ELIT
Economic Laboratory Transition
Research Podgorica

Montenegrin Journal of Economics

For citation:

Afanasiev, M.Y. (2023), "Guidelines for the Diversification of the Regional Economy", *Montenegrin Journal of Economics*, Vol. 19, No. 2, pp. 189-206.

Guidelines for the Diversification of the Regional Economy*

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ARTICLE INFO

Received Juna 07, 2022
Revised from July 08, 2022
Accepted August 08, 2022
Available online April 15, 2023

JEL classification: G10, G15, G40

DOI: 10.14254/1800-5845/2023.19-2.16

Keywords:

Diversification,
regional economy,
strong sector,
economic complexity,
resource security,
innovation activity.

ABSTRACT

There is no universal solution to promote economic development and structural change. It is necessary to take into account the peculiarities of the regions when developing and designing industrial and regional economic policy. An approach to assessing the priority areas of diversification of the regional economy based on recommendations for the development of sectors is presented. The approach is focused on increasing the economic complexity of the regional economy, taking into account the evolutionary conditionality of its development, the impact of innovative activity of regions and resource availability for sectors. Along with the standard approach to assessing economic complexity, approximation capabilities are used. Estimates of the probabilities of the emergence of new strong sectors in the economy of the region are obtained on the basis of a model that allows us to estimate the probabilities of the emergence of new strong sectors using the characteristics of evolutionary conditionality. The identification of sectors whose development depends on the innovation activity of regions is based on a regression analysis of production volumes on the characteristics of regional differentiation and innovation activity. A condition is described that makes it possible to assess the sufficiency of the resource availability for the sector in the region for its development to the level of a strong one. The possibilities of the proposed approach were tested for 14 sectors of the economy of the Belgorod region on the data of 2019. For each sector estimates were obtained according to six criteria: the economic complexity of the sector; the evolutionary conditionality of its development to the level of a strong one; the increase in the economic complexity of the region as a result of the sector development to the level of a strong one on the basis of a standard approach or on the basis of approximation; the dependence of the volume of production of the sector on the innovation activity of the region; the sufficiency of the resource availability of the sector in the region; the growth of GRP in the region. Sectors whose characteristics have the property of pareto-optimality in the task of multi-criteria selection are considered as priorities when choosing the direction of diversification of the regional economy. The implementation of the proposed approach using digital technologies in regional situation centers can ensure coordination of decisions taken by regions when choosing priority areas of diversification.

* The work was supported by the Russian Science Foundation (RSF project 23-28-00235)

INTRODUCTION

The theory of diversification and empirical estimates are presented in the works (Blien and Wolf, 2006; Fuchs, 2011; Illy 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. 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. Harnessing the potential of diversification is at the heart of the European Union's strategy to promote economic development, the growth of European regions and a new industrial policy (European Commission, 2011; McCann and Ortega-Argiles, 2015).

A number of studies have presented theoretical and empirical evidence of the existence of "localized capabilities" that are associated with certain accumulated competencies and knowledge. Such localized opportunities work as a source for related diversification of regional economies (Storper, 1995). In the process of diversification, regions are more likely to expand in sectors that are closely related to the strong sectors that have already developed (Frenken et al., 2007; Frenken and Boschma, 2011; Klepper, 2006). Related diversification implies that economic development, both at the national and regional levels, largely depends on specific local opportunities that accumulate over time. This means that there is no universal solution to promote economic development and structural change. It is necessary to take into account the peculiarities of the regions when developing and designing industrial and regional economic policy. There are arguments in favor of government intervention to stimulate diversification processes, since the private sector usually focuses its economic activities and efforts around its main areas of activity, which strengthens the existing specialization. If economic policy is not aimed at increasing the diversity of economic activities, this can lead to structural development traps, i. e. specialization, which is difficult to leave. Therefore, from the point of view of economic policy, it is important to consider how to launch and expand the process of economic diversification. However, there are limits to diversification, determined by the level of technological capabilities of the country. Therefore, in the process of diversification, a rapid transition to technologically complex activities is unlikely. Rather, a strategy of gradual diversification should be followed, with transitions to more complex sectors linked to already existing strong sectors, as technological potential and opportunities accumulate over time. In a broad sense, gradual diversification corresponds to a catch-up development strategy (Polterovich, 2020, 2021) and it does not contradict the approaches to the formation of economic policy of leading scientists (Makarov et al., 2014, 2018; Dementiev, 2020, 2021). Further, the number of strong sectors is considered as an assessment of the diversification of the region's economy. Thus, diversification is associated with the emergence of a new strong sector in it. The task of setting priorities for the development of sectors to the level of strong ones is considered.

1. METHODOLOGY

1.1 Structure of strong sectors

Based on the concept of the revealed comparative advantages, a matrix $A = (a_{c,p})$ is formed describing the structures$(a_{c,p_1}, \cdots, a_{c,pm})$ of strong sectors of regional economies. To describe the structure of the regional economy, data on production volumes in a wide range of sectors were used. First, we will determine the indicator RCA_{cp} of the revealed comparative advantages:

$$RCA_{cp} = (y_{cp} / \sum_p y_{cp}) / (\sum_c y_{cp} / \sum_{cp} y_{cp}), \qquad (1)$$

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 and 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:

$$a_{c,p} = \begin{cases} 1, & \text{если } RCA_{cp} > 1; \\ 0, & \text{если } RCA_{cp} \leq 1. \end{cases}$$

The matrix $A = (a_{c,p})$ contains data on the sectors of the economy that are developed in different regions at the level of the revealed comparative advantages determined using the expression (1). The rows of this matrix correspond to regions, the columns correspond to sectors of the economy. Vector $(a_{c,p_1}, \cdots, a_{c,pm})$ will be called the structure of the strong sectors of the region 's economy.

1.2 Economic complexity

One of the guidelines of the approach presented below to the diversification of the region's economy is to increase its economic complexity. Countries and regions exporting complex goods usually have a higher level of per capita material well-being than countries and regions exporting simple goods. If diversification is associated with the emergence of new sectors of the economy, then such sectors can be considered as priority areas of diversification, the development of which contributes to an increase in the economic complexity of the region. In accordance with the standard approach to the assessment of economic complexity presented in the works (Hartmann, 2017; Hausmann et al., 2006; Hidalgo and Hausmann, 2009), matrices are formed to calculate the economic complexity of regions and sectors. The eigenvalues and eigenvectors of these matrices are calculated. As a result, an estimate of the economic complexity ECI_c is known for each region. An estimate of the economic complexity ECI_p is known for each sector.

The concept of "economic complexity of a region" is considered as a characteristic reflecting the level of its technological development, which, in turn, is determined by strong sectors in the structure of its economy. Similarly, the economic complexity of the sector depends on the level of technological development of those regions in which this sector is present in the structure as a strong one. The economic complexity of a region ECI_c or sector ECI_p is a latent characteristic. Estimates of economic complexity have the following properties. The economic complexity of a region is proportional to the average level of economic complexity of strong sectors in the structure of its economy:

$$ECI_c = a_1 \sum_p r_{c,p} ECI_p,\ r_{c,p} = a_{c,p}/k_{c,0},\ k_{c,0} = \sum_p a_{c,p}, \qquad (2)$$

where a_1 is a positive constant. Note that $k_{c,0}$ are not zero, because for any c there exists a p, for which $a_{c,p} = 1$.

The economic complexity of the sector is proportional to the average level of economic complexity of the regions in the structure of the economies of which this sector is strong:

$$ECI_p = a_2 \sum_c r^*_{p,c} ECI_c,\ r^*_{p,c} = a_{c,p}/k_{p,0},\ k_{p,0} = \sum_c a_{c,p}, \qquad (3)$$

where a_2 is a positive constant. The indicator $k_{c,0}$, which is equal to the number of strong sectors in the economy structure of the region c, will be called as *diversification* of the region's economy c. Let's enter some additional designations: $\boldsymbol{c} = \left(ECI_{c_1}, ECI_{c_2}, \cdots\right)^T$ — vector-column of values of economic complexity for regions; $\boldsymbol{p} = \left(ECI_{p_1}, ECI_{p_2}, \cdots\right)^T$ — vector-column of values of economic complexities for the sectors; $\boldsymbol{R}_1 = (r_{c,p})$, $\boldsymbol{R}_2 = (r^*_{p,c})$ — weight matrices. From the relations (2) and (3) it follows that $c = a_1 a_2 \boldsymbol{R}_1 \boldsymbol{R}_2 \boldsymbol{c}$, $\boldsymbol{p} = a_1 a_2 \boldsymbol{R}_2 \boldsymbol{R}_1 \boldsymbol{p}$. Thus, the economic complexity of the region is defined as the eigenvector of the matrix $\boldsymbol{R}_1 \boldsymbol{R}_2$, and the economic complexity of the sector is the eigenvector of the matrix $\boldsymbol{R}_2 \boldsymbol{R}_1$.

The matrices $\boldsymbol{R}_1 \boldsymbol{R}_2$ and $\boldsymbol{R}_2 \boldsymbol{R}_1$ are stochastic: their elements are non-negative, and their row sum is equal to 1. The matrix $\boldsymbol{R}_1 \boldsymbol{R}_2$ has a maximum eigenvalue equal to 1, and the corresponding eigenvector, which consists of the same coordinates. In the works (Hausmann and Rodrik, 2003; Sciarra et al., 2020) as the values of estimates of the economic complexity of regions and sectors, it is proposed to use the eigenvector of the matrix $\boldsymbol{R}_1 \boldsymbol{R}_2$, which corresponds to the second maximum eigenvalue. And as the values

of the estimates of the economic complexity of the sectors - the eigenvector of the matrix $\boldsymbol{R}_2\boldsymbol{R}_1$, which corresponds to the second maximum eigenvalue.

1.3 The probability of the emergence of new strong sectors in the region

Denote $w_{i,j} = (\boldsymbol{R}_1\boldsymbol{R}_2)_{ij}$. In the work (Afanasiev and Kudrov, 2021) it is shown that the values $w_{i,j}$ can be interpreted as a characteristic of the embedding degree of the set of strong sectors of the region c_i into the set of strong sectors of the region c_j. The lower this value, the fewer strong sectors of the c_i region are included in the set of strong sectors of the c_j region. Therefore, the nesting indicators reflect the evolutionary conditionality of the structures of strong sectors of regional economies. Using embedding indicators, a model has been developed that allows predicting the emergence of new strong sectors in the region's economy. As a result of testing the model for each region, the probabilities of the emergence of new strong sectors in its structure are estimated. Quantitative assessments make it possible to justify the feasibility of developing a new strong sector in the region, taking into account the evolution of past economic activity, and can be considered as a measure of the evolutionary conditionality of the emergence of a sector in the region as a strong one. If the predicted probability value exceeds 0.5, then the emergence of a new strong sector in the region can be considered evolutionarily conditioned.

1.4 Approximation of estimates of economic complexity.

Opportunities to diversify the economy of the $\boldsymbol{c*}$ region are associated with the emergence of a new strong p* sector. The emergence of such a strong new sector, which leads to an increase in the economic complexity of the region, can be considered a priority. To estimate the change in the economic complexity of the region, in the matrix $\boldsymbol{A} = (\boldsymbol{a_{c,p}})$, the value of the element $(\boldsymbol{a_{c*,p*}})$ can be changed from 0 (previously the p* sector was not strong in the c* region) to 1 and calculate the eigenvector of the new matrix $\boldsymbol{R_1R_2}$ in accordance with a standard approach (Hartmann, 2017; Hausmann et al., 2006; Hausmann and Rodrik 2003; Hidalgo and Hausmann, 2009).

An alternative option is to approximate the change in $\Delta ECI_{c*}(p*)$ estimates of the economic complexity of region c* based on estimates of the economic complexity of sector p* and all strong sectors of the economy of region c*. It is assumed that there are no other changes in the structure of regional economies. When one new strong sector appears in the economy of a particular region, estimates of the economic complexity of all regions, all sectors, constants a_1 and a_2 change. Denote by $\Delta ECI_c(c*, p*)$ the change in the economic complexity of region c, and by $\Delta ECI_p(c*, p*)$ - the change in the economic complexity of sector p. Suppose, that the change of a_1 is small compared to $\frac{a_1}{max_c k_{c,0}}$. Then

$$\Delta ECI_{c*}(c*, p*) \approx \frac{a_1}{k_{c*,0}+1}(ECI_{p*} - \sum_{p\neq p*} r_{c*,p} ECI_p + \sum_p a_{c*,p}\Delta ECI_p(c*, p*)),$$
$$\Delta ECI_c(c*, p*) \approx \frac{a_1}{k_{c,0}}(\sum_p a_{c,p}\Delta ECI_p(c*, p*)), \text{ где } \quad k_{c,0} = \sum_p a_{c,p};\ r_{c,p} = \frac{a_{c,p}}{k_{c,0}}.$$

Let's also assume that for any pair (c*, p*), the value $\sum_p a_{c*,p}\Delta ECI_p\ (c*, p*)$ is small compared to $ECI_{p*} - \sum_{p\neq p*} r_{c*,p} ECI_p$. Then

$$\Delta ECI_{c*}(c*, p*) \approx \frac{a_1}{k_{c*,0}+1}(ECI_{p*} - \sum_{p\neq p*} r_{c*,p} ECI_p).$$

In this case, the fulfillment of the inequality $ECI_{p*} > \sum_{p\neq p*} r_{c*,p} ECI_p$ can be considered as a condition for increasing the economic complexity of the region c* in case a new sector p* appears in its economy as a strong one. This condition means that the economic complexity of the p* sector should be higher than the average economic complexity of all strong sectors in the economy of the c* region. If increasing economic complexity is one of the priorities for the development of regional economies, then the value

$$\Delta_{p*}(c*) = ECI_{p*} - \sum_{p\neq p*} r_{c*,p} ECI_p \quad (4)$$

can be considered as a criterion for choosing a sector to develop to the level of a strong one in the c* region. Note that the second term in the right part of formula (4) does not depend on p*. Preference may be given to a sector that has development potential in the c* region and a relatively high assessment of economic complexity. If the assumptions made above are fulfilled, the value

$$ECI_{c*} + \frac{a_1 \Delta_{p*}(c*)}{k_{c*,0}+1} \quad (5)$$

is an assessment of the economic complexity of the c* region after the emergence of a new strong p* sector. For other regions, we can assume $\Delta ECI_c(c*, p*) = 0$. Similarly, the value

$$ECI_{p*} + \frac{a_2 \Delta_{c*}(p*)}{k_{p*,0} + 1}$$

is an assessment of the economic complexity of the p* sector after its emergence as a strong one in the c* region.

1.5 The impact of the region's innovation activity on the development of the sector

Based on the regression analysis, the innovative activity of the sectors is revealed. The of the innovation activity of the sector r_INN_p takes the value 1 if the coefficient at the index of innovation activity is significant for the sector p in the regression of the volume of production to the components of the expanded economic basis. Otherwise, the indicator r_INN_p takes the value 0.

To assess the impact of the region's innovation activity on the development of the sector, the components of the economic basis are used, including characteristics of regional differentiation and indices of innovation activity. The description of the economic basis {L, te, s^1 ,s^2 } and the methodology of its application for assessing socio–economic development at the regional level are presented in (Aivazian, et al., 2018; 2020). The description of the innovation activity indices used below, built on the basis of the stochastic boundary concept, is given in (Lysenkova and Afanasiev, 2020). An expanded economic basis is being formed {L, te, s^1 ,s^2 , INN}, including the INN innovation activity index, which reflects not only the economic structure of the regional economy, but also the specifics of the innovation activity of the regions. 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 the influence of these components. A regression analysis of the production volumes of each sector of the economy is carried out using an expanded economic basis. Let's build the regressions

$$\ln y_{ij} = const_i + \beta 1_i \ln L_j + \beta 2_i te_j + \beta 3_i s_j^1 + \beta 4_i s_j^2 + \beta 5_i INN_j + \varepsilon_{i,j} \quad (6)$$

Here y_{ij} is the volume of production of sector i in region j ; L_j is the scale of the economy of region j (the Rosstat indicator "number of economically active population" is used as a characteristic of the scale of the economy); te_j is an assessment of the technical efficiency of regional production (Afanasyev, Kudrov, 2019); s_j^1 is the index industry specialization (the first main component of the GRP structure); s_j^2 — the index of industrialization (the second main component of the GRP structure). When constructing the main components, the methodology and indicators of Rosstat for the sectoral structure of GRP were used (Aivazyan et al., 2016). INN is an index of innovation activity (one of the author's indexes is used here, built on the basis of the stochastic boundary concept based on data on international patent applications (TEMPZ), patent applications (TEPZ), granted patents (TEVP), newly developed production technologies (TETTCH) (Lysenkova and Afanasiev, 2020). $\varepsilon_{i,j}$ is the regression error. From the set of sectors, those for which the evaluation of the parameter $\beta 5_i$ is positive and significant at the 95% level are distinguished. The volume of production of each of these sectors depends on the level of innovation activity of the regions, determined by the INN index.

1.6 Resource Availability

For each sector p_j , a sign of resource availability is determined $res\_p_{j_{(c_i)}}$ in each region c_i, in which this sector is not strong, that is, for a pair of region c_i sector p_j, the inequality $\mathrm{RCA_{c_i p_j}} < 1$ is satisfied. The sign $res\_p_{j_{(c_i)}}$ takes the value 1 if the error $\varepsilon_{i,j}$ of the regression (6) satisfies the condition under which the inequality $RCA_{c_i p_j} \geq 1$ is satisfied for the expected output of the p_j sector in the c_i region. That is, with the expected volume of production determined by the expression (6) for $\varepsilon_{i,j} = 0$, the p_j sector will be strong in the c_i region. Otherwise, the sign $res\_p_{j_{(c_i)}}$ takes the value 0.

The assessment of the sufficiency of the resource availability for the sector in the region is determined by the level of compliance of the actual volume of production of the sector with the expected one, which is due to the peculiarities of differentiation of the region. The regions where the expected volume of production in the sector is higher than the actual one were identified. In such regions, the transformation of the sector into a strong one is possible due to the unrealized potential of economic development. This applies to all sectors, including those whose production volume does not depend on the level of innovation activity of the region. If the actual output of the sector is higher than expected one, then the sector, having already realized the growth potential in the region, still has not become strong. In this case, the development of the sector to the level of a strong one can be based on the growth of innovation activity in the region. Different metrics can be used to compare the actual output of the sector with the expected output in a particular region and to assess resource availability. For example, the resource availability of the p_j sector in the c_i region can be assessed based on the concept of revealed comparative advantages. With sufficient resource provision, the indicator $E\_RCA_{c_i p_j}$ of the revealed comparative advantages corresponding to the expected output of the p_j sector in the c_i region should be at least 1 in order for the sector to become strong. This means that the inequality

$$(E\_y_{c_i p_j} / (E\_y_{c_i p_j} + \sum_{p \neq p_j} y_{cp})) \,/\, (\sum_c \frac{y_{cp}}{\sum_{cp} y_{cp}}) > 1, \qquad (7)$$

must be satisfied. where $E\_y_{c_i p_j}$= $\exp\{ln y_{c_i p_j} - \varepsilon_{i,j}\}$. Inequality (7) is equivalent to inequality

$$\varepsilon_{i,j} < \ln\left(\frac{\left(1-u_{p_j}\right) RCA_{c_i p_j}}{1-u_{p_j} RCA_{c_i p_j}}\right), \qquad (8)$$

where $u_{p_j} = \sum_c y_{cp_j} / \sum_{cp} y_{cp}$ and $RCA_{c_i p_j}$ defined by the formula (1). Note, that the right side of inequality (8) is a negative value. This follows from the inequality$RCA_{c_i p_j} < 1$, which is executed because the p_j sector is not strong in the c_i region. Thus, if the error $\varepsilon_{i,j}$ of regression (6) is less than $\varepsilon *_{i,j} = \ln\left(\frac{\left(1-u_{p_j}\right) RCA_{c_i p_j}}{1-u_{p_j} RCA_{c_i p_j}}\right)$, then the p_j sector has the sufficient resource availability in the c_i region in the sense that with the expected volume of production it will become strong one. Otherwise, we believe that the resource availability in the c_i region is not enough to turn the p_j sector into a strong one. Accordingly, with any positive error value, the resource availability is insufficient.

1.7 The task of choice

The choice of the priority direction for diversification of the economy of the $c*$ region is associated with the choice of the $p_{j_{k(c*)}}$ sector to develop it to the level of strong one. The rationale for the choice may be the solution of a multi-criteria optimization problem, taking into account a number of characteristics for each sector $p_{j_{k(c*)}}$ from a set of sectors $(p_{j_{1(c*)}} \cdots p_{j_{k(c*)}} \cdots)$, that are not strong in the c* region. Including the economic complexity of the region; the economic complexity of the sector; a sign of evolutionary conditionality, taking into account the probability of the emergence of the sector as a strong one; a sign of the growth of economic complexity; a sign of the innovative activity of the sector; a sign of the resource availability for the sector. In addition to these characteristics, using the matrix $Y = (y_{cp})$, where y_{cp} is the

volume of production of sector p of the economy of region c, it is not difficult to calculate an estimate of the GRP growth for region $c*$ in the case when sector $p_{j_{k(c*)}}$ turns into a strong one. The solution to such a multi-criteria optimization problem is a set of sectors whose characteristics has the property of Pareto-optimality.

Further, the Belgorod region is considered as the c* region for which the initial data are formed and the task of choosing priority areas of economic diversification is formally solved. This region is chosen as an example because it occupies the first position in the list of regions used by Rosstat.

2. CALCULATION RESULTS

2.1 Structure of strong sectors

The matrix $A = (a_{c,p})$, which characterizes the structure of strong sectors of regional economies, is based on data on tax revenues for 2019 by 82 sectors in 79 regions of the Russian Federation. This approach makes it possible to characterize the structures of regional economies, including sectors focused on both external and internal markets. Column (5) of Table A1 of the application shows the number of strong sectors in the structure of the economy of each region, that is, an assessment of diversification. The most diversified (with more than 35 strong sectors) economies of the regions: 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) are the economies of the regions: Astrakhan region – 9; Tyumen region – 8; Orenburg region – 6. There are 24 strong sectors in the structure of the economy of the Belgorod region.

2.2 Economic complexity

Column (3) of Table A1 presents non-normalized estimates of the economic complexity of 82 sectors. Column (6) contains non–normalized estimates of the economic complexity of 79 regions, calculated as the values of eigenvectors in accordance with the standard approach described above. The values of the constants are determined as a result of solving the systems of equations (2) and (3): a_1= 1.9305; a_2= 1.9756.

The point in Figure 1 characterizes the region in the space "number of strong sectors" (abscissa axis) – "*assessment of the economic complexity of the region*" (ordinate axis). There is a non-linear relationship between the number of strong sectors and estimates of the economic complexity of the regions. At the same time, the correlation coefficient of the characteristics of the diversification of regional economies and estimates of the economic complexity of the regions is quite high and is equal to 0.635.

The regions in the lower left part of the figure are characterized by high specialization in the extractive industry. These are the Orenburg region (6 strong sectors), the Tyumen region (8), the Astrakhan region (9), the Tomsk region (10), the Republic of Sakha (Yakutia) (11). The normalized assessment of the economic complexity of the Belgorod region is 0.8364.

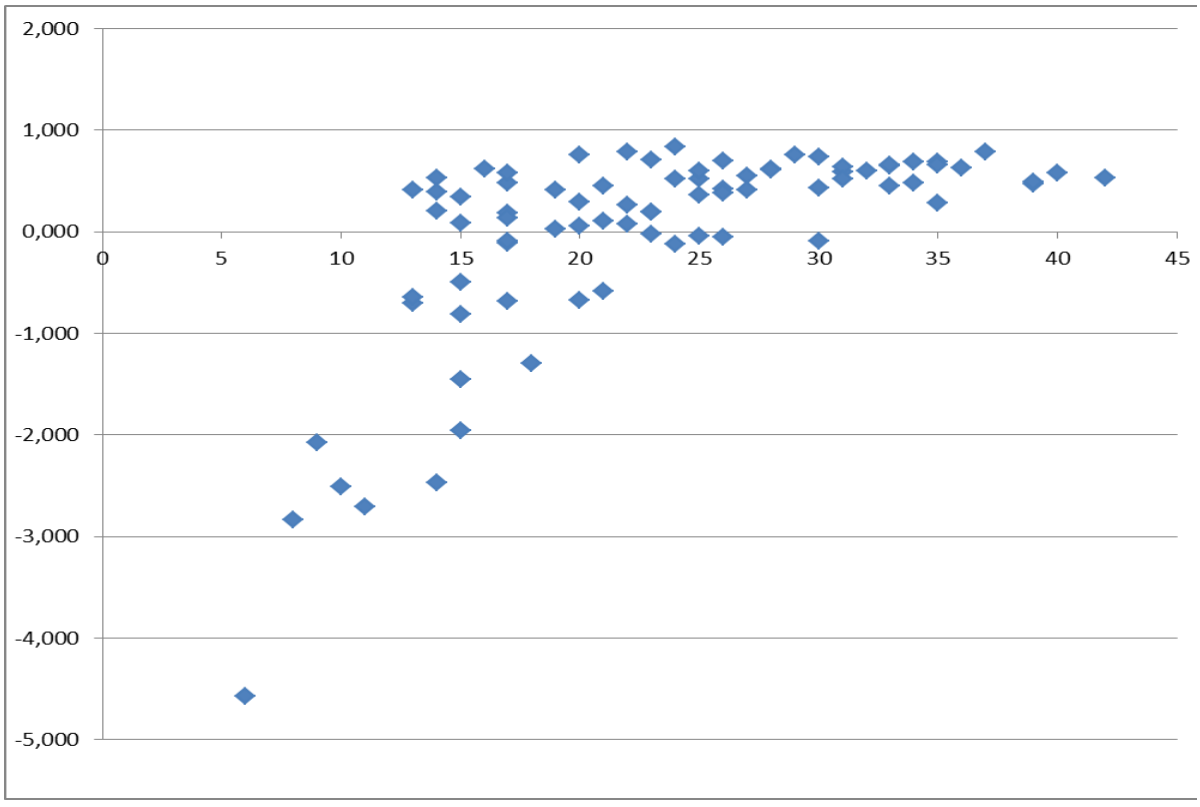

Figure 1. On the abscissa axis - the number of strong sectors of the region on the ordinate axis – the assessment of economic complexity.

2.3 The probability of the emergence of new strong sectors in the region

For each region, the probability of occurrence of any sector in its structure as a strong one is estimated. The simulation results presented in the paper (Afanasyev and Kudrov, 2021b), do not contradict the hypothesis about the statistical significance of the influence of the characteristics of evolutionary conditionality on the probability of the sector appearing as a strong one. They are consistent with the conclusions in the work (Neffke et al., 2011), where it is shown that it is easier for regions to develop new industries if they are connected with existing ones in the region. For example, in the Belgorod region, 11 sectors have probabilities of occurrence as strong above 0.5. Table 1 shows the probabilities of development in the Belgorod region of 14 sectors to the level of strong one. The probabilities of the development of three more sectors marked in Table 1 with a sign (*) are below 0.5. The development of these sectors is not evolutionarily conditioned for the region. For comparison, we will consider the possibility of developing these three sectors in the Belgorod Region to the level of strong ones.

Table 1. The probability of the emergence of sectors as strong in the Belgorod region

Code of the sector	1125	1130	1155	1160	1202	1203	1205
Probability	0.510	0.705	0.540	0.716	0.636	0.592	0.862
Code of the sector	1220	1270*	1285*	1290*	1305	1315	1320
Probability	0.536	0.142	0.175	0.417	0.716	0.537	0.508

2.4 Approximation of estimates of economic complexity

The possibilities of approximating the $\mathrm{ECI}_{c*}(\mathrm{p}*)$ estimate of the economic complexity of the c* region in the event of the emergence of a new strong p* sector in it are shown in the work (Afanasyev and Gusev, 2022). Further, the approximation estimates are given for the Belgorod region in comparison with the estimates obtained on the basis of the standard approach. The initial non-normalized assessment of the economic complexity of this region is indicated in the first row of column (6) of Table A1 and is equal to 0.067. According to 2019 data, there are 24 strong sectors in the economy of the Belgorod region. These sectors are marked with a sign (*) in column (3) of Table A1. The average estimate of the economic complexity of the strong sectors of the Belgorod region is 0.0347. The results of the approximation are presented in Table 2.

Table 2. The results of the approximation of estimates of the economic complexity of the Belgorod region

The structure of Table 2 by columns.

(1) the code of the sector considered as a new strong one in the region's economy;
(2) estimates of the economic complexity of the sector from column 3 of Table A1;
(3) non-normalized estimates of the economic complexity of the region, obtained in accordance with the standard approach when a new strong sector appears, indicated in column (1);
(4) non-normalized estimates of the economic complexity of the region, obtained as a result of approximation by the formula (5);
(5) approximation error in % relative to the true value indicated in column (3);
(6) a true normalized estimates of the economic complexity of a region with an average of 0 and a standard deviation of 1, obtained in accordance with the standard approach when a new strong sector appears, specified with column (1).

(1)	(2)	(3)	(4)	(5)	(6)
1125	0.081212	**0.071585**	0.070626	-1.34	0.877999
1160	0.053407	**0.069069**	0.068478	-0.85	**0.855238**
1202	0.052563	**0.068992**	0.068413	-0.83	**0.854471**
1290*	0.047159	**0.068085**	0.067996	-0.13	**0.846277**
1205	0.032066	**0.067207**	0.066831	-0.56	**0.838414**
1315	0.028627	**0.066614**	0.066565	-0.07	**0.832918**
1203	0.025861	**0.066562**	0.066351	-0.31	**0.832629**
1285*	0.017248	**0.065481**	0.065686	0.31	**0.822845**
1270*	0,0073	**0.064817**	0.064918	0.15	**0.819533**
1220	-0.0046	**0.063917**	0.0640	0.12	**0.808533**
1130	-0.00508	**0.063772**	0.063962	0.29	**0.807296**
1155	-0.01239	**0.063442**	0.063398	-0.07	**0.804374**
1305	-0.03929	**0.060504**	0.061321	1.35	**0.777539**
1320	-0.08985	**0.05616**	0.057416	2.23	**0.738046**

In column (1) of Table 2, the codes of the same 14 sectors that are presented in Table 1 are indicated. The estimates of economic complexity based on approximation was tested for them. None of these sectors is strong in the Belgorod region according to 2019 data. In table 2, these sectors are ordered in descending order by estimates of their economic complexity taken from column (3) of Table A1. These estimates of the economic complexity of the sectors are given with higher accuracy in column (2) of table 2. Column (3)

of Table 2 shows an un-normalized assessment of the economic complexity of the Belgorod Region obtained in accordance with the standard approach, when a new strong sector appears in the region's economy, indicated in column (1). It should be noted that the order of values of economic complexity in column (3) of Table 2 fully corresponds to the order of estimates of economic complexity of sectors in column (2). In other words, Spearman's rank correlation coefficient of economic complexity estimates of the region from column (3), obtained in accordance with the standard approach, and estimates of economic complexity of sectors from column (2), is equal to 1. The higher the economic complexity of the sector, the higher the economic complexity of the region in which this sector becomes strong one. The Pearson correlation coefficient of economic complexity estimates from columns (2) and (3) of Table 2 is 0.9989. Column (4) of Table 2 shows an estimate of the approximation of the economic complexity of the region according to formula (5) for the corresponding sector. The score in column (4) is higher the higher the estimate of the economic complexity of the sector in column (2). This follows from formula (4). Accordingly, Spearman's rank correlation coefficient and Pearson's correlation coefficient of the estimates from column (4) and from column (2) are equal to 1. Spearman's rank correlation coefficient of the approximation estimates and the true estimates are 1; the Pearson correlation coefficient is 0.9989.

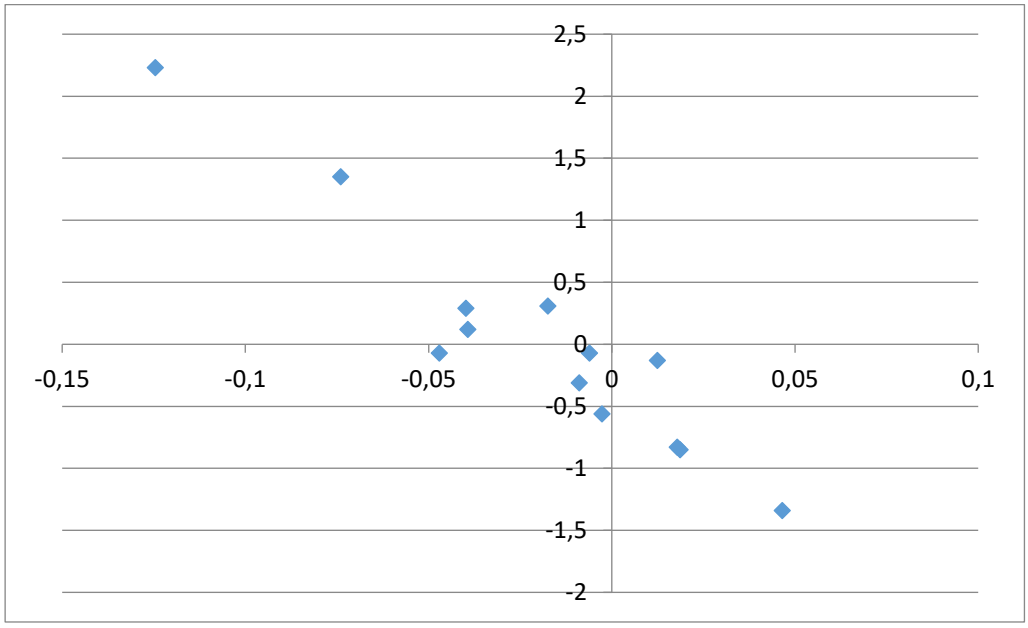

Figure 2. Dependence of the approximation error (ordinate axis) from the value $\Delta_{p*}(c*)$ (abscissa axis)

Column (5) of Table 2 shows the deviation in % of the approximation estimate from the estimate obtained on the basis of the standard approach. The maximum error value for the selected 14 sectors is 2.23%. It can be concluded that the approximation gives good results. However, it should be noted that with an increase in the modulus of the value $\Delta_{p*}(c*)$, determined by the formula (4), the absolute value of the error value increases. Recall that the value $\Delta_{p*}(c*)$ characterizes the deviation of the assessment of the economic complexity of the sector p* from the average assessment of the economic complexity of all strong sectors in the economy of the region c*. As shown in Fig. 2, the approximation estimates are lower than the estimates obtained on the basis of the standard approach for positive values of the value $\Delta_{p*}(c*)$ and higher for negative values. Some exceptions may be related to the accuracy of the calculation at values $\Delta_{p*}(c*)$ close to zero.

2.5 The impact of the region's innovation activity on the development of the sector

Let us consider as an index of innovation activity INN one of the author's indexes, built on the basis of the concept of a stochastic frontier on data on international patent applications (TEMPZ). Based on the regression analysis described in paragraph 2.5, 20 sectors have been identified, the development of which depends on the innovative activity of regions when creating international patent applications (Afanasiev et al., 2021). These sectors are marked with a sign (*) in column (1) of Table A1 of the appendix. Regions, forming international patent applications and demonstrating activity in this area, influence the development of each of these 20 sectors. From the results of the regression analysis, it follows that the economic potential of the development of each of the 20 sectors is associated with the growth of the scale of the regional economy, specialization or industrialization of the region, and an increase in the technical efficiency of production. Depending on which components of the economic basis have significant estimates of the coefficients in the regression (6). Another way is associated 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 volumes depend on the innovation activity of the region when creating the corresponding result of innovation activity. Of the 14 sectors listed in Tables 1 and 2, for each of which the possibility of emerging as a strong one in the Belgorod region is analyzed, the development of three sectors depends on the innovation activity of the regions. These are sectors: 1270 "Construction"; 1315 "Railway transport activities"; 1320 "Pipeline transport activities". They are marked as dependent on the innovation activity of the regions in column (6) of summary table 5.

2.6 Resource availability

As an example, column (4) of Table A1 provides estimates of the availability of resources of the construction sector in all regions. Column (9) of Table A1 shows in which regions the construction sector has demonstrated comparative advantages and is strong (value 1), and in which it is not (value 0). The estimates obtained indicate that the construction sector, according to 2019 data, is strong in the economy of 33 regions. In these regions, the growth of production in this sector will no longer lead to diversification of the structure of strong sectors of the economy. The construction sector is not strong for 46 regions. For these regions, economic diversification is possible due to the growth of production in this sector and its transformation into a strong sector. According to data for 2019, the construction sector is among the 20 industries whose production volume depends on the innovation activity of the region.

Let's evaluate the fulfillment of the resource availability condition (8) for the construction sector in regions where this sector is not strong. Column (7) of Table A1 shows the values of regression errors (6). Column (8) shows the threshold value of the right side of the inequality (8) for checking the fulfillment of the condition for the availability of resources of the sector in the region. Note that for all regions where the sector is not strong, the threshold value is negative. If for a region in which the construction sector is not strong, the regression error value in column (9) is less than the threshold value in column (10), then the construction sector has sufficient availability of resources in the region in the sense that it will become strong with the expected volume of production. In this case, the development of the sector in the region to the level of a strong one can rely on the economic potential of the region. According to the data for 2019, 11 such regions were identified. They are marked with a sign (*) in column (9) of Table A1. Among them is the Belgorod region. The fulfillment of the conditions of resource availability was also tested in 14 industries, the development of each of which to a strong level is considered as a possible option for diversifying the economy of the Belgorod region.

The results of the regression analysis of the production volumes of these sectors by the components of the expanded economic base are presented in Table 3. Three of them depend on the innovative activity of the regions: 1270 "Construction"; 1315 "Railway transport activities"; 1320 "Pipeline transport activities". Column (10) shows the value of the regression error (6) of the output of each of the 14 sectors for the Belgorod region by components of the expanded economic base. Column (11) of Table 3 shows the threshold values (the right side of the inequality (8) for the regression error at which the resource availability condition is met. The result of checking the availability conditions of resources is indicated in column (7) of summary table 4.

Table 3. Characteristics of resource availability of sectors according to the data of 2019.

Table structure by columns:

(1) the code of the sector;
(2) the number of observations to construct the regression (the number of regions with non-zero sector output);
(3) coefficient of determination R^2;
(4) estimates of a constant in regression, t-statistics in parentheses;
(5) estimates of the regression coefficient for the logarithm of the economically active population and t-statistics;
(6) estimates of the regression coefficient for the index of technical efficiency of regional production and t-statistics;
(7) estimates of the regression coefficient for the first main component of the GRP structure and t-statistics;
(8) estimates on of the regression coefficient for the second main component of the GRP structure and t-statistics;
(9) estimates of the regression coefficient for the TEMPZ innovation activity index and t-statistics;
(10) error in regression (6) for the sector in the Belgorod region;
(11) the threshold value of the resource security condition (the right side of the inequality (8)).

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1125	79	0.521	-8.257 (-4.21)	1.821 (6.27)	-0.090 (-0.35)	-0.636 (-2.39)	0.440 (1.57)	0.879 (0.73)	-1.248	-0,337
1130	69	0.854	9.614 (13.40)	1.864 (17.36)	0.376 (3.78)	-0.0097 (-0.08)	0.034 (0.31)	-0.645 (-1.34)	2.422	-0,941
1155	66	0,628	-0,876 (-3,80)	1,344 (5.33)	0,568 (2.73)	-0,222 (-1.05)	0,864 (3.80)	-1.256 (-1.31)	-0,288	-0,165
1160	69	0,381	-3,380 (-0.86)	2,983 (5.11)	0,498 (1.01)	-0,678 (-1.61)	-0,178 (-0.35)	2.017 (0.96)	-1,534	-0,521
1202	63	0.572	3.015 (-0.86)	3.271 (6.36)	-0.776 (-1.80)	-0.087 (-0.21)	1.481 (3.38)	-0.132 (-0.07)	1.658	-1,133
1203	79	0.608	-4.645 (-2.91)	1.768 (7.23)	-0.411 (-1.99)	-0.789 (-3.90)	0.468 (2.15)	-0.063 (-0.06)	0.281	-1,398
1205	78	0.655	-2.915 (-2.03)	1.643 (7.49)	0.244 (1.30)	–-0.390 (-2.19)	0.829 (4.29)	-0.523 (-0.62)	0.729	-0,024
1220	72	0.573	-3.873 (-1.17))	1.454 (2.86)	0.272 (0.63)	0.991 (2.40)	0.599 (1.33)	0.787 (0.56)	-1.878	-3,285
1270	79	0,767	7,212 (12,77)	1,139 (14,42)	0,090 (1,32)	0,228 (3,23)	0,158 (1,99)	0,274 (3,76)	-0,75	-0,152
1285	79	0.623	3.276 (4.29)	0.987 (8.45)	-0.304 (-3.09)	0.453 (4.69)	0.201 (1.93)	0.096 (0.20)	0.246	-0,303
1290	77	0.551	-0.818 (-0.68)	1.444 (7.86)	-0.477 (-3.03)	0.206 (1.39)	0.291 (1.78)	0.011 (0.01)	-0.209	-0,412
1305	74	0.553	-3.873 (-1.17))	1.454 (2.86)	0.272 (0.63)	0.991 (2.40)	0.599 (1.33)	-3.238 (-1.56)	-6.529	-7,627
1315	65	0,377	1,231 (0,50)	1,242 (3,55)	0,305 (1,10)	1,297 (4,86)	-0,238 (-0,72)	0,593 (2,12)	-1.392	-3,323
1320	80	0,584	5,290 (5,56)	1,184 (8,91)	0,292 (2,53)	0,400 (3,34)	-0,004 (-0,03)	0,261 (2,116)	-0.029	-0,259

2.7 The task of selection

Table 4 can be considered as the result of a comprehensive assessment of the directions of a particular region diversification. This is one of the possible forms of digital support for strategic decision-making. Based on such information, expert decisions can be made and priority areas of diversification of the regional economy can be selected. Such information can become the basis for determining priorities in the implementation of regional development projects aimed at increasing the number of jobs in the region and improving material well-being.

Table 4. Comprehensive assessment of the considered diversification options according to the data of 2019.

Table structure by columns:

(1) the code of the sector whose development to the level of strong ones is considered as possible options for diversifying the economy of the Belgorod region;
(2) estimates of the economic complexity of the sectors from column 3 of Table A1;
(3) estimates of the evolutionary conditionality of the sector: "yes" if the predicted probability of occurrence is higher than 0.5, otherwise "no";
(4) estimates of changes in the economic complexity of the region based on the standard approach as a result of the emergence of a new strong sector: "yes" if the economic complexity of the region increases, otherwise "no";
(5) estimates of the change in the economic complexity of the region based on the approximation:: "yes" if the economic complexity of the region increases, otherwise "no";
(6) "yes" if the output of the sector depends on the innovation activity of the regions, otherwise "no";
(7) "yes" if the condition of resource availability of the sector in the region is met, otherwise "no";
(8) estimates of the region's GRP increase in % if the sector turns into a strong one.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1125*	0.0812	yes	yes	yes	no	yes	0.010
1160*	0.0534	yes	yes	yes	no	yes	0.152
1202*	0.0525	yes	yes	yes	no	no	0.641
1290	0.0471	no	yes	yes	no	no	0.365
1205	0.0321	yes	yes	no	no	no	0.017
1315*	0.0286	yes	no	no	yes	no	0.099
1203	0.0258	yes	no	no	no	no	0.318
1285	0.0172	no	no	no	no	no	0.607
1270*	0,0073	no	no	no	yes	no	3.811
1220	-0.0046	yes	no	no	no	no	0.560
1130	-0.0051	yes	no	no	no	no	0.055
1155	-0.0124	yes	no	no	no	yes	0.089
1305	-0.0393	yes	no	no	no	no	0.143
1320*	-0.0898	yes	no	no	yes	no	0.331

The choice of a sector for development in the region to a strong level based on the data presented in Table 4 is associated with the solution of a multi-criteria task. Each criterion corresponds to one of the columns of the table, with the exception of the first one. Estimates of changes in economic complexity in

columns (4) and (5) are considered as alternative. If estimates of economic complexity based on the standard approach are available, then estimates from column (4) are used, which is more preferable. If these estimates are not available, then the estimates from column (5) obtained on the basis of approximation can be used. Note that for our example, the estimates in columns (4) and (5) differ only for sector 1205. The solution to the problem is a set of sectors, each of which has a set of characteristics with the property of Pareto-optimality. There are six such sectors: 1125 "production of leather and leather products"; 1160 "production of rubber and plastic products"; 1202 "production of computers, electronic and optical products"; 1270 "construction"; 1315 "railway transport activities"; 1320 "pipeline transport activities". They are marked with a sign (*) in column (1) of Table 4. Regardless of how the economic complexity is assessed, the totality of the characteristics of the 1205 sector is not Pareto-optimal. Pareto optimal options deserve attention first of all. The most favorable development conditions are in sectors 1125, 1160 and 1270, for which the resource availability condition is met. The growth of production volumes in these sectors can be based on the economic potential of the region. The development of sectors 1315 and 1320 can be based on the growth of innovation activity in the region. The economic and innovative potential of the region may not be enough for the development of the 1202 sector. However. the development of this sector is evolutionarily conditioned.

CONCLUSION

The results are obtained that develop the methodology for choosing priority areas of diversification of the region's economy. Based on the standard approach, estimates of the economic complexity of sectors and regions are calculated. The possibility of approximating estimates of economic complexity is substantiated. The condition of resource availability has been formalized, the fulfillment of which indicates the possibility of developing the sector to the level of a strong one. The possibilities of information support and solving the problem of determining the priority direction of diversification are shown on the example of the Belgorod region. 14 sectors that are not strong in the economy of the Belgorod region according to 2019 data are considered as possible directions (column 1 of table 4). Estimates of economic complexity based on a standard approach are given for each sector (column 2 of Table 4). Among them are 11 sectors whose development in the region is evolutionarily conditioned: the predicted probability of such a sector appearing as a strong one in the region is above 0.5 (column 3 of Table 4). Based on the standard approach, the change in the economic complexity of the region as a result of the development of each of the sectors to a strong one is estimated (column (4) of Table 4). The change in the economic complexity of the region is also estimated on the basis of approximation (column 5 of Table 4). Based on the regression approach, the sectors whose development depends on the innovation activity of the region are identified (column 6 of Table 4). The sectors whose expected output ensures their development to a strong one are indicated (column 7 of Table 4). Estimates of GRP increase in % are calculated if the sector becomes strong (column 8 of Table 4). Summary table 4 contains the characteristics of the sectors according to seven criteria. The "*economic complexity*" estimates from column 5 are used if the estimates derived from the standard approach are not available (column 4). Among the evaluated 14 sectors, six sectors were identified whose characteristics have pareto-optimality properties: 1125 "*leather and leather goods production*"; 1160 "*rubber and plastics production*"; 1202 "*production of computer, electronic and optical products*"; 1270 "*construction*"; 1315 "*railway transport activities*"; 1320 "*pipeline transport activities*". Of course, the number of criteria under consideration can and should be expanded. First of all, based on estimates of the number of jobs created, an increase in the socio-economic development of the region, an increase in material well-being as a result of the emergence of new strong sectors, the costs of developing the sector to the level of a strong one. This is one of the tasks of digitalization of the regional management system. The implementation of the proposed approach using digital technologies in regional situation centers can ensure coordination of decisions taken by regions when choosing priority areas of diversification. The methodology used makes it possible to take into account in real time and display in the initial information considered by any region, the predicted results of decisions already made by other regions. At the same time, each region should be considered as unique, the specifics of which do not allow making standard management decisions.

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APPLICATION

Table A1. Estimates of the economic complexity of sectors and regions

Table structure by columns:

(1) the code of the sector in accordance with the structure of tax revenue data; the sign (*) indicates sectors whose production volumes depend on the innovation activity of the regions;
(2) the number of regions. in which the sector is strong;
(3) non-standardized estimates of the economic complexity of the sector; the sign (*) indicates sectors that are strong in the Belgorod region;
(4) name of the region;
(5) number of strong sectors in the region;
(6) non-standardized estimates of the economic complexity of the region;
(7) regression error values (6);
(8) threshold value of the right side of the inequality (8) to check the fulfillment of the condition of resource availability of the sector in the region;
(9) 1 if the Construction sector is strong in the region, otherwise 0; the sign (*) indicates regions in which the Construction sector has sufficient resource availability.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1020	40	0.0467*	Belgorod region	24	**0.0670**	-0,75	-0,152	0*
1025	32	-0.0292	Bryansk region	31	0.0402	0,304	0,443	1
1030	11	-0.0700	Vladimir region	37	0.0617	0,043	-0,316	0
1046	11	-0.1167	Voronezh Region	34	0.0285	0,279	-0,040	0
1047	7	-0.1799	Ivanovo region	28	0.043	0,412	-0,071	0
1055	13	-0.4351	Kaluga Region	29	0.0584	-0,177	0,258	1
1060	6	-0.5638	Kostroma region	33	0.0246	-0,323	-0,354	0
1075	10	-0.0078*	Kursk region	22	0.0618	-1,087	-0,013	0*
1080	12	-0.2254	Lipetsk region	36	0.0443	-0,044	0,224	1
1081	15	-0.0847	Moscow region	39	0.0266	1,265	0,028	1
1084*	17	-0.3330	Oryol region	30	0.0561	0,134	-0,009	0

1090	41	0.0569*	Ryazan region	16	0.0435	0,347	-0,772	0
1095	38	0.0522*	Smolensk region	31	0.0455	1,523	-0,245	0
1100	50	0.0392*	Tambov region	28	0.0419	-0,525	0,708	1
1105	13	0.0635*	Tver region	42	0.0335	0,09	0,084	1
1110	37	0.0238*	Tula region	34	0.0514	0,109	0,663	1
1115	9	0.0501	Yaroslavl region	25	0.0318	0,493	-0,612	0
1120	26	0.0740	Moscow	24	-0.0386	1,83	0,253	1
1125	21	0.0812	Republic of Karelia	26	0.0215	-0,302	0,209	1
1130	36	-0.0051	Komi Republic	14	-0.2957	1,398	-0,647	0
1135	25	0.0054*	Arkhangelsk region	20	-0.0186	-0,154	-0,493	0
1140	22	0.0617*	Volgograd region	25	0.0413	0,882	0,152	1
1145	5	0.0021	Kaliningrad Region	15	0.0126	0,536	-0,157	0
1150	12	-0.1497	Leningrad region	14	0.0332	0,75	-0,303	0
1155	25	-0.0124	Murmansk Region	17	-0.0367	0,603	-0,766	0
1158	15	0.0336*	Novgorod region	32	0.0404	0,268	0,343	1
1160	30	0.0534	Pskov region	35	0.0503	0,015	0,204	1
1165	44	0.0536*	Saint Petersburg	23	-0.0031	0,752	0,476	1
1170	28	0.0259*	Republic of Adygea	22	-0.016	-0,062	0,108	1
1175	14	0.0337*	Krasnodar Territory	27	0.0354	0,406	0,224	1
1176	1	0.0140	Astrakhan region	9	-0.2532	0,364	-0,691	0
1177	5	0.0329*	Volgograd region	17	0.0274	0,129	-0,326	0
1180	8	0.0665*	Rostov region	33*	0.0461	-0,331	0,111	1
1185	18	0.0475	Republic of Dagestan	19	0.0198	-1,482	0,378	1
1190	11	-0.1165	Republic of Ingushetia	15	-0.0168	-2,532	1,057	1
1195	6	-0.0898	Kabardino-Balkarian Republic	17	0.0381	-1,043	-0,900	0*
1200	31	0.0365*	Karachay-Cherkess Republic	27	0.0202	-0,079	0,084	1
1201	20	0.0640*	Republic of North Ossetia - Alania	14	-0.0029	-0,704	-0,107	0*
1202	27	0.0526	Chechen Republic	13	0.0186	-10	-8,399	0*
1203	29	0.0259	Stavropol Territory	23	0.0527	0,232	-0,254	0
1205	34	0.0321	Republic of Bashkortostan	17	-0.1003	-0,312	0,076	1
1215	16	-0.0036	Republic of Mari El	31	0.0325	-0,28	-0,190	0*
1220	27	-0.0046	Republic of Mordovia	15	0.0582	-0,2	0,328	1
1221	9	-0.1234	Republic of Tatarstan	13	-0.1025	-0,112	-0,376	0
1223	19	-0.0331	Udmurt Republic	15	-0.078	-0,182	-0,723	0
1225*	28	0.0155	Chuvash Republic	40	0.0383	-0,057	0,403	1
1245	36	-0.0198	Perm Territory	20	-0.0983	0,179	-0,428	0
1250*	48	0.0106*	Kirov region	35	0.0473	0,153	0,024	1

1255	46	0.0347*	Nizhny Novgorod region	24	0.033	0,31	-0,202	0
1261	57	0.0196*	Orenburg region	6	-0.5249	-0,315	-1,157	0
1262	9	0.0233	Penza region	26	0.0513	-0,1	-0,108	0*
1263*	33	0.0152*	Samara region	20	-0.1144	-0,2	-0,486	0
1270*	33	0.0073	Saratov region	21	-0.0135	0,219	-0,556	0
1280*	28	0.0509	Ulyanovsk region	25	0.0152	-0,363	-0,442	0
1285	27	0.0172	Kurgan region	26	0.0175	-0,091	-0,277	0
1290	40	0.0472	Sverdlovsk region	30	0.0229	0,797	-0,145	0
1305	47	-0.0393	Tyumen region	8	-0.3363	-0,897	-0,017	0*
1315*	36	0.0286	Chelyabinsk region	35*	0.0071	0,089	-0,500	0
1320*	35	-0.0898	Republic Altai	30	-0.0352	0,64	0,921	1
1325	20	-0.1135	Republic of Buryatia	25	-0.0047	-0,771	0,150	1
1330*	19	-0.1723	Republic of Tyva	17	0.0044	-0,783	0,219	1
1340	23	-0.0230	Republic of Khakassia	22	0.0473	-0,673	0,179	1
1345*	17	-0.0011	Altai Territory	33	-0.2383	0,063	-0,325	0
1350	11	0.0064	Trans - Baikal Territory	19	-0.1845	-1,027	0,318	1
1355*	14	0.0030	Krasnoyarsk Territory	15	0.008	-0,648	-0,380	0*
1360	4	0.0100	Irkutsk region	15	0.0295	-0,343	-0,685	0
1363	3	0.0266	Kemerovo region	20	-0.0104	-0,406	-0,341	0*
1365*	4	-0.0312	Novosibirsk region	39	-0.3	0,6	-0,003	0
1375*	5	-0.0997	Omsk region	17	-0.0295	0,164	-0,566	0
1380	3	-0.0220	Tomsk region	10	-0.3225	0,147	-1,144	0
1385*	5	-0.0191	Republic of Sakha (Yakutia)	11	-0.0221	-0,756	-0,059	0*
1390*	11	0.0560	Kamchatka Krai	23	-0.0039	1,136	0,023	1
1395*	8	-0.2530	Primorsky Territory	26	-0.0307	0,397	-0,043	0
1398*	14	-0.0658	Khabarovsk Territory	21	-0.0896	0,876	-0,073	0
1400	55	0.0178*	Amur region	17	-0.0358	-0,217	0,863	1
1410*	58	0.0226*	Magadan region	23	-0.0278	1,429	0,664	1
1420*	57	0.0245*	Sakhalin Region	18	-0.1673	0,263	0,546	1
1430	35	0.0271	Jewish Autonomous Region	21	0.024	-0,67	-8,399	0
1440	24	0.0280	Chukotka Autonomous Okrug	13	-0.0964	1,103	0,515	1
1445	14	0.0196						
1447	3	0.0265						
1450	6	0.0493						