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Universidade do Sul de Santa Catarina, Brazil

## \*CORRESPONDENCE

Galina N. Semenova  
✉ Sg6457@mail.ru

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# Scenarios of the innovative development of education in the context of the Russian economy's modernization: entrepreneurial universities vs. high-tech universities

Vera V. Dvoretzkaya<sup>1</sup>, Irina S. Antonova<sup>2</sup>, Galina N. Semenova<sup>3,4\*</sup>  
and Elena N. Belkina<sup>5</sup>

<sup>1</sup>Financial University Under the Government of the Russian Federation, Moscow, Russia, <sup>2</sup>Institute of Linguistics and Intercultural Communication, I.M. Sechenov First Moscow State Medical University, Moscow, Russia, <sup>3</sup>Department of State and Municipal Finance, Plekhanov Russian University of Economics, Moscow, Russia, <sup>4</sup>Department of State and Municipal Finance, Moscow State Regional University, Moscow, Russia, <sup>5</sup>Department of State and Municipal Administration, Kuban State Agrarian University, Krasnodar, Russia

The article is aimed at identifying the scenarios of the innovative development of education in the context of the Russian economy's modernization through the opposition of entrepreneurial universities and high-tech universities. The authors conduct a system econometric analysis. The scenario analysis showed that the strategic prospects (optimistic, long-term scenario) of the innovative development of education to support the modernization of the Russian economy through the optimization of universities' activities require the upgrading of equipment by 982.51% for increasing the research activities to 10269.44% (compared to the threshold), which will bring Russian universities to the 1st place in the QS ranking. In the medium-term period, the share of modern (less than 5 years old) equipment in Russian universities should tend to be 90%. As it is shown by a probable and promising scenario, this will improve the position of the Russian universities in the QS ranking by 6.17%. It is proved that only high-tech universities contribute to the innovative development of education in the context of the Russian economy's modernization. Therefore, the reduction of state funding of higher education and science makes no sense in Russia, as well as the development of entrepreneurial universities. Instead, the focus should be on the upgrading of university equipment. The originality of this paper lies in a new vision of the prospects for the development of the system of higher education in Russia in the Decade of Science and Technology (2022–2031). This new vision is as follows: for the innovative development of education in the context of the Russian economy's modernization, it is necessary to refuse the diversification of universities and to achieve their unification, making a choice either in favor of entrepreneurial universities or in favor of high-tech universities.

## KEYWORDS

sustainable development education, education policy, educational governance in developing countries, education quality, adult literacy, university innovations, entrepreneurial universities, high-tech universities

## 1. Introduction

The development of education is paid close attention to within the ongoing global sustainable development initiative, enshrined in Goal 4 adopted by the UN. In the generalized formulation of this goal related to the development of education, each country chooses for itself its vision of the directions of education development that are relevant to it and the prospects for their implementation. In particular, the formulation of the objective under consideration includes ensuring full coverage of the population by school education, which is most acutely manifested in lagging countries (for example, African ones), and by now has been successfully achieved in developing countries, including Russia.

The experience of developing countries is the most useful because it is universal and interesting, and can be used by most of the participants in international economic relations, while the experience of developed and lagging countries is specific and has limited prospects for practical use. In Russia, the goal under consideration is supported at the government level and is achieved with an emphasis on the innovative development of higher education, intended to ensure the availability of higher education and continuous learning for all parties, improve the quality and efficiency of higher education, and provide scientific and educational support for ongoing programs of the Russian economy's modernization.

The problem lies in the uncertainty of what characteristics universities should have to better facilitate the innovative development of education and support the Russian economy's modernization. As a result of a large-scale reorganization nowadays, there are two types of universities in Russia. The first type: entrepreneurial universities focused on achieving the greatest possible financial independence from the state and the effectiveness of educational and scientific activities while striving to reduce risks.

The second type: high-tech universities that rely on public funding and take on a large risk load in the implementation of progressive educational programs and R&D aimed at creating advanced innovations. As it is shown by the successful international experience, universities of only one of these types prevail in the higher education system. The originality of this paper lies in a new vision of the prospects for the development of the system of higher education in Russia in the Decade of Science and Technology (2022–2031). This new vision is as follows: for the innovative development of education in the context of the Russian economy's modernization, it is necessary to refuse the diversification of universities and to achieve their unification, making a choice either in favor of entrepreneurial universities, or in favor of high-tech universities.

The working hypothesis of this study is that only high-tech universities facilitate the innovative development of higher education under the conditions of the modernization of the Russian economy. Thus, during the Decade of Science and Technology in Russia, it is necessary to develop high-tech universities. The goal of this article is to identify scenarios of innovative development of education in the context of the Russian economy's modernization through the opposition of entrepreneurial universities and high-tech universities.

## 2. Literature review

The fundamental basis of this research is the theory and practice of innovative development of higher education. The scientific

foundations of this theory are disclosed in the works of [Awais and Ameen \(2019\)](#), [Belayutham et al. \(2019\)](#), [Veiga Ávila et al. \(2019\)](#), and [Cockshut et al. \(2020\)](#). The issues of modernization of universities and their contribution to the innovative development of the higher education and science system are considered in the works of [Goyal and Sergi \(2015\)](#), [Popkova and Zmiyak \(2019\)](#), [Batoool \(2022\)](#), [Nguyễn et al. \(2022\)](#), [Parejo et al. \(2022\)](#), and [Prenger et al. \(2022\)](#). According to the above literature sources, innovative development of higher education is defined in this paper as the improvement of the position of the leading universities in international university rankings (e.g., the ranking QS) through an increase in R&D activity of universities.

In the existing literature, the innovative development of higher education is connected based on two alternative platforms. The first platform is entrepreneurial universities, which specific feature is an increase in the share of the university's revenues from non-government sources, which implies the focus on the management of universities' finances ([Cunningham and Menter, 2021](#); [Vesperi and Gagnidze, 2021](#)). Based on international experience, [Bodolica and Spraggon \(2021\)](#) note the contribution of entrepreneurial universities to the innovative development of higher education.

The second platform is high-tech universities, which specific feature consists in the modernization of equipment for university R&D, which implies the focus on the management of universities' innovative activities ([Pogodaeva et al., 2015](#); [Vladimirov et al., 2019](#)). Based on the works of [Kurdve et al. \(2020\)](#), [Tang \(2022\)](#), and [Zhang et al. \(2022\)](#), in which the key role of university R&D in the innovative development of higher education is pointed out, the hypothesis of this paper is as follows. Hypothesis H: modernization of equipment (growth of the cost of new (not older than 5 years) machinery and equipment in the total cost of machinery and equipment) facilitates an increase in the R&D activity of Russian universities, thus improving their position in the World University Rankings according to QS.

As shown by the literature review, individual components of the problem of innovative development of higher education have been studied in detail, but the problem as a whole has not been sufficiently worked out due to two research gaps. The first gap is associated with the insufficiently studied Russian experience in the innovative development of education in the context of economic modernization. The second gap is the insufficient study of the relationship between the innovative development of education and economic modernization, as well as the requirements for universities. To fill the identified gaps, the research has been conducted in this article.

## 3. Materials and methodology

To test the developed hypothesis, a system econometric analysis is carried out. As a key characteristic of an entrepreneurial university, its independence from government funding was chosen, as an indicator of which is the share of the university's revenues from non-government sources. As a key characteristic of a high-tech university, its infrastructure was chosen—the upgrade of equipment, an indicator of which is the cost ratio of machinery and equipment (not older than 5 years) in the total cost of machinery and equipment.

The data on the listed indicators are taken from the monitoring materials of the universities by [Ministry of Science and Higher Education of the Russian Federation \(2020\)](#). The top 10 universities in Russia were selected for the study, according to the World University

Rankings 2021 (QS, 2020). The empirical data for the study are given in Table 1.

The research is conducted in three consecutive stages. The 1<sup>st</sup> stage: determination of the contribution of entrepreneurial and high-tech universities to the R&D activity of Russian universities. Using the method of correlation analysis, the relationship between the key characteristics of entrepreneurial and high-tech universities and the results for the innovative development of education in the context of the Russian economy's modernization in the field of education, R&D, and international and financial and economic activities is determined. The following fact is in favor of the proposed hypothesis: the coefficient of correlation ( $r$ ) between the R&D activity ( $y_2$ ) and the cost ratio of machinery and equipment (not older than 5 years) in the total cost of machinery and equipment ( $x_1$ ) is larger than the coefficient of correlation between the R&D activity and the share of the university's revenues from non-government sources ( $x_2$ ).

At the 2nd stage, the dependence of the place in the QS ranking in 2021 ( $z$ ) on educational activity ( $y_1$ ), R&D activity ( $y_2$ ), international activity ( $y_3$ ) and financial and economic activity ( $y_4$ ) is determined. Second, the dependence of R&D activities ( $y_2$ ), on equipment upgrade in Russian universities ( $x_1$ ) is found. Using the method of regression analysis, the dependence of the place in the ranking on the results of universities is revealed, as well as the dependence of key results on the characteristics of the entrepreneurial and high-tech universities. The research model of this paper is as follows:

$$\begin{cases} z = a_z + b_{z1}y_1 + b_{z2}y_2 + b_{z3}y_3 + b_{z4}y_4, \\ y_2 = a_{y2} + b_{y2x1}x_1 \end{cases} \quad (1)$$

Hypothesis H is deemed proven if three following conditions are observed simultaneously: (1)  $r_{y_2x_1} > r_{y_2x_2}$ , (2)  $b_{z2} > 0$ , and (3)  $b_{y_2} > 0$ .

At the 3rd stage, the prospects for the innovative development of the system of higher education under the conditions of the modernization of the Russian economy in the Decade of Science and Technology in Russia based on the development of high-tech universities are determined. Based on the obtained dependencies by the simplex method, scenario analysis of strategic prospects and current (tactical) possibilities of innovative development of education is carried out in favor of supporting the modernization of the Russian economy through the optimization of universities' activities. Based on the research model (1), the consequences of an increase in the universities' activities in the sphere of the modernization of equipment (an increase in the cost of new (not older than 5 years) machinery and equipment in the total cost of machinery and equipment) for the R&D activity of Russian universities and their provision in the World University Rankings according to QS are determined.

## 4. Results

At the 1st stage of the research, to determine the contribution ratio of entrepreneurial and high-tech universities to the performance of the Russian higher education system, let us turn to the results of the correlation analysis of the data from Table 1 and Figure 1.

According to Figure 1, results in the field of educational activity do not depend on the type of university, as evidenced by a negative correlation. The R&D performance of the Russian higher education

system is determined by the contribution of high-tech universities to it (correlation with the equipment upgrade: 19.86%). International and financial and economic activities are equivalent in universities of both types, and are manageable.

At the 2nd stage of the research, to determine the proper direction for the innovative development of education in the context of the Russian economy's modernization, let us turn to the multiple linear regression equation obtained on the basis of the data from Table 1 and reflecting the contribution of all three selected (manageable by changing the type of university) directions to the place of universities in the QS ranking in 2021:

$$\begin{cases} z = 135.66 - 0.028y_2 + 0.063y_3 + 0.054y_4, \\ y_2 = 808.52 + 9.6293x_1 \end{cases} \quad (2)$$

According to the obtained equation, only R&D activity ( $y_2$ ) demonstrates negative regression dependence with the resulting variable ( $z$ ), and therefore only one needs to be managed in the interests of innovative development of education in the context of the Russian economy's modernization. Thus, with an increase in the effectiveness of R&D activities by 1% (compared to the threshold), the position of Russian universities in the QS ranking improves (decreases, tending to the top of the ranking) by 0.028 places. The multiple correlation was 58.58%, that is, it turned out to be moderate, but strong enough to take into account the obtained regression equation.

To determine the conditions and prospects for the optimization of R&D activities based on data from Table 1, its regression dependence on the only positively influencing factor—equipment upgrade ( $x_1$ ) is determined. According to model (2), when the equipment is upgraded by 1%, the effectiveness of R&D activities of the Russian universities increases by 9.6293% (compared to the threshold).

At the 3rd stage of the research, based on model (2) and using the simplex method, the following scenarios of innovative development of education in the context of the Russian economy's modernization were compiled (Figure 2).

The scenario analysis, conducted using Figure 2, showed that the strategic prospects (optimistic scenario) of innovative development of education in the context of supporting the Russian economy's modernization through the optimization of universities' activities require equipment upgrades by 982.51% to increase R&D activities to 10269.44% (compared to the threshold), which will bring Russian universities to the 1st place in the QS ranking.

Tactical capabilities (realistic scenario) make it possible to achieve the equipment upgrade by no more than 90%. This will increase the results of R&D activities up to 1675.16% (compared to the threshold), which will allow Russian universities to take 244.79th place in the QS ranking (to improve by 6.17% compared to 2020).

## 5. Discussion

This paper's contribution to the literature consists in the development of scientific provisions of the theory and practice of innovative development of higher education through clarification of the cause-and-effect relationships between innovative development of higher education and university management in

TABLE 1 Statistics of higher education in Russia in 2020 based on top universities according to QS ranking.

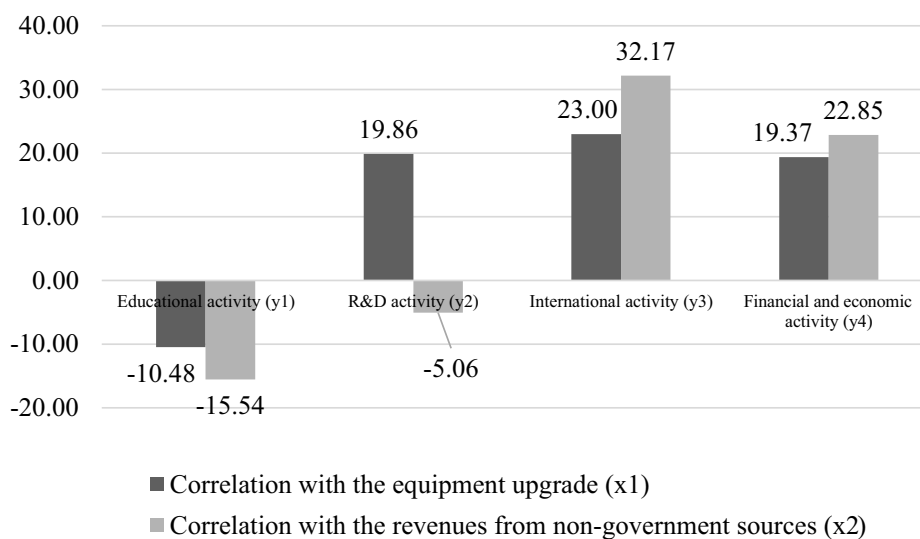
Place in the QS ranking in 2021	University	Cost ratio of machinery and equipment (not older than 5 years) in the total cost of machinery and equipment, %	Share of the university's revenues from non-government sources, %	Educational activity	R&D activity	International activity	Financial and economic activity	Ratio to threshold values, %			
								Educational activity	R&D activity	International activity	Financial and economic activity
Z		$X_1$	$X_2$					$Y_1$	$Y_2$	$Y_3$	$Y_4$
Threshold values based on average statistics for the Russian Federation:				64.5	136.37	4.02	2139.6	-	-	-	-
74	Lomonosov Moscow State University	52.78	46.57	83.81	979.35	7.5	3637.88	129.94	718.16	186.57	1518.31
225	Saint Petersburg State University	2.32	26.91	86.91	603.4	13.87	4236.28	134.74	442.47	345.02	1768.06
228	Novosibirsk State University	5.07	30.97	81.0	586.81	5.72	3773.55	125.58	430.31	142.29	1574.94
250	Tomsk State University	41.92	18.96	76.23	1694.19	20.74	5485.34	118.19	1242.35	515.92	2289.37
281	Moscow Institute of Physics and Technology (MIPT/Moscow Phystech)	43.82	45.55	94.56	4061.84	11.0	8767.6	146.60	2978.54	273.63	3659.27
282	Bauman Moscow State Technical University	11.45	26.65	79.07	1575.16	5.13	6349.84	122.59	1155.06	127.61	2650.18
298	HSE University (National Research University Higher School of Economics)	46.26	41.64	86.27	1461.66	9.56	8169.24	133.75	1071.83	237.81	3409.53

(Continued)

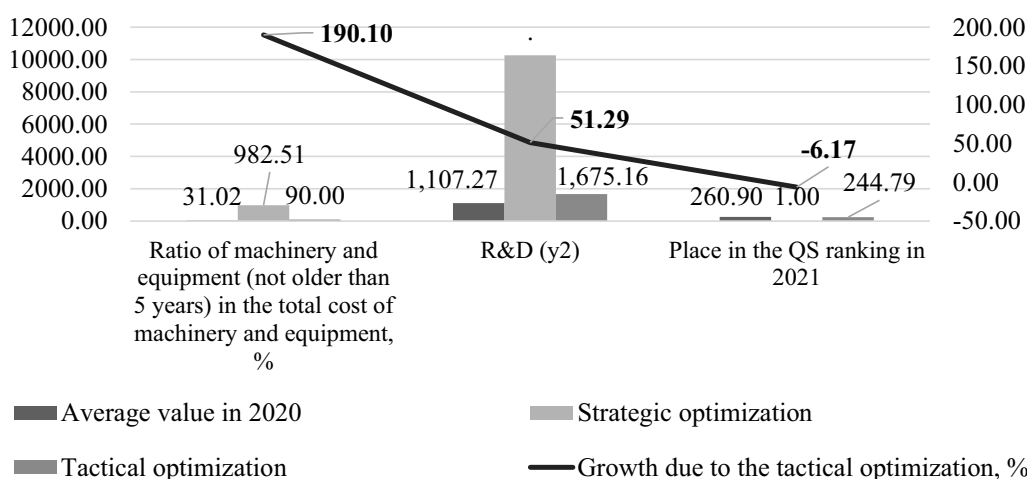
TABLE 1 (Continued)

Place in the QS ranking in 2021	University	Cost ratio of machinery and equipment (not older than 5 years) in the total cost of machinery and equipment, %	Share of the university's revenues from non-government sources, %	Educational activity	R&D activity	International activity	Financial and economic activity	Ratio to threshold values, %			
								Educational activity	R&D activity	International activity	Financial and economic activity
Z		$x_1$	$x_2$					$y_1$	$y_2$	$y_3$	$y_4$
314	National Research Nuclear University MEPhI (Moscow Engineering Physics Institute)	25.09	36.99	89.4	3187.97	21.83	9751.86	138.60	2337.74	543.03	4070.06
326	RUDN University	41.68	63.08	68.72	302.66	28.49	6835.7	106.54	221.94	708.71	2852.96
331	Ural Federal University–UrFU	39.85	40.24	70.26	646.74	10.8	3236.57	108.93	474.25	268.66	1350.82

Compiled by the authors based on [QS \(2020\)](#), [Ministry of Science and Higher Education of the Russian Federation \(2020\)](#).



**FIGURE 1**  
Correlation of the results of the higher education system with the contribution of the entrepreneurial and high-tech universities in Russia: calculated and constructed by the authors.



**FIGURE 2**  
Scenarios of the innovative development of education in the context of the Russian economy's modernization: calculated and constructed by the authors.

Russia. As a result of the conducted research, two alternative scenarios of the innovative development of higher education in Russia in the Decade of Science and Technology (2022–2031) were obtained; they describe the distinction of innovative development of education between entrepreneurial universities and high-tech universities (Table 2).

As shown in Table 2, the scenario of the development of entrepreneurial universities implies the approach to university management that is connected with the strengthening of their financial independence from the state. Here the key tool of university management is the increase in the share of the university's revenues from non-government sources. The focus of university management is on the management of universities' finances. The

consequences of universities' management for the R&D activity of Russian universities according to this scenario are negative: the correlation is -5.06%. The consequences of university management for World University Rankings according to QS in the Decade of Science and Technology in Russia according to this scenario are connected with the deterioration of the positions of Russian universities in World University Rankings according to QS.

The alternative is the scenario of the development of high-tech universities. This scenario implies the approach to university management that is connected with the modernization of equipment. The key tool of university management here is an increase in the cost of new (not older than 5 years) machinery and equipment in the total cost of machinery and equipment. The focus



TABLE 2 Alternative scenarios of the innovative development of higher education in Russia: entrepreneurial universities vs. high-tech universities.

Criteria of comparison of the scenarios	Alternative scenarios of the innovative development of higher education in Russia	
	Entrepreneurial Universities	High-Tech Universities
Approach to universities management	Strengthening of the financial independence from the state	Modernization of equipment
The key tool of universities management	Increase in the share of the university's revenues from non-government sources	Increase in the cost of new (not older than 5 years) machinery and equipment in the total cost of machinery and equipment
Focus of universities management	Management of universities'	
finances	Management of the innovative activities of universities	
Consequences of universities management for the R&D activity of Russian universities	Negative: correlation is -5.06%	Positive: correlation is 19.86%
Consequences of universities management for the World University Rankings according to QS in the Decade of Science and Technology in Russia	Deterioration of the positions of Russian universities in the World University Rankings according to QS	Improvement of the positions of Russian universities in the World University Rankings according to QS, up to strategic academic leadership

Compiled by the authors.

of university management is on the management of universities' innovative activities. The consequences of university management for the R&D activity of Russian universities according to this scenario are positive: the correlation is 19.86%. The consequences of universities management for the World University Rankings according to QS in the Decade of Science and Technology in Russia, according to this scenario, are connected with the improvement of the positions of Russian universities in the World University Rankings according to QS, up to strategic academic leadership.

Therefore, unlike Bodolica and Spraggon (2021), Cunningham and Menter (2021), and Vesperi and Gagnidze (2021), the inexpedience of the development of entrepreneurial universities in the Decade of Science and Technology in Russia was substantiated. The theoretical importance of the results obtained lies in proving the hypothesis that for the innovative development of higher education in Russia the scenario of the development of high-tech universities is preferable. This strengthened the evidential base of the works of Kurdve et al. (2020), Tang (2022), and Zhang et al. (2022).

## 6. Conclusion

Thus, the developed hypothesis is confirmed: only high-tech universities contribute to the innovative development of education in the context of the Russian economy's modernization. Therefore, the reduction of state funding of higher education and science makes no sense in Russia, as well as the development of entrepreneurial universities. Instead, the focus should be on the upgrading of university equipment. The share of modern (less than 5 years old) equipment in Russian universities should tend to be 90%.

As it is shown by a probable and promising scenario, this will improve the position of the Russian universities in the QS ranking by 6.17%. The key conclusion as a result of this research is that to increase the rate of innovative development of higher education under the conditions of the modernization of the Russian economy in the Decade of Science and Technology in Russia it is necessary to develop high-tech universities.

The practical significance of the authors' conclusions and recommendations is that they will allow raising the effectiveness of the management of Russian universities and will strengthen the strategic academic leadership of Russia. Due to this, the paper strengthened the scientific base of the practical implementation of the program "Priority 2030" in the Decade of Science and Technology in Russia.

## Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

## Author contributions

VD, IA, GS, and EB: writing, original draft, and writing, review and editing. All authors contributed to the article and approved the submitted version.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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