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UNIVERSITY PERFORMANCE AND REGIONAL DEVELOPMENT: THE CASE OF RUSSIA'S NORTH-WEST

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The role of universities in regional socio-economic systems is pivotal. However, despite the overall trend of GRP growth, regions of Russia's Northwestern Federal District underperform on education-related measures. These include the share of education in GRP, the percentage of individuals employed in the education sector and the number of universities and students. These trends pose a substantial challenge to regional development, especially in the context of the fourth industrial revolution and the rise of the knowledge economy. The lack of attention to the education sector may stem from the gross underestimation of its contribution to regional development. By implementing their 'third mission', universities exert influence on the economy, politics and socially responsible industries in their home region. A better understanding of the role of universities in regional development requires a comprehensive evaluation of their performance. This study aims to evaluate the performance of regional universities and examine its impact on regional socio-economic indicators. The paper proposes a methodology for evaluating the performance of regional universities and presents the results of its application in the regions of Russia's Northwestern Federal District. The universities of the Arkhangelsk region and St Petersburg demonstrated the highest performance levels, whilst those of the Leningrad region were the lowest. Correlation analysis showed a significant connection between universities' performance levels and the key socio-economic indicators of regional development. Universities' performance levels vary significantly across Russia's Northwestern regions. The findings may interest researchers studying regional development issues and administrators of universities prioritising the implementation of the third mission. Additionally, the results can inform decisions regarding the advancement of higher education at the regional level within the Northwestern Federal District.

Keywords:

region, regional economy, regional development, Northwestern Federal District, higher education, universities' performance

Introduction

The Northwestern Federal District (NWFED) is considered one of the 'locomotives' of Russia's economic development. Given their geographical location, the Baltic and Arctic parts of the district are an area of active international co-

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operation, a transport and logistics hub, and a centre for developing high-tech industries. Therefore, the district holds a special place in the spatial organization of higher education [1] determining the choice of its regions for the study.

Table 1 shows the change in the education's contribution to the GRP in the NWFD regions. Based on the data, its proportion fluctuated between 2.2 % and 4.4 % in 2015, whereas in 2021, it varied between 1.9 % and 3.9 %. Eight regions experienced a decrease in the economic contribution of education.

Table 1

Education as a share of GRP in NWFD regions, %

Region	2015	2016	2017	2018	2019	2020	2021	Net change
Arkhangelsk region	3.4	3.9	3.7	3.7	3.9	4.0	3.9	0.5
Vologda region	2.2	2.0	2.2	2.2	2.2	2.7	1.9	-0.3
St Petersburg	4.3	3.3	3.6	3.7	3.7	3.8	2.4	-1.9
Kaliningrad region	3.4	2.9	2.9	2.9	3.0	2.9	2.7	-0.7
Leningrad region	2.4	1.9	2.1	2.1	2.1	2.2	2.1	-0.3
Murmansk region	3.2	2.9	3.1	3.2	3.1	2.5	2.1	-1.1
Novgorod region	2.9	2.9	2.8	3.2	3.1	3.0	2.5	-0.4
Pskov region	4.4	3.5	3.6	3.9	3.8	3.8	3.8	-0.6
Republic of Karelia	3.6	3.6	3.7	3.9	4.0	3.9	3.2	-0.4
Komi Republic	2.6	3.1	3.0	3.0	3.0	3.6	2.7	0.1

Compiled based on Rosstat data¹.

Since 2015, the major providers of the GRP growth observed in the NWFD have been manufacturing (Vologda, Murmansk, Leningrad, Novgorod regions), mining (the Republic of Karelia), wholesale and retail trade (St. Petersburg)². There is no doubt that human capital is a principal contributor to economic growth, while its formation and development depend on the performance of higher education institutions. Thus, assessing their performance is a non-trivial task for regional development.

Full human capital realization is a prerequisite for the knowledge economy. The commonly used measures of a region's human capital include the share of employees with higher education, the average years of education of the labour force, the number of students per 1,000 population, etc. The estimations of the human capital's contribution to regional development vary from 10 % [2] to 26 % [3], which validates the importance of higher education underpinning the need to factor it in when making managerial decisions on regional development.

¹ Regions of Russia. Socio-economic indicators, *Rosstat*, URL: <https://rosstat.gov.ru/folder/210/document/13204> (accessed 01.09.2023).

² Gross regional product in basic prices (OKVED 2), 2023, *EMISS*, URL: <https://fedstat.ru/indicator/61497> (accessed 01.09.2023).

Recently, there has been a wide-ranged discussion around the university ceasing to be exclusively a regional educational and research centre. Universities are increasingly tasked with socio-economic initiatives aimed at transforming society [4]. The Third Mission is related to preparing students for participating in civil society, influencing economic, social and political life, combining training and community services, acquiring knowledge through economic practice, networking, and gaining invaluable life experience [5]. Thus, universities actively influence the economy, politics, and social sphere in their regions. They are becoming both important centres for managing social processes and, at the same time, an invaluable social resource [6].

By providing initial and advanced training for intellectual resources and maintaining their professionalism, universities directly affect the level and quality of regional development [7–9]. Education brings various economic benefits to individuals, such as increased personal income. Employers also benefit by utilizing the professional knowledge and skills of their employees to generate profits. Additionally, society as a whole enjoys positive externalities from the application of the intellectual wealth of its human capital in both productive and non-productive sectors [10].

Since universities fulfil socially significant functions, this study applies a functional approach that allows conducting an in-depth analysis to understand their behaviour and influence on socio-economic systems. Allied studies widely use this approach to analyse higher education systems in general [9; 11] and assess the factors affecting regional development [12–14].

The paper reveals the scope of the functional approach, characterizes the main functions of universities, presents the author's methodology for assessing their performance in regions, describes the study findings, and presents the results of the correlation analysis of regional universities' performance of their functions in conjunction with major socio-economic indicators of regional well-being. The final part of the article presents the main conclusions.

Functional approach to regional university assessment

The functional approach asserts that an object's essence and characteristics are defined by the execution of its primary functions. Each function plays a crucial role in determining the overall performance of the object.

Researchers apply the functional approach to studying higher education systems. For example, Firsova and Chernyshova [11] analyse educational, research, innovation and partnership functions to assess the efficiency of regional higher education systems using mathematical methods. However, due to the complexity of the calculations and the interpretation of the results, this approach has not been widely used. Ogurtsova and Chelnokova [9] identify three main functions of the university: educational, scientific, and social. They assess each function by changes in one, two, or three indicators. They note that "evaluating the functional

dynamics, structure, and extent of implementation of primary functions within a regional higher education system offers valuable insights into their equilibrium and correlation with the development of the regional economic system.” [9, p. 171]. However, the results of the correlation analysis do not quantitatively confirm the conclusions drawn, and the paper does not present a comprehensive assessment of a higher education system’s performance. Thus, there is a need for a new comprehensive model for assessing the performance of universities in Russian regions.

As indicated by the literature review, the functions of universities identified by various authors vary both in terms of their classification and terminology. Therefore, it is necessary, first of all, to specify these functions. Education and research have always been fundamental for higher education institutions. They are enshrined in the missions of most Russian and international universities [15]. The educational function involves a university’s international integration. Thus, it is important to assess it through the lens of international cooperation (student and faculty mobility programmes) promoting the exchange of knowledge and best practices, and expanding educational and research opportunities.

Recently, there has been a significant discussion surrounding the concept of the Third Mission in academia. This discussion has been prompted by a paradigm shift towards the University 3.0 model, which includes ‘serving the regional community’ as an additional function alongside the conventional roles of universities [16–18].

Researchers increasingly believe that the university is becoming an active participant in regional socio-economic life. Therefore, the socio-cultural function of the university is of particular importance. In addition, given the developing concept of lifelong education, a noteworthy feature of higher education is the broader participation of different age groups. Researchers distinguish the function of retraining and advanced training of employees (e. g., [19; 20]). Since the development of a university depends on its priorities set by the administration (research university, entrepreneurial university, etc.) and on the timeliness and quality of management decisions, the management function requires additional consideration. In addition, the ESG agenda, actively developing today as a logical practice-oriented direction of the global sustainable development concept, largely focuses on the management function. Thus, there are five main functions (educational, research, retraining and advanced training of workforce, socio-cultural and managerial) comprehensively characterizing the university’s performance.

To respond to the current global challenges, regions strive to attract and effectively use various resources, including human and intellectual ones. The implementation of the Third Mission makes universities a great driving force in their regions, which requires high-quality performance of all functions and a balance between them.

Methodology for assessing universities' performance in a region

As previously mentioned, the proposed methodology is rooted in a functional approach and has several stages. The first one is the selection of indicators to assess the universities' performance in a region. Table 2 presents those chosen to measure the performance of each of the five functions taking into account the criteria of meaningfulness (the selected indicators should characterize the functions of a higher education system), accessibility (availability of initial data in open statistical databases), continuity (availability of initial data for the studied period).

Table 2

Universities' performance indicators for sustainable development of the region

Function	Indicators
Educational	k1 — number of students enrolled in bachelor's, specialist's, and master's programmes per 1,000 population k2 — teaching staff per 100 students k3 — share of candidates and doctor of sciences in academic staff k4 — number of international students enrolled in bachelor's, specialist's, and master's programmes, per 100 students k5 — number of double degree programmes per 1,000 students k6 — number of leading foreign professors and lecturers per 1,000 students k7 — share of full-time students enrolled in bachelor's, specialist's, and master's programmes having studied abroad for at least a semester (trimester) in the total number of students
Research	k8 — number of PhD students per 1,000 students k9 — number of doctoral students per 1,000 students k10 — number of researchers per 100 academic staff k11 — number of license agreements per 1,000 academic staff k12 — number of publications co-authored with overseas organisations per 1,000 academic staff k13 — number of publications per 100 academic staff k14 — R&D as a proportion of revenue
Retraining and advanced training	k15 — number of students in vocational education training (VET) per 1,000 students k16 — number of sponsoring companies (with agreements signed) per 1,000 students k17 — number of internship providers (with agreements signed) per 1,000 students
Socio-cultural	k18 — number of personal computers per 1 student k19 — number of printed publications per 1 student
Managerial	k20 — income from all sources per 1 student k21 — number of staff per 100 students k22 — space per student k23 — average Unified State Exam score for state-funded students k24 — average Unified State Exam score for tuition-paying students

It is worth noting that the selection of indicators for the socio-cultural function, which is associated with the cultivation of high moral qualities and values in students, posed a particularly challenging task. In a broad sense, the purpose of higher education is to create conditions for the development of experts understanding new phenomena and processes of social life, possessing a system of values, cultural and ethical principles, norms of behaviour, being ready for socially responsible professional activity and continuous education in the dynamically changing world [21, p. 7]. Values and principles can only be established through large-scale surveys, so there are no direct indicators available in open databases by region, which imposes a certain limitation on the research. However, given the significance of the socio-cultural function, it was not excluded from the analysis. In the proposed methodology, this function is assessed through indirect indicators of the conditions for its implementation: availability of cultural and intellectual values to students and faculty in the university as access to printed and electronic publications.

We propose utilizing 24 individual indicators that describe the five functions of the higher education system, allowing for a comprehensive assessment of universities' performance within their respective regions.

This study relies on the data of the monitoring of higher education institutions¹ and the monitoring of university admissions.² The monitoring of higher education institutions presents the data by individual universities, which requires their aggregation by region (for absolute indicators) or calculation based on the weighted average (for relative indicators).

The values of the indices were normalized using the following formula:

$$K_{ij} = \frac{k_{ij} - k_{min}}{k_{max} - k_{min}},$$

where K_{ij} is the normalized value of the i -th indicator for the j -th region; k_{ij} is the value of the i -th indicator for the j -th region; k_{min} and k_{max} are the minimum and maximum values of the i -th indicator for all the regions under consideration, respectively.

Following normalization, the values of the indicators range from 0 (representing the worst) to 1 (representing the best). This form allows for a comparison of each studied parameter's result to the best outcome among the regions.

¹ Information and analytical materials based on monitoring of higher education institutions, 2021, *Main Information and Computing Center*, URL: <https://monitoring.miccedu.ru/?m=vpo&year=2021> (accessed 10.07.2023).

² Monitoring of university admissions, 2022, *National Research University Higher School of Economics*, URL: <https://ege.hse.ru> (accessed 10.07.2023).

The second stage is the calculation of group indices for each function (using the arithmetic mean of the normalized values of all the indicators characterizing it) and the integral index (using the geometric mean of the five group indices). It provides a comprehensive performance assessment for the totality of universities' functions. The values of group (for individual functions) and integral (for all the functions) indices also range from 0 to 1.

In devising the methodology for calculating the normalized values of indicators, group, and integral indices, the authors drew upon existing practices, particularly those outlined in references [12; 22–24]. This consideration instils confidence in the reliability and applicability of the approach for assessing universities' performance.

Table 3 presents the criteria boundaries used to qualitatively interpret the quantitative values of group and integral indices. The authors draw on the practice of calculating specialized indices, including sustainable development ranking compilation.¹

Table 3

Criteria boundaries of group and integral indices

Criteria Boundaries	0.00–0.24	0.25–0.49	0.5–0.74	0.75–1.00
Name	C	B	A	A+
Level	Low	Insufficient	High	Leading

A low value of an index indicates the need for strong and comprehensive actions to improve the universities' performance in the region. An insufficient level indicates the need for comprehensive actions to improve individual functions or unbalanced indicators. A high level shows the importance of further promotion of the regional universities' performance and achieving a balance in the functions' performance. A leading level is the highest possible level of performance. It indicates the need to use various methods and tools to maintain it and disseminate it to other regions.

The proposed methodological tools allow us to assess the performance of each of the functions, to comprehensively assess the aggregate level of universities' performance in a region, to conduct a comparative cross-functional and interregional analysis, and to identify and assess the relation between group and integral indices.

¹ RSPP's sustainable development indices. Moscow, 2021, *Russian Union of Industrialists and Entrepreneurs*, URL: <http://media.rspp.ru/document/1/4/7/47655a38f9c-7740514c3eab59958cee1.pdf> (accessed 05.05.2022); ESG-ranking of the subjects of the Russian Federation, 2021, *RAEX Rating Review*, URL: https://raex-rr.com/esg/ESG_rating_regions (accessed 05.05.2022).

Research Results

The proposed methodological tools were tested on the NWF D regions. The sample included ten of the eleven of them: the Nenets Autonomous District was excluded from the analysis due to the lack of most of the required data.

The first stage of the study involved the creation of a database on the universities' performance indicators (Table 2). The data cover seven years from 2015 to 2021.¹

The analysis shows a decrease in the number of students per 1,000 population in eight of the regions. The exceptions are St. Petersburg and the Pskov region (Fig. 1). Gorokhov and Savenkova [25], as well as Erokhina and Gagarina [7], also noticed this negative trend. In general, it indicates a decline in the accessibility of higher education in the NWF D regions.

In nine regions, the number of teaching staff per 100 students also shows a downward trend. The exception is the Leningrad region, where it grew from 3.55 to 4.14.

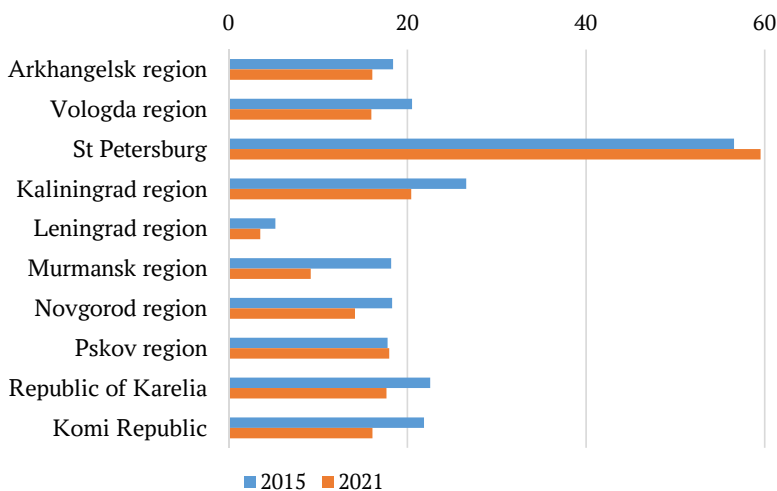


Fig. 1. Changes in the number of students per 1,000 population

The share of academic staff with a degree in St. Petersburg remained relatively stable throughout the analyzed period (exceeding 73%). Seven NWF D regions saw an increase in the indicator. It fell only in the Leningrad and Novgorod regions having a sufficiently high initial level (higher than in St. Petersburg) (Fig. 2).

The share of overseas students rose in the universities of eight of the regions. The exceptions are the Leningrad and Pskov regions, where it reduced (from 7.02

¹ The study does not cover earlier and later periods due to the lack of data.

to 6.93 % and from 9.11 to 8.68 %, respectively). At the same time, the share of students studying at least a semester (trimester) abroad decreased everywhere except for the Vologda and Novgorod regions, where it grew from 0 % to 0.02 % and from 0.13 % to 0.38 %, respectively.

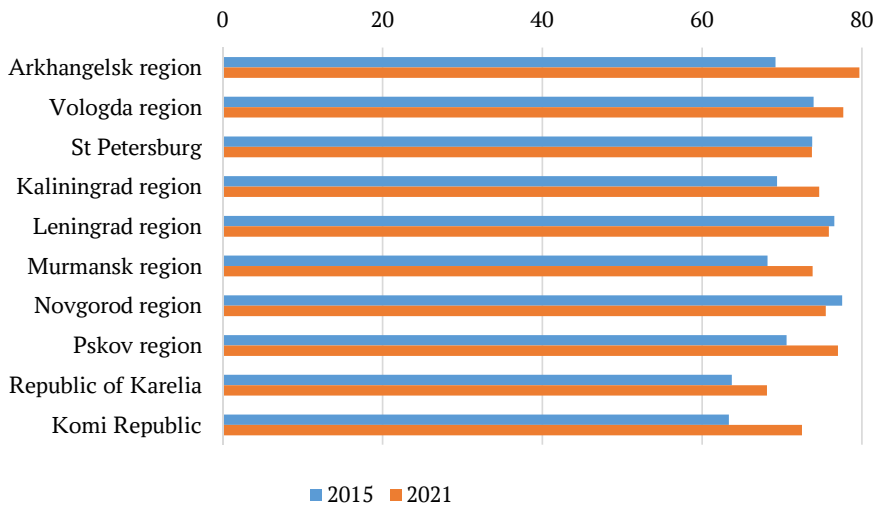


Fig. 2. Changes in the share of academic staff with an academic degree

The number of overseas professors per 1,000 students increased in five NWFD regions (Fig. 3). However, in 2021, it dropped everywhere compared to 2020, possibly influenced by international policy factors, with four of the NWFD regions reaching a zero level.

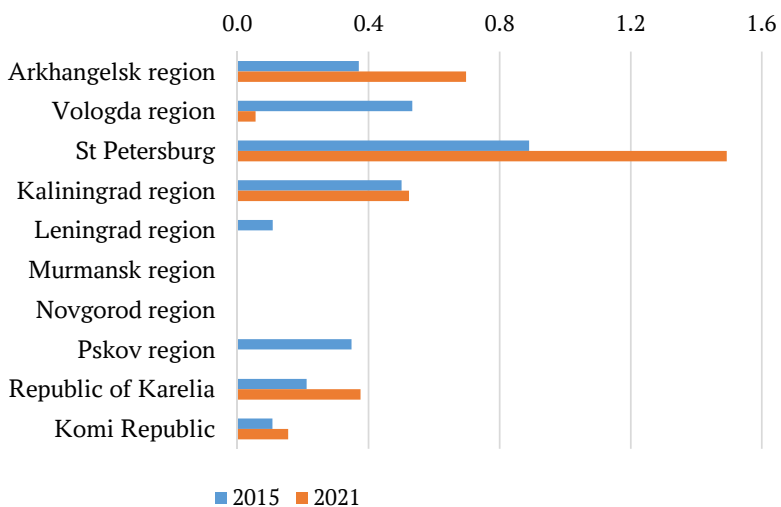


Fig. 3. Changes in the number of foreign professors per 1,000 students

The number of PhD students per 1,000 students grew in the Arkhangelsk, Kaliningrad, Murmansk and Pskov regions, while in the others it fell. In 2021, it ranged from 3.25 in the Leningrad Region to 45.71 in St. Petersburg.

In 2021, the number of doctoral students per 1,000 students dropped to a critical level: to zero in seven out of ten regions with a maximum of 0.28 (St. Petersburg). The negative trend in the number of PhD and doctoral students undermines the future scientific potential of the NWFD regions.

The share of R&D in university revenues rose in four regions (the Arkhangelsk, Kaliningrad, Murmansk and Pskov regions) and decreased in all the others (Fig. 4).

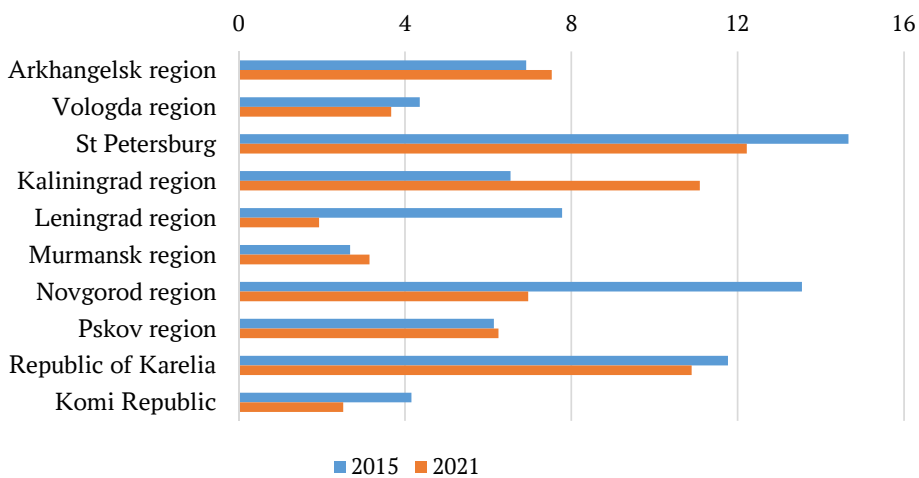


Fig. 4. Changes in the share of R&D in university revenues

The number of publications per 100 academic staff declined only in the Arkhangelsk region (Fig. 5). The number of articles co-authored with overseas organizations per 1,000 academic staff grew in all the NWFD regions (Fig. 6). According to experts, a powerful impetus for increasing publication activity was the introduction of effective contracts [26].

In nine out of ten NWFD regions, the number of students enrolled in vocational education training per 1,000 students increased. The exception was the Republic of Karelia, where it fell from 282.58 in 2015 to 219.64 in 2021.

In seven regions, the number of sponsoring companies per 1,000 students grew (Fig. 7). Close cooperation between universities and employers benefits the region's economy, providing enterprises with much-needed young personnel and graduates with a promising place of employment. Studies indicate that graduates employed within their degree field experience higher earnings and greater job satisfaction [27].

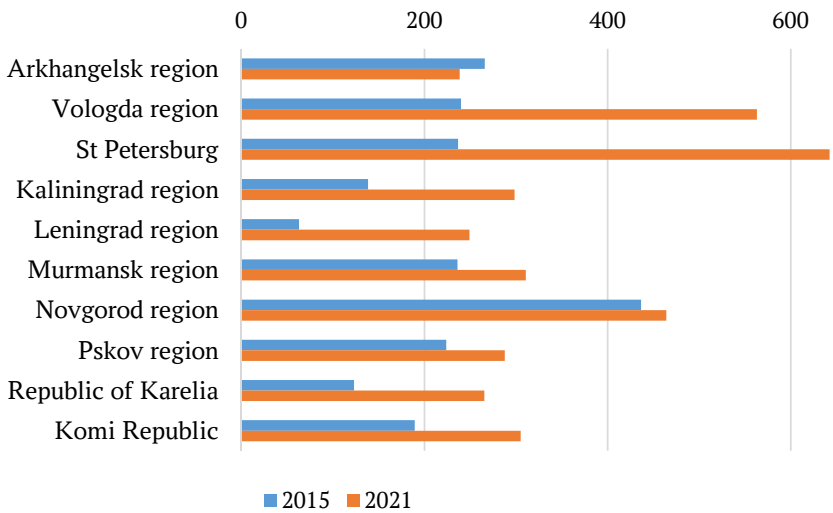


Fig. 5. Changes in the number of publications per 100 academic staff

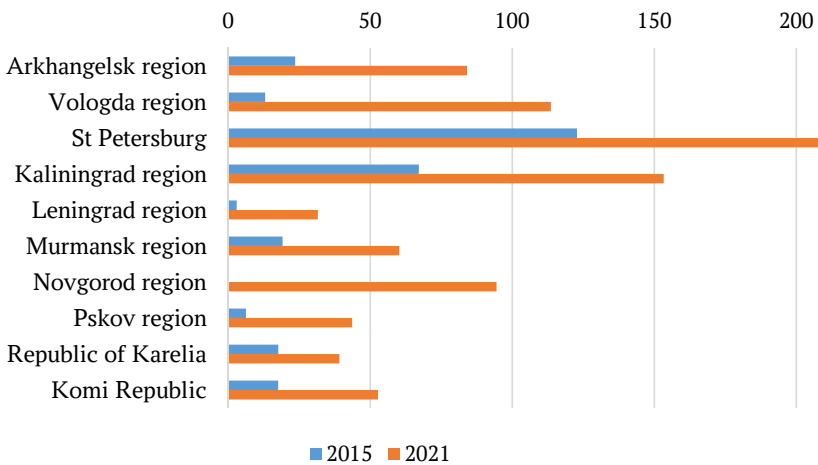


Fig. 6. Changes in the number of articles co-authored with foreign organizations per 1,000 academic staff

Income from all sources per student rose across the regions. In eight of them, space per student increased (except for St. Petersburg and the Pskov region, where it fell from 18.14 m² to 17.43m² and from 18.26m² to 17.94m², respectively).

The average Unified State Exam score of state-funded students increased in all the NWFED regions except for the Pskov region, where it dropped from 64.1 to 63.3. The Vologda region had the minimum level throughout the studied period, ranging from 59.0 in 2015 to 62.7 in 2021. The average Unified State Exam score

for tuition-paying students increased in eight regions out of ten. The exceptions are the Vologda region and the Komi Republic, where it fell from 62.9 to 62.7 and from 58.8 to 58.3, respectively.

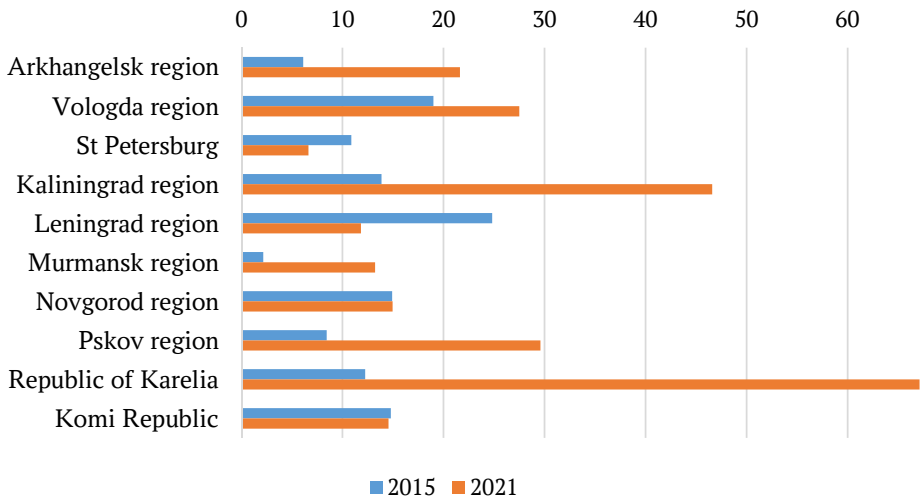


Fig. 7. Changes in the number of sponsoring companies per 1,000 students

In the studied period, the number of computers per student grew in nine regions, except for the Vologda region, where it increased until 2019 and then declined in 2021 to 0.25, which is the minimum (with a maximum of 0.42 in the Murmansk region). Increased use of electronic resources led to a reduction in printed educational publications per student in eight regions out of ten. The exceptions are the Republic of Komi and the Murmansk region, where their numbers grew to 258.76 and 226.22, respectively. These are the maximum values among the regions (with a minimum value of 110.25 in the Kaliningrad region).

A vicious practice of teaching work intensification and widespread 'optimization' were accompanied by a fall in the total number of staff of educational institutions per 100 students in nine regions (Fig. 8). This trend contradicts the stated goals of improving the quality of education and providing an individual educational trajectory.

The analysis of the changes in individual indicators included in the universities' performance assessment shows positive trends in most regions (in particular, increasing publication activity, the number of students in vocational education training, revenue per student, the average Unified State Exam score, etc.) determining universities' positive impact on regional development. However, there are some negative trends (decreasing number of students, teaching staff, and the total number of staff, etc.), which can be extremely detrimental for the future intellectual and scientific potential of the NWFD regions.

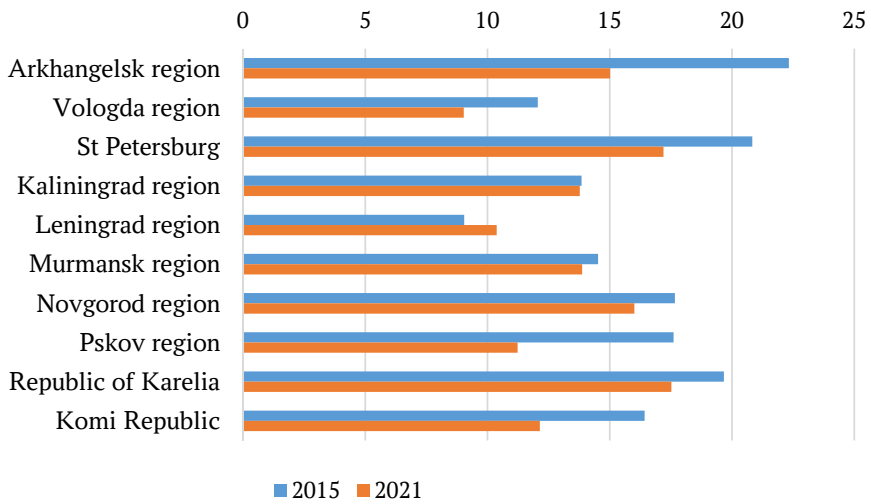


Fig. 8. Changes in the number of staff per 100 students

Group indices characterize the performance of each of the universities' functions. Table 4 shows the values of group indices at the beginning and end of the studied period, as well as changes in them.

Table 4

Dynamics of group indices of universities' performance in the NWFD regions

Region		Arkhangelsk region	Vologda region	St. Petersburg	Kaliningrad region	Leningrad region	Murmansk region	Novgorod region	Pskov region	Republic of Karelia	Komi Republic
Educational function	2015	0.47 B	0.29 B	0.74 A	0.33 B	0.27 B	0.15 C	0.35 B	0.42 B	0.40 B	0.16 C
	2021	0.67 A	0.17 C	0.86 A+	0.37 B	0.21 C	0.13 C	0.51 A	0.30 B	0.38 B	0.15 C
	Net change	0.2	-0.12	0.12	0.04	-0.06	-0.02	0.16	-0.12	-0.02	-0.01
Research function	2015	0.37 B	0.15 C	0.76 A+	0.44 B	0.07 C	0.20 C	0.57 A	0.17 C	0.45 B	0.16 C
	2021	0.37 B	0.43 B	0.86 A+	0.50 A	0.02 C	0.20 C	0.33 B	0.15 C	0.29 B	0.08 C
	Net change	0.00	0.28	0.10	0.06	-0.05	0.00	-0.24	-0.02	-0.16	-0.08

The end of Table 4

Region		Arkhangelsk region	Vologda region	St. Petersburg	Kaliningrad region	Leningrad region	Murmansk region	Novgorod region	Pskov region	Republic of Karelia	Komi Republic
Retraining and advanced training function	2015	0.40 B	0.63 A	0.39 B	0.69 A	0.52 A	0.14 C	0.27 B	0.13 C	0.28 B	0.47 B
	2021	0.48 B	0.47 B	0.20 C	0.73 A	0.33 B	0.26 B	0.21 C	0.31 B	0.52 A	0.39 B
	Net change	0.08	-0.16	-0.19	0.04	-0.19	0.12	-0.06	0.18	0.24	-0.08
Socio-cultural function	2015	0.99 A+	0.77 A+	0.61 A	0.34 B	0.14 C	0.32 B	0.31 B	0.70 A	0.92 A+	0.43 B
	2021	0.72 A	0.23 C	0.36 B	0.25 B	0.10 C	0.89 A+	0.42 B	0.52 A	0.46 B	0.70 A
	Net change	-0.27	-0.54	-0.25	-0.09	-0.04	0.57	0.11	-0.18	-0.46	0.27
Management function	2015	0.60 A	0.30 B	0.95 A+	0.41 B	0.45 B	0.21 C	0.38 B	0.39 B	0.49 B	0.48 B
	2021	0.48 B	0.11 C	0.82 A+	0.50 A	0.49 B	0.41 B	0.45 B	0.20 C	0.48 B	0.38 B
	Net change	-0.12	-0.19	-0.13	0.09	0.04	0.20	0.07	-0.19	-0.01	-0.10

Note: * the low (C) group indices are highlighted; the leading (A+) group indices are in bold.

Source: calculated based on data of the Monitoring of higher education institutions¹ and the Monitoring of university admissions.²

Table 4 shows that in 2021 only St. Petersburg universities had the leading (A+) level of educational function performance. A possible explanation is the fact that this region leads in three of the seven indicators for assessing this function (the number of students per 1,000 inhabitants, the number of double degree programmes per 1,000 students, the number of foreign professors per 1,000 students), and it has high values in the remaining four indicators.

¹ Information and analytical materials based on monitoring of higher education institutions, 2021, *Main Information and Computing Centre*, URL: <https://monitoring.miccedu.ru/?m=vpo&year=2021> (accessed 10.07.2023).

² Monitoring of universities admissions, 2022, *National Research University Higher School of Economics*, URL: <https://ege.hse.ru> (accessed 10.07.2023).

Over the studied period, the Arkhangelsk region improved its position from B to A due to the increase in the share of academic staff with the degree of candidate and doctor of sciences, the share of overseas students and the high share of students who studied abroad for at least a semester (trimester).

The improvement of the position of the Novgorod region to level A was due to the increase in the share of overseas students and the number of double degree programmes per 1,000 students, as well as the share of academic staff with the degree of candidate and doctor of sciences.

The group index of the educational function includes international student exchange indicators. Yaskova attributes the high values in these regions to long-term international cooperation and partnerships with Nordic and Baltic educational institutions due to their geographical position [1].

Over the studied period, the Komi Republic and the Murmansk region saw a low (C) level of educational function performance. In these regions, there are no double degree programmes, the share of overseas students is low, and the number of foreign professors per 1,000 students leaves much to be desired. In the Leningrad region, the group index of the educational function fell from level B to C due to a decline in the number of students per 1,000 population, the number of foreign professors per 1,000 students and the share of academic staff with a degree. The Vologda region saw a similar decrease to level C due to a significant reduction in the number of students per 1,000 population, teaching staff per 100 students, and foreign professors per 1,000 students. It is hard to disagree with the opinion that negative trends in personnel training weaken a region's economy and erode its competitive advantages [7].

St. Petersburg maintained the leading (A+) level in research function performance among the NWFED regions over the studied period. In 2021, the Kaliningrad region reached the lower boundary of level A. This is due to an increase in the number of graduate students per 1,000 students, the number of publications per 100 academic staff, and the share of R&D in revenues. The Vologda region showed the most considerable increase in the value of the research function group index due to an increase in the number of researchers per 100 academic staff, publication activity and the number of license agreements per 1,000 academic staff.

The Novgorod region saw the most significant decline due to a decrease in the number of candidate and doctoral students per 1,000 students, researchers per 100 academic staff, and licensing agreements per 1,000 academic staff. The Komi Republic, the Leningrad and Pskov regions, saw a low (C) level of research function performance. Other studies (for example, [25]) also note negative trends

in these regions' scientific and innovative spheres, such as a decrease in the number of researchers with academic degrees, organizations training postgraduate students, etc.

The Kaliningrad region saw a high level (A) of retraining and advanced training function performance. The index values grew in the Arkhangelsk, Murmansk and Pskov regions, as well as in the Republic of Karelia, where, in 2021, it reached level A. The Vologda, Novgorod, and Leningrad regions, the Komi Republic, and St. Petersburg, the leader in two previous functions, demonstrated a decrease in the index values.

In 2021, the group index of socio-cultural function was at the leading (A+) level in the Murmansk region and a high (A) level in the Arkhangelsk and Pskov regions and the Komi Republic due to the high values of all indicators used for assessing this function. At the same time, the Vologda Region and the Republic of Karelia saw a fall in the index (by two positions) due to a decrease in all indicators used for its assessment. The Leningrad regions had a low (C) level of the group index throughout the studied period.

St. Petersburg maintained the leading (A+) level in the management function performance over the studied period. This region showed higher values of four indicators, except for the space per student. In the Murmansk region, the index showed a maximum increase of 0.2 due to the growth in income and space per student and a less significant (compared to the others) decrease in staff per 100 students. In the Kaliningrad region, the group index grew from level B to A, mainly due to the increase in the average Unified State Exam score for state-funded and tuition-paying students. According to Yaskova, a factor making this region attractive to students, besides its geographical, historical and cultural features, is its cross-border cooperation with European states [1].

The Vologda and Pskov regions experienced the most dramatic decrease in this index associated with the decline in the number of university staff per 100 students, a slower growth of the average unified state exam score for state-funded students, and the income from all sources per 1 student.

The analysis of group indices of the five functions of universities by region identified cross-functional imbalance in all the NWFED regions. In 2021, the maximum difference between the group indices of individual functions (0.76) was in the Murmansk region. The differences were extremely dramatic in St. Petersburg and the Komi Republic as well, 0.66 and 0.62, respectively.

Comparison of the group indices by region also shows a high level of heterogeneity, as evidenced by descriptive statistics (Table 5).

Table 5

**Descriptive statistics on the group indices of the functions
of higher educational institutions of the NWFD regions**

Descriptive statistics	Function				
	Educational	Research	Retraining and advanced training	Socio-cultural	Managerial
Average	0.371	0.333	0.334	0.499	0.441
Median	0.348	0.334	0.324	0.494	0.426
Min	0.113	0.013	0.010	0.011	0.056
Max	0.860	0.859	0.821	0.994	0.950
Std Dev.	0.192	0.210	0.191	0.242	0.192
Variation	0.517	0.631	0.575	0.485	0.435
Asymmetry	0.821	0.684	0.478	0.023	0.697
Excess	-0.136	0.0537	-0.188	-0.750	0.827

The high coefficient of variation of the group indices indicates their considerable difference across the regions. Positive asymmetry suggests that values less than the average are more common. That is a consequence of the previously mentioned effect of St. Petersburg's monocentrism. Its indicators raise the average value significantly, while the values for the other regions become lower.

The analysis of paired correlations between group indices of individual functions of the universities in the NWFD regions (Table 6) shows that the group indices of educational and research functions have a strong statistically significant relation. In addition, each is positively and statistically significantly related to the group index of the management function.

Table 6

Paired variable correlations

Group Index	GIEF	GIRF	GIRATTF	GISCF	GIMF
Group Index of Educational Function (GIEF)	1.000	0.777*	0.001	0.039	0.734*
Group Index of Research Function (GIRF)	0.777*	1.000	0.058	0.086	0.669*
Group Index of Retraining and Advanced Training Function (GIRATTF)	0.001	0.058	1.000	0.081	0.00
Group Index of Socio-Cultural Function (GISCF)	0.039	0.086	0.081	1.000	0.025
Group Index of Management Function (GIMF)	0.734*	0.669*	0.00	0.025	1.000

Note: * The correlation is significant at 0.01 (two-tailed).

Analysis of the changes in integral indices of the universities' performance (Table 7) shows that a high (A) level was observed in two regions: the Arkhan-

gelsk region and St. Petersburg. While in the former region, the indicator was relatively stable over the studied period, in the second, despite its leadership in three of the five analyzed functions, it fell markedly.

Table 7

Integral indices of the universities' performance in the NWFD

Region	2015	2016	2017	2018	2019	2020	2021	Net change
Arkhangelsk region	0.53 A	0.53 A	0.48 B	0.52 A	0.50 A	0.55 A	0.53 A	0.00
Vologda region	0.36 B	0.36 B	0.32 B	0.33 B	0.30 B	0.20 C	0.24 C	-0.12
St Petersburg	0.66 A	0.59 A	0.62 A	0.52 A	0.50 A	0.50 A	0.54 A	-0.12
Kaliningrad region	0.42 B	0.37 B	0.36 B	0.49 B	0.46 B	0.43 B	0.44 B	0.02
Leningrad region	0.23 C	0.14 C	0.17 C	0.12 C	0.06 C	0.14 C	0.15 C	-0.08
Murmansk region	0.19 C	0.26 B	0.35 B	0.33 B	0.39 B	0.37 B	0.30 B	0.11
Novgorod region	0.36 B	0.29 B	0.39 B	0.36 B	0.27 B	0.33 B	0.37 B	0.01
Pskov region	0.30 B	0.15 C	0.16 C	0.19 C	0.26 B	0.27 B	0.27 B	-0.03
Republic of Karelia	0.47 B	0.44 B	0.40 B	0.42 B	0.44 B	0.42 B	0.42 B	-0.05
Komi Republic	0.30 B	0.29 B	0.23 C	0.21 C	0.22 C	0.25 B	0.26 B	-0.04

Note: * the low (C) integral indices are highlighted.

In the Republic of Karelia (showing negative dynamics), the Kaliningrad and Novgorod regions (showing positive dynamics), the level of universities' performance was insufficient. In the Murmansk region, it rose from C to B. Universities of the Pskov region and the Komi Republic were in transition between these two levels. In the Vologda region, it reduced from B level to C.

In the Leningrad region, the level was low and worsening. The identified changes are consistent with the results of other studies attributing them to the phenomenon of "capital-centrism", which suggests that the universities of St. Petersburg are more attractive for students, research and teaching staff than the universities of the Leningrad region [28].

To characterize the impact of the universities' performance on regional development there was a correlation analysis of universities' performance and the main socio-economic indicators of regional development conducted. The sources

of data for these indicators were Rosstat¹, EMISS² and the Quality of life ranking of the Russian regions, regularly published by the Ria Rating agency³. The values of the indicators were normalized using the following formula (see p. 122). Then, paired correlations for the group indices and the normalized values of the socioeconomic indicators were calculated. Table 8 provides the values of the correlation coefficients.

Table 8

**The results of the correlation analysis of regional development indicators
and group indices of universities' functions**

Indicator	Group Index				
	GIEF	GIRF	GIRATTF	GISCF	GIMF
Share of innovative goods, works, and services in total goods, works, and services	0.51	0.37	-0.01	0.25	0.46
Innovation activity level, the share of organizations carrying out innovation activities in the total number of organizations surveyed in the reporting year	0.38	0.50	-0.40	-0.10	0.49
Employment rate, %	0.19	0.41	-0.03	-0.23	0.60
Number of highly productive jobs per 1,000 people employed	0.35	0.36	-0.09	0.13	0.51
Ratio of average per capita income and subsistence minimum	0.50	0.53	-0.07	-0.22	0.70
Quality of life (ranking)	0.22	0.29	0.10	-0.53	0.50

Note: * significant positive correlations ($p=0.05$) are in bold, significant negative correlations ($p=0.05$) are highlighted.

The correlation analysis shows a positive and statistically significant relation between four socio-economic indicators with the educational function's group index, and five indicators with the research function's performance. Previous studies have also identified the latter relation. For instance, Noskov concludes that universities' research affects regions' innovative development and is a significant factor in their economic growth [29].

A negative correlation between the socio-cultural function and the quality of life may signal issues in the function's performance, suggesting that it is not achieving the anticipated impact on regional development. As already mentioned, in seven of the ten NWFED regions, the group index of socio-cultural function de-

¹ Regions of Russia. Socio-economic indicators, *Rosstat*, URL: <https://rosstat.gov.ru/folder/210/document/13204> (accessed 01.07.2023).

² Official statistical indicators, *EMISS*, URL: <https://fedstat.ru/> (accessed 28.08.2023).

³ Russian regions ranking by the quality of life — 2021, 2022, *RIA Novosti*, URL: https://ria.ru/20220214/kachestvo_zhizni-1772505597.html (accessed 01.07.2023).

creased over the studied period. It is possibly due to its assessment being based on indirect indicators. Therefore, it is essential to conduct additional research on the socio-cultural function of the university and ways to assess its performance and impact on regional development. The possible explanation for the negative correlation between the innovative activity of companies and the group index of the retraining and advanced training function is that innovative companies might be less open to students to guard their trade secrets. It is also possible that the impact of this function has a delayed effect. When employees improve their skills and undergo retraining, their companies cannot fully use their innovative potential.

A positive statistically significant correlation between the performance of the management function and the major regional socio-economic indicators suggests that the synchronization of the regional development policy and regional universities through establishing common goals and development paths yields the best results for sustainable development of the NWFD regions.

Thus, universities' performance has a considerable influence on the socio-economic development of their regions. The proposed methodology for assessing the universities' performance can help to identify additional opportunities for regional socio-economic development or problem areas impeding it. For example, the NWFD regions should direct their attention to a significant imbalance between the performance of their universities' main functions since the overall result of higher education's influence on the regions is limited by the "weakest link in the system", which is a deterrent to achieving the best results.

Conclusion

Regional development is currently a focal point of attention. While natural conditions such as favourable geographical location, raw materials, and agro-climatic resources play a significant role in determining the productivity of a regional economy, the realisation of this potential hinges on policy efficiency, particularly in harnessing human capital [2]. Human capital is emerging as the primary resource in the knowledge economy, and its development is greatly influenced by higher education.

This study assesses the level of universities' performance in the regions of the Northwestern Federal District. The need for such an assessment is due to the importance of higher education for regional socio-economic development. The authors share the opinion that measuring the efficiency of the regional universities' performance and finding suitable tools for managing them is essential nowadays [30].

The methodology proposed in the article allows, using open statistical data, to comprehensively assess universities' performance, to track the changes in indi-

vidual indicators, group and integral indices, to detect bottlenecks in the performance of regional universities' functions, to conduct cross-functional and interregional comparisons and to develop recommendations for improving universities' performance for regional development.

The results of adopting the method to study the NWFD regions show that they differ markedly in their universities' performance. The correlation analysis indicates a statistically significant relation between the performance of individual functions and the major socio-economic indicators of regional development. An imbalance in the functions' performance observed in all the regions limits the possibilities for higher education to influence regional development. The results can be taken into account by regional and federal authorities, as well as the heads of universities when developing measures to improve the universities' performance to ensure their favourable impact on the socio-economic development of the NWFD regions.

The theoretical and methodological significance of the work lies in summarizing the results of previous empirical studies, identifying the main functions of universities, and developing a methodology for assessing universities' performance in the context of regional socio-economic development. A further research avenue is the assessment of the impact of universities' performance on sustainable regional development. The results can provide the basis for developing recommendations for optimizing universities' performance to promote sustainable regional development.

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