

Universities as social and economic development drivers in regions

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Abstract — The article analyzes the impact of universities on the social and economic development of regions in terms of selected performance indicators of higher education institutions using the example of federal universities of the Russian Federation and parameters for assessing the regional development of the regions in which they are located. Using econometric approaches, a selection of factors of higher education institutions that have the greatest connection with the region was performed, a regression model was developed, and forecast values of social and economic development parameters of territories for the future period were calculated. Thus, conclusions were reached about the impact of universities on the social and economic development of regions from research activities results.

Keywords — *universities, higher education, regional development, regional economy, public administration, innovations*

I. INTRODUCTION

The transformation of classic appreciation of a university during the transition to a new technological paradigm has contributed to giving them a new role as drivers of regional development. Higher education institutions, possessing both human and material resources, have become the main suppliers of innovative products necessary for economic growth. Close interaction between universities, government and business has contributed to increasing the importance of each institution, creating positive effects that affect the social and economic development of regions in which they are located.

A research of the higher education impact on the social and economic development of regions was conducted on the example of the Russian Federation. Federal universities with special status among all higher education institutions of the

country were chosen as objects. The peculiarity of these universities is the motivation for their establishment. The idea of creating federal universities was dictated by the need to strengthen the competitiveness of all regions of the country, including the domain of science and education. The target of federal universities establishment is to develop a higher education system based on the optimization of regional educational structures and strengthening the relations of higher education institutions with the economy and social sphere of the regions.

Higher education institutions assigned as participants in social and economic processes have taken on a number of tasks to identifying key performance parameters that have an impact on the region. The relevance of study is justified by the lack of sufficient empirical data on the factors influencing the universities activities on regional development, which can be stimulated by authorities with the aim of social and economic development of territories.

The goal of research is to determine the influence of universities on the social and economic development of the regions of the Russian Federation exemplified by five federal universities using the proposed methodology.

II. REVIEW OF LITERATURE

The issues of universities impact on regional development are relevant considering the transformation of the role of higher education institutions from a knowledge translator and a producer of scientific results to the role of an economic engine in the processes of generating and transferring new knowledge to the non-academic sector and their commercialization.

The new mission of the higher education institutions laid the

responsibility for the innovative development of the territory where they are located. They actively interact with other participants in the economy, performing a transfer of knowledge and technologies and joint research projects in order to generate new knowledge and subsequent commercialization of products. This model of innovations transition from the science to the economy sphere is described in the concept of the “quadruple helix”. It explains the impact of various institutions on the innovation process, including those ones representing the social segments that make up the fourth element – the civil society as an active consumer and participant in innovation. The new element is a complement to the theory of a “triple helix”, in which the state, business and the university stood out. [1], [2]

A number of authors consider cross-sectoral interaction as an important element of the universities inclusion in the production, social and innovative regional infrastructure [3].

Another study of the university’s third mission is the publication of Sánchez-Barrioluengo M., Benneworth P. “Is the entrepreneurial university also regionally engaged?”. According to the authors, there is a problem in combining innovative interaction with firms and regional authorities: universities are guided either by particularly focused results of knowledge transfer, or by a more general contribution to regional economic development activities. The latter, in turn, plays a key role in enhancing the financial advantages of the higher education institution and its faculty staff, accordingly realizing the role of a driver for the region development, the university provides opportunities for its own further growth. [4]

Other authors state that the contribution of some universities to local and regional economic dynamics is much greater than to production. Universities form ways of transferring knowledge and skills to attract outstanding students to the regional economic system. Thus, universities are divided into two types, not only developing academic advantage in disciplines with direct research results useful for the industry, but also demonstrating the development of relations with industry for regional economic development. [5]

Haktan Sevinc in his scientific paper “The role if universities in local economic development: a case of TRA2 region in Turkey” considers universities contribution to the local economy, and concludes that there is a high impact on the economic development of the regions. According to the author, higher education institutions make positive external effects for certain industries and companies, improve infrastructure, help attract investment, which ensures the increase of their cities and regions competitiveness. [6]

The role of universities in terms of the formation and strengthening of formal and informal ties as a contribution to local and regional development is considered in the article “The University in the community. The university’s contribution to local and regional development by providing educational services for adults”, authored by Albulescua I., Albulescu M. Universities need to develop cross-organizational interaction in order to obtain and provide benefits to regional authorities and businesses in conditions of

mutual assistance. Researchers have concluded that partnerships with universities can provide different players with access to skilled human resources according to their needs and the ability to use research universities to innovate or improve products and services. [7]

The goal of “The Role of Universities in Regional Development: Conceptual Models and Policy Institutions in the UK, Sweden and Austria” Trippl M., Sinozic T., Smith H. L. research is to provide a basis for analyzing the universities contribution to regional economic and social development. Therefore, the authors considered four conceptual models of the structure of higher education institutions, emphasizing the different types of activities and the results by which universities benefit the regional economy and society [8].

Thus, a review of the literature showed that there is currently no precise understanding of how regions can benefit from various types of higher education institutions activities. Universities endowed with a new role independently determine priority areas that should contribute to its implementation, transforming at the same time into one of the regional participation models of higher education institutions considered in the scientific community.

III. METHODOLOGY

To assess the impact of federal universities on the social and economic development of the regions, five higher education institutions that operate in the corresponding number of constituent entities of the Russian Federation were selected. Three of them are represented in the international QS and THE ratings, which characterizes their focus on improving competitiveness and entering the international educational space. These include:

- Kazan Federal University (hereinafter – KFU) in the Republic of Tatarstan;
- Southern Federal University (hereinafter – SFedU) in the Rostov Region;
- Siberian Federal University (hereinafter – SibFU) in the Krasnoyarsk Territory;
- Northern (Arctic) Federal University (hereinafter – NArFU) in the Arkhangelsk Region;
- North-Eastern Federal University (hereinafter – NEFU) in the Sakha Republic.

General theoretical methods, which include classification, analysis and synthesis of information received, as well as practical methods, namely, comparison and contrast of the generated data were used as research methods.

At the first stage, to obtain results on the presence or absence of universities impact on regional development, the econometric approach of calculating pairwise regression of linear and nonlinear models was used, after which the coefficient of determination was calculated, which explains the change in the final result when independent factors change.

At the second stage, the paired regression equations for each university were constructed with the corresponding three

significant independent factors, then, substituting the expected values of the independent indicators incorporated in the roadmaps of higher education institutions development into it, a forecast was made of the dependent variable value characterizing the social and economic development of the region for the next period. Roadmaps are a visual representation of a step-by-step scenario for the higher education institutions development for a certain period, which gradually describes the measures to achieve the general goal, as well as indicators for their assessment.

The third stage included comparison of the obtained forecast values with the data of previous years, determining the presence or absence of dynamics, formulating conclusions regarding the dependence direction – direct or feedback.

To determine the universities impact on the social and economic development of the regions, the following possible regressors were chosen – X:

- Number of students (X1);
- Number of research students (X2);
- Number of patents (X3);
- Number of research and development works (X4);
- University income from research and development works (hereinafter - R&D) (X5);
- Higher education institution income from extrabudgetary sources (X6);
- R&D volume (X7);
- Number of small innovative enterprises (X8).

The number of students enrolled at the university included students undergoing higher education programs; the indicator of patents and research and development works showed the number of results obtained and implemented, respectively, in the current year.

The following parameters were taken as dependent parameters – Y, reflecting regional development: gross regional product (hereinafter – GRP) (Y1), average salary in a region (Y2) and unemployment rate (Y3).

Sources of data necessary for the research were self-examination reports of universities, as well as collections by the Federal State Statistics Service “Regions of Russia [9]. Social and economic indicators” for the period from 2010 to 2018. The initial period for the database development is determined by the year of the establishment of majority of the selected federal universities.

To generate the research conclusions, a hypothesis was determined about the federal universities impact on the social and economic development of the regions in which they are located. It should have been confirmed or refuted in accordance with the obtained results.

IV. RESULTS

The calculations were made according to the performance indicators of five federal universities in the corresponding number of constituent entities of the Russian Federation. In accordance with the specified methodology and the generated database, the following research results were obtained. Having determined the close relationship of the Y1, Y2 and Y3 dependent parameters with the X1-X8 independent factors, we obtained data from which it follows that in all the regions under consideration, the performance indicators of federal universities have the greatest impact on the change in the gross regional product volume and the average wage. The relationship with the unemployment rate in three of the five studied constituent entities of the Russian Federation is below the limit set by us – 0.5, which excludes the further forecasting due to the unreliability of its results.

Consider the research results of the federal universities impact on gross regional product. Table 1 presents the initial data of the indicator for the 2010-2018 period in each region of the country.

Paired regressions of linear and non-linear models were constructed to identify the impact of the results of the federal higher education institutions activities as independent indicators on the gross regional product of the constituent entities of the Russian Federation. Table 4 shows the obtained values of the determination coefficient for each pair of dependent and independent parameters, from which three indicators of universities with the greatest relationship with GRP were identified (Table 2).

TABLE I. GROSS REGIONAL PRODUCT OF THE REGIONS, MILLION RUB

Year	Republic of Tatarstan	Rostov region	Krasnoyarsk Territory	Sakha Republic	Arkhangelsk region
2010	1,001,622.8	659,667.4	1,055,525	386,825	372,804.8
2011	1,305,947	765,967.2	1,170,827	486,831	439,116.8
2012	1,437,001	843,560.3	1,183,228	541,307	472,470.9
2013	1,551,472.1	917,689.1	1,256,934	570,285	500,095.1
2014	1,661,413.8	1,007,758.8	1,410,720	658,140	540,133.6
2015	1,833,214.5	1,171,784.1	1,667,000	747,602	617,128
2016	1,944,100	1,220,000	1,767,900	862,695	683,360
2017	2,114,176.1	1,332,688.9	1,882,300	916,578.62	743,562.8
2018	2,440,300	1,400,000	1,785,078	1,060,000	752,485.6

TABLE II. R-SQUARED VALUE OF FEDERAL UNIVERSITIES INDICATORS WITH GRP

Higher Education Institution	Y1X1	Y1X2	Y1X3	Y1X4	Y1X5	Y1X6	Y1X7	Y1X8	Type of dependency
SFedU	0.47	0.89	0.19	0.50	0.86	0.81	0.96	0.45	Polynomial
SibFU	0.86	0.68	0.27	0.47	0.81	0.48	0.92	0.18	Polynomial
NEFU	0.72	0.80	0.88	0.92	0.03	0.84	0.03	0.67	Exponential
NArFU	0.32	0.64	0.45	0.26	0.98	0.45	0.60	0.34	Polynomial
KFU	0.89	0.88	0.84	0.57	0.92	0.98	0.94	0.96	Polynomial

The results showed that in most cases, two of the three university indicators are highly dependent on the regional parameter. This is noted in the Rostov region, Krasnoyarsk Territory and the Sakha Republic. From the selected indicators for the Arkhangelsk region, only the change in income from research and development works more strongly explains the change in the gross product of the region. For the Republic of Tatarstan, the results of Kazan Federal University activities are important, since they have a very high impact on the constituent entity's GRP.

For each pair of dependent and independent parameters having the largest value of the determination coefficient, pairwise regression equations were constructed. The resulting equations are presented in Table 3.

A forecast for 2019 was built using the regression equations describing the change in gross regional product with an increase or decrease in the selected indicators of universities in the future. Table 4 presents data on the gross regional product for the two years preceding the forecast one. After substituting the expected values into the equations, the predicted values of GRP in 2019 were calculated

TABLE III. PAIRWISE REGRESSION EQUATIONS FOR PREDICTING GRP

Higher Education Institution	Regression equations		
SFedU	X2: $y = 5.3301x^2 - 14359x + 10000000$	X5: $y = -0.000002x^2 + 5.5448x - 2000000$	X7: $y = -0.0000007x^2 + 2.4253x - 841049$
SibFU	X1: $y = 0.0161x^2 - 1167.3x + 20000000$	X5: $y = 0.000000000003x^2 - 0.0024x + 2000000$	X7: $y = -0.000001x^2 + 2.5776x + 562621$
NEFU	X3: $y = 421374e^{0.0137x}$	X4: $y = 153987e^{0.0062x}$	X6: $y = 109646e^{0.000002x}$
NArFU	X2: $y = -14.447x^2 + 8242.3x - 518936$	X5: $y = 0.000005x^2 + 0.4331x + 325417$	X7: $y = -0.00001x^2 + 4.708x + 94433$
KFU	X6: $y = 0.00000002x^2 + 0.208x + 870311$	X7: $y = -0.00000003x^2 + 0.7885x + 909371$	X8: $y = 474.37x^2 + 2004.5x + 971115$

TABLE IV. COMPARISON OF REAL VOLUMES OF GROSS REGIONAL PRODUCTS WITH FORECAST RESULTS

	Republic of Tatarstan	Rostov region	Krasnoyarsk Territory	Sakha Republic	Arkhangelsk region
2017	2,114,176.1	1,332,688.9	1,882,300	916,578.62	743,562.8
2018	2,440,300	1,400,000	1,785,078	1,060,000	752,485.6
2019	X6: 2,661,458 X7: 2,426,575 X8: 2,683,156	X2: 1,282,995 X5: 1,397,106 X7: 1,258,982	X1: 1,765,034 X5: 1,997,694 X7: 2,039,173	X3: 1,115,251 X4: 1,142,225 X6: 726,654	X1: 651,033 X5: 479,173 X7: 587,710

Depending on the level of regressors impact on the regional parameter in the future period, it is possible to achieve the calculated forecast values.

Then, similar calculations were performed, where the average wage in the corresponding constituent entity of the Russian Federation was taken as a regional parameter.

The differences in the average earnings are related to the production and resource capabilities of the region, the current situation on the labor market, climatic conditions and other reasons. In particular, the wages of those living in the northern regions are higher than the national average, as they include surcharges for the climatic features of the area, which are valid in the Krasnoyarsk Territory, the Sakha Republic and the

Arkhangelsk region. Differentiation also depends on the industry specification of the entity that creates jobs. The Republic of Tatarstan with a developed oil industry belongs to such a region. The lowest average wage, among the entities considered, is inherent in the Rostov region - the southern region with an underdeveloped tourism sector.

Determination of the relationship between the indicators of federal universities and constituent entities of the Russian Federation made it possible to determine its type and calculate the determination coefficient, the results of which are presented in Table 6

TABLE V. AVERAGE WAGE, RUB

Year	Republic of Tatarstan	Rostov region	Krasnoyarsk Territory	Sakha Republic	Arkhangelsk region
2010	17,350.1	15,244	23,254	28,708	22,192.1
2011	20,009.4	16,950	25,659	34,051.5	24,611.4
2012	23,233.7	19,189	28,672	39,915.6	28,531.3
2013	26,034.5	21,867	31,623	46,542	32,465.3
2014	28,293.6	23,818	34,178	51,110.5	35,572.1
2015	29,147.1	25,008	36,071	54,630.9	38,299.6
2016	29,792.5	26,661	38,361	59,000	40,790
2017	31,563	27,552.1	39,705	62,206	42,950
2018	35,172	31,448	45,635	68,871	48,307

TABLE VI. R-SQUARED VALUE OF FEDERAL UNIVERSITIES INDICATORS WITH AVERAGE WAGE

Higher Education Institution	Y1X1	Y1X2	Y1X3	Y1X4	Y1X5	Y1X6	Y1X7	Y1X8	Type of dependency
SFedU	0.50	0.86	0.24	0.37	0.84	0.74	0.94	0.45	Polynomial
SibFU	0.88	0.62	0.47	0.71	0.72	0.34	0.88	0.36	Polynomial
NEFU	0.80	0.82	0.96	0.95	0.93	0.84	0.08	0.74	Polynomial
NArFU	0.43	0.66	0.55	0.30	0.99	0.45	0.69	0.32	Polynomial
KFU	0.80	0.92	0.80	0.70	0.92	0.98	0.94	0.98	Polynomial

The similarity of influencing indicators of universities with a determination coefficient above 0.5 on gross regional product and average wages confirms the dependence of the social and economic development of the region on the activities results of the federal higher education institutions

and determines specific factors of impact, the stimulation of which will create positive effects for the entity development.

Having built the paired regression equations shown in Table 7, a forecast was made for the change in the average wage in the region. The results are described in Table 8.

TABLE VII. PAIRWISE REGRESSION EQUATIONS FOR PREDICTING AVERAGE WAGES

Higher Education Institution	Regression equations		
SFedU	$X2: y = 0.0345x^2 - 127.31x + 120409$	$X5: y = -0.00000005x^2 + 0.1165x - 42026$	$X7: y = -0.00000001x^2 + 0.0417x - 10668$
SibFU	$X1: y = 0.0003x^2 - 21.684x + 425875$	$X5: y = 0.00000000000007x^2 - 0.00006x + 38833$	$X7: y = -0.00000004x^2 + 0.0744x + 10134$
NEFU	$X3: y = -4.8421x^2 + 943.51x + 25874$	$X4: y = 0.6142x^2 - 16.795x + 18195$	$X5: y = -0.000001x^2 + 0.7466x - 40489$
NArFU	$X2: y = -0.9339x^2 + 535.63x - 36337$	$X5: y = 0.0000004x^2 + 0.0126x + 19699$	$X7: y = -0.0000004x^2 + 0.2322x + 7804.4$
KFU	$X6: y = -0.000000003x^2 + 0.0061x + 11789$	$X7: y = -0.000000005x^2 + 0.0194x + 12801$	$X8: y = 3.974x^2 + 169.58x + 15294$

TABLE VIII. COMPARISON OF REAL VALUES OF AVERAGE WAGES WITH FORECAST RESULTS

	Republic of Tatarstan	Rostov region	Krasnoyarsk Territory	Sakha Republic	Arkhangelsk region
2017	31,563	27,552.1	39,705	62,206	42,950
2018	35,172	31,448	45,635	68,871	48,307
2019	X6: 36,535 X7: 31,505 X8: 38,498	X2: 32,229 X5: 22,684 X7: 31,218	X1: 60,384 X5: 38,775 X7: 44,530	X3: 68,454 X4: 76,849 X5: 89,182	X2: 40,154 X5: 49,625 X7: 41,289

The results revealed that each dependent parameter changes the independent factor differently. This is clearly shown in the Arkhangelsk region, where an increase in income from extrabudgetary sources will positively affect the average earnings, but it will negatively affect the volume of gross regional product. Also, during the research, a

trend was noted for the direct and reverse impact of university performance indicators. An example of reverse relationship is the indicator of research work volume at North-Eastern University, the reduction of which will lead to an increase in the average wage.

V. DISCUSSION

In our view, taking into account these features of the relationship between the indicators of universities and regions will allow to build a competent policy in the regions management and determine priority areas in the activities of higher education institutions, which will stimulate the social and economic development of regions in the future.

Thus, the hypothesis that federal universities have impact on the social and economic development of the regions in which they are located has been confirmed, higher education institutions are important entities in the process of regional development, along with other participants of this process. The economic development of the region is one of the most important tasks of universities. R-squared value turned out to be significantly higher than the limit set by us, and for all the objects examined, with the exception of the Northern Arctic Federal University, it was high, which indicates the forecasts reliability and the possibility of their further application.

VI. CONCLUSION

According to the research, the main results of the universities' activities, namely the ongoing research and development works, the created intellectual products, impact on regional development: patents or developments, as well as income obtained after their sale. Among the higher education institutions examined, Kazan Federal University has a larger number of performance indicators with a high proportion of variation that explains the change in dependent variables characterizing the social and economic development of the Republic of Tatarstan. Siberian, Southern, and Northeastern federal universities have a rather high impact on the Krasnoyarsk Territory, Rostov Region, and the Sakha Republic, respectively. The results of the Northern Arctic University activities in the Arkhangelsk region are reflected in regional development to a lesser extent.

The research showed that the activities of universities affect the level of social and economic development of regions by stimulating the main results of higher education institutions. Universities are important subjects of regional development, playing the role of an economic entity and an employer, but this is possible only through close interaction with other institutions.

Account of the results obtained during the research will not only increase the level of social and economic development of a particular region, but will also affect the country's economy, its macroeconomic stability

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