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ORIGINAL ARTICLE

Science or industry: Improving the quality of the Russian higher education system

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ABSTRACT

The shape of the modern Russian science and higher education system is largely determined by the peculiarities of its structure during the Soviet period: its division into research and higher education sectors. However, throughout the 21st century, the higher education system has undergone significant reforms. An important focus of these reforms has been the development of the research mission of higher education institutions (HEIs). At the same time, the government launched reforms that focused on the development of regional markets, where universities were an important driver of this development, and on the interaction of universities with local employers. There have also been reforms aimed at changing the system to determine the number of state-funded places and places for targeted enrolment and how they are distributed between universities. All these reforms have changed the functioning of universities. In this study, we describe the current landscape of the Russian higher education system, and how different types of universities are involved in research, attracting more talented students and engaging with other sectors of the economy.

Key words: Russia, higher education institutions, R&D and research, vocational education

INTRODUCTION

The modern Russian system of higher education has inherited many features from the Soviet system, on the one hand, and on the other hand, has been influenced by the market economy and reforms in higher education. All of this determines the functioning of universities. Let us first focus in more detail on the main features inherent in the Soviet system of higher education and research, which have been highlighted by numerous scholars.[1–4] Under the Soviet model of higher education and science, the research sector was primarily engaged in research. The research sector included both research institutes that engaged in basic research and sectoral institutes that focused on applied research for specific industries.[4] It was assumed that there would be a link between research results, the training of highly qualified personnel, and the development of industries.

The purpose of Soviet higher education was to prepare highly qualified personnel for various industries in alignment with the principles of a planned economy. Additionally, the Soviet economic focus on industrialization and militarization was closely tied to this objective. Higher education institutions (HEIs) were managed by sectoral ministries, which enabled them to establish connections with specific industries. Planning the higher education sphere, which included determining the required number of graduates, was based on the needs of industries. A clear example of this industry alignment was the creation of technical HEIs at large industrial enterprises to train engineers in plant-specific roles.[3] In addition, there was the practice of targeted training,[5,6] by which training specialists attended universities through government-assigned sponsorships from a region, a national republic, a factory, or an

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organization. Study applicants were enrolled at the universities within the framework of future job placements provided to industry customers and were obliged to work for the organization that sent them to study. They were eligible for non-competitive admission. In other words, future workforce needs were often assessed locally in advance. Connections with other sectors were further reinforced through a graduate distribution system, which placed graduates in specific positions across the Soviet Union, where they typically worked for 3 years.

Only a small number of universities were primarily involved in training faculty for other universities and research sectors, *i.e.*, they were involved in training in foundational disciplines and in relevant research. These institutions had an academic orientation and represented about 8% of universities in the USSR by 1990.[7] Most of these universities were located in the RSFSR, accounting for about 7% of the total number of Russian universities.[1,7] Thus, only a small number of universities and faculty members were involved in basic research. There was a differentiation in the university sector, with the majority of HEIs related to sector.

The collapse of the USSR led to a significant crisis in higher education. The higher education sector found itself in a new market economy in which no new rules had been developed, and a number of old rules continued to apply. The main players were forced to adapt. HEIs faced significant financial strain, which eventually led to an outflow of human capital.[8] Concurrently, there was a sharp increase on the demand side as well as a shift in demand;[3,9] entrants began to prefer to go to HEIs rather than secondary vocational education. In general, there was sharp massification. The government could not fully finance higher education. Abandoning free education was politically unfeasible, so one solution was to allow universities to provide paid educational services. Therefore, in 1992, Law No. 3266-1 was adopted, which provided such an option to universities that began training specialists in new fields driven by applicant demand.

In addition, the market structure has changed.[3] Many HEIs, primarily sectoral ones, which were related to struggling industries, have restructured and began to train in new fields, and the sectoral component is no longer the basis of their identity. Some universities ceased to exist. At the same time, HEIs associated with promising or stable areas continued to actively interact with industries. While preserving their sectoral identity, they simultaneously opened up training in new disciplines.

In 1996, Federal Law No. 125, "On Higher and Postgraduate Professional Education", attempted to establish the following vertical hierarchy of HEIs: universities, academies, and institutes. Within the framework of this law, academies represented specialized HEIs that trained specialists for a certain field of study and conducted relevant research. Institutes were to train, retrain, and (or upgrade the qualifications of employees for a certain field of professional activity. The difference between academies and institutes was minimal. Universities, in turn, represented classical HEIs that were to become leading research centers. The division was nominal; it was not supported by financial obligations on the part of the state and certain accountability on the part of universities, but on the demand side, on the side of society, there was a clear perception that universities were more valuable. As HEIs were given the opportunity to open new fields of study, and there was pressure from both HEIs and regional authorities, the majority of HEIs became universities at the beginning of the 21st century. In 2012, the legislative division between universities, academies, and institutes was abolished.[1]

Contemporary reforms at the university level

Since the beginning of the 21st century, the Russian higher education system has undergone significant reforms. In the current context, the traditional separation of institutions and students belonging to higher vocational education no longer exists, and it is not reflected in official statistics. A more meaningful division in the university sector is related to the statuses that universities receive within the framework of various government initiatives. An important direction for reform was enhancing the research mission of universities, especially through establishing and developing a sector of leading universities.

In 2009, the government began awarding the status of a research university, and in 2012 launched the Russian University Excellence Initiative (Project 5-100). All of these programs were aimed at boosting research activity in higher education to compete in the global academic market. Thus, a new class of leading research universities was formed. In general, researchers have assessed all these initiatives as positive:[10–12] Russian universities improved in global rankings, increased publication outputs, and, in some fields, caught up with or even exceeded research production in the research sector. Additionally, government initiatives have aimed to strengthen university ties to regional economies, as seen in developments such as the creation of federal universities (2006) and flagship universities (2016).

The main purpose of creating federal universities was to develop a system of higher professional education at the regional level and strengthen links with regional economies. The program of flagship universities was

created in order to stop the outflow of young people from the regions, address local economic challenges, and establish links with the local economies. The results of this program have been assessed as positive,[9,13–15] although not all universities have achieved key indicators, and there is differentiation among flagship universities. Indeed, the percentage of graduates staying in the regions increased, the average score of the unified state exam increased, and the level of conducted research and development (R&D) increased; therefore, support for the R&D projects of flagship universities from regional authorities and industrial partners increased by more than 35%. Flagship universities also began to establish links with regional markets.

We can also highlight the latest initiatives: Advanced Engineering Schools (2022) and Priority 2030 (2021). The Advanced Engineering Schools are aimed at training specialists in high-tech export-oriented sectors of the economy. Universities selected for this program are to establish advanced engineering schools in cooperation with technology companies, the aim of which is to jointly train specialists and develop research in relevant fields. While it is too early to say what the results will be, we can already observe an improvement in the quality of enrollment. Priority 2030 is the successor to Project 5-100, in which the government tries to overcome the problem of the first-generation initiatives for excellence. Unlike Project 5-100, which focused on elevating a small group of elite universities to international prominence, Priority 2030 emphasizes the development of a larger number of universities, including regional universities, with the goal of fostering both academic excellence and economic and social development. It is too early to assess the results of this program.

There were several other various reforms, for example, attempts in 2012 and 2018 to create an applied bachelor's degree, raise secondary vocational education to the level of higher vocational education, and start implementing it in HEIs.[1] However, these attempts were unsuccessful.

Contemporary reforms of the system for determining the number of state-funded and targeted admission places

The university graduate distribution system, targeted enrollment, and number of state-funded places were essential links between industry and higher education. In the conditions of the market economy, the distribution system did not survive, but the targeted enrollment and state-funded placements continued to exist.

Determining the number of state-funded places by field of study has become an important instrument of state policy. Despite the fact that the government can not forecast the market demand for specialists, it still continues to determine the number of state-funded places. The government has maintained and even increased the number of state-funded placements for several fields of study that were not in demand.[3]

Initially, the number of state-funded placements was determined as a result of negotiations between the university and the founding body. The Law on Education (1996) stated that it was for the founder to determine the number of state-funded places, but no specific procedure was laid down.[16] From 2003 to 2024, the system of determining and distributing the number of state-funded placements significantly changed, with major changes already taking place after 2013.[16–19] A competitive system for the distribution of state-funded placements among universities appeared and was significantly modified; the system became more centralized. The competition criteria were modified; they were related to the performance of universities. In general, a number of researchers have noted that a competitive system can lead to imbalances and losses among regional HEIs.[20–22]

However, the consequences of such an imbalance have not yet been assessed. The system for determining the number of state-funded placements has also become centralized. Mathematical models are used to determine state-funded places in different areas, taking into account forecast data on the needs of regional markets, key industries, and the state development strategy. The government, as the main and largest customer and manages the number of placements, tries to provide the necessary workforce for the most important industries in the state. Thus, since 2020, the largest growth in state-funded placements has been in the fields of engineering, education, and medicine.[23] At the same time, for example, in the fields of economics and management, there has been a slight decline in the number of places.[24–27] The government is actively trying to link universities with sectors to provide training for specific industries and regions. In 2024, the number of places received by regional universities increased. The share of state-funded students in public HEIs increased from 44.8% in 2010 to 53.4% in 2022.[28] However, little is known about whether graduates go on to work in their specialty.

For a long time, the government did not particularly control targeted enrollment. However, in 2018, the Ministry of Education and Science drew attention to the fact that the competition for targeted enrollment is quite low, with about 13% of applicants studying for it. Often, the scores of those who entered targeted enrollment were significantly lower than those who entered on a competitive basis. An applicant had to look for companies that were interested in future specialists.

Applicants could initially conclude a contract with several organizations and enroll in several universities in different specialties. In addition, the period of time that a graduate had to work at a HEI was not specified in the legislation.

A sample study[6] of targeted admissions in 2021 in fields such as IT and medicine confirmed that there is a significant gap in the quality of admission to budgeted and targeted places, where targeted places are often filled by applicants with extremely low scores who apparently have not mastered the school program at an adequate level. The system of targeted recruitment has long remained closed and non-transparent, and it is not clear what criteria employers use to select applicants. Between 2019 and 2024, the government undertook a number of significant measures that have affected the way these students are now admitted and further employed. Since 2019, a student has been sent to university with the obligation to work for the customer of the targeted training for at least 3 years and according to the terms and conditions defined by the customer. Since 2024, a maximum mandatory period of employment of 5 years has been introduced. If a graduate refuses to work, they must return the funds to the state for the money spent on their studies. The government centrally determines the number of placements for targeted training.

However, the places are not completely filled; for example, in 2023 only 78% of the target places were filled. Only state agencies, state corporations, or organizations that have a state share in their charter capital can order targeted training, which is paid for by the government. The government makes public the lists of fields of study and quotas for which targeted enrollment is carried out. In 2024, a single platform for customers and entrants was created. An entrant can now enter into a contract with only one organization. In addition, the customer can set conditions for the level of student success during training. In total, more than 145,000 places were allocated for targeted training in 2024. On average, more than 76% of the budgeted placements are allocated for the training of medical specialists in various fields. Large quotas have also been allocated for future specialists in the design of aircraft and rocket engines, railway operations, and train traffic systems. All of these measures are aimed at increasing competition within the framework of targeted recruitment, making this system transparent, and, as a result, obtaining well-trained specialists for the organizations that are important for the state.

In general, the period up to 2010 can be seen as a period with a high level of autonomy and a low level of state regulation. Next, a period with a high level of state intervention followed, the aim of which was to increase the level of efficiency of the higher education system, to get value for money, and, at the same time, to develop higher education in accordance with the doctrine of Russia's development. As a result, a number of projects were implemented that focused on international visibility and scientific development, and a number of projects aimed at training the necessary specialists. Thus, using various instruments, the government has had a significant impact on the research and educational activities of universities since 2010. State-funded placements are an important source for sustaining the existence of many universities, and various project initiatives have become such a source. Balancing between these initiatives, universities now adapt to meet different benchmarks established by the government. The government has built a new hierarchy in the higher education sector, which has its roots in the Soviet era. Our goal is to define how various categories of Russian HEIs differ, depending on research and industrial orientation.

METHODOLOGY

We used a nationwide comparative research design. The analysis covers all 485 Russian state civil HEIs (only parent organizations); thus, the sample is fully representative. The period of observation was from 2015 to 2023, when various initiatives to stimulate scientific activity were already being fully implemented, and at the same time, the system of state-funded placement allocations was being reformed.

Three sources of administrative data were used for the analyses. The first is monitoring the effectiveness of educational institutions (collected annually by the Ministry of Education and Science on the basis of universities' mandatory self-reporting, https://monitoring.miccedu.ru/?m=vpo). The second source is monitoring the quality of admission (https://ege.hse.ru/stata_2023_1), which contains data on the number of students enrolled in Russian HEIs on state-funded, fee-paying, and targeted placements and the scores of unified state examinations (USEs) for each field of study. The third source is data on the employment and salaries of graduates of Russian educational organizations (https://tochno.st/datasets/graduates_university).

The analysis used a variety of indicators characterizing the level of interaction with the industry, the quality of research, and education. The study compared four categories of universities, distinguished by the presence of state-awarded status and the presence of industry specialization for HEIs without status. The four analyzed categories of universities are as follows. (1) Research universities (large universities with a high degree of involvement in science): 31 HEIs having status

of national research university, 2 HEIs having special status (Moscow State University and Saint Petersburg State University), and 2 classical universities participating in Project 5-100 (Tyumen State University and Peoples' Friendship University of Russia). (2) Federal and flagship universities (large universities involved in relationships with industry and research activity): 10 HEIs having status of federal university, 34 HEIs having status of flagship university, 2 sectoral universities participating in Project 5-100 (I.M. Sechenov First Moscow State Medical University and V.I. Ulyanov Saint-Petersburg State Electrotechnical University LETI). (3) Sectoral universities: Universities that are under the authority of sectoral ministries, as well as universities that have a specific sectoral identification in their names, such as technical, architectural-construction, medical, and theatre. (4) Classical universities: Universities that are not under the authority of sectoral ministries, without specific sectoral identification, without special statuses like national research, federal, or flagship, and that did not participate in Project 5-100.

The empirical design of the study consists of a description of the landscape of the Russian science and higher education system in terms of R&D activities, interaction with industry, and the effectiveness of R&D activities through interaction with industry. We also describe the quality of admission and the success of universities' graduates. We used mean values of the indicators in the analysis to compare four groups of HEIs.

The key restriction of empirical analysis is that it is descriptive and does not reveal any relationships between indicators. In addition, we did not investigate fee-paying enrollment as a proxy for demand.

RESULTS

Modern landscape of the Russian higher education system

Three-quarters (354) of Russian public universities are industry-specific and have a pronounced specialization, although their statuses as industry-specific are not enshrined in legislation (Figure 1). The majority of sectoral universities have technical, creative, agricultural, or medical specializations. There are also 58 classical universities (average number of students: 9000), 10 federal and 34 flagship universities as well as 35 research universities (average number of students: 14,000 for all three categories). Sectoral universities prevail in terms of numbers. However, they are small in terms of students—on average, about 5000 students. The largest sectoral universities usually focus on transport, technical, and pedagogical studies (about 7000 students) and the smallest on creative studies and sports (up to 2000 students). Sectoral universities train about half of all Russian students (49%), and federal and flagship, research, and classical HEIs train 20%, 18%, and 13% of students, respectively.

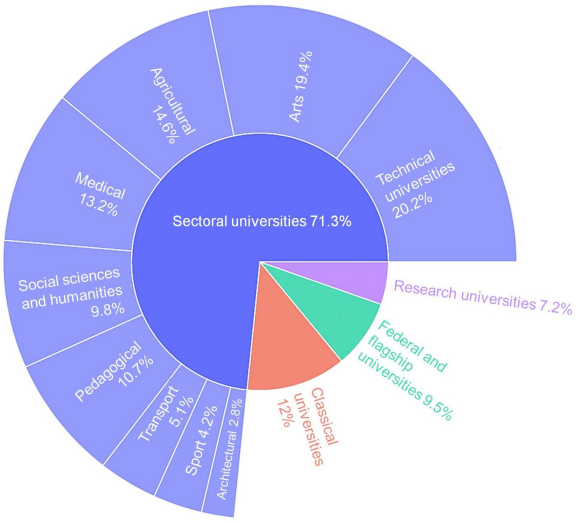

Figure 1. The structure of Russian HEIs by category and industry sector (total sample $n = 485$, sample of sectoral HEIs $n = 354$). HEIs, higher education institutions.

Due to university policies and government policies, the allocation of the student population by field of study can vary considerably. While classical universities train students in a wide range of fields of study, the student body is concentrated in the core fields of study in sectoral universities. To assess the concentration of the student population by field of study, we considered the maximum value of the students' proportions studying in a particular field of study at each university. The higher the value of the maximum share of students in one field of study, the higher the concentration, and, accordingly, the smaller the share of students studying in other fields.

Classical universities have the lowest concentration (45%) of the student population in one field of study (Figure 2). Only a quarter of classical universities have more than 50% of students studying in one field. In the remaining universities, the contingent of students is more or less evenly dispersed across different fields of science. In research universities, the average concentration of students in one field of study is 66%. Half of the research universities have a pronounced specialization, with an average of 86% of the students trained in the core fields of study. Another six research universities have moderately pronounced specialization, as they have from 50% to 70% of the contingent studying in one field of science. Finally, one-third of the research universities are similar to classical universities in terms of student distribution, and their names do not reflect any specialization.

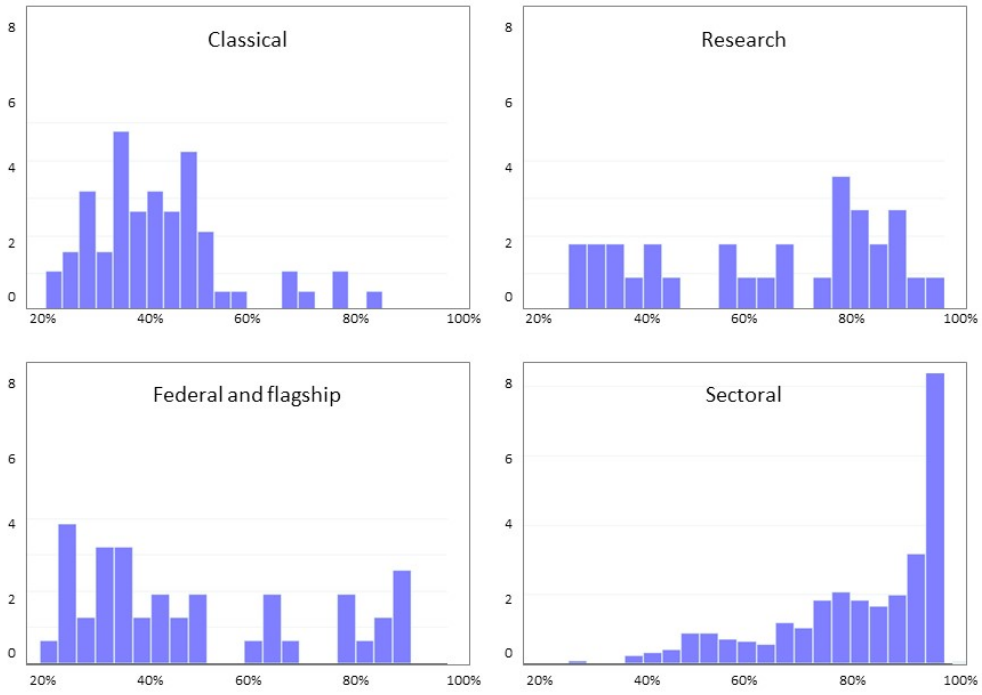

Figure 2. The distribution of HEIs according to the highest proportion of students trained in one field of study. HEIs, higher education institutions.

The majority of federal and flagship universities (61%) have a dispersion of the student population by field of study comparable to classical HEIs. The remaining 17 universities have more than half of their student bodies concentrated in one field of science. In federal universities, the maximum proportion of students in one field of study does not exceed 51%, while flagship universities often have a strong specialization.

Finally, the overwhelming majority of sectoral universities (96%) have more than half of their student bodies concentrated in the core field of study. Moreover, more than 90% of the student body is trained in one field of study in half of sectoral universities. The majority of these universities specialize in culture and arts (31%), and one-quarter of them specialize in medicine. There are also 20 universities with engineering specializations and 21 universities specializing in social sciences. Thus, sectoral universities train students primarily in their core fields of study.

Interaction with industry through education

Universities mainly interact with industry by training students and conducting research projects for industry or with industrial partners.

Many universities are involved, to some extent, in training students specifically for enterprises. Our research showed that only 10% of universities did not have targeted admissions. Half of them are sectoral universities specializing in arts and humanities. The highest share of placements on targeted admission is in sectoral universities, at 8.7% (Figure 3). It is noteworthy that research universities had a high proportion of students enrolled in targeted places until 2019 (7.4% on average), which decreased to 5% after 2019. Federal and flagship universities had, on average, 7.3% places for targeted admission before 2020, and 5.3% after the reforms. Classical universities have the lowest proportion of targeted placements (on average, 3.7%). A sharp decline in the proportion of students enrolled in targeted placements after 2019 is typical for all categories of universities, despite the classical universities. The decline was not so sharp for sectoral universities. Among sectoral universities, the highest share of students (28%) enrolled in target admission placements is medical universities, followed by transport universities (15%), pedagogical universities (9%), and agricultural universities (7%). The proportion of target students in medical universities has increased significantly.

Sectoral universities are more involved in training students for enterprises than the rest. The number of organizations with which agreements for training specialists are concluded is significantly higher among sectoral universities compared to other universities (Figure 4). This is primarily because sectoral universities, as a rule, are not very large, and they do not have a wide

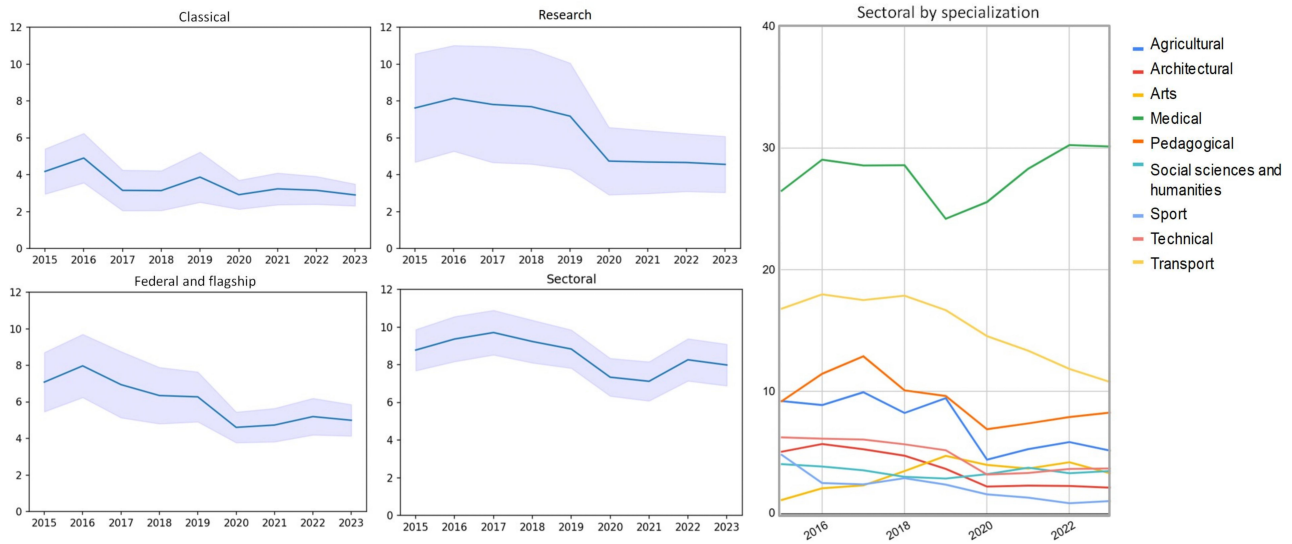

Figure 3. The average proportion of students enrolled in targeted placements at Russian HEIs (the blue area around the line is the confidence interval). HEIs, higher education institutions.

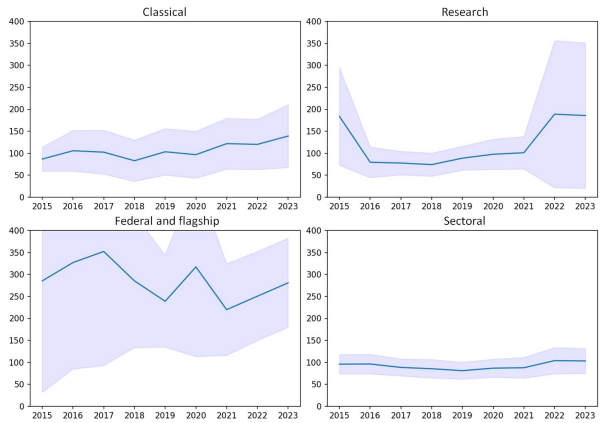

Figure 4. The average number of organizations with which agreements for training specialists are concluded (the blue area around the line is the confidence interval).

variety of programs; thus, they are limited to interactions with enterprises from their core industries.

The graph shows a significant increase in the average value and confidence interval among research universities in 2022 and 2023. This is due to a very sharp increase in the indicator for the N.E. Bauman Moscow State Technical University, while other research universities had similar values in 2022 and 2023. The sharp increase in the average value for federal and flagship universities in 2020 can be explained by the very rapid growth of the indicator (48 times) for Togliatti State University.

To summarize, the leaders in the area of interaction with industry are sectoral universities that train a significant share of staff on request from enterprises. However, the number of their relations with industry representatives is much more limited than those of universities with a wider variety of training areas.

Interaction with industry through science

Another important product that universities produce is scientific knowledge. Its commercialization may be a proxy for successful interaction with industrial partners. It is natural that the highest volume of R&D from extra-budgetary sources per faculty member is observed at research universities (Figure 5). All other universities lag behind them in this indicator and do not show the same active growth as research universities. This may be due to the large scale of research universities, a higher level of funding and higher research quality. Consequently, companies may have more confidence in research universities. Among the sectoral universities, the leaders in terms of R&D are the universities whose fields of specialization are largely related to the production sectors of the economy—these are institutions that specialize in technical, transport, agricultural, and construction studies.

At the same time, the R&D share from extra-budgetary funds in total R&D revenues for universities of all categories varies between 50% and 60%, except for research universities, which show higher values for this indicator (62%, on average, over the whole observed period, Figure 6). The largest share of extra-budgetary revenues in total R&D revenues is inherent in sectoral universities of transport and architectural specialization.

Thus, while the absolute leaders in R&D output are research universities, the share of R&D performed

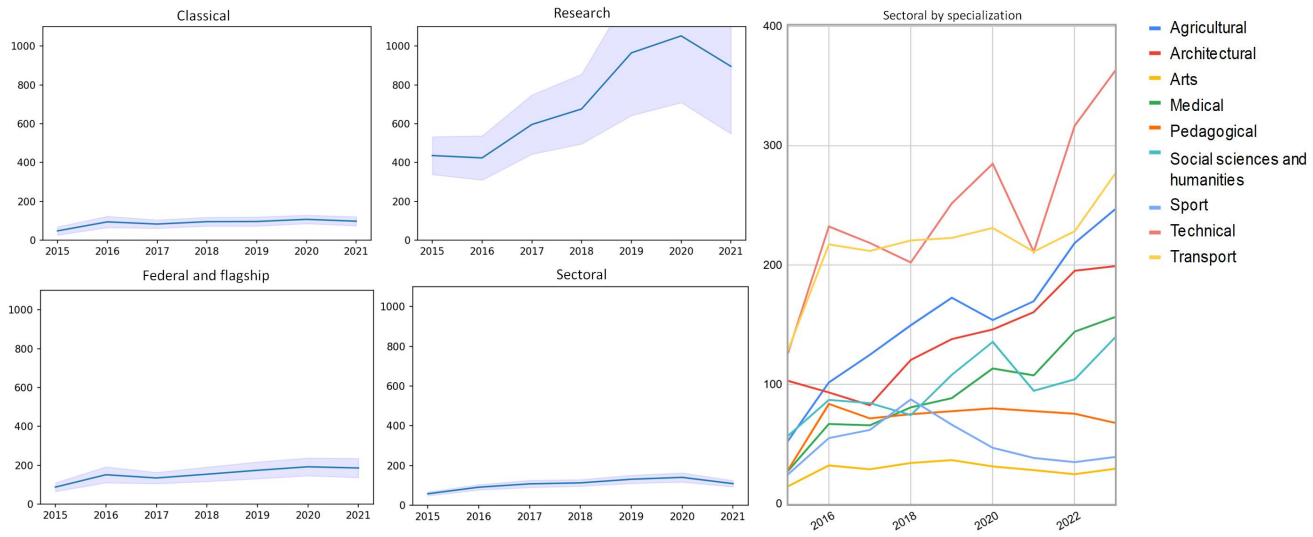

Figure 5. The average volume of R&D received from extrabudgetary sources per 100 faculty members (the blue area around the line is the confidence interval).

outside the state order hardly varies for all categories of universities.

The production of scientific knowledge in universities of different categories

The leaders in the production of scientific knowledge visible to the international academic community are research universities (Figure 7). They produced significantly more publications indexed in Scopus—an average of 95 publications per 100 faculty members over the last 5 years, while the average output of federal and flagship universities was 28 and classical universities was 26. Sectoral universities produced an average of 14 publications per 100 faculty members during a 5-year period. The most productive were technical universities. Agricultural, medical, construction, and social universities are also leaders in terms of the growth dynamics of publication activity.

The output is different with regard to publications in journals indexed in the national bibliometric database RSCI, where the requirements for the journals are much more lenient compared to Scopus. In terms of publications in the RSCI, the most productive are sectoral universities, producing an average of 287 papers per 100 faculty members over the last 5 years (Figure 8). Classical universities lag somewhat behind, although they show the same positive dynamics as sectoral universities. Federal and flagship universities as well as research universities produce a smaller number of publications in RSCI. They also show slower growth than classical and sectoral universities. In general, sectoral universities are leaders in dynamic growth; the volume of their publication activity increased by 3.4 times. Among the sectoral universities, the most productive in terms of RSCI publications are the agricultural universities as well as the universities in the social sciences and humanities.

Thus, we can conclude that research activity is poorly developed in sectoral and conventional classical universities, probably due to fewer resources allocated by the state for science or lower academic standards. Nevertheless, universities in these categories try to keep up with the leaders in higher education, successfully increasing the number of publications, at least in national journals.

Quality of admission

The quality of admission was shown to be different for state-funded and targeted placements. Students applying for state-funded placements tend to have a USE that is three points higher than that of students applying for targeted places (Figure 9). Research universities have the highest USE scores and show the largest difference between the scores for state-funded and targeted placements. Classical, sectoral, and flagship and federal universities have approximately similar quality of admission to state-funded and targeted places, but the USE for targeted places is slightly lower at sectoral HEIs (62.2 points, on average, for sectoral HEIs and 63.4 and 64.7 points for classical, and federal and flagship universities, respectively). The difference between USEs for state-funded and targeted placements is greater for sectoral universities (on average 3.16), while it is around 1.5 for classical and federal and flagship universities. The average growth of the USE was 1.21% for state-funded places and 1.09% for targeted places. The highest growth was observed for sectoral HEIs (2.12% for state-

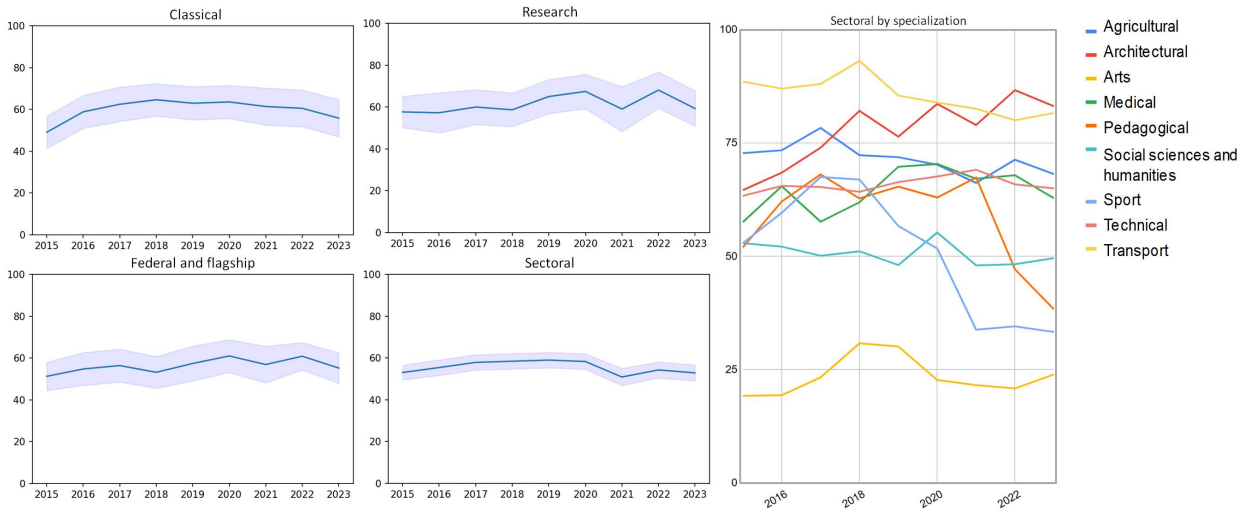

Figure 6. The proportion of R&D revenues received from extrabudgetary sources in total revenues of HEIs (the blue area around the line is the confidence interval). HEIs, higher education institutions.

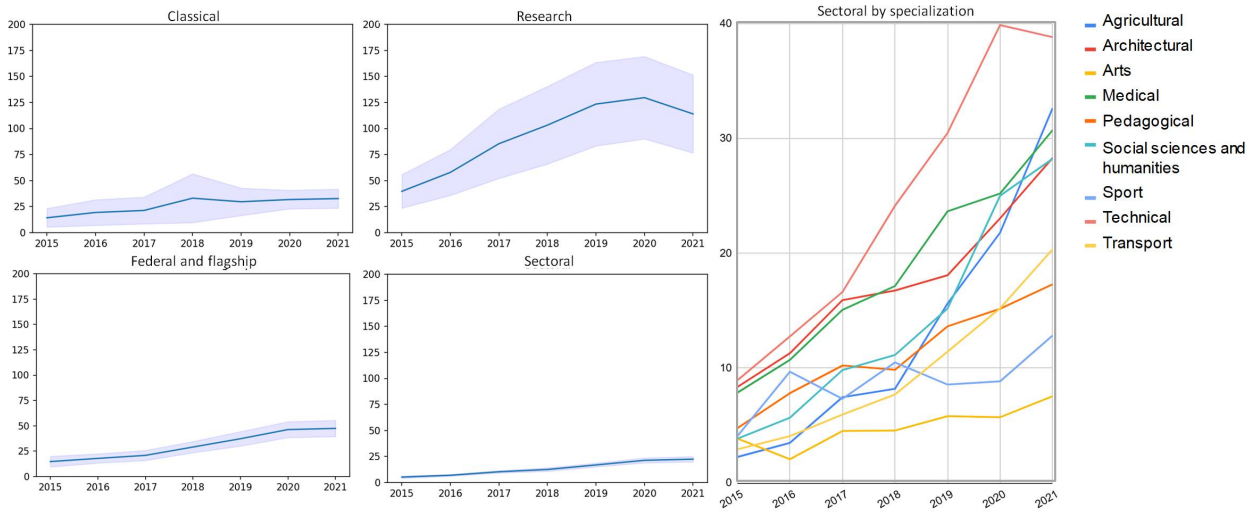

Figure 7. The average number of publications in Scopus indexed journals per 100 faculty members (the blue area around the line is the confidence interval).

funded places and 1.62% for targeted places). The other HEI categories showed a growth of less than 1% for both types of placements, except for state-funded places at federal and flagship universities (growth of 1.16%).

Graduates' success

While the average salary of graduates from research universities is the highest compared to other categories of universities, the highest employment rate is observed for graduates from sectoral universities (Figure 10). There was almost no statistically significant difference in salary and employment rates between the four categories of HEIs. The employment rate of graduates from classical universities differs significantly from the employment rate of graduates from other HEIs, but the difference is very small (Pearson $\chi^2[2, n = 485] = -0.1177$, $P < 0.009$). The average salary of graduates from research and sectoral universities is significantly different from that of other categories of HEIs (for research universities: Pearson $\chi^2[2, n = 485] = 0.2120$, $P < 0.000$; for sectoral universities: $\chi^2[2, n = 485] = -0.1170$, $P < 0.010$).

Therefore, research universities outperformed all other categories of universities in terms of the quality of admission and success of their graduates in the labor

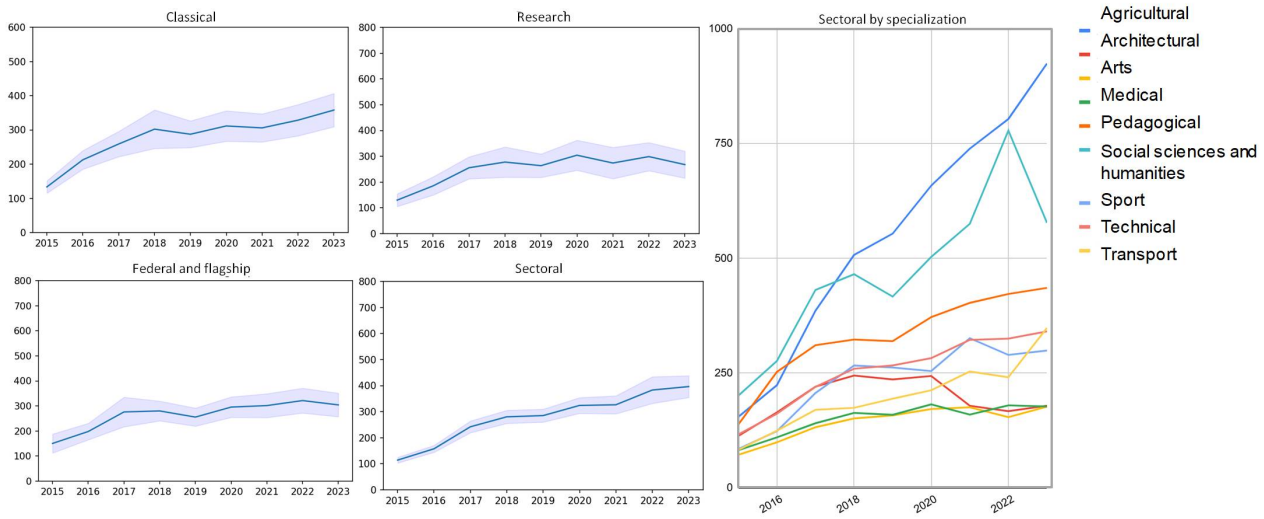

Figure 8. The average number of publications in RSCI-indexed journals per 100 faculty members (the blue area around the line is the confidence interval).

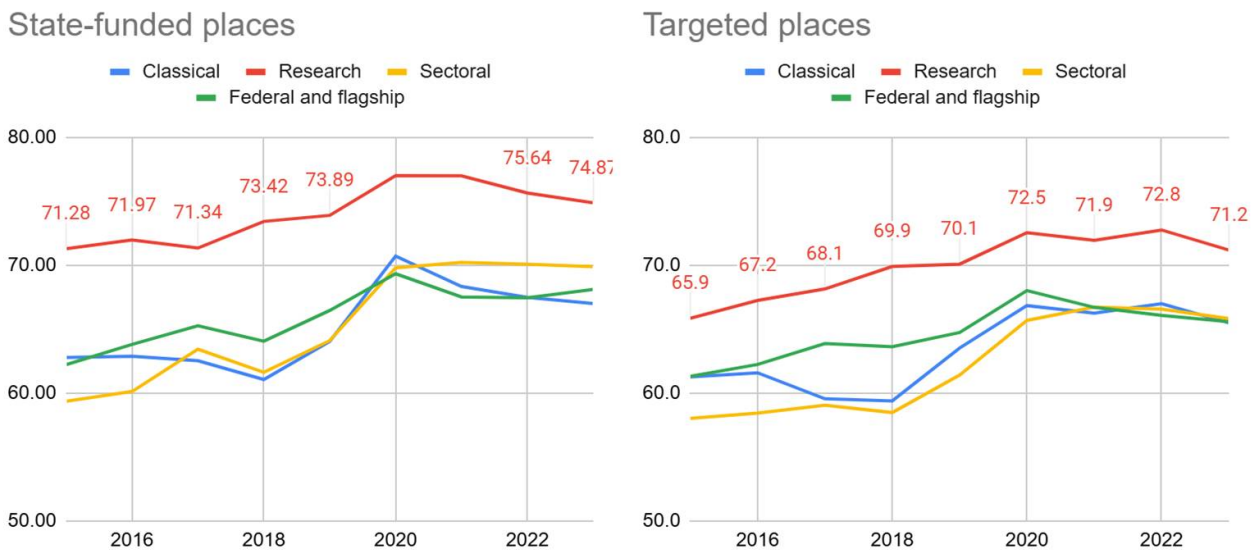

Figure 9. Average USE scores for state-funded and targeted placements.

market. Sectoral HEIs, in turn, also showed higher values for the salaries of their graduates compared to those of classical, federal, and flagship HEIs. Additionally, they were the only ones where the quality of admission to targeted placements was consistently higher than the quality of admission to state-funded placements.

CONCLUSION

State regulation and market forces influenced the current higher education system at the same time, while retaining some features of the Soviet higher education system. The government's policy toward higher education aims to increase efficiency, including funding projects and regulation, through the allocation of state-funded placements by fields of study and HEIs. This has a significant impact on the interaction between HEIs and industry. The imbalance created by the Soviet system continues[1] to affect the results of universities, as we have shown in our research: universities of different types achieve different results.

Despite the fact that the government has almost abandoned the allocation of sectoral HEIs,[1–4] and despite the fact that HEIs themselves have been moving

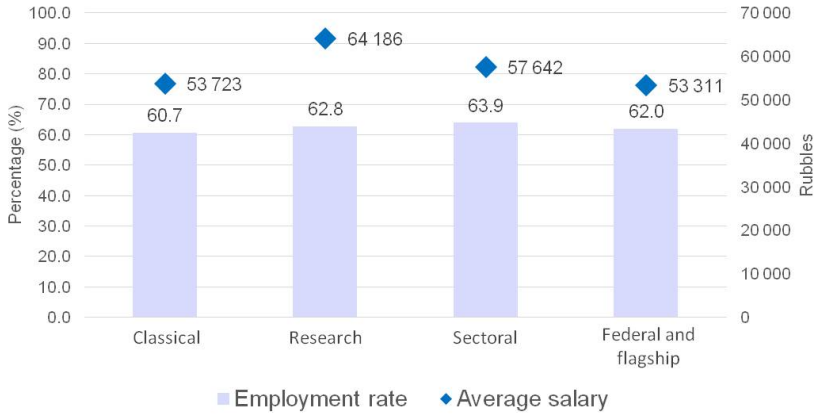

Figure 10. Average salaries and average employment rates in the first year after graduation for 2023 graduates.

away from their strictly sectoral identity,[3] we found that most HEIs still retain a clear sectoral specialization. The entire university system provides higher professional education than academic education, which is present mainly in selective universities. Few sectoral universities were granted the status of research universities and had higher requirements for research activities. We found that sectoral universities, unlike other types of HEIs, are significantly less involved in research activities and do not have international visibility. They fulfill their educational mission to a greater extent, and the results of their research are actively published in local journals. Sectoral universities have the highest level of targeted enrollment, while the quality of enrollment is quite low.

We also found that the greatest difference between the quality of students enrolled in state-funded and targeted placements was in sectoral universities. It is important to note the high level of heterogeneity among sectoral universities. Thus, HEIs in sectors with a high level of state participation have a higher level of targeted enrollment. Sectoral universities have a closer connection with specific employers than other types of HEIs. The labor market performance of graduates from sectoral universities is good: they are the most successful in terms of employment rates, and they are second only to graduates from research universities in terms of salaries. On the basis of our results, we recommend that sectoral universities pay more attention to the quality of admission for targeted studies and also to academic visibility at the international level.

It is also important to note that federal and flagship universities were supposed to become drivers of economic development in their regions.[1] We found that these universities have relatively good-quality admissions and a large number of links with industry, but this does not translate into graduate success or R&D performance. This is likely to indicate that, despite the quantity, the quality of links with industry needs work. In addition, it may also indicate that the quality of human capital is not sufficiently high. Accordingly, we recommend that federal and flagship universities review both the policy of building links with industry and improve the quality of human capital.

Our study highlights the dynamic evolution of the Russian higher education system, marked by state-driven initiatives aimed at fostering research capabilities, enhancing university-industry collaboration, and meeting labor market demands. The reforms have created a diverse landscape, with leading universities emerging as centers for research excellence and sectoral universities maintaining close ties with industries. While research universities have excelled in producing internationally recognized research, sectoral universities play a crucial role in providing skilled specialists to various industries. The effectiveness of these reforms varies, reflecting successes in certain areas, such as increased graduate employment in specific sectors, and challenges, such as disparities in funding and resources.

Based on the results of the analysis, the following directions for further research emerged. First, it would be useful to compare the effectiveness of higher education systems in the post-Soviet space in terms of sectoral and other categories of HEIs, since the systems of the CIS countries, having common historical origins, developed along different trajectories after the 1990s. Second, in the modern education system, secondary vocational education has started to compete with higher education.[29] Accordingly, the question arises about the effectiveness of the systems of secondary vocational education and higher education, both at the individual and institutional levels. Third, in the existing HEI typology, the role of classical universities is unclear; they are not strong enough in research activities, and they are less involved in interaction with industry. Thus, it would

be helpful to investigate their diversity and learn about their primary functions.

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Panova A, Slepykh V: Conceptualization, Methodology, Writing—Original draft, Writing—Review and Editing. All authors have read and approved the final version of the manuscript.

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The author has no conflicts of interest to declare.

Data availability statement
Data used to support the findings of this study are available from the corresponding author upon request.

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