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The Approach to the Diversification of the Regional Economy Taking Into Account Evolutionary Conditionality, Resource Availability and Innovation Activity

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ABSTRACT

The approach to assessing the possibility of diversifying the regional economy is presented on the basis of the author's methodology for the formation of recommendations for the development of regions and sectors. The approach is based on regression analysis using an extended economic basis, including the characteristics of regional differentiation and innovation activity. On this basis, sectors can be identified, the development of which depends on the regional innovation activity. The estimates obtained allow us to appraise the impact of the characteristics of regional differentiation and innovation activity on the development of such sectors. The research showed that innovation activity can contribute to diversification if the region has a relatively high level of economic development. As a result of the approbation of the proposed approach, 20 sectors with the volume of production depending on the innovative activity of the regions aimed at the creating of international patent applications have been identified. The study shows that for these sectors, regions can be identified in which the growth of innovation activity can be accompanied by an increase in the volume of production of this sector and its emergence as a strong one. Further, the study considered the Construction sector as an example and identified 17 priority regions for the development of this sector and its transformation into a strong one. The study provides recommendations for the development of the Construction sector in four regions, taking into account the probabilistic estimates of the emergence of a new strong sector in the region, obtained using the characteristics of evolutionary conditionality.

INTRODUCTION

Two main theories describe the mechanism of knowledge creation and dissemination: localized specialization and economic diversification. The theory of localized specialization was first presented in detail in the work (Marshall, 1890). The theory claims that companies surrounded by other representatives of the same industry will grow faster due to the circulation of knowledge within the industry. This theory was developed in the works (Arrow, 1962; Romer, 1986). The opposite theory and empirical estimates are presented in the works (Blien, Wolf, 2006; Fuchs, 2011; Illy, Schwartz et al., 2011). According to this theory, companies benefit from facing a heterogeneous environment consisting of different industries, as new ideas come from the external environment. The mechanisms by which diversity leads to economic growth are commonly referred to as diversification.

Diversification, defined as the expansion of the structure of the economy, is an important goal in all countries and is defined as one of the most important priorities of economic development. The development of unique specializations and the use of the potential of diversification is at the heart of the recently announced strategy of the European Union to promote economic development, growth of European regions and a new industrial policy (European Commission, 2011a, 2011b; McCann, Ortega-Argiles, 2015). Oil exporters also recognized the need for the diversification strategy, recognizing the limitations of oil-based growth and the need to find alternative ways to preserve and improve national welfare (International Monetary Fund, 2015, 2016).

Further, the paper presents an approach to the diversification of the regional economy based on the author's methodology for the formation of recommendations for the development of regions and sectors using the characteristics of regional differentiation, innovation activity and evolutionary conditionality. Based on the regression analysis of the production volumes of the sectors of the economy, the sectors whose development depends on the innovation activity of the regions are identified. In the course of the study, quantitative characteristics were obtained that allow us to judge the impact of regional innovation systems on the development of such sectors. It is shown that the influence of the regional innovation system can contribute to diversification if the region has a relatively high level of economic development. Taking into account the estimates of the probabilities of the Construction sector emerging as a strong one, obtained using the model presented in (Afanasiev & Kudrov, 2021) the paper provides recommendations for the development of this sector in four regions.

1. METHODOLOGY

At the first stage of the recommendations formation, the correlation analysis of the components of the economic basis, including the characteristics of regional differentiation and innovation activity indexes, is carried out. The description of the economic basis {L, te, s^1,s^2} proposed by the authors and the methodology of its application for assessing socio-economic development at the regional level are presented in (Aivazian, Afanasiev, Kudrov, 2018, 2020). The description of the innovation activity indexes used below, built on the basis of the stochastic boundary concept, is given in (Lysenkova & Afanasiev, 2020). To exclude the effects of multicollinearity in the construction of regression models, it is necessary to have statistically independent characteristics of the economic basis and indexes of innovation activity.

The second stage of the recommendations formation is the expansion of the economic basis at the expense of an additional component - one or more indices of innovation activity. Extended economic basis {L, te, s^1, s^2, INN}, including the index of innovative activity INN, reflects not only the economic structure of the regional economy, but also the specifics of the innovation activity of the regions, focused on a specific result of innovation activity. At this stage, a regression analysis of the production volumes of each sector of the economy is carried out using the economic basis extended by including the innovation activity index. As estimates of production volumes, data on tax revenues by sectors of the economy can be used, which makes it possible to characterize the structures of regional economies, including sectors oriented to both external and internal markets. The premise is taken into account that the volumes of tax revenues by economic sectors in the regions correctly reflect the proportions of production volumes. If the index of innovation activity statistically depends on some components of the economic basis, then to

prevent the effect of multicollinearity, it is advisable to use a modification of the index, cleared of these components influence.

The regression is given by

$$\ln T_{ij} = const_i + \beta 1_i \ln L_j + \beta 2_i te_j + \beta 3_i s_j^1 + \beta 4_i s_j^2 + \beta 5_i INN_j + \varepsilon_{i,j} \quad (1)$$

Where

T_{ij}— the amount of tax revenue from sector i in region j;

L_j— the scale of the region's economy j (the Rosstat indicator "number of economically active population" is used as a characteristic of the scale of the economy);

te_j— assessment of the technical efficiency of regional production;

s_j^1 — index of industry specialization (the first main component of the GRP structure);

s_j^2 — the industrialization index (the second main component of the GRP structure).

The author's methodology (Ayvazyan et al., 2016) and Rosstat indicators for the sectoral structure of GRP were used to construct the main components. INN— index of innovation activity (one of the author's indexes is used here, built on the basis of the concept of stochastic frontier according to data on international patent applications (TEMPZ), patent applications (TEPZ), granted patents (TEVP), developed production technologies (TETTCH) (Lysenkova & Afanasiev , 2020). $\varepsilon_{i,j}$— regression error.

From the total of 82 sectors, sectors are distinguished for which the evaluation of the parameter $\beta 5_i$ is positive and significant at 95% level. The volume of production of each of these sectors depends on the level of innovation activity of the regions, determined by the INN index. Further in paper the main attention is paid to these sectors of the economy.

At this stage of the study, the level of compliance of the actual volume of production of the sector with the expected volume of production, due to the characteristics of differentiation of the expanded economic basis, is calculated. The regions in which the actual output of the sector is lower than expected are identified. These regions also have sufficient resource security. In such regions, we can expect the sector to turn into a strong one due to the unrealized potential of economic development. On the contrary, if the actual volume of production is higher than expected, then the region has already used its growth potential due to the characteristics of the economic basis and its resource availability is insufficient for the development of the sector. In this case, the development of the sector to a strong level can be based on the growth of regional innovation activity.

Let consider a specific sector of economy *i* and the corresponding regression of the form (1). In accordance with the results obtained at the second stage of the study, we consider the sector for which the estimate of the coefficient $\beta 5_i$ is positive and significant at 95% level. Let order the regions in ascending order of the regression error values $\varepsilon_{i,j}$. Those regions for which the error $\varepsilon_{i,j}$ is below zero do not fully use their economic opportunities determined by the expanded economic basis {L, te, s^1, s^2, INN}. Such regions have sufficient resources, but have not fully used the potential of economic development. The growth of innovation activity in such regions does not have a sufficient economic basis for the development of the sector. Therefore, it is difficult to expect that this growth will lead to a significant increase in the production volumes of the sector of the economy we are interested in. Regions with the positive error $\varepsilon_{i,j}$ exceed the level of development determined by the components of the extended economic basis. The development potential determined by the expanded economic basis has been realized in such regions. At this stage of the development of the sector, the growth of production is possible due to an increase in the innovative activity of the region. Based on a comparison of regression errors, it is possible to assess how a particular region looks relative to other regions in terms of the potential impact of its innovation activity on the growth of the sector's output. The characteristics of the expanded economic basis reflect the main economic features of the regional economy: scale, structure, efficiency, innovation activity.

Therefore, the error $\varepsilon_{i,j}$ can be considered in a broad sense as a characteristic of the resource availability of the region for the development of the economic sector. The negative value of this error

indicates the sufficient resource availability of the sector in the region and the unrealized potential of economic growth. The positive value of this assessment indicates that the sector has insufficient resource availability and low potential for economic growth. In this case, innovation activity becomes a priority source of growth in the sector's output and a factor of diversification.

The structures of strong sectors of regional economies are described. First, we will determine the indicator of the identified comparative advantages RCA_{cp}:

$$RCA_{cp} = \left(y_{cp} / \sum\nolimits_{p} y_{cp} \right) / \left(\sum\nolimits_{c} y_{cp} / \sum\nolimits_{c,p} y_{cp} \right), \quad (2)$$

where y_{cp} — the volume of production of the *p* sector of the region's economy *c*; RCA_{cp} — the ratio of the share of production from sector *p* in the total volume of production from all sectors of the economy of region *c* to the share of production of sector *p* for all regions in the volume of production from all sectors of the economy of all regions. According to the work (Hausmann & Klinger, 2006), to identify comparative advantages in the economy it is used the indicator RCA_{cp} for which a condition of the type of restriction from below is checked. If the value of RCA_{cp} is greater than or equal to one, then it is assumed that the economy of region *c* has identified comparative advantages in the output of sector *p*; otherwise, there are no identified comparative advantages:

$$a_{c,p} = \begin{cases} 1, \text{ если} \quad RCA_{cp} \geq 1; \\ 0, \text{ если} \quad RCA_{cp} < 1. \end{cases}$$

The matrix $\mathbf{A} = \left(a_{c,p} \right)$ contains data on the sectors of the economy that are developed in different regions at the level of the identified comparative advantages determined using the expression (2). The rows of this matrix correspond to regions, the columns correspond to sectors of the economy. Vector $\left(a_{c,p_1}, \ldots, a_{c,pm} \right)$ will be called the structure of the strong sectors of the region 's economy.

The possibilities of diversification of production are being considered. The assessment of the diversification of the structure of strong sectors of the region's economy is the number of strong sectors. Thus, the diversification of the regional economy is associated with the emergence of a new strong sector in it. If the sector we are interested in is already strong in the region's economy, then an increase in the volume of production of this sector will not lead to diversification. If the sector is not strong, then in the context of the characteristics of an expanded economic basis, two main development paths leading to diversification are possible.

a) Economic development of the region, as a result of which the sector becomes strong, not relying on the growth of innovation activity of the region. This option is available for any region in which the sector is not strong, but has sufficient resources.
b) The emergence of a new strong sector due to the growth of innovation activity. This option is available for a region in which the sector is developing with realized economic growth potential and insufficient resource availability.

In the paper (Afanasiev & Kudrov, 2021), the authors set and solved the problem of forecasting the emergence of new strong sectors in the region. Based on the methods of probabilistic and statistical modeling, a model is constructed that allows estimating the probability of a new strong sector appearing in the region, taking into account the characteristics of the structure of the economy. The possibility of constructing such a model is based on the assumption that the emergence and development of sectors is largely due to the evolution of past economic activity. The model uses the indicators of nesting structures of strong sectors of regional economies introduced by the authors. These indicators are based on probabilistic interpretation and properties of the matrix elements, according to which economic complexity is estimated in accordance with the traditional approach. The probability of the emergence of a strong sector in its structure is estimated for each region. If the predicted probability value exceeds 0.5, then

the emergence of a new strong sector in the region can be considered evolutionarily conditioned. It is possible to recommend the development of the sector to the level of a strong one in the region where the sector is not strong, but its development is evolutionarily conditioned. If, at the same time, the resource provision of the sector in the region is sufficient, then its development to the level of a strong one can be based on the potential of economic growth. If the resource provision is insufficient, then the main development of the sector may be the growth of innovative activity in the region.

2. RESULTS

The correlation matrix of the components of the economic basis and the indexes of innovation activity is presented in Table 1. Correlation analysis of 4 components of the economic basis and 4 indexes of innovation activity shows:

- all components of the economic basis can be considered mutually independent;
- innovation activity indexes can be considered mutually independent (with the exception of TEMP and TEMP indexes, the dependence of which is due to their specifics);
- each index of innovation activity is independent or weakly dependent on the economic basis.

Table 1. Correlation matrix of the components of the basis and indexes of innovation activity, constructed according to 2015 data.

	L	*te*	*s1*	*s2*	*TEMPZ*	*TEPZ*	*TEVP*	*TETTCH*
L	1	0,178	-0,135	0,195	0,231	0,207	0,120	0,146
te	0,178	1	0,202	0,238	0,120	-0,200	-0,193	0,214
s1	-0,135	0,202	1	-1,61E-10	-0,223	-0,309	-0,359	-0,058
s2	0,195	0,238	-1,61E-10	1	0,398	0,056	0,146	0,167
TEMPZ	0,231	0,120	-0,223	0,398	1	0,047	0,067	0,405
TEPZ	0,207	-0,200	-0,309	0,056	0,047	1	0,873	0,158
TEVP	0,120	-0,193	-0,359	0,146	0,067	0,873	1	0,136
TETTCH	0,146	0,214	-0,058	0,167	0,405	0,158	0,136	1

Source: Own

Table 2 presents the results of a regression analysis of tax revenue volumes (in logarithms) by sector on the characteristics of the economic basis, expanded, as an example, by the TEMPZ innovation activity index, based on data on international patent applications.

Table 2. Sectors whose development depends on the innovation activity of regions according to 2019 data.

Name of the economic sector	*N**	R^2	*Const*	$\beta 1_j$	$\beta 2_j$	$\beta 3_j$	$\beta 4_j$	$\beta 5_j$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Provision of services in the field of oil and natural gas production	66	0,468	-6,314 (-1,604)	2,282 (4,230)	0,066 (0,146)	2,435 (5,421)	-0,658 (-1,309)	1,162 (2,203)
Production of other non-metallic mineral products	80	0,617	4,879 (6,080)	1,182 (10,545)	0,020 (0,202)	-0,189 (-1,872)	0,433 (3,903)	0,229 (2,203)
Other productions	78	0,673	4,547 (5,130)	1,220 (9,865)	-0,128 (-1,186)	0,127 (1,093)	0,434 (3,516)	0,280 (2,376)
Production and distribution of gaseous fuels	78	0,469	7,700 (9,746)	0,757 (6,897)	0,090 (0,956)	0,140 (1,406)	0,289 (2,856)	0,226 (2,253)
Collection, processing and disposal of waste; processing of secondary raw materials	79	0,801	7,946 (17,125)	1,113 (17,154)	0,110 (1,958)	0,168 (2,886)	0,103 (1,585)	0,230 (3,840)

Construction	79	0,767	7,212 (12,778)	1,139 (14,428)	0,090 (1,321)	0,228 (3,235)	0,158 (1,991)	0,274 (3,767)
Wholesale and retail trade; repair of motor vehicles and motorcycles	80	0,782	7,257 (16,591)	1,056 (17,286)	0,168 (3,167)	0,046 (0,840)	0,022 (0,367)	0,159 (2,806)
Railway transport activities	65	0,377	1,231 (0,500)	1,242 (3,552)	0,305 (1,103)	1,297 (4,866)	-0,238 (-0,728)	0,593 (2,121)
Pipeline transport activitie	80	0,584	5,290 (5,563)	1,184 (8,919)	0,292 (2,530)	0,400 (3,348)	-0,004 (-0,033)	0,261 (2,116)
Air and space transport activities	79	0,712	4,893 (8,754)	1,092 (14,012)	0,113 (1,674)	0,170 (2,418)	0,169 (2,183)	0,154 (2,102)
Postal communication and courier activities	80	0,742	5,870 (9,214)	1,129 (12,685)	0,140 (1,816)	0,143 (1,784)	0,080 (0,903)	0,233 (2,827)
Activities of hotels and other places for temporary residence	80	0,745	5,590 (11,643)	1,062 (15,832)	0,124 (2,132)	0,165 (2,740)	0,020 (0,307)	0,143 (2,298)
Telecommunications activities	80	0,787	-2,063 (-2,405)	1,783 (14,893)	0,113 (1,089)	0,129 (1,197)	0,226 (1,908)	0,288 (2,590)
Financial and insurance activities	80	0,800	4,553 (7,759)	1,362 (16,624)	0,085 (1,195)	0,037 (0,507)	0,197 (2,427)	0,175 (2,304)
Activities related to the provision of financial services, other than insurance and pension services	79	0,740	4,466 (6,809)	1,410 (15,466)	0,073 (0,943)	0,433 (5,490)	0,186 (2,216)	0,327 (3,949)
Real estate operations	80	0,878	7,565 (31,719	0,989 (29,702	0,084 (2,907	0,243 (8,115	-0,004 (-0,109	0,099 (3,210
Professional, scientific and technical activities	80	0,853	7,805 (24,761)	0,923 (20,960)	0,055 (1,448)	0,207 (5,222)	0,048 (1,101)	0,078 (1,902)
Administrative activities and related additional services	79	0,816	5,671 (12,978)	1,021 (16,732)	0,163 (3,050)	0,175 (3,172)	0,069 (1,138)	0,119 (2,090)
Education	80	0,764	4,273 (10,312)	1,095 (18,929)	0,068 (1,351)	0,169 (3,243)	0,126 (2,190)	0,170 (3,170)
Activities in the field of health and social services	80	0,716	2,534 (4,960)	1,138 (15,953)	0,087 (1,407)	0,152 (2,366)	0,073 (1,034)	0,183 (2,758)

* the number of regions with non-zero tax revenues from this sector

Source: Own

Column (1) of Table 2 shows the names of sectors whose production volumes in the regions depend on the value of the TEMPZ innovation activity index, based on data for 2019. about international patent applications. Column (2) for each sector shows the number of observations to build a regression (the number of regions with non-zero tax revenues from this sector). Column (3) is the coefficient of determination R^2. In column (4) - the estimate of the constant in the regression, in parentheses t-statistics. Column (5) shows an estimate of the regression coefficient for the logarithm of the economically active population and t-statistics. In column (6) - the estimate of the regression coefficient for the index of technical efficiency of regional production and t-statistics. In column (7) - the estimate of the regression coefficient for the first main component of the GRP structure and t-statistics. In column (8) - the estimate of the regression coefficient for the second main component of the GRP structure and t-statistics. In column (9) - the estimate of the regression coefficient for the TEMPZ innovation activity index and t-statistics. The coefficient of determination R^2 is quite high for almost every one of the 20 sectors of the economy. This means that the basis used for the characteristics of regional differentiation, expanded due to the index $TEMPZ_i$ quite well explains the specifics of the production volumes of the sectors.

At this stage of the study, 20 sectors of the economy have been identified, the development of which depends on the innovation activity of the region when creating international patent applications. Regions, forming international patent applications and demonstrating activity in this area, influence the development of each of these 20 sectors. It follows from the simulation results that the economic development potential of each of these sectors is associated with the growth of the scale of the regional economy, specialization or industrialization of the region, and an increase in multifactor productivity. Depending on which components of the economic basis there are significant estimates of the coefficients in the regression (1). Another way is connected with the realization of the potential of innovation activity. If we replace the TEMPZ index with another index of innovation activity, we will get a list of sectors whose output vol-

umes depend on the innovation activity of the region when creating the corresponding result of innovation activity.

According to the data of 2019, the Construction sector is one of the 20 sectors whose production volume depends on the innovation activity of the region. Let consider the estimates of regression errors (1) of the output of the Construction sector for all regions.

Table 3. Construction sector: estimates according to 2019 data.

Name of the region	*The order in the arrangement*	*Error estimation*	*Number of strong sectors*	*1-strong sector, otherwise - 0*
(1)	(2)	(3)	(4)	(5)
Chechen Republic *	1	-10	13	0
Republic of Ingushetia *	2	-2.532	15	0
Republic of Dagestan *	3	-1.482	19	0
Kursk region *	4	-1.087	22	0
Kabardino-Balkarian Republic *	5	-1.043	17	0
Trans - Baikal Territory *	6	-1.027	19	0
Tyumen region *	7	-0.897	8	0
Republic of Tyva *	8	-0.783	17	0
Republic of Buryatia *	9	-0.771	25	0
Republic of Sakha (Yakutia)*	10	-0.756	11	0
Belgorod region*	11	-0.75	24	0
Republic of North Ossetia - Alania*	12	-0.704	14	0
Republic of Khakassia*	13	-0.673	22	0
Jewish Autonomous Region*	14	-0.67	21	0
Krasnoyarsk Territory*	15	-0.648	15	0
Tambov region*	16	-0.525	28	0
Kemerovo region*	17	-0.406	20	0
Ulyanovsk region*	18	-0.363	25	0
Republic of Kalmykia*	19	-0.352	14	0
Irkutsk region*	20	-0.343	15	0
Rostov region*	21	-0.331	33	0*
Kostroma region*	22	-0.323	33	0*
Orenburg region*	23	-0.315	6	0
Republic of Bashkortostan*	24	-0.312	17	0
Republic of Karelia*	25	-0.302	26	0
Republic of Mari El*	26	-0.28	31	0
Amur region*	27	-0.217	17	0
Samara region*	28	-0.2	20	0
Republic of Mordovia*	29	-0.2	15	0
Udmurt Republic*	30	-0.182	15	0
Kaluga Region*	31	-0.177	29	0
Arkhangelsk region*	32	-0.154	20	0
Republic of Tatarstan*	33	-0.112	13	0
Penza region*	34	-0.1	26	0
Kurgan region*	35	-0.091	26	0
Karachay-Cherkess Republic	36	-0.079	27	1
Republic of Adygea*	37	-0.062	22	0
Chuvash Republic	38	-0.057	40	1
Lipetsk region	39	-0.044	36	1
Pskov region	40	0.015	35	1
Vladimir region	41	0.043	37	1
Altai Territory	42	0.063	33	1
Chelyabinsk region**	43	0.089	35	0*
Tver region**	44	0.09	42	0*

Tula region	45	0.109	34	1
Volgograd region**	46	0.129	17	0
Oryol region	47	0.134	30	1
Tomsk region**	48	0.147	10	0
Kirov region	49	0.153	35	1
Omsk region**	50	0.164	17	0
Perm Region**	51	0.179	20	0
Saratov region**	52	0.219	21	0
Stavropol Territory	53	0.232	23	1
Sakhalin Region**	54	0.263	18	0
Novgorod region	55	0.268	32	1
Voronezh Region	56	0.279	34	1
Bryansk region	57	0.304	31	1
Nizhny Novgorod region**	58	0.31	24	0
Ryazan region**	59	0.347	16	0
Astrakhan region**	60	0.364	9	0
Primorsky Territory **	61	0.397	26	0
Krasnodar Region	62	0.406	27	1
Ivanovo region	63	0.412	28	1
Yaroslavl region**	64	0.493	25	0
Kaliningrad Region**	65	0.536	15	0
Novosibirsk region	66	0.6	39	1
Murmansk Region**	67	0.603	17	0
Republic Altai	68	0.64	30	1
Leningrad region**	69	0.75	14	0
Saint Petersburg**	70	0.752	23	0
Sverdlovsk region	71	0.797	30	1
Khabarovsk Territory	72	0.876	21	1
Vologda region	73	0.882	25	1
Chukotka Autonomous Okrug	74	1.103	13	1
Kamchatka Krai	75	1.136	23	1
Moscow region	76	1.265	39	1
Komi Republic	77	1.398	14	1
Magadan region	78	1.429	23	1
Smolensk region	79	1.523	31	1
Moscow	80	1.83	24	1

** - a region in which the sector can become strong due to both economic growth and innovation activity of the regions; * - a region where the sector can become strong due to economic growth.

Column (1) of this table shows the names of the regions. Column (2) shows the region number in ascending order of the error $\varepsilon_{i,j}$. Column (3) of Table 3 shows the error values $\varepsilon_{i,j}$.

Source: Own

Column (4) of Table 3 shows the number of strong sectors in the structure of the region's economy, that is, an assessment of economic diversification. The most diversified (with more than 35 strong sectors) economies of the regions are: Tver Region - 42; Chuvash Republic - 40; Moscow Region - 39; Novosibirsk Region - 39; Vladimir Region - 37; Lipetsk region - 36. The least diversified (with the number of strong sectors less than 10) economies of the regions: Astrakhan region - 9; Tyumen region - 8; Orenburg region - 6.

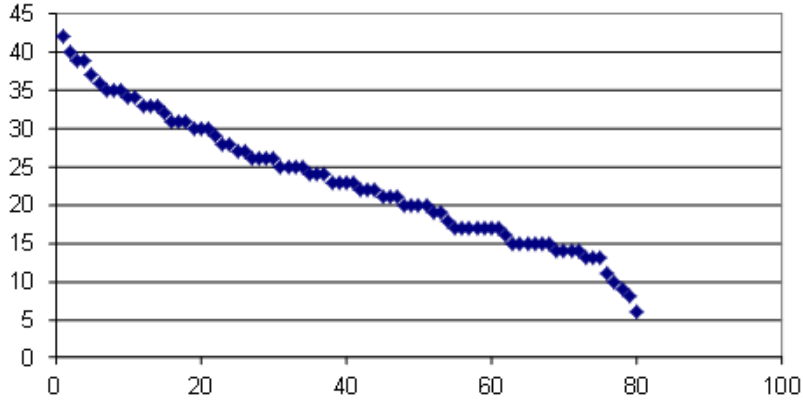

Fig. 1. Distribution of the number of strong sectors by region

Source: Own

Figure 1 shows the distribution of strong sectors by region. On the abscissa axis – the number of the region, on the ordinate axis - the number of strong sectors, ordered in descending order.

Column (5) of Table 3 provides, as an example, estimates of the identified comparative advantages of the Construction sector for different regions. It is indicated in which regions the Construction sector has identified comparative advantages and is strong (value 1), and in which regions it is not (value 0). The estimates obtained indicate that the Construction sector, according to 2019 data, is strong in the economy of 27 regions. In these regions, the growth of the output of this sector will no longer lead to diversification of the structure of strong sectors of the economy. The Construction sector is not strong for 53 regions. For these regions, economic diversification is possible due to the growth of the output of this sector and its transformation into a strong sector.

3. DISCUSSION

It is noteworthy that in the 35 regions with the lowest error estimates $\varepsilon_{i,j}$ (region numbers in column (2) from 1 to 35) the Construction sector is not strong. The negative value of the error estimate $\varepsilon_{i,j}$ for these regions indicates that the sector has not reached the level of economic development corresponding to their differentiation characteristics, has sufficient resource security and unrealized potential for economic development. Under these conditions, innovation activity does not have the necessary economic basis and cannot lead to a significant increase in the volume of production of the sector. The possibility of turning the Construction sector into a strong sector for such regions marked with a "*" in Table 3 is associated with the growth of the scale of the economy, the development of manufacturing industries and an increase in multifactor productivity.

In the economies of the 10 regions with the highest regression error values (region numbers in column (2) from 71 to 80), the CONSTRUCTION sector is strong. Moreover, in each of these regions, the level of production volumes of the construction sector is provided, corresponding to their differentiation characteristics and sufficient to realize the potential of innovation activity. Table 4 shows examples of some major construction projects based on the innovative capabilities of the regions. Including competencies related to the construction of high-rise structures and the use of 3D printers. But there will be no change in the structure of the strong sectors of these 10 regions due to the growth of the production volume of the Construction sector. The same can be said about 13 other regions (in column (2) their numbers range from 36 to 68) in which the construction sector is strong. It can be expected that the growth of the sector's output in these 13 regions, which does not lead to diversification, will be provided both through the economic development of the region and through innovation activity.

For diversification based on the transformation of the construction sector into a strong one, the regions marked with "**" in Table 3, in which this sector is not strong, with positive estimates of regression

errors, are also promising (1). In these regions, the Construction sector does not have sufficient resources, but it can become strong due to increased innovation activity.

Based on the model presented in the paper (Afanasiev & Kudrov, 2021), estimates of the probability of the construction sector appearing as a strong one in the region are obtained. In column (5) of Table 3, the sign "0*" marks four regions for which these estimates exceed the threshold value of 0.5. These are Tver region - 0.86; Kostroma region - 0.53; Chelyabinsk region - 0.52; Rostov region - 0.52. According to 2019 data, the Construction sector is not strong in these regions. Moreover, in the Rostov region and in the Kostroma region, this sector has sufficient resource security and can become strong due to the potential for economic growth. In the Tver Region and the Chelyabinsk Region, the transformation of this sector into a strong one may be mainly due to an increase in the innovation activity of the regions.

Table 4. Large projects in the construction sector for the regions with the highest estimates of regression errors.

Name of the region	*Major projects in the Construction sector*
Moscow*	Design and construction of sections of the street and road network of the South-Eastern Chord and Southern Rockade The cost is 138.7 billion rubles. Deadlines 2019-2023
	Execution of works within the framework of the III stage of construction of the North-Eastern chord The cost is 52.0 billion rubles. Deadlines 2019-2022
Komi Republic**	Execution of works on the construction of gas distribution facilities in the Komi Republic under the Program of gasification of the regions of the Russian Federation The cost is 7, 18 billion rubles.
Moscow region***	Construction and reconstruction of sections of the M-5 Ural highway on the bypass section of Oktyabrsky settlement with a bridge over the Moscow River The cost is 25.2 billion rubles. Deadlines 2019-2023
	Construction and reconstruction of the M-5 Ural highway on the Ulyanovsk - Nepetsino section. The cost is 15.4 billion rubles. Deadlines 2019-2023
Kamchatka Territory ****	Creation of the international resort "Three volcanoes" in the Kamchatka Territory. The cost is 39.2 billion rubles.

Source:
* Top 10 Construction state Contracts in 2019 https://infraone.ru/sites/default/files/analitika/2019/stroitelstvo_2019_infraone_research.pdf
** Portal "State Expenditures" https://spending.gov.ru
*** Top 10 Construction state Contracts in 2019
https://infraone.ru/sites/default/files/analitika/2019/stroitelstvo_2019_infraone_research.pdf
**** Top 10 Construction state Contracts in 2019
https://infraone.ru/sites/default/files/analitika/2019/stroitelstvo_2019_infraone_research.pdf

CONCLUSION

The approach to the formation of recommendations for the development of regions and sectors of the economy, taking into account innovation activity, is proposed. The approach is based on the regression analysis method using an extended economic basis.

The approbation of the approach confirmed the possibility of identifying a set of economic sectors whose production volume in the region depends on innovation activity. As an example, 20 sectors have been identified, the volume of production of which depends on the innovation activity of the regions aimed at creating international patent applications.

For each sector, the development of which depends on innovation activity, regions can be identified that have sufficient resources to turn the sector into a strong one based on the realization of the potential of economic growth. For the Construction sector of such regions - 39. However, only two of them, the

Rostov Region and the Kostroma region, have sufficiently high estimates of evolutionary conditionality. 17 regions have also been identified as priorities for the development of the construction sector and its transformation into a strong one based on increased innovation activity. However, only two of them, the Tver Region and the Chelyabinsk Region, have sufficiently high estimates of evolutionary conditionality. Thus, taking into account the evolutionary conditionality, resource availability and innovation activity, four regions are priorities for the development of the construction sector and its transformation into a strong one.

REFERENCES

Aivazian, S., Afanasiev, M., Kudrov, A. (2016), "Clustering methodology of the Russian Federation regions with account of sectoral structure of GRP", *Applied Econometrics*, Vol. 41, pp. 24–46.

Aivazian, S.A., Afanasiev, M.Y., Kudrov, A.V. (2018), "The method of comparing the RF regions", *Economics and Mathematical Methods*, Vol. 54, pp. 43-51 (in Russian)

Aivazian, S.A., Afanasiev, M.Yu., Kudrov, A.V. (2020), "Methodology of socio-economic development assessment given the characteristics of regional differentiation", *Model Assisted Statistics and Applications,* Vol. 15, No. 4, pp. 311-314, doi 10.3233/MAS-200502 (in Russian)

Afanasiev, M.Y., Kudrov A.V. (2021), "Economic Complexity, Embedding Degree and Adjacent Diversity of the Regional Economies", *Montenegrin Journal of Economics*, Vol. 17, No. 2, pp. 7-22, doi: 10. 14254/1800-5845/2021.17-2.1

Arrow, K. J. (1962), "The economic implications of learning by doing", *The Review of Economic Studies*, Vol. 29, No. 3, pp. 155–173.

Blien, U., Wolf, K. (2006), "Local employment growth in West Germany: A dynamic panel approach", *Labour Economics*, Vol. 13, No. 4, pp. 445–458.

European Commission (2012a), *A stronger European Industry for Growth and Economic Recovery, Green paper and COM documents*, COM (2012), 582/3, Brussels

European Commission (2011b), *Cohesion Policy 2014-2020: Investing in growth and jobs, Green paper and COM documents,* COM (2011) 614, Brussels.

Fuchs, M. (2011), "The determinants of local employment dynamics in Western Germany", *Empirical Economics*, Vol. 40, No. 1, pp. 177–203.

Hausmann, R., Klinger B. (2006), "Structural transformation and patterns of comparative advantage in the product space", *CID Working Paper,* No. 128.

Illy, A., Schwartz, M., Hornych, C., Rosenfeld, M. (2011), „Local economic structure and sectoral employment growth in German cities", *Journal of Economic and Social Geography*, Vol. 102, No. 5, pp. 582–593.

International Monetary Fund (2015), "Long-Run Growth and Macroeconomic Stability in Low-Income Countries—The Role of Structural Transformation and Diversification", *International Monetary Fund Staff Policy Paper*, ttps://www.imf.org/external/np/res/dfidimf/diversification.htm

International Monetary Fund (2016), "Economic Diversification in Oil-exporting Arab countries", *Annual Meeting of Arab Ministers of Finance*, Manama, Bahrain. https://www.imf.org/en/Publications/ Policy-Papers/Issues/2016/12/31/Economic-Diversification-in-Oil-Exporting-Arab-Countries-PP5038

Lysenkova, M., Afanasiev, M. (2020), "Comparative analysis of regional innovative development indexes in the space of expert-defined characteristics of regional differentiation", SHS Web of Conferences, Vol. 93 of 3rd *International Scientific Conference on New Industrialization and Digitalization*, EDP Sciences, 2021, 05002, doi: 10.1051/shsconf/20219305002

Marshall, A. (1890), *Principles of Economics*, MacMillan, London.

McCann, P., Ortega-Argiles, R. (2015), "Smart Specialization, Regional Growth and Applications to European Union Cohesion Policy", *Regional Studies*, Vol. 49, No. 8, pp. 1291-1302

Romer, P.M. (1986), "Increasing returns and long-run growth", *Journal of Political Economy*, Vol. 94, No. 5, pp. 1002–1037.