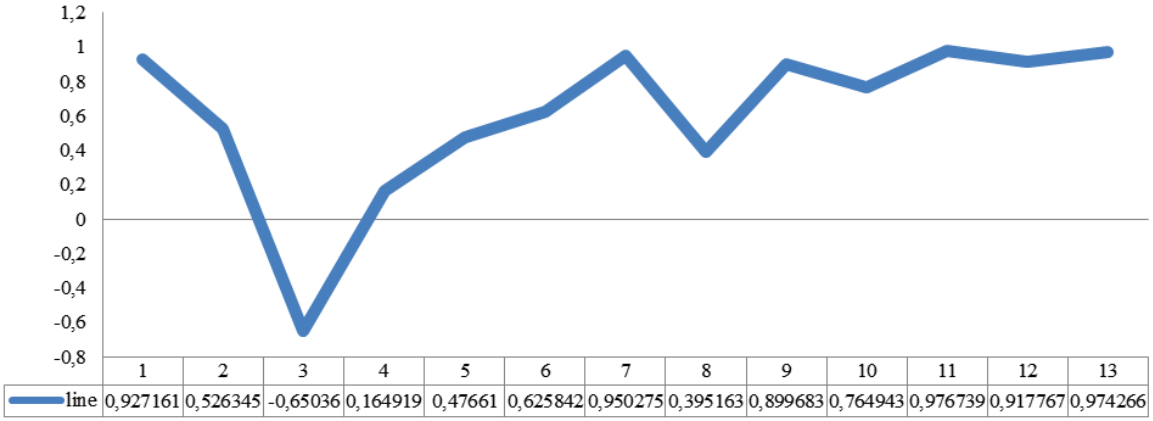
Industries	TEIIP	Rank
Manufacture of food products, beverages and tobacco	0,325	1
Manufacture of vehicles and equipment	0,295	2
Manufacture of electrical and optical equipment	0,286	3
Metallurgical manufacture and production of metal goods	0,259	4
Manufacture of machinery and equipment	0,249	5
Chemical manufacture	0,245	6
Manufacture of rubber and plastic products	0,241	7
Manufacture of leather, leather products and footwear	0,218	8
Processing of wood and manufacture of wood products	0,206	9
Manufacture of other non-metallic mineral products	0,192	10
Pulp and paper industry; publishing and printing activities	0,190	11
Textile and clothing manufacture	0,186	12

As a result of the ranking the obtained values TEIIP in the manufacturing industries, we found the following. The manufacture of food products, beverages and tobacco ranks first (0,325). In the second place, with a noticeable lag, there is the manufacture of vehicles and equipment (0,295). In the third place there is the manufacture of electrical and optical equipment with a value of TEIIP (0.286). The fourth position is occupied by metallurgical manufacture and production of metal goods (0.259). Further there is the manufacture of machinery and equipment (0.249), the

chemical industry (0,245), the manufacture of rubber and plastic products (0.241). Wood processing and production of leather and leather products and have reached roughly the same low value TEIIP - 0.21. Among the sectors that showed the lowest values of TEIIP were pulp and paper industry and publishing and printing industry, textile and clothing production and manufacture of other non-metallic mineral products (less than 0.2).

As a result of the study, we concluded that the clustering processes will the most effective in the food industry, the mechanical engineering and the chemical industries. With reasonable approach, and the corresponding state support these industries can bring the Russian economy to a qualitatively new level of innovation development.

The next step we evaluated the impact of each industries that we studied at the GDP dynamics. The study period was 12 years (2002 to 2013). For this we used the method of correlation analysis (Figure 2).



	1	2	3	4	5	6	7	8	9	10	11	12	13
line	0,927161	0,526345	-0,65036	0,164919	0,47661	0,625842	0,950275	0,395163	0,899683	0,764943	0,976739	0,917767	0,974266

Fig.2.The analysis of the impact of innovative development of manufacturing industries at the GDP dynamics for 2002-2013

1 – The manufacturing industry - total.
2 – Manufacture of food products, beverages and tobacco.
3 – Textile and clothing manufacture.
4 – Manufacture of leather, leather products and footwear.
5 – Processing of wood and manufacture of wood products.
6 – Pulp and paper industry; publishing and printing activities .
7 – Chemical industry.
8 – Manufacture of rubber and plastic products.
9 – Manufacture of other non-metallic mineral products.
10 – Metallurgical manufacture and production of metal goods.
11 – Manufacture of electrical and optical equipment.
12 – Manufacture of machinery and equipment.
13 – Manufacture of vehicles and equipment.

Figure 2 shows that in the manufacturing industry as a whole, the correlation coefficient is 0.927. This shows the high dependence of the GDP dynamics from the volume of production innovative products in the manufacturing industry. In the manufacturing industry the following industries the most significantly affected to the dynamics of the GDP: the manufacture of electrical and optical equipment (0.976), the manufacture of vehicles and equipment (0.974), chemical manufacturing (0.950), the manufacture of machinery and equipment (0.917). The following industries had an average impact on the dynamics of the GDP: pulp and paper industry; publishing and printing (0,625), the manufacture of food products, beverages and tobacco (0,526), the manufacture of wood and of products of wood (0.476). The manufacture of leather, leather products and footwear production had almost no impact at the GDP (0.164). And textile and clothing manufacture adversely affect to the dynamics of the GDP (-0.650).

3. Conclusions

The aim of this study was to identify the points of cluster growth in the industries Russia. In this paper, we developed the method for taxonomic evaluation of innovative development of industries based on the system of indicators that characterize the innovative development of industries grouped in two main blocks: innovation activity and innovation effectiveness industries of Russian economy. We conducted the study the innovative development of the industries using this method.

As result of the research of innovation activity, we obtained the following conclusions.

The highest value of the coefficient of the total innovation activity and the coefficient of technological innovation activity of organizations in 2013 were found in the manufacture of electrical and optical equipment and the chemical manufacture. The values of these coefficients in the manufacture of vehicles and equipment, the manufacture of machinery and equipment and the metallurgical manufacture have been slightly lower.

The coefficient of the intensity use of innovations was the highest in the manufacture of leather, leather products and footwear. This was unexpected, since the values of the previous indicators were low there. The values of this coefficient in the chemical manufacture and the manufacture of electrical and optical equipment were significantly lower. The value of the coefficient in the manufacture of vehicles and equipment was slightly higher than the average value of the industry in total. Thus, we found that the manufacture of electrical and optical equipment, the chemical manufacture, the manufacture of vehicles and equipment were the most innovation active in the manufacturing industry.

The analysis of effectiveness of innovations in the manufacturing industry has revealed that the highest value of the coefficient intensity of creation new advanced production technologies (APT) was in the food industry. In second place the pulp and paper industry; publishing and printing activities. The level of the coefficient in the manufacture of electrical and optical equipment and the manufacture of vehicles and equipment was much lower, but higher than the industry average. The analysis of the share of innovative products in total production showed that the leader in this indicator was the manufacture of vehicles and equipment. The value of this coefficient in the manufacture of electrical and optical equipment, rubber and plastics and chemical manufacture was much less.

The analysis of effectiveness of innovative in the manufacturing industry revealed that the greatest value of the coefficient was observed in the pulp and paper industry; publishing and printing activities. In the second place there is the textile and clothing manufacture, the manufacture of vehicles and equipment, the machinery and metallurgical manufacture.

We calculated the taxonomic efficiency indicator of innovation processes in the industry (TEIIP) and made the ranking of obtained values. The results of this are as follows. On the first place there was the manufacture of food products, beverages and tobacco. On the second place there was the manufacture of vehicles and equipment. On the third place there was the manufacture of electrical and optical equipment. The values of the coefficient in the metallurgical manufacture, machinery and equipment manufacturing and chemical manufacture were lower.

The correlation analysis of the impact of innovative development of the studied manufacturing industries to the GDP dynamics shown that the manufacture of electrical and optical equipment, the manufacture of vehicles and equipment, the chemical manufacture, the manufacture of machinery and equipment had the most significant effect to the GDP dynamics.

As a result of the study, we concluded that the most effective processes of the clustering will be in the food industry, mechanical engineering, manufacture of electrical and optical equipment, and in the chemical industry. With the reasonable approach, and the corresponding state support they can bring the Russian economy to a qualitatively new level of economic development.

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