Education in
the structure of the social and investment model of economic growth: Scenarios of development and mechanisms of management

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Elena G. Popkova

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Education in the structure of the social and investment model of economic growth: Scenarios of development and mechanisms of management

Topic editor

Elena G. Popkova — Peoples' Friendship University of Russia, Russia

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Quality management of higher education within the framework of the socio-investment model of economic growth: State audit and financial control

Anatoliy B. Yaroshchuk*, Azamat Yu. Guliev and Mikhail N. Mikhaylenko

The State University of Management, Moscow, Russia

The article aims to study the contribution of quality management in higher education through state audit and financial control to the implementation of the socio-investment model of economic growth. The article is based on the scientific hypothesis that quality management in higher education should be based on university rankings. The article presents the authors' view on the interpretation of recent results in the research field of quality management in higher education and reveals the strengths and weaknesses of the hypothesis. Systematization and critical analysis of the indicators of quality and effectiveness in higher education based on the leading university rankings for 2022—the Ministry of Education and Science of the Russian Federation—are performed. The case study method is used for the case analysis of the management of quality and effectiveness on the example of the leading Russian university, which has been the leader of these rankings for many years: Lomonosov Moscow State University (MSU). The scientific novelty and originality of the article are associated with a systematic view of the quality and effectiveness of higher education, which was first formed by the authors through a combination and grouping of indicators from the leading university rankings for 2022. The theoretical significance of the authors' conclusions lies in the fact that the article clearly identifies a significant contribution of the quality control of education and the performance management of universities to the implementation of the socio-investment model of economic growth. The practical significance of the obtained results is that the scientific and methodological basis for monitoring and assessing quality and effectiveness in higher education based on the leading university ratings for 2022 makes it possible to improve the state audit and financial control of university activities in the implementation of the socio-investment model of economic growth.

Introduction

Education and universities play a system-forming role in the socio-investment model of economic growth. The essence of this model is that the source of economic growth and development is social investments, that is, investments to develop and unlock human potential (Makhalina et al., 2020). The socio-investment model of economic growth is manifested in the following: the development of digital competencies among the population, the training of digital personnel for business, lifelong learning, targeted, and corporate (requested and paid by employers) training to improve the qualification level of employees of enterprises. All this is implemented based on universities (Henze et al., 2022; Liao et al., 2022).

Two conditions must be met for universities to successfully fulfill this role. The first condition is the high quality of the university's activities—both educational and scientific—as it determines the effectiveness of social investments (Depoo et al., 2022). The quality of educational services determines the growth of human potential achieved through training—the development of competencies and the improvement of the qualification level of human resources of economy and business (Popkova et al., 2021). The quality of scientific activity of universities determines internally-generated intangible assets—advanced technologies and university innovations that allow increasing productivity in knowledge-intensive and innovation-related workplaces (Brasher et al., 2022).

The second condition is the high performance of the university. The socio-investment model of economic growth is based on social investments, but not on non-commercial investments (Sibirskaya et al., 2019). In the conditions of a modern market economy, social investments have a pronounced commercial nature, and therefore the activities of universities are associated with the generation of public goods, not social ones. Services of higher education do not conform to the criteria of public goods: they are consumed collectively (non-exclusion criterion), the list of consumers-beneficiaries cannot be limited (criterion of non-competition in consumption), a good cannot be decomposed into separate units, and the fee collection for services is complicated (criterion of indivisibility).

However, the services of higher education that are provided by modern universities fully conform to all criteria of economic goods: they are exclusive (services are provided only to enrolled students), competitive in consumption (production capacities of universities are limited, and consumption of their higher education services by certain people reduces the possibilities for their consumption by other people), clearly divisible (could be divided into educational programs, separate disciplines, and detailed services) and envisage collection of fee for the services (from the state, students or employers). Effectiveness means commercial attractiveness, competitiveness, and payback of social investments in terms of their contribution to economic growth (Johnes et al., 2022).

These conditions are met through quality management in higher education, which includes not only corporate governance by the leadership (rector's office) and management bodies (deans of faculties, heads of departments, and laboratories) of the university but also state audit and financial control of university activities. It should be noted that state monitoring and regulation of universities' activities are specific in each country. Financial control over the activities of universities in Russia is understood as monitoring the effectiveness from the position of universities' revenues from the provision of paid services of higher education, budget financing/own revenues ratio, and revenues from the commercialization of university innovations.

In Russia, state audit is understood as quality control of higher education services that are provided by universities. In the course of quality control, attention is paid to the following indicators: level of knowledge (independent knowledge test with the help of state examinations), correspondence of educational programs to the federal state educational standards, the infrastructure of academic buildings and classrooms, level of qualification of universities' academic staff and teacher/student ratio.

The issues of monitoring and managing the quality and effectiveness of universities have been studied in sufficient detail and covered in the existing literature by Efimova et al. (2021) and Zheng et al. (2021). Nevertheless, there remains uncertainty as to what contribution monitoring and management make to the implementation of the socio-investment model of economic growth, this is a gap in the literature. The article aims to fill the identified gap in the literature and examine the contribution of quality management in higher education through state audit and financial control to the implementation of the socio-investment model of economic growth.

Literature review

The article is based on the scientific provisions of the concept of university management. When selecting literature sources for inclusion in the literature review, preference was given, first, to the most cited and, therefore, most significant publications on the topic of the paper, to ensure the reliability of the theoretical framework; second, to the latest literature sources on the topic of the paper, to take into account the current state of affairs in the subject sphere of the research.

In their works Contreras and Lozano (2022), Okure (2022), Shi et al. (2022), and Thai and Noguchi (2021) note the significant contribution of management and control to improving the quality and effectiveness of universities. The theoretical substantiation of the standards of quality and management in higher education is based on the provisions of the competence-based approach to personnel training (Noaman et al., 2017; Alzafari and Ursin, 2019). Educational standards allow guaranteeing the required integration and close connection between the labor market and the higher education services market (Gerasimova et al., 2019; Dallasheh and Zubeidat, 2022). This is an advantage of educational

standards compared to the absolute power of universities, since its absence of control may lead to the critical reduction of the quality of higher education services and the gap between them and the realities of the labor market (Bazarsky et al., 2022).

The advantage of the educational standards compared to a high level of control over the activities of universities and norming of personnel training and the limited character of government control (Mujallid, 2021). Due to this, educational standards ensure the proper quality of higher education services and, at the same time, preserve a high level of freedom and independence of universities in the aspect of management and organization of the educational process (Brøgger, 2019). This facilitates the development of the diversity of the directions of training and educational programs and supports "healthy" competition between universities (Morley and Aynsley, 2007).

In their works, Galleli et al. (2022), Kaidesoja (2022) and Wut et al. (2022) note the completeness, objectivity, and diversity of university rankings, which are evolving under the influence of the development of national systems and global trends in higher education; in recent years, international university rankings have been supplemented by indicators of gender neutrality of universities [or example, the indicator "female/male ratio," taken into account by Times Higher Education (THE), 2022] and indicators regarding the achievement of the Sustainable Development Goals (for example, "SDG rating," taken into account by QS, 2022a).

Also, new dynamically developing and progressive universities are annually incorporated into the international university rankings. For example, Times Higher Education (THE) (2022), in addition to the main (general) international university rankings, also includes "Emerging Economies University Rankings 2022" and "Young University Rankings 2022." The reviewed literature allows us to determine the amount of elaboration associated with the subject of this study as high.

Socio-investment model of economic growth is a modern model that is based on the principles of sustainable development (Wang, 2022) and supports the top-priority implementation of the following Sustainable Development Goals: SDG 1 (fight against poverty through the creation of jobs), SDG 4 (quality education and affordable higher education; Jabeen and Khan, 2022), SDG 5 (gender-neutral jobs), (Ogujiuba and Mngometulu, 2022), SDG 8 (decent work, corporate social responsibility, high-performance jobs that ensure human potential development, green jobs that support economic growth; Huidobro et al., 2022).

The essence of the described model and its main specific feature consist, on the hand, in the reliance on highly qualified and creative human resources with the acceleration of economic growth rate and the humanistic treatment of economic growth, which is to serve the interests of society and each individual (Bajraktari et al., 2022; Usman, 2022). Nevertheless, there remains uncertainty about the contribution of quality control and management of universities to the implementation of the socio-investment model of economic growth.

This raises a research question (RQ): How should monitoring, state audit, and financial control of university activities be carried out to manage the quality and effectiveness of higher education within the framework of the socio-investment model of economic growth? As an answer to this question, authors such as Bellantuono et al. (2022), Catalán and Santelices (2022), and Naven and Whalen (2022) reproduce the widespread hypothesis that monitoring, state audit, and financial control in higher education allow conducting university ratings.

To test this hypothesis and strengthen its scientific justification, this article examines the modern Russian experience of quality and performance management in higher education. In Russia, the core of the socio-investment model of economic growth is the education of students at state universities on a budgetary basis. This makes Russia a particularly suitable subject for the research in this article since public investment is known to be associated with the highest risks to quality and effectiveness.

Thus, in countries where private social investments in the form of paid educational services in higher education provided by private universities prevail, quality and effectiveness, due to high flexibility and adaptability, are assessed with the help of internal monitoring, control, and audit of private universities, with dual systems of control and audit (internal and external; Kızılay and Ödemiş, 2021). In contrast, state universities, which rely on funding from the state budget, also rely primarily on external monitoring and control—university ratings (Akah et al., 2022; Negash et al., 2022).

Materials and methods

Theoretical and methodological base of the research

The article is based on a systematic approach and presents the authors' view on the interpretation of recent results in the research field of quality management in higher education. The article is based on a widespread and well-developed scientific hypothesis that quality management in higher education should be based on university ratings. The article rethinks this hypothesis from the standpoint of stakeholder theory and forms a systematic view of monitoring and management of the quality and effectiveness of universities. Using the method of cause and effect analysis, the article in-depth studies and reveals the contribution of university ratings to the implementation of the socio-investment model of economic growth.

Order and methodology of hypothesis testing

To demonstrate the strengths and weaknesses of the formulated hypothesis, this article uses content analysis and generalization methods to systematize and critically analyze

quality and effectiveness indicators in higher education based on the leading university rankings for 2022: Times Higher Education [Times Higher Education (THE), 2022] and QS (2022a) "World University Rankings 2022," "Graduate Employability Rankings" from QS (2022b), "University rankings on the demand for graduates in the labor market" from RAEX (2022), as well as information and analytical materials on the results of monitoring the effectiveness of educational institutions of higher education in 2022 from the Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation) (2022).

As an approbation, an analysis of quality and performance management was carried out using the example of Lomonosov Moscow State University (MSU), which is a leading Russian university, as well as a long-term leader of all the above rankings, using the case study method and the obtained system of indicators. The results of the university rankings for 2022 make it possible to assess the quality and effectiveness of the management of the selected university, as well as to analyze its contribution to the implementation of the socio-investment model of economic growth in Russia.

To ensure the objectivity of the research and the high precision, completeness, and correctness of its results, this paper, first, combines the quantitative and qualitative research methods. Quantitative methods are used to collect, overview and analyze the most actual and relevant statistics. Qualitative methods are used to rethink the statistics and provide qualitative scientific treatment.

Second, this paper is based on the generally recognized and reliable sources of statistical information and takes into account a whole range of these sources (but is not limited by one of them). These sources are the information and analytical materials of the Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation) (2022), which reflect the main indicators of the Russian universities' activities, and the international university rankings Times Higher Education (THE) (2022) and QS (2022a).

Results

The system of quality and effectiveness indicators in higher education based on the leading university rankings for 2022

To form a holistic view of quality and effectiveness indicators in higher education, a systematization and critical analysis of the leading university rankings for 2022 was carried out using content analysis and generalization methods (Table 1).

As shown in Table 1, each component of the management of quality and effectiveness in higher education is presented in the considered university rankings, but only by separate indicators. The quality of higher education services, provided by a university, is characterized by the indicators "teaching" [Times Higher

Education (THE), 2022], "faculty/student ratio," "employer reputation" (QS, 2022a), as well as "educational activities," "salary of the teaching staff" and "teachers' qualification level" [Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation), 2022].

Productivity and quality of the scientific activities are characterized by the indicators "research," "citations" [Times Higher Education (THE), 2022], "citations per faculty," "academic reputation" (QS, 2022a), as well as "research activities" [Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation), 2022]. Financial effectiveness is characterized by the indicators "industry income" [Times Higher Education (THE), 2022] and "financial and economic activity" [Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation), 2022]. Internationality of a university is characterized by the indicators "international outlook" [Times Higher Education (THE), 2022], "international students ratio," "international faculty ratio" (QS, 2022a), and "international activities" [Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation), 2022].

The results from Table 1 revealed the weaknesses of the formulated hypothesis, which are the discrepancy and fragmentary nature of university rankings. None of the rankings provides a complete picture of the quality and effectiveness of universities. Indicators from different rankings are often in conflict with one another. So, for example, the indicator "faculty/student ratio" from the QS ranking (2022a) shows the number of academics per student, according to this indicator, the more teachers there are for each student, the higher the quality of higher education services provided by the university.

At the same time, the indicator "financial and economic activity" from the materials of the Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation) (2022) has a better value, the fewer teachers work at the university. In addition, in Russia, state universities have strict norms and standards that minimize the number of teachers per student, designed to maximize the financial and economic effectiveness of universities. The revealed contradiction between quality and effectiveness dictates the need for simultaneous consideration of all these indicators for a reliable comprehensive assessment.

The strength of the hypothesis under consideration is that systematic monitoring of the leading university rankings for 2022 makes it possible to assess the quality and effectiveness in higher education with high accuracy and reliability. For this purpose, the authors recommend grouping indicators with the following generalized components of university management: (1) the quality of higher education services provided by the university; (2) productivity and quality of scientific activity; (3) financial efficiency; (4) internationality of the university; and (5) employment of graduates. When monitoring the quality and

TABLE 1 The system of quality and effectiveness indicators in higher education based on the leading university rankings for 2022.

Components of management	Statistical indicators	The essence of the indicator	Source of official statistics
Quality of higher education services provided by the University	Teaching	The learning environment	Times Higher Education (THE) (2022)
	Faculty/student ratio	Number of academics per student	QS (2022a)
	Employer reputation	The ability to attract and retain the best teaching staff	QS (2022a)
	Educational activities	The passing score for enrolling in a bachelor' or specialist degree program in an intramural form of education at the expense of budgetary funds	Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation) (2022)
	Salary of the teaching staff	The ratio of the salary of the teaching staff to the average salary in the economy of the region	Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation) (2022)
	Teachers' qualification level	Number of teachers with academic degrees per 100 students	Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation) (2022)
Productivity and quality of scientific activity	Research	Volume, income, and reputation	Times Higher Education (THE) (2022)
	Citations	Research influence	Times Higher Education (THE) (2022)
	Citations per faculty	Total number of academic citations in papers	QS (2022a)
	Academic reputation	Teaching and research quality	QS (2022a)
	Research activities	Cost of R&D per teacher (commercialization of university innovations)	Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation) (2022)
Financial effectiveness	Industry income	Knowledge transfer	Times Higher Education (THE) (2022)
	Financial and economic activity	Income from all sources per teacher	Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation) (2022)
Internationality of the University	International outlook	Staff, students, and research	Times Higher Education (THE) (2022)
	International students ratio	The ability to attract quality students and staff from across	QS (2022a)
	International faculty ratio	the world	QS (2022a)
	International activities	Share of international students	Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation) (2022)
		Share of foreign teachers	
Employment of graduates	The demand for graduates by employers		RAEX (2022)
	Graduate Employability		QS (2022b)

Compiled by the authors.

effectiveness, state audit, and financial control of higher education, it is recommended to take into account the selected components of university management in an integrated manner.

Case study of quality and performance management of higher education in Russia

As a result of studying the case experience of implementing the socio-investment model of economic growth in Russia, a significant feature has been identified. This feature consists in the fact that when making decisions on state orders related to the allocation of budget places to universities, state regulatory bodies of higher education seek to fill in the gaps in the labor market. Because of this, the most promising areas of placement of social investments remain uncovered by budget places.

As a rule, budget places are not allocated for those educational programs that are in the highest demand among applicants (allowing getting the most prestigious job, guaranteeing the best employment conditions: comfort and remuneration, career building) and which are very popular as paid educational services.

Instead, the state allocates the main budget places for those educational programs that are not popular. This makes it possible to increase their attractiveness and overcome the shortage of personnel in the labor market.

The described feature has a contradictory interpretation in the existing literature, where the authors note the increased risks of imbalance associated with it, the increasing disparity of the higher education services market from the labor market (Crowley-Vigneau et al., 2022; Taranov and Ugnich, 2022; Timofeyev and Dremova, 2022). This could potentially limit the contribution of social investment to economic growth. To determine what the real implications for economic growth are provided by social investments in the Russian model, a case analysis of quality and performance management was conducted on the example of a leading Russian university, which is a long-term historical leader of all the above rankings: Lomonosov Moscow State University (MSU).

In all the rankings under consideration, MSU occupies the best or leading position among Russian universities. Thus, according to the Times Higher Education rankings [Times Higher Education (THE), 2022], MSU is in 158th place (56.8 points), in the ranking of universities by QS (2022a), in 78th place (65.6 points). Monitoring by the Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation) (2022) does not result in a rating, but reflects the ratio of indicators for the university to the average indicators in Russia—MSU is significantly ahead of the average Russian level of quality and effectiveness in all indicators.

As a result of detailed analysis in the context of the selected indicators, it was revealed that according to the "teaching" indicator, MSU in 2022 demonstrated a very high result [80.3 points out of 100 possible; Times Higher Education (THE), 2022]. The value of the indicator "employer reputation" is high [76.5 points), and the indicator "faculty/student ratio" is very high: 99.8 points (QS, 2022a]. MSU also demonstrated very high values of the indicators "educational activity" (84.28 points), "teachers' salaries" (205.77), and "teachers' qualification level" (10.76; Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation), 2022). According to the totality of the considered indicators, it is possible to characterize the quality of higher education services provided by MSU as high.

According to the "research" indicator, MSU in 2022 showed a high result (69.9 points)—the highest indicator among Russian universities presented in the rating. But according to the "citations" indicator, the result was low [12.8 points; Times Higher Education (THE), 2022]. By comparison, the value of this indicator in another Russian university—Don State University—is 96.9 points in 2022. The value of the indicator "academic reputation" is high: 79.5 points (the highest among Russian universities). But the value of the indicator "citations per faculty" is low: 5.9 points (QS, 2022a). By comparison, the value of this indicator in Novosibirsk State University is 19.5 points in 2022.

At the same time, MSU also demonstrated a very high value of the indicator "research activity": 726.42 million rubles [Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation), 2022]. According to the totality of the considered indicators, the productivity and quality of MSU scientific activity can be characterized as high.

According to the "industry income" indicator, MSU in 2022 demonstrated a very high result: 99.3 points [Times Higher Education (THE), 2022]. MSU also demonstrated a very high value of the indicator "financial and economic activity": 4,015.53 million rubles [Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation), 2022].

According to the indicator "international outlook" MSU in 2022 demonstrated a high result: 72.5 points [Times Higher Education (THE), 2022], with just Tomsk State University (among Russian universities in 2022) ahead (73.6 points). The value of the indicator "international students ratio" is very high (87.8 points), 5th position in Russia, with Tomsk State University (93.8 points) being the leader. But the value of the indicator "international faculty ratio" is low (7.3 points; QS, 2022a). By comparison, the Russian leader in 2022—National Research Nuclear University MEPhI (Moscow Engineering Physics Institute)—has this indicator at the level of 37.2 points.

MSU also demonstrated a very high value of the indicator "international activity": 12.25% [Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation), 2022]. According to the totality of the considered indicators, the internationality of MSU can be characterized as high.

In 2022, MSU also became the best university in terms of the level of demand for graduates by employers, taking first place in the all-Russian rating of RAEX (2022) and in the QS rating (2022b), taking 121th–130th place in the world in terms of "graduate employability." According to the totality of the considered indicators, it is possible to characterize the level of employment opportunities for MSU graduates as high.

Discussion

The article develops the scientific provisions of the university management concept. Unlike Galleli et al. (2022), Kaidesoja (2022), and Wut et al. (2022), the article proves that university rankings, despite their diversity, are not universal. They allow for international comparisons, determining the global competitiveness of universities. Nevertheless, university rankings, when used in isolation, are unsuitable for corporate and state management of universities and for the purposes of making decisions about the provision of state-funded places to universities. To overcome this limitation, it is advisable to take into account the results of several university rankings.

Unlike Crowley-Vigneau et al. (2022), Taranov and Ugnich (2022) and Timofeyev and Dremova (2022), the article proves that the peculiarity of the socio-investment model of economic growth in Russia does not hinder, but supports its implementation. The impact of the labor market on the market of higher education services is not unilateral (direct), but it also has the opposite effect – these markets are systemically interdependent and influence each other. The allocation of budget places to universities for the least popular educational programs allows not only to overcome the shortage of personnel in the labor market but also stimulates the demand of employers for professions supported by the state. Thanks to this feature, the integration of the labor market and the market of higher education services is achieved in Russia.

The contribution of the article to the literature consists in the systematization of quality and effectiveness indicators in higher education based on the leading university rankings for 2022. Thanks to this, the article has formed a scientific and methodological basis for a multi-criteria assessment of the activities of universities, which allows determining the quality and effectiveness of universities with the highest accuracy, completeness, and reliability.

The paper's originality consists in its proposing a new approach to the implementation of state audit and financial control over the activities of universities. The key conclusion of the research is as follows: no university rating can be exhaustive, all of them have natural limits. Based on this conclusion, to raise the effectiveness of quality management in higher education, we should not limit ourselves to the improvement of a single university rating. For example, such a rating in Russia is the materials of the Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation) (2022).

Instead of this, a new approach to quality management in higher education in the socio-investment model of economic growth offers to consider—in a comprehensive manner—the materials of several ratings—internal and external—international, among which an important place belongs to Times Higher Education (THE) (2022) and QS (2022a). The proposed new approach will allow increasing the precision, completeness, objectivity, and reliability of state audit and financial control over the activities of universities.

Conclusion

Based on the results of the study, it can be concluded that the article answered the posed RQ and strengthened the evidence base of the hypothesis that monitoring, state audit, and financial control in higher education allow for university ratings. It is demonstrated that the weak side of this hypothesis is the inconsistency and fragmentation of university rankings.

The strength of the hypothesis under consideration is that systematic monitoring of the leading university rankings for 2022 makes it possible to assess the quality and effectiveness

of higher education with high accuracy and reliability. For this purpose, the authors recommend grouping indicators with the following generalized components of university management: (1) the quality of higher education services provided by the university; (2) productivity and quality of scientific activity; (3) financial efficiency; (4) internationality of the university; and (5) employment of graduates. The authors' recommendations were tested using a case study of quality control and management and the efficiency of higher education in Russia.

The scientific novelty and originality of the article are associated with a systematic view of the quality and effectiveness of higher education, which was first formed by the authors through a combination and grouping of indicators from the leading university rankings for 2022. The theoretical significance of the authors' conclusions lies in the fact that the article clearly identifies a significant contribution of the quality control of education and the performance management of universities to the implementation of the socio-investment model of economic growth.

Rethinking the existing hypothesis from the standpoint of stakeholder theory proved that only when the results of university rankings are systematically taken into account, they satisfy the interests of all stakeholders—university administration and management, state regulators of higher education, students, teachers and employers—and ensure the contribution of university rankings to the implementation of the socio-investment model of economic growth.

The practical significance of the obtained results is that the scientific and methodological basis for monitoring and assessing quality and effectiveness in higher education based on the leading university ratings for 2022 makes it possible to improve the state audit and financial control of university activities in the implementation of the socio-investment model of economic growth. The scientific and methodological basis formed in the article for monitoring and evaluating the quality and effectiveness of higher education is based on the leading university rankings for 2022. It makes it possible to improve the internal corporate governance (leadership by the rector's office and management bodies by the deans of faculties and heads of departments and laboratories) of the university, as well as external (by the state) management of the quality and effectiveness of universities in support of the implementation of the socio-investment model of economic growth.

In conclusion, it is worth noting that such socio-investment models of economic growth, involving a significant number of budget places at universities, are characteristic of many countries around the world. Among them are Germany, France, Italy, Greece, the Czech Republic, Slovakia, Finland, Norway, Iceland, Argentina, China, and India, as well as other countries in which there are many state universities. This makes the experience of Russia useful for many other countries to which the conclusions of this study can be extended and for which the results and recommendations of this article will be useful.

However, the focus on Russia's experience is a limitation of this research. Experience of other countries, where there are many state universities, needs further study. Given the popularity of country models of higher education, it is expedient to study this experience separately for each country.

Though the general conclusion of this research—that it is necessary to take into account the materials of a set of university rankings for the most reliable state audit and financial control of the activities of universities—could be extended to other countries, the list of specific rankings and indicators will vary. The samples of prospective university rankings and their indicators for the monitoring and management of quality in higher education in the socio-investment model of economic growth in various countries of the world should be determined and substantiated in further studies.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found here: 1. Ministry of Science and Higher Education of the Russian Federation (Ministry of Education and Science of the Russian Federation) (2022). Information and analytical materials on the results of monitoring the effectiveness of the activities of educational institutions of higher education in 2022. URL: https://monitoring.miccedu.ru/iam/2022/_vpo/inst.php?id=1725 (data accessed: 03.09.2022). 2. QS (2022a). World University Rankings 2022. URL: https://www.topuniversities.com/university-rankings/world-university-rankings/2022 (data accessed: 03.09.2022). 3. QS (2022b). Graduate Employability Rankings. URL: https://www.unipage.net/ru/2273 (data accessed: 03.09.2022). 4. RAEX (2022). Ranking of universities the demand for graduates in the labor market. URL: https://raex-rr.com/education/universities/rating_of_universities_by_graduates_in_demand#cart (data accessed: 03.09.2022). 5. Times Higher Education (THE) (2022). World University Rankings 2022. URL: https://www.timeshighereducation.com/world-university-rankings/2022#!/page/0/length/25/locations/RUS/sort_by/rank/sort_order/asc/cols/scores (data accessed: 03.09.2022).

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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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Promoting future work skills in vocational training and baccalaureate setting through engagement in volunteering

María del Carmen Olmos-Gómez*, Marina García-Garnica and Jose Javier Romero-Díaz de la Guardia

Department of Methods of Research and Diagnosis in Education, University of Granada, Granada, Spain

The aim of the present study was to analyze differences in future work skills as a function of participation in volunteering and work. The present study was based on a total sample of 3,101 students enrolled in secondary and baccalaureate education and vocational training in Andalusia (Spain). Once the quality parameters of the instrument were determined, its reliability and validity were confirmed, and data collection was initiated. With regards to data analysis, multivariate analysis (ANOVA) was conducted which interacted the variable describing engagement in volunteering and the variable pertaining to employment, with both variables having two levels (yes−no). From the data obtained, it was concluded that working or having worked at some point in time was particularly related with aspects related to intelligence linked with the society in which work is carried out. Other conclusions were that workers and volunteers possessed better competency attributions, knowledge of new means of communication and multidisciplinary skills. These outcomes were related with a series of motivations such as professional development, personal growth and putting their abilities into practice in order to improve their professional career.

Introduction

In the present day, transformations in the social and occupational fields are producing constant development at both a technological and an educational level. Today, the work of educational institutions is more important than ever for establishing collaborative networks in the formative setting. This work should be conducted alongside businesses and community organizations in order to achieve a better type of education which is capable of taking on new challenges and capitalizing on the job opportunities created by the huge social, human and technological change in which we are immersed in the 21st century

(Mischel and Shoda, 1995; Wong et al., 2010; Australian Collaborative Education Network (ACEN), 2015).

Volunteering is one of the most used forms of occupational development by professional entities. This is because it provides practical experiences in which problems are solved in specific systems (Vorotilkina and Koroleva, 2019) and it strengthens demand for young motivated workers who are interested in the progress of their company. In other words, companies seek out young people who are capable of contributing positive ideas, developing their personality whilst, at the same time, addressing their work interests (Lobanova, 2020).

Current literature suggests that a number of companies are using voluntary action as a means of job hiring, given that this activity provides beneficial outcomes for both sides (as much for the corporations themselves as for the volunteering sector) (Lee et al., 2018). These corporations are benefitted due to the fact that they improve their image, obtaining a competitive advantage over other corporations whilst, at the same time, the arrangement helps to sustain and run voluntary activities (Bocquet et al., 2020). Work such as that carried out by Vlaholias et al. (2015) has identified that it is necessary to measure the size and reach of voluntary activities, including those of charitable non-profit organizations, in order to get a real idea of existing voluntary action. Participation in volunteering should generate satisfaction in those involved. To achieve this it is important to keep in contact with participants and support them to encourage greater cooperation (Rozmiarek et al., 2021).

This describes the concept of volunteering as an aspect that can be developed for the acquisition of skills that promote the working future of young people. Within this concept, it is important to highlight which professional skills contribute greater quality to student training, *via* experiences that provide a service to the community to improve the lives of those individuals that make up the community (Trevethan, 2017; Carrillo et al., 2019). It is also important to identify the learning programs that encapsulate them.

This concept is based on the idea of learning *via* '*in situ*' learning, typically achieved through practical sessions (service-learning [SL]) in which students perform activities outside of the classroom (Rodríguez-Gallego, 2014). Thanks to this new approach to learning, students can apply their knowledge and participant in an institution other than the educational institution (Mackaway et al., 2011).

The learning obtained through practical experiences enables activation of transformative competencies so that, at a later point, the learning will be able to act (Fraile et al., 2020; Mezirow, 2020). It is, therefore, necessary to clarify that, in order to respond appropriately to the diverse situations that must be managed throughout development, skills must be acquired which enable the learner to question any belief or personal assumption at the time. When students are able to perform this process adequately it is because transformative learning has been carried out correctly through reflection and dialog (Gewessler and Norris, 2020; Álvarez Justel and Ruiz Bueno, 2021).

The Phoenix Report on future work skills for H2020 (Davies et al., 2011) proposed that one road towards skill development lies within work efforts and occurs *via* the implementation of a training process which leads to the attainment of essential skills for the future workplace. With regards to these skills, values linked to volunteering take on an important role. These include social intelligence, interculturality and critical thinking, with all of these making the link established between job development and volunteering essential. These skills include critical thinking or the capacity to evaluate ideas, contribute new ideas and make decisions. Considering the values referred to above in turn, social intelligence focuses on cognitive capacity and problem solving. Social intelligence is based on adapting to the context and perceived social support. Innovative and adaptive thinking refers to the capacity for change. Intercultural skills enable effective interaction in a diverse world that is in a state of constant development. Further, mastery of "Big Data" is important as this is based on spatial and mathematical knowledge of information for its application in real world situations. An effective relationship with media and social networks is useful for the transmission of knowledge, as is the capacity to combine various disciplines. Multidisciplinary skills are crucial in a society that is evolving at different levels. A creative mentality is needed to establish new response processes and deal with the diverse situations faced by individuals. Knowledge management is important for structuring and making use of both short- and long-term memory, covering also reasoning and the basis of memory. Finally, virtual collaboration in digital settings is needed, both individually and collectively, as a means of advancing individual and social development.

These skills within the entrepreneurial framework are developed by Jardim (2021) who concludes that entrepreneurial skills (creativity and innovation, spirit of initiative, self-efficacy and resilience, strategic planning and evaluation, problem solving and decision making, transformational leadership, clear and visual communication, teamwork and networking, and digital communication) are necessary for professional success in the labor market, where innovation, the promotion of creating value and communicating efficiently are fundamental. For this, they must be developed from education in general and integrated as part of the curriculum or in an interdisciplinary way, following the methodology of learning by discovery.

Therefore, the transmission by the educator of inspirational strategies, valuing the entrepreneurial culture, should be one of the tools that promote the entrepreneurial mindset and the transfer of knowledge to society to improve its resources and social problems (Jardim et al., 2021).

Given the situation currently being lived due to COVID-19 and the constantly changing social demands and transformations taking place in job settings, all individuals have had to adapt to e-learning and new online model of learning. Active populations in some regions of the European Economic Community, such as the Mediterranean basin, find themselves under a large degree of adaptive stress due to the closure of a large number of small and

medium businesses. This has had consequences on rates of unemployment and social exclusion (Olmedo-Moreno et al., 2020). These important social problems must be tackled with proactive employment and social interaction policies but, also, through prior actions such as educational policies which promote job insertion and occupational autonomy.

Such future actions should be focused on humanizing interpersonal actions, encouraging compassionate and empathetic voluntary actions to help other peers who find themselves in a difficult situation (Gelles et al., 2020). They should also provide the skills and knowledge needed to achieve success, with these actions, at a later point, facilitating necessary job inclusion (Akhmetshin et al., 2019).

In this context, the main aim of the present study is to determine whether or not significant differences exist in perceptions of the future work skills addressed at secondary and baccalaureate educational institutions in Andalusia, as a function of whether students are employed (yes–no) and engaged in volunteering (yes–no).

Materials and methods

Method

The present research design was non-experimental, quantitative, descriptive-exploratory, cross-sectional and ex post-facto in nature. A non-probabilistic, convenience and incidental sample was recruited.

Participants

A total sample of 3,101 individuals took part, consisting of 46.51% male and 53.48% females. With regards to age, representation was selected to cover ages 15 to 35. Specifically, those aged between 15 and 20 years made up 80.2%, those aged 20–30 corresponded to 14.6% and those aged 30 and over made up 5.2% of the sample ($M = 20.59$, $SD = 6.75$). With regards to having a job, 69.8% were not engaged in any occupational activity, relative to 30.2% who were. Finally, with regards to volunteering, 13.3% reported that they were volunteers and 86.7% reported that they were not.

Instruments

The present study was conducted by members of the Department of Research Methods and Diagnostics in Education in the Faculty of Educational and Sport Sciences in Melilla and the Faculty of Educational Sciences. Both of these faculties belong to the University of Granada and are dedicated towards the personal, professional and academic orientation of students. A questionnaire was developed and validated to estimate future work skills in

secondary students in Andalusia and the way in which participation in volunteering and current employment or employment history influences their development. On the one hand, the questionnaire incorporated sociodemographic variables and, on the other, it included variables related with future work skills. Design of the instrument was based on main theoretical foundations and international recommendations for test development (Comrey, 1985). For data collection, the present study counted on the voluntary participation of secondary students from 14 institutions in Andalusia. Permission was granted to enter university classrooms prior to data collection, in accordance with the Helsinki protocol.

During the elaboration of the questionnaire, the Phoenix Report on future work skills for H2020 was considered (Davies et al., 2011). This was adapted to the context of unaccompanied foreign minors by Expósito-López et al. (2020).

With the aim of examining comprehension and clarity of questionnaire items, an expert group considered the different options, correcting and adjusting the questionnaire according to highlighted corrections. This process was based on the Delphi technique and was performed in five rounds. Experts showed 85% agreement ratings (Chacón-Cuberos et al., 2021). The final questionnaire comprised 10 questions which were divided into two factors, alongside the sociodemographic variables. Factor 1 encapsulated questions linked with cognitive and adaptive skills, whilst factor 2 considered questions pertaining to collaboration and integration skills.

This version of the questionnaire was administered to a pilot sample of 1,159 students in order to evaluate the content validity and consistency of the questionnaire. Inter-rater agreement between the experts was higher than 85%. Construct validity was examined using confirmatory factor analysis (CFA) employing the program IBM Amos Graphics®. Goodness of fit was examined according to the goodness-of-fit criteria stipulated by Kock (2014). In the case of χ^2 values, non-significant p values indicate good model fit. Values of comparative fit index (CFI), normalized fit index (NFI) and incremental fit index (IFI) are considered to be acceptable when higher than 0.90, with values higher than 0.95 being excellent. Finally, root mean square error approximation (RMSEA) values are considered excellent when they are lower than 0.05 and acceptable when lower than 0.08 (Chacón-Cuberos et al., 2021). Reliability analysis was conducted *via* examination of the Cronbach alpha coefficient, setting the reliability index at 95%.

Procedure

Firstly, authorization was requested and received from the Andalusian Education Authority to contact directors of the institutions. These were then contacted *via* letter and, once permission was received, questionnaires were administered, in-person. A member of the team was present at all times in order to clarify doubts and address any problems. Both teachers and students were informed that the study was voluntary in nature and

that anonymity would be protected throughout. Information was also provided about the aims and objectives of the study. Next, the questionnaire was administered in paper format to students 25 min before the end of class. Data were collected during the first and second term of the 2020–2021 academic year. Likewise, approval was received from the Research Ethics Committee of the University of Granada (reference number: 1678/CEIH/2020).

Data analysis

Once data had been collected, homogeneity of data was verified by examining asymmetry and kurtosis, in addition to outcomes of the Levene test. Outcomes supported the use of parametric tests. Thus, a multivariate ANOVA was used. This test is considered to be the most appropriate test for comparing two groups. Namely, the two groups pertained to employment, which had two levels (yes–no) and volunteering, which also had two levels (yes–no). These two groups were compared in relation to the two factors previously established through confirmatory analysis conducted by Chacón, Expósito-López et al. (2020). In this sense, the ten variables were divided into the two groups that demonstrated greatest validity in this previous analysis. The ten skills were scored according to four levels which corresponded to the following ranges: Level 1 (0–10), level 2 (11–13), level 3 (14–17) and level 4 (18–20). These can be consulted in the appendix provided by Expósito-López et al. (2020). Data were analyzed using the program SPSS 24.0.

Results

Table 1 presents results of the multivariate ANOVA analysis. It can be seen that significant differences existed between perceptions of the ten evaluated skills [Skills for Future Work (H2030)] in those who were employed and those who engaged in volunteering.

Multivariate tests permit simultaneous analysis of the relationship between different levels of the same variable (future work skills) and the significance of the relationship between the levels of two different variables (employment, yes–no; volunteering, yes–no) using mean individual scores (Andréu, 2011). Results point to significant differences, albeit with small effect sizes, with regards to the different examined skills and the relationship they hold with volunteering, employment and the interaction between both. The sample size and proportion of variance explained (by the ANOVA) (Coe and Merino, 2003; see Table 1), in relation to the variable describing the skill of designing a new way of thinking, produced a result of $\eta^2 = 0.14$. Normally, eta-values higher than 0.14 determine a large effect. This suggests that the differences found to emerge in this future work skills can be attributed to the effect of the ability to establish new ways of thinking as a function of the capacity to adapt to the context and situations. The high value could be due as much to the

representation of workers in the same as the specific influence of volunteering, given that different levels were studied and various measures derived from different populations (Comrey, 1985; Richardson, 2011; Closas et al., 2013; Lakens, 2013). In the same way, significant differences were shown with regards to the interaction between volunteering and employment, as a function of original and adaptive thinking skills and intercultural skills, and sample size which, despite not being very large, is notable for being close to 0.10.

The fit of ANOVA data to the gathered data revealed significant associations in relation to the skills of "creating meaning" ($p = 0.004$), "intercultural competence" ($p = 0.013$), "literacy pertaining to new means of communication" ($p = 0.004$), "multidisciplinary skills" ($p = 0.001$), "design a new way of thinking" ($p = 0.004$) and "cognitive load management ($p = 0.002$)," as a function of volunteering. Thus, it can be observed, in all cases, that being a volunteer implied positive development of the skills presented above.

With regards to outcomes pertaining to students as a function of employment, significant differences were found regarding "social intelligence" ($p = 0.004$), "original and adaptive thinking" ($p = 0.004$), "intercultural competence" ($p = 0.004$), "computational thinking" ($p = 0.004$), "interdisciplinary skills" ($p = 0.004$) and "designing a new way of thinking" ($p = 0.004$). In the case of skills based on social and contextual intelligence and adaptation, intercultural skills and computational skills, students who were not employed perceived themselves to be more competent at these skills. The groups of employed students considered themselves to have better skills with regards to discipline and adaptation to change.

Obtained outcomes pertaining to the interaction between work skills as a function of the interaction between volunteering and employment revealed significant differences regarding "creating meaning" ($p = 0.007$), "original and adaptive thinking" ($p = 0.000$), "intercultural competence" ($p = 0.000$), "literacy pertaining to new means of communication" ($p = 0.003$), "interdisciplinary skills" ($p = 0.000$) and "designing a new way of thinking" ($p = 0.000$). Students who were volunteers and employed, or who had been employed at a point in time, considered themselves to have better abilities when it came to creating meaning, use and knowledge of new means of communication, and multidisciplinary skills. Students who volunteered but were not employed considered themselves to have better intercultural attitudes and better approaches to designing new thinking for problem solving and context adaptation. In contrast, those who volunteered and were not employed believed that they were more apt when it came to adaptive thinking.

Table 2 presents outcomes of the multivariate ANOVA analysis, which was used as an analytical technique to analyze dependent and independent associations between variables. This test demonstrated that significant differences existed in questionnaire responses [Skills for Future Work (H2030)] which reflected different perceptions of skills, as a function of the two examined levels of volunteering and employment. This enabled

TABLE 1 Analysis of variance (ANOVA) and effect size (η^2) outcomes regarding perceptions of future work skills as a function of being in employment or volunteering.

Items	Volunteering			Employment			Volunteering × employment (corrected model)		
	F	p	η^2	F	p	η^2	F	p	η^2
1. Create meaning	8.311	0.004	0.003	1.204	0.273	0.000	4.074	0.007	0.004
2. Social intelligence	2.022	0.155	0.001	4.289	0.038	0.001	2.119	0.096	0.002
3. Original and adaptive thinking	0.326	0.568	0.000	26.629	0.000	0.009	9.036	0.000	0.009
4. Transcultural competence	6.203	0.013	0.002	20.803	0.000	0.007	9.006	0.000	0.009
5. Computatio-nal thinking	1.214	0.271	0.000	4.183	0.041	0.001	1.969	0.116	0.002
6. Literacy pertaining to new means of communication	13.181	0.000	0.004	0.54	0.463	0.000	4.632	0.003	0.005
7. Transdiscipli-nary abilities	4.342	0.037	0.001	8.588	0.003	0.003	6.781	0.000	0.007
8. Design new ways of thinking	11.513	0.001	0.004	30.639	0.000	0.01	14.141	0.000	0.014
9. Cognitive load management	5.12	0.024	0.002	0.024	0.876	0.000	1.723	0.16	0.002
10. Virtual collaboration	0.651	0.42	0.000	4.951	0.026	0.002	1.878	0.131	0.002

Multilevel linear adjustment was applied to reduce type I error (α). To this end, the α-value was divided by the number of pairwise comparisons for each ANOVA.

TABLE 2 Analysis of variance (ANOVA) and effect size (η^2) results for the sums of aggregated scales pertaining to future work skills, as a function of volunteering and employment.

Origen	Dependent variable	Type I sum of squares	df	Squared mean	F	p	η^2
Corrected model	FACTOR1	5.642a	3	1.881	4.73	<0.005	0.005
	FACTOR2	2.220b	3	0.74	1.499	>0.005	0.001
Intersection	FACTOR1	25219.23	1	25219.23	63428.13	<0.005	0.954
	FACTOR2	20575.66	1	20575.66	41683.8	<0.005	0.931
Employment	FACTOR1	1.145	1	1.145	2.88	>0.005	0.001
	FACTOR2	0.075	1	0.075	0.151	>0.005	0.000
Volunteering	FACTOR1	4.495	1	4.495	11.305	<0.005	0.004
	FACTOR2	0.853	1	0.853	1.727	>0.005	0.001
Employment* volunteering	FACTOR1	0.002	1	0.002	0.006	>0.005	0.000
	FACTOR2	1.293	1	1.293	2.619	>0.005	0.001

The critical alpha level was adjusted for multiple testing to reduce type I error (α). To this end, the α-value was divided by the number of pairwise comparisons conducted in each ANOVA. Outcomes were adjustment to determine significance in terms of 95% confidence intervals and *$p < 0.005$.

observation of differences in variance of the independent means pertaining to these variables.

Table 2 presents ANOVA outcomes. It can be seen that significant differences were not identified and only small effects were found for factor 1 with regards to the interaction between employment and volunteering ($F = 0.006$, $p > 0.005$, $\eta^2 = 0.000$). The same occurred with factor 2, with significant differences not being found with regards to the interaction between employment and volunteering ($F = 2.619$, $p > 0.005$, $\eta^2 = 0.001$; Cohen et al., 2003; Richardson, 2011; Lakens, 2013).

Outcomes demonstrated small effect sizes and little explained variance (ANOVA), with this being lower than 0.14 (Cohen, 1988) and not being considered as a meaningful effect (Badenes et al., 2018). With regards to factor 2, identified

differences were related with disciplinary behavior and acceptance of norms. In line with that examined, the group of unemployed students reported agreement with this item to a lesser extent, in this way, showing that they had greater difficulty accepting disciplinary actions and complying with accepted behavior norms.

Discussion and conclusion

In order to carry out the present study, the inter-relationship between volunteering and being in present employment, or having been employed at some timepoint, was analyzed. This analysis was conducted in students enrolled on secondary or

baccalaureate education, or vocational training, for whom employment (in the case of being employed) was short-term and not a part of their formative development. For this reason, they were still undertaking regulated education with the purpose of working towards a professional future which encouraged their social development. As a result of this, differences in the future work skills of these groups were compared with the aim of identifying tools which could facilitate inclusion in the workforce. Outcomes from ANOVA analysis demonstrated significant differences and moderate effect sizes in relation to participant response frequencies when asked about the different examined skills. Differences were seen in both personal student development and in the two established factors of cognitive and adaptability skills (factor 1) and collaboration and integration skills (factor 2). Thus, differences were found which favored volunteering, specifically, when examining variables linked with competencies pertaining to thinking, interculturality, use of new channels of communication, disciplinary norms, cognitive thinking and problem solving. As supported by the literature, this may be due to the fact that volunteering is an organized, social and sustainable activity, which is performed in a set time and within a given organization or entity and has repercussions that affect the participant themselves and other individuals (Penner, 2002). A series of values exist which are obtained following engagement in voluntary actions. These activities bring with them social benefits but, also, personal benefits given that they improve various aspects related with cognitive and moral development. At the same time, they help advance other abilities such as teamwork, time management and self-confidence (Madsen, 2004). All of these aforementioned outcomes were supported by present findings. Given that participants were adolescent students (82%), they represent an important social group. Any type of impact related with their training and development of their personality will have repercussions on the future workforce as, in just a short period of time, they will be leaders in our society. Involvement in volunteering is influenced by diverse factors related with organizational characteristics, cultural norms, motivation, and the personality of participants and their satisfaction with the tasks they carry out (Sundram et al., 2018). This activity may be influenced by specific values such as altruism, solidarity, responsibility and generosity (Jardim and Marques da Silva, 2018), all of which are common values when it comes to interculturality, digital literacy and disciplinary skills.

Present findings demonstrate that being employed, or having been employed at some point in time, is specifically linked to aspects related with intelligence pertaining to the society in which students develop, the adaptation of though, new types of computational thinking, interculturality and interdisciplinarity. According to Schieman and Gabriel (2008), education is one of the main routes to achieving greater personal control. This control will determine different employment and work opportunities in the future and economic security, thanks to socialization effects (Hitlin and Kirkpatrick, 2015).

For this reason, individuals who possess a high level of education tend to obtain more positive educational outcomes, reaching greater levels of control (Uchechi et al., 2016). Thus, students should continue to strive for a permanent ongoing education and pursue continued formation. This will equip them to achieve better future employment, finding better gaps to fill in the job market and enabling them to develop a professional path that is in line with their vocations.

The present research also highlights other relevant aspects. For example, students were not aware of the importance of volunteering to their working future. This is seen in the fact that although the interaction did produce differences in various skills when examined separately, these differences did not emerge when outcomes were examined according to factors. In the case of the latter, only the factor pertaining to collaboration and integration skills produced significant differences. These differences favored workers, with volunteering seeming to have greater impact over more traditional skills, such as those related with altruism and the development of social interactions (Czike and Kuti, 2006). Vocation-linked learning, and students' choice of vocation is part of their sense of self and subjugated to it, in relation to social benefits of students is part of their sense of self and is subjugated to it, in relation to the social benefits (Karlsson et al., 2022). Despite the fact that, in the present day, volunteers opt to engage in this activity in order to obtain some type of personal benefit, only when the analysis was broken down to consider individuals skills, were workers and volunteers observed to possess better skill attributions, knowledge about new media and multidisciplinary skills. This finding was related with a series of motivations such as professional development, personal growth and the practical application of skills as a means to improving one's professional and occupational development (Handy et al., 2010). The real reasons behind which individuals decide to become volunteers have been found to be personal realization and other personal circumstances (Chacon et al., 2010).

Limitations of the study

It is necessary to highlight some of the limitations of the present study. Firstly, the sample should be broadened to include more teaching institutions, going beyond Andalusia and even Spain (and perhaps even Europe). Likewise, the need is highlighted to conduct more studies that are capable of providing evidence about future work skills. It would be useful to identify the agents and social principles required for this concept to come to life. Another of the limitations faced by the present study was due to challenges in accessing the sample caused by the covid-19 pandemic and described at an earlier point in the study. This complicated the recruitment of participants. Nonetheless, it is important to indicate that data collection was completed as expected within an acceptable time frame.

As a continuation of this study, we propose the creation of evaluation and diagnostic tools for the detection of values that

promote employment, based on the labor competencies developed in this study. These values will allow us to know the involvement of users in volunteering, with respect to labor market insertion, creating synergies that promote such market insertion. In this way, we will be able to establish improvements in the educational strategies of secondary school, high school and vocational training, for their future incorporation into the labor market from a business-social value perspective.

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.

Ethics statement

The studies involving human participants were reviewed, approved and conducted according to the guidelines of the Declaration of Helsinki, and approved by the Research Ethics Committee of the University of Granada (reference number: 1678/CEIH/2020). Written informed consent to participate in this study was provided by the participants' legal guardian/ next of kin.

Author contributions

MO-G conceived the hypothesis of this study and writing— review and editing. MG-G and JR participated in data collection. MO-G and JR analyzed the data. All authors contributed to data interpretation of the statistical analysis, wrote the manuscript with significant input, contributed to the data analysis interpretation, and read and approved the final manuscript.

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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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Educational and labor migration in the new horizons of economic integration in the Eurasian Economic Union

Inna V. Andronova* and Sergey V. Ryazantsev

Department of International Economic Relations, Peoples' Friendship University of Russia, Moscow, Russia

The paper focuses on clarifying the cause-effect relations of educational and labor migration in implementing the social investment model of economic growth in the Eurasian Economic Union (EAEU). The paper aims to investigate the role of educational and labor migration in implementing the social investment model of economic growth in Russia under the new horizons of economic integration in the EAEU. The authors use the correlation analysis method to determine the role of educational and labor migration in implementing the social investment model of economic growth in the EAEU. The experience of implementing the social investment model of economic growth based on educational and labor migration in the EAEU has been studied using the case study method. The authors present their forecast for implementing the social investment model of economic growth in the EAEU up to 2024. The conditions for developing educational and labor migration in the EAEU in 2022 are determined. The novelty of this research lies in studying educational and labor migration as factors of economic growth in the social investment model in a new perspective of economic integration. The research contributes to the literature by developing the scientific foundations of the concept of the knowledge economy through clarification and rethinking of the role of human resources in the social investment model of economic growth under conditions of economic integration. The practical significance of this research lies in the fact that the developed policy implications for the regulation of educational and labor migration under the new horizons of economic integration make it possible to most effectively implement the social investment model of economic growth in the practice of the EAEU.

KEYWORDS

educational migration, labor migration, social investment model of economic growth, economic integration, Eurasian Economic Union (EAEU)

Introduction

Economic integration is a promising tool for implementing the socio-investment model of economic growth. This is due to the fact that the acceleration of this growth could be a synergetic effect of economic integration, which is achieved due to the optimization of labor division and removal of customs limitations on the international movement of commodities and production factors. In particular, economic trade ensures favorable conditions for educational and labor migration, which facilitate the optimization of the international flows of social investments (Anh Do and Bui, 2022; Bishnoi and Bishnoi, 2022; Dankyi et al., 2022; Moran and Ward-Christie, 2022; Siyahhan and Ghoddusi, 2022).

In this paper, educational and labor migration is understood as a combination of the free flow of foreign students and the flow of labor migrants, achieved due to the common inclusive social environment – the absence of customs barriers and the society's openness (AbuJarour, 2022; Ghouse et al., 2022; Ramlackhan and Catania, 2022; Remme et al., 2022). It should be noted that these two processes are implemented not separately but in a systemic manner. That is, there is no strict differentiation between educational and labor migration, which is implemented and stimulated in a comprehensive manner (Thomas, 2008; Shen et al., 2021).

Education, the development of human resources, and the realization of human potential are at the heart of a new social investment model of economic growth (Sibirskaya et al., 2019). This model was shaped by the United Nations Sustainable Development Goals (SDGs) and is especially important in the Decade of Action when the implementation of SDGs has reached the finish line (Popkova, 2021; Popkova et al., 2021). Massively accessible and quality education (SDG 4), opportunities for human development with social equality (SDG 5 and SDG 10), and decent work and economic growth (SDG 8) systemically form the social investment model of economic growth (Popkova et al., 2017).

Thus, according to World Population Review (2022), the top 10 countries with the Best Educational Systems – 2021 showed high resilience to the economic crisis caused by the COVID-19 pandemic. For example, while the decline in economic growth in 2020 was 3.27% globally, it was only 0.004% in Australia. In 2021, when the global average economic growth rate was estimated at 5.80%, the economic growth rate was 7.44% in the USA and 6.96% in France (World Bank, 2022).

Increased resilience to crises and accelerated post-crisis economic recovery after crises determine the high relevance of the social investment model of economic growth and the attractiveness of its practical implementation by countries worldwide (Singh, 2022). The problem is that this model conflicts with the current trend of globalization because it implies limiting the outgoing flow (outflow) of social capital (Wang, 2022). This links the social investment model of economic growth with the mercantilist model, in which similar restrictions were imposed on financial capital.

This is the contradiction of economic growth in the social investment model, since freedom of international trade and the international division of labor are essential conditions for economic efficiency and economic growth (Ashraf and Goodell, 2022). At the current stage of development of the world economy, globalization is so strong and spontaneous that limiting it is difficult and threatens the global competitiveness of the economy (Bajraktari et al., 2022).

As a promising solution to the problem and resolution of this contradiction, this paper proposes the development of economic integration to support the implementation of the social investment model of economic growth.

The socio-investment model of economic growth implies that the key manifestations of this growth are not only the growth of GDP but also the number of personnel involved with R&D. The factors of economic growth in the considered model, from the position of educational and labor migration, are as follows: (1) share of skilled personnel (determined from the position of the share of employees with higher education in the structure of the employed and the unemployed by the level of education); (2) activity of attraction of foreign students (number of students in the educational organizations of higher professional education) and 4) international migration of the population.

The paper aims to investigate the role of educational and labor migration in the implementation of the social investment model of economic growth in Russia under the new horizons of economic integration in the EAEU. The novelty of this research lies in the study of educational and labor migration as factors of economic growth in the social investment model in a new perspective of economic integration.

The paper's contribution to the literature is the disclosure of the unique and promising experience of implementing the socio-investment model of economic growth in the EAEU. This experience could be useful for other developing countries. The design of this paper is as follows. The first research task is to identify the role of educational and labor migration in the implementation of the socio-investment model of economic growth in the EAEU. The second task is to perform a case study of the implementation of the socio-investment model of economic growth based on educational and labor migration in the EAEU. The third task is to develop policy implications on the regulation of educational and labor migration under the conditions of new horizons of economic integration in the EAEU.

Literature review

Underpinning theory

The theoretical basis of this research is the scientific basis of the concept of the knowledge economy. According to this concept, human resources are the key – the most valuable and systemic factor of production in the economy (Santos-Hermosa and Atenas, 2022; Xu et al., 2022). In this regard, when managing labor migration, public authorities seek, on the one hand, to prevent the outflow of personnel from the economy, the so-called "brain drain" (Agrati and Vinci, 2022; Atjonen et al., 2022).

On the other hand, they seek to attract the best human resources from around the world, creating favorable employment opportunities (including international recognition of diplomas and support for the social adaptation of migrants) and life in the country (high quality of life) (Eschenbacher, 2022; Fang and Huang, 2022; Westerveen et al., 2022).

Some countries, especially those that are "aging" and experiencing a demographic crisis (negative natural population growth), are interested in an influx of migrant personnel of any kind without strict educational requirements (Galos, 2022). For example, some remote areas of European countries have resettlement programs aimed at attracting young families.

State management of educational migration in the knowledge economy in implementing the social investment model of economic growth is carried out according to the same principle (Holliman et al., 2022). In international university rankings, including QS and THE, the presence of international students and professors is considered a competitive advantage for universities (Al-Qadri et al., 2022).

The outflow of students and teachers is not noted as an advantage. Such indicators are not considered due to their negative interpretation, although the international exchange of knowledge and experience, including international educational internships for students and teachers, is interpreted positively (Finch and Finch, 2022).

Relationship between variables involved in this research

The literature review revealed a high degree of elaboration of educational and labor migration as factors of the social investment model of economic growth. However, the existing publications consider the countries of the world in isolation, which is a limitation of the available literature. Economic integration, actively practiced in the world economy, provides a transition from isolated to the systemic economic growth of integrated countries.

For example, after the formation of the Eurasian Economic Union (EAEU), the five countries (Russia and Belarus – Western Europe, Kazakhstan and Kyrgyzstan – Central Asia, and Armenia – Fore Asia) began to implement common strategies for the socioeconomic development of member countries; common macroeconomic statistics of this integration association began to be maintained (Jemeljanova et al., 2017; Kiselev et al., 2019).

The uncertainty of the effects of educational and labor migration on economic growth in the implementation of the social investment model under conditions of economic integration is a gap in the literature. This raises the research question (RQ) of what role educational and labor migration play in the implementation of the social investment model of economic growth in the new horizons of economic integration in the EAEU.

The hypothesis of this research is based on the evidence of migration support for economic growth in the EAEU noted in the literature (Doskaliyeva et al., 2017; Antonova and Kashevarova, 2022; Yelikbayev and Andronova, 2022) and consists of the fact that educational and labor migration supports economic growth in its social and investment model in the new horizons of economic integration in the EAEU. To fill the research gap identified in the literature, the authors clarify the causal links between educational and labor migration in implementing the social investment model of economic growth in the EAEU.

Materials and methods

The methodology of this research is based on the method of correlation analysis. It is used to assess the level of connection between the economic growth rate and the number of personnel involved with R&D (separately) and the factors of educational and labor migration. The data were collected through the systematization of the official statistics of the Eurasian Economic Commission. The indicators of the results of implementing the socio-investment model of economic growth is the economic growth rate and the number of personnel involved with R&D (Eurasian Economic Commission, 2022a).

The factors of educational and labor migration are as follows: (1) share of employees with higher education in the structure of the employed by the level of education (Eurasian Economic Commission, 2022a); (2) share of employees with higher education in the structure of the unemployed by the level of education (Eurasian Economic Commission, 2022a); (3) number of students of educational organizations of higher professional education who arrived from other countries – EAEU members – at the start of

the academic year; 2020/2021, people (Eurasian Economic Commission, 2022b) and (4) International migration of the population in January-December 2021 (number of individuals registered with authorities during the change of permanent residence; people), arrived (Eurasian Economic Commission, 2022c).

The research is conducted in three stages. The first stage determines the role of educational and labor migration in the implementation of the social investment model of economic growth in the EAEU. To verify the hypothesis and determine the role of educational and labor migration in the implementation of the social investment model of economic growth in the new horizons of economic integration in the EAEU, the authors conduct a statistical analysis. The research is based on data current as of the beginning of 2022 (based on the results of 2021).

The authors apply the method of correlation analysis to determine the relationship between indicators of educational and labor migration and the results of the implementation of the social investment model of economic growth: (1) with the number of personnel engaged in research and development and (2) with the index of physical volume of GDP as a percentage of the previous year (Eurasian Economic Commission, 2022a).

The indicators of educational and labor migration are as follows: (1) the share of employees with higher education in the structure of employment by level of education (Eurasian Economic Commission, 2022a); (2) the share of employees with higher education in the structure of the unemployed by level of education (Eurasian Economic Commission, 2022a); (3) the number of students in educational institutions of higher professional education who came from other EAEU countries (at the beginning of the academic year 2020/2021) (Eurasian Economic Commission, 2022b); (4) international migration of the population in January-December 2021 (the number of persons registered in the bodies of internal affairs at the change of permanent residence; people arrived) (Eurasian Economic Commission, 2022c).

The research hypothesis is considered proven if a positive correlation is detected. The second stage studies the experience of the implementation of the social investment model of economic growth based on educational and labor migration in the EAEU. The case study provides a socioeconomic and legal overview of the regulation of educational and labor migration in the EAEU.

The third stage develops policy implications for improving state regulation of educational and labor migration in the context of the new horizons of economic integration in the EAEU. In developing the recommendations, the authors make and consider the forecast of the implementation of the socio-investment model of economic growth in

the EAEU up to 2024. The authors also consider the conditions for developing educational and labor migration in the EAEU in 2022.

Results

The role of educational and labor migration in the implementation of the social investment model of economic growth in the Eurasian Economic Union

To determine the role of educational and labor migration in the implementation of the social investment model of economic growth in the new horizons of economic integration in the EAEU, the authors determined the correlation of indicators of educational and labor migration with the results of the social investment model of economic growth (Table 1) using the method of correlation analysis.

The results obtained in Table 1 revealed a very strong relationship between the number of personnel engaged in R&D and international migration (99.92%), a strong relationship with the number of students in educational institutions of higher professional education who arrived from other EAEU countries (42.42%), and a moderate relationship with the share of employees with higher education in the structure of employment by level of education (20.90%). There is also a strong correlation of the index of physical volume of GDP as a percentage of the previous year (the rate of economic growth) with the share of workers with higher education in the structure of the unemployed by level of education (32.50%) and with international migration (33.28%). The authors also found a moderate relationship between the share of workers with higher education in the structure of employment by level of education (18.54%) and the number of students in educational institutions of higher education who arrived from other EAEC countries (8.30%). The connection between the number of personnel engaged in R&D and the index of the physical volume of GDP as a percentage of the previous year (the rate of economic growth) was strong (30.81%).

Thus, the correlation coefficients are predominantly positive and significant. This indicates a close relationship between the indicators of educational and labor migration and the results of the implementation of the social investment model of economic growth. Consequently, educational and labor migration is important in implementing the social investment model of economic growth in the EAEU, which confirms the hypothesis put forward.

TABLE 1 Correlation analysis of educational and labor migration with the results of the social investment model of economic growth in the EAEU in 2021.

Correlation analysis of educational and labor migration with the results of the social investment model of economic growth in the EAEU in 2021	Share of employees with higher education in the structure of employment by level of education, %	Share of employees with higher education in the structure of the unemployed by level of education, %	Number of students in educational organizations of higher vocational education who arrived from other EAEU countries (at the beginning of the academic year 2020/2021 people)	International migration of the population in January-December 2021 (the number of persons registered in the bodies of internal affairs at the change of permanent residence; people arrived)	Number of personnel engaged in R&D (people)	Index of physical volume of GDP (in percent to the previous year)
EAEU	35.7	25.1	91854	697333	736614	104.6
Armenia	33.5	28.3	2379	10200	4499	105.7
Belarus	33.8	22.6	10570	0	25622	102.3
Kazakhstan	42.5	37.0	63835	10982	22665	104.1
Kyrgyzstan	23.4	19.4	8602	8229	4495	103.6
Russia	35.5	24.0	6468	667922	679333	104.7
Correlation with the number of personnel engaged in R&D,%	20.90	−18.06	42.42	99.92		30.81
Correlation with the index of physical volume of GDP,%	18.54	32.50	8.30	33.28		

Compiled by the authors based on the materials of Eurasian Economic Commission (2022a,b,c).

Case study of the implementation of the social investment model of economic growth based on educational and labor migration in the Eurasian Economic Union

The best practices of the EAEU in creating a single labor market and comfortable social standards of living for citizens of member countries are highly appreciated by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) and form the basis of recommendations for the forthcoming Global Compact for Safe, Orderly and Regular Migration (Eurasian Economic Commission, 2022d).

The materials of the Federal Center of Theoretical and Applied Sociology of the Russian Academy of Sciences (2022) point out that the prevalence of the Russian language in integrated countries, the cultural inclusiveness of the societies of these countries, and the openness of universities to international students and professors play a key stimulating role in the development of educational migration in the EAEU. Joint development of educational programs, exchange of students and graduate students, and faculty internships have been practiced for many years.

In 2022, the Ministry of Science and Higher Education of the Russian Federation (2022) proposed the creation of a common digital science and education space in the EAEU. The cooperation implies the access of researchers to domestic and international projects of the EAEU countries of the "megascience" class, as well as the development and joint use of the latest digital services for users in science, education, and entrepreneurship in the integration union.

The EAEU actively and comprehensively supports labor migration through a coordinated policy of regulating labor migration within the union. This provides benefits in the form of full social security, medical care for workers of EAEU countries, credit for work (insurance) experience, export of pensions, direct recognition of education documents without any procedures, and legal guarantees for the education of children of migrant workers on an equal basis with local residents in the EAEU countries. Migrant workers are not required to fill out a migration card and register in the state of employment if they stay in the country for up to 30 days. The case studies on the regulation of labor migration from the EAEU countries in each EAEU country are also systematized (Eurasian Economic Commission, 2022e).

In Armenia, Public Employment Organizations, which cooperate with the Ministry of Labor and Social Affairs, organize internal and external labor movements as part of the state program to regulate employment.

In Belarus, the Ministry of Internal Affairs develops and implements state programs, carries out international cooperation, prepares proposals for improving legislation and concluding international agreements, coordinates informational (advertising) announcements about employment outside the country of citizens and foreigners permanently residing in the country, licenses activities related to employment outside the country, and collects and makes available to other ministries statistical and tax information on emigrant workers.

In Kazakhstan, the formation of policy in the field of migration is the responsibility of the Department of Social and Migration Policy and Development of State Bodies. This department organizes and cooperates with the authorized bodies of foreign countries and international organizations in the regulation of migration processes, analyzes the migration situation in Kazakhstan, makes recommendations on improving the management of migration processes, and performs implementation and monitoring functions.

In Kyrgyzstan, the Ministry of Labor and Social Development and the State Migration Service under the Government of the Kyrgyz Republic perform the functions of social and legal protection in the field of labor, employment, and migration.

In Russia, the Federal Migration Service is creating programs to attract highly qualified specialists and skilled workers in professions that are in short supply and demand on the Russian labor market. The Federal Migration Service of Russia develops programs for the organized recruitment of foreign workers. It creates mechanisms to encourage foreign workers in demand on the Russian labor market to sign long-term employment contracts and obtain permanent residency status in the Russian Federation. It simplifies entry and removes restrictions for labor activities and training of family members of foreign workers who have signed long-term labor contracts. Additionally, the Federal Migration Service is responsible for creating a mechanism for attracting foreign workers to jobs that cannot be replaced by Russian workers.

The Federal Migration Service of Russia also improves the mechanism for foreign citizens to work based on patents and simplifies the procedure for entry, exit, and stay in the Russian Federation for foreign citizens involved in investment and entrepreneurial activities. The Federal Migration Service of Russia improves the system of issuing permits for labor activity, creates centers to assist immigration into the Russian Federation and medical examination of immigrants, including those abroad, and provides free legal assistance to foreign citizens through its territorial subdivisions and overseas offices.

Policy implications for the regulation of educational and labor migration in the context of the new horizons of economic integration in the Eurasian Economic Union

Nowadays (mid-2022), favorable conditions for developing educational and labor migration processes in the EAEU have been created. These conditions include successful mass vaccination and minimal coronavirus restrictions on educational and labor migration to the EAEU. In addition to the loyal customs control of educational and labor migrants from EAEU countries (compared to general international migrants and even migrants from CIS countries), this opens up great opportunities for the development of migration in the EAEU.

The ongoing COVID-19 pandemic, as well as the crisis caused by international sanctions, which worsened in 2022, allows us to make the author's forecast for the implementation of the social investment model of economic growth in the EAEU until 2024, according to which educational and labor migration will act as a significant catalyst for economic growth.

For the most successful implementation of the role of educational and labor migration in the implementation of the social investment model of economic growth in the new horizons of economic integration in the EAEU, the authors offer the following recommendations for improving the state regulation of educational and labor migration.

First, it is proposed to make fuller use of the opportunities of the digital economy of the EAEU through the infrastructural and regulatory provision of opportunities for remote employment and distance learning as innovative forms of educational and labor migration. It is also advisable to improve the mechanism of the digital labor market by improving and institutionalizing the practice of remote job search and registration of documents for employment with the subsequent arrival of migrants with their families in the host country.

Second, it is recommended to organize special educational courses aimed at supporting the social and labor adaptation of migrants in the EAEU. It is advisable to conduct literacy courses for migrants in the field of labor law in the country of residence, as well as individualized courses to fill gaps in professional competencies (if necessary).

Third, it is suggested that migrant workers be more fully included in national programs to overcome personnel shortages in remote areas and in certain sectors of the economy. These programs should be conducted at the level of the EAEU.

Fourth, it is recommended to expand the range of support and guarantees in the profession for educational migrants along with local graduates of professional and higher education organizations.

Discussion

The paper develops the scientific foundations of the concept of the knowledge economy, clarifying and rethinking the role of human resources in the social investment model of economic growth under conditions of economic integration. The contribution of this research to the literature is to justify the need to consider the context – the individual economic growth of countries or the systemic growth of integrated economic systems. The reviewed best practices in the regulation of educational and labor migration in the EAEU revealed their significant contribution to the implementation of the social investment model of economic growth.

In contrast to Agrati and Vinci (2022), Atjonen et al. (2022), Santos-Hermosa and Atenas (2022), and Xu et al. (2022), this research substantiates that educational and labor migration, unlike individual economies, has a specific, positive impact on economic growth in its social and investment model, implemented under conditions of economic integration. The best practices of the EAEU demonstrate that educational and labor migration does not lead to a brain drain but rather ensures overcoming personnel shortages where they can be observed and balancing the labor market. For workers, educational and labor migration provides improved opportunities for professional employment and career building, making it possible to reach the fullest human potential.

In contrast to Al-Qadri et al. (2022), Eschenbacher (2022), Fang and Huang (2022), Finch and Finch (2022), Galos (2022), Holliman et al. (2022), and Westerveen et al. (2022), it has been proved that the approach to state regulation of educational and labor migration in conditions of economic integration (as opposed to the approach in the individual economic growth of countries) should involve stimulating social mobility and creating social (educational and labor) elevators rather than retention of personnel. Artificial retention of human resources in the country leads to their degradation and unemployment, while the creation of a single education market and the labor market in the integration association of countries (as in the successful example of the EAEU) makes it possible to free the flow of human resources and most effectively manage them in full economic freedom in support of the implementation of social investment model of economic growth.

The key conclusion of this research is that economic integration provides advanced capabilities for the implementation of the socio-investment model of economic growth. The advantages of economic integration for the implementation of this model are, first, an increase in the capacity utilization of universities due to the inflow of foreign students. This allows for the most complete development of the export potential of the higher education system and the maximization of its contribution to economic growth.

Second, stimulation of the inflow of skilled personnel in the process of migration. After graduation, foreign students can stay in the host country and become highly qualified personnel. Third, integrated economies have better opportunities for knowledge exchange. To train the required personnel, they are not necessarily limited to their own universities; the gap in their activities could be filled by partner universities in other countries, within integration unions.

Conclusion

Thus, this research filled the identified gap in the literature and answered the posed RQ, proving the hypothesis put forward. Using the EAEU as an example, the authors demonstrate that, in the conditions of economic integration, educational and labor migration plays an important role and supports economic growth in its social investment model. The obtained results allow us to draw the following conclusions. First, the best practices of the EAEU in creating a single labor market based on legal unification and a wide range of social guarantees provide favorable conditions for educational and labor migration.

Second, educational and labor migration supports the implementation of the social investment model of economic growth in the EAEU. Thus, increased employment and reduced unemployment of highly qualified personnel (workers with higher education), an increased number of students from EAEU countries, and an influx of international migrants increase the number of personnel engaged in R&D and accelerate the rate of economic growth.

Third, in 2022, conditions for educational and labor migration in the EAEU will be favorable. The forecast for the development of these processes until 2024 is optimistic. The authors provide recommendations for improving the state regulation of educational and labor migration in the new horizons of economic integration in the EAEU.

Thus, it is possible to conclude that transition from predominantly labor migration to systemic educational and labor migration generates a synergetic effect in the form of the development of the knowledge economy. The inflow of unskilled personnel, which raise the unemployment level, is replaced by highly qualified personnel with recognized diplomas, which, in particular, can be received in the territory of the host country. The successful experience of the EAEU shows that the systemic educational and labor migration supports the implementation of the socio-investment model of economic growth, accelerating economic growth through knowledge-intensive employment and the development of human potential.

The theoretical significance of the research is due to the fact that it clarifies the causal relationship between educational and labor migration in the implementation of the social investment model of economic growth in the EAEU. The practical significance of the research lies in the fact that the developed policy implications for the regulation of educational

and labor migration under the new horizons of economic integration make it possible to most effectively implement the social investment model of economic growth in the practice of the EAEU. The social implication of this research lies in its describing the systemic interconnection between SDG 4, SDG 8 and SDG 17. The paper proposed a promising new tool for the achievement of SDG 8 – educational and labor migration, which is ensured due to economic integration.

The conclusions and proposed recommendations are reliable and useful not only for the EAEU but also for other integration associations of countries. Nevertheless, a prerequisite for the reliability of the author's conclusions and the effectiveness of these recommendations is the creation of a single labor market in the integration association of countries. It is proposed to devote further research in the continuation of this article to an in-depth study of the prospects for meeting this condition and the development of recommendations for the creation of a single labor market in other integration associations of countries (e.g., in the EU and NAFTA).

Data availability statement

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

Author contributions

Both authors listed have made a substantial, direct, and intellectual contribution to the work, and approved it for publication.

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Digital education in the social investment model of Gross Domestic Product growth in the context of Industry 4.0

Veronika V. Yankovskaya[1]*, Aleksandr E. Suglobov[2], Natalya V. Bykovskaya[3] and Timur A. Mustafin[4]

[1]Department of Political Analysis and Sociopsychological Processes, Plekhanov Russian University of Economics, Moscow, Russia, [2]Department of Audit and Corporate Accounting, Financial University Under the Government of the Russian Federation, Moscow, Russia, [3]Moscow Timiryazev Agricultural Academy, Moscow, Russia, [4]Diplomatic Academy of the Russian Foreign Ministry, Moscow, Russia

The motivation for this research was the desire to disclose the potential for human potential development that is created by Industry 4.0. The goal of this paper is to study the modern international experience and prospects for implementing the social investment model of economic growth under the conditions of Industry 4.0 with the help of the development of digital education. The method of regression analysis is used to model the econometric dependence of human development on digital education in 2019–2021. The paper's contribution to the literature consists in the development of scientific provisions of the concept of the social investment model of economic growth through reconsidering the approach to human potential development with the help of education under the conditions of Industry 4.0. Unlike the existing approach, which implies the foundation on traditional (pre-digital) education, this paper offers a new approach to human potential development under the conditions of Industry 4.0, which is based on digital education. The advantage of the authors' approach is its allowing for the fullest use of new opportunities that open under the conditions of Industry 4.0. The main conclusion of this research is that under the conditions of Industry 4.0, the social investment model of economic growth should be based on digital education. The theoretical significance of the results obtained lies in their allowing reconsidering the role of education in the implementation of the social investment model of economic growth under the conditions of Industry 4.0. It is proved that this role is performed most successfully with the help of digital education. The practical significance of the conclusions is due to the fact that implementation of the authors' recommendations will allow balancing the level of human development in the countries of distinguished categories: countries with the highest Gross Domestic Product (GDP) growth rate; countries with the highest level of human development; countries with the most developed digital education. The social significance of the paper consists in its support for the practical implementation of SDG 4, SDG 8, and SDG 10.

KEYWORDS

digital education, digital personnel, social investment model, Gross Domestic Product (GDP) growth, Industry 4.0

1. Introduction

In the context of the "knowledge economy," the concept of a social investment model of Gross Domestic Product (GDP) growth has gained wide popularity. According to this concept,

GDP growth is based on human development, since human resources are the central factor of production, acting as a source of social (labour), information (knowledge) and intellectual (technology) capital. In the context of Industry 4.0, the social investment model of GDP growth is supported in the national programmes of technological modernization of most countries of the world. This is reflected in the adopted and implemented initiatives for training digital personnel for high-tech sectors of the economy, in which digital education plays a central role (Vinnikova et al., 2021; Zhang, 2021).

There are three central ideas in the social investment model: (1) educate a labour force so that it is ready for new jobs in the knowledge economy; (2) raise employment levels through providing specific support (child-care/kindergartens, etc.); (3) promote a living wage. All these three ideas are supported and developed under the conditions of Industry 4.0. Whilst Industry 4.0 involves the dissemination and active use of disruptive technologies, artificial intelligence (AI) and greater automation, it also created new opportunities for human potential development.

The advantages of transition to Industry 4.0 for human potential development include the creation of new knowledge-intensive, highly efficient and highly paid jobs, as well as additional opportunities for the development of talents and the manifestation of innovative activity by company employees in Industry 4.0. The key role in ensuring these advantages belongs to education. Leading technologies provide opportunities for the formation of digital education, which is treated as the use of digital technologies and automation tools (from the Internet to virtual and augmented reality and robots) in the process of training, development of digital competencies with students (training of digital personnel) and the active development of new—remote—form of education (Lacka et al., 2021; Qureshi et al., 2021; Sayaf et al., 2021; Secundo et al., 2021; Zawacki-Richter, 2021).

Here it is important to take into account the experience of developing countries that demonstrate the fastest rates of GDP growth (Zhang, 2021). For example, Eritrea, which demonstrated one of the highest rates of GDP growth in 2019 (8.7%, the third place in the world), according to the materials of the World Bank (2022), takes 182nd place in the ranking of human development (0.434), according to UNDP (2022), and in the IMD (knowledge) Digital education rating (2020), this country is not represented, which indicates a low level of digital education development.

A bright example of high-tech GDP growth, one of the highest rates of which in 2019 was demonstrated by China (6.1%), is the reliance on Automation (Robotization) within a large-scale failure and a decrease in the importance of human resources and sidelining it in the system of production factors. For example, in terms of Digital/Technological skills in 2020, China ranks the 12th, in terms of Total Public Expenditure on education, 51st, and in terms of Robotization, the 1st (World Robots Distribution) as reported by IMD (2022). This indicates a pronounced predominance of Automation over digital education as a source of GDP growth (Fan et al., 2021).

In this regard, the problem arises of determining whether in the context of Industry 4.0 the social investment model of GDP growth is implemented, and what role digital education plays in it. The above examples show that, under the conditions of Industry 4.0, the social investment model of economic growth becomes more popular and effective, since knowledge-intensive and high-tech economic growth is necessary and is achieved. The quick development of digital education, which became popular around the world during the COVID-19

pandemic, deserves special attention since it could be laid at the basis of the successful realisation of the technocratic model of GDP growth.

The goal of this paper is to study the modern international experience and prospects for implementing the social investment model of economic growth under the conditions of Industry 4.0 with the help of the development of digital education. The paper's originality is due to its reconsidering the role of education in the social investment model of economic growth. We present a new proprietary vision of this role under the conditions of Industry 4.0; in it, the development of human potential is performed not with the help of not traditional education but digital education.

2. Literature review

Digital education as a new form of delivery of educational services is considered in the works of Speight (2017), Popkova and Zmiyak (2019), Batool (2022), Blankson (2022), Fernández-Sánchez et al. (2022), and Suyo-Vega et al. (2022). The place of education, social investment and human development in the system of sources of GDP growth is determined in the works of Goyal and Sergi (2015), Ibrahim (2018), Munir and Arshad (2018), Marquez-Ramos and Mourelle (2019), Reyes and Useche (2019), Uddin and Sarntisart (2019), Anetor (2020), Karambakuwa et al. (2020), and Tahir et al. (2020).

The conducted literature review showed that existing studies and publications do not sufficiently take into account the latest experience and the specifics of GDP growth in the context of Industry 4.0. The social investment model of GDP growth is considered either at the theoretical level of economic science or is based on the experience of past years without taking into account the latest data that appeared in the context of Industry 4.0. Digital education is considered apart from GDP growth and therefore their relationship is poorly understood.

Thus, the uncertainty about the place of digital education in the social investment model of GDP growth in the context of Industry 4.0 is the study gap that this article aims to fill in. That is why an important direction for further research of the social investment model of economic growth is the clarification of the role of education in its implementation. This leads to the following research question (RQ): What role does digital education play in the implementation of the social investment model of economic growth under the conditions of Industry 4.0?

The works of Algraini (2021), Grisolia et al. (2022), Guijarro-Garvi et al. (2022), and Indrawati and Kuncoro (2021) state that the social investment role of economic growth is based on education with the preference for the traditional (pre-digital) practise. This position is proved by the fact that an increase in human potential, which is a source of economic growth, takes place through education (Bloom et al., 2021; Nouira and Saafi, 2022; Wang et al., 2022).

Digital education, which often implies the use of a remote form of training, is criticised in the existing works of Maaravi and Heller (2021), Rodríguez-Abitia et al. (2020), and Saltos-Rivas et al. (2021), because it may reduce the quality of education. Contrary to this, Gunathilaka et al. (2022), Kasımoğlu et al. (2022), and Li et al. (2022) note the important contribution of digital education to the support for the normal functioning of the educational system under the conditions of lockdowns that took place during the COVID-19 pandemic.

This demonstrates the large potential of digital education and is the basis for offering the following hypothesis (H): digital education plays an important role in the implementation of the social investment

model of economic growth under the conditions of Industry 4.0. To search for an answer to the set RQ and to test hypothesis H, we perform the econometric modelling of the relationship between digital education and human potential development and the relationship between human potential development and economic growth.

3. Materials and methodology

The methodological apparatus of the study is based on the method of regression and correlation analysis. To test the developed hypothesis, a sample of countries divided into the three categories, highlighted by the authors of this study, was formed: countries with the highest rate of GDP growth, according to the World Bank (2022) rating, countries with the highest level of human development, according to the UNDP (2022) rating, and countries with the most advanced digital education, according to the IMD (2022) rating. The values of the indicators, required to test the developed hypothesis, for the countries of the sample are collected in Table 1.

We test the hypothesis by finding the regression dependence of human development (z, according to the materials of UNDP, 2022) on digital education (x, indicator "Knowledge" based on the materials of IMD, 2022). The research model has the following form:

$$z = a + b * x. \qquad (1)$$

Hypothesis H is deemed proved if the regression coefficient at the factor variable x is positive [$b > 0$ in the model (1)], which will prove a positive contribution of digital education to the development of human potential. The reliability of the econometric model is determined with the help of the correlation coefficient, the F-test and the t-test.

In addition to this, we determine the differences in the contribution of human development (z, according to the UNDP, 2022) to GDP growth (y, according to the World Bank, 2022). It is assumed that this contribution will be different amongst the distinguished categories of countries, which will be a sign of the differences in the social investment model of economic growth. We build regression curves to discover these differences. The logic of the research is clearly shown in Figure 1.

Figure 1 shows that Industry 4.0 has a strong influence and determines GDP growth at present. This forms a close connection between economic growth and human development, and between human development and digital education. In this regard, it becomes necessary to embed digital education into a new model of GDP growth by establishing a direct link between digital education and GDP growth (eliminating the mediation of human development).

4. Results

To test the offered hypothesis using the data from Table 1, we calculated the regression dependence of human development (z, according to the materials of the UNDP, 2022) on digital education (x, indicator "Knowledge" based on the materials of IMD, 2022). This allowed specifying the research model (1) and obtaining the following equation of simple linear regression:

$$z = 0.5582 + 0.0043 * x. \qquad (2)$$

The obtained regression equation shows that an increase in the level of the development of digital education by 1 point leads to an increase in the level of human development by 0.0043. The demonstrated regularity is objective since it takes into account the pre-pandemic experience (2019) and the experience of the COVID-19 pandemic (2020–2021) for the entire sample of countries. The reliability of the econometric model (2) is tested in Table 2.

The results from Table 2 show that the level of human development in the countries of the sample is by 79.44% explained by the influence of digital education. Significance F equals $7.3*10^{-11}$, therefore, model (2) conforms to the highest level of significance 0.01 (it is the most accurate, and the model's error is minimal). At the set level of significance, with 45 observations, table F equals 7.2636. Observed $F = 73.5653$—it exceeds table F; therefore, the F-test was passed.

The observed value of t-Stat for the factor variable equals 8.5770. Similarly, it exceeds the table value (2.692 with 44 degrees of freedom). Therefore, the t-test was also passed. The standard error of the regression model is small, equalling 0.0590. The performed tests confirmed the reliability of the econometric model (2) and proved the hypothesis H: the regression coefficient at the factor variable x is positive [$b > 0$ in the model (2)], which is proof of the positive contribution of digital education to the development of human potential.

Based on model (1), we established that maximisation of the level of the development of digital education (100 points) will allow for almost complete realisation of human development potential, due to which it will reach 0.99 (out of maximum possible 1). Due to digital education, the level of human development in the distinguished categories of countries will be balanced, which will make a significant contribution to the reduction of their socio-economic inequality.

In countries with the highest GDP growth rate, the level of human development will grow by 32.35%, which will require an increase in the level of the development of digital education by 94.64%. In countries with the highest level of human development, the level of human development will grow by 3.66%, which will require an increase in the level of digital education development by 34.44%. In countries with the most developed digital education, the level of human development will grow by 5.52%, which will require an increase in the level of digital education development by 19.21%.

In addition to this, based on the data from Table 1, we determined the differences in the contribution of human development (z, according to the UNDP, 2022) to GDP growth (y, according to the World Bank, 2022; Figure 2).

Regression curves (Figure 2) demonstrate that the largest contribution to economic growth is made by human development in countries with the highest level of human development, where an increase in the human development level by 0.1 leads to an acceleration of the GDP growth rate by 16.547%. In countries with the most developed digital education, an increase in the level of human development by 0.1 leads to an acceleration of the GDP growth rate by 3.5444%. In countries with the highest GDP growth rate, an increase in the human development level by 0.1 accelerates the GDP growth rate by 0.0574%. This additionally strengthens the evidence base and scientific arguments in favour of the suggested hypothesis,

TABLE 1 Statistics of digital education in the social investment model of Gross Domestic Product (GDP) growth in the context of Industry 4.0 in 2019–2021.

Category of countries	Country	GDP growth, annual %	Human development Index	Knowledge (digital competitiveness index), score 1−100
–	–	*y*	*z*	*x*
2019				
Countries with the highest GDP growth rate	China	5.95	0.758	78.067
	Philippines	6.12	0.712	53.539
	Mongolia	5.60	0.735	43.669
	Indonesia	5.02	0.707	48.395
	Russia	2.20	0.824	75.017
Countries with the highest level of human development	Norway	0.75	0.954	80.333
	Switzerland	1.14	0.946	90.850
	Ireland	5.44	0.942	74.805
	Germany	1.06	0.939	83.072
	Australia	2.17	0.944	80.702
Countries with the most developed digital education	USA	2.29	0.920	90.998
	Singapore	1.10	0.935	90.503
	Sweden	1.99	0.937	89.727
	Canada	1.88	0.922	87.849
	Denmark	1.49	0.930	85.987
2020				
Countries with the highest GDP growth rate	China	2.24	0.761	85.105
	Philippines	−9.52	0.718	42.557
	Mongolia	−4.56	0.737	44.127
	Indonesia	−2.07	0.718	41.260
	Russia	−2.66	0.824	67.891
Countries with the highest level of human development	Norway	−0.72	0.957	78.196
	Switzerland	−2.38	0.955	89.770
	Ireland	6.18	0.955	68.812
	Germany	−3.70	0.947	81.028
	Australia	−0.05	0.944	77.848
Countries with the most developed digital education	USA	−2.77	0.926	97.922
	Singapore	−4.14	0.938	92.031
	Sweden	−2.17	0.945	89.199
	Canada	−5.23	0.929	88.825
	Denmark	−1.99	0.940	86.145
2021				
Countries with the highest GDP growth rate	China	8.11	0.768	82.500
	Philippines	5.70	0.699	35.158
	Mongolia	1.64	0.739	36.916
	Indonesia	3.69	0.705	36.578
	Russia	4.75	0.829	65.728

(Continued)

TABLE 1 (Continued)

| Category of countries	Country	GDP growth, annual %	Human development Index	Knowledge (digital competitiveness index), score 1–100
Countries with the highest level of human development	Norway	3.88	0.961	73.499
	Switzerland	4.22	0.962	86.929
	Ireland	13.59	0.959	65.790
	Germany	2.63	0.942	75.854
	Australia	2.24	0.951	69.844
Countries with the most developed digital education	USA	5.95	0.921	85.601
	Singapore	7.61	0.939	84.132
	Sweden	5.08	0.947	86.485
	Canada	4.54	0.936	81.795
	Denmark	4.86	0.948	81.415

Compiled by the authors based on materials from IMD (2022), UNDP (2022), and World Bank (2022).

FIGURE 1
The hypothesis and logic of the study. Developed and compiled by the authors.
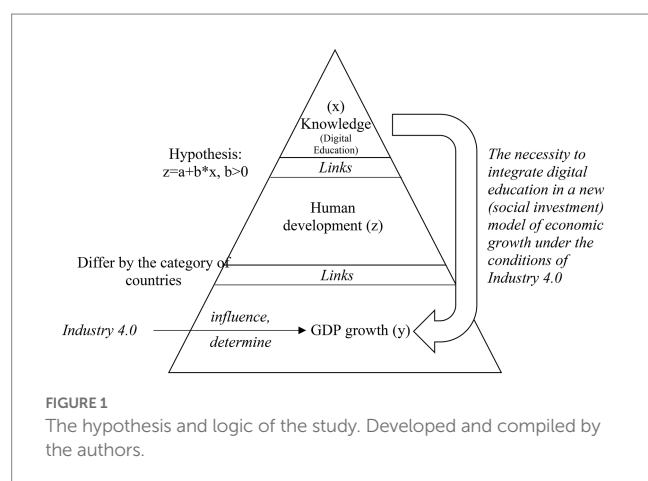
since it is a sign of the prospects of the social investment model of economic growth that is based on digital education.

5. Discussion

This paper's contribution to the literature consists in the development of the scientific provisions of the concept of the social investment model of economic growth through reconsideration of the approach to human potential development with the help of education under the conditions of Industry 4.0. Unlike the existing approach, which implies the foundation on traditional (pre-digital) education (Algraini, 2021; Indrawati and Kuncoro, 2021; Grisolia et al., 2022; Guijarro-Garvi et al., 2022), we offered a new approach to human potential development under the conditions of Industry 4.0, which is based on digital education.

The advantage of the authors' approach is that it allows for the fullest use of new opportunities that open under the conditions of Industry 4.0. On the one hand (at the input), the leading technologies of Industry 4.0 are used in digital education, which allows raising its effectiveness and ensuring the mass availability of life-long learning.

On the other hand (at the output), the digital competencies of broad masses of the population are developed and the training of digital personnel for Industry 4.0 is ensured. Thus, the entire system of education is modernised according to the conditions of Industry 4.0 and makes the most comprehensive contribution to the implementation of the social investment model of economic growth.

6. Conclusion

The developed hypothesis was confirmed. Under the conditions of Industry 4.0, digital education should be put in the basis of the social investment model of economic growth. The theoretical significance of the results obtained consists in their allowing for reconsideration of the role of education in the implementation of the social investment model of economic growth under the conditions of Industry 4.0. It was proved that this role is performed most successfully with the help of digital education.

The practical significance of the conclusions made is that they allow improving the practise of human development through the most comprehensive realisation of the digital education potential. The practical implementation of the authors' recommendations will allow balancing the level of human development in countries of the distinguished categories (countries with the highest GDP growth rate; countries with the highest level of human development; countries with the most developed digital education) at the almost maximum level –0.99.

The social significance of this paper is that it supports the practical implementation of the Sustainable Development Goals (SDGs), which were adopted by the UN. In particular, this paper strengthened the scientific and methodological framework and offered applied recommendations to implement the following SDGs (1) SDG 4 through human development based on digital education; (2) SDG 8 through developing the potential of knowledge-intensive and highly-efficient employment in the social investment model of economic growth under the conditions of Industry 4.0 due to the development of digital education; (3) SDG 10 through revealing the prospects for the reduction of global inequality by levelling the differences and

TABLE 2 Regression dependence of the human development index on knowledge (digital competitiveness index) for the entire sample in 2019−2021.

Regression statistics						
Multiple R	0.7944					
R square	0.6311					
Adjusted R-square	0.6225					
Standard error	0.0590					
Observations	45					
ANOVA and F-test						
	df	SS	MS	F observed	F table	Significance F
Regression	1	0.2564	0.2564	73.5653	7.2636	$7.3*10^{-11}$
Residual	43	0.1499	0.0035	Level of significance: 0.01		
Total	44	0.4063				
Regression coefficients and t-test						
	Coefficients	Standard error	t-Stat	p-Value	Lower 95%	Upper 95%
Constant	0.5582	0.0383	14.5781	$3*10^{-18}$	0.4810	0.6355
x	0.0043	0.0005	8.5770*	0.0000	0.0033	0.0053

*t-table at the level of significance of 0.01 at 44 degrees of freedom equals 2.692.
Calculated and compiled by the authors.

FIGURE 2
Regression curves. Calculated and constructed by the authors.
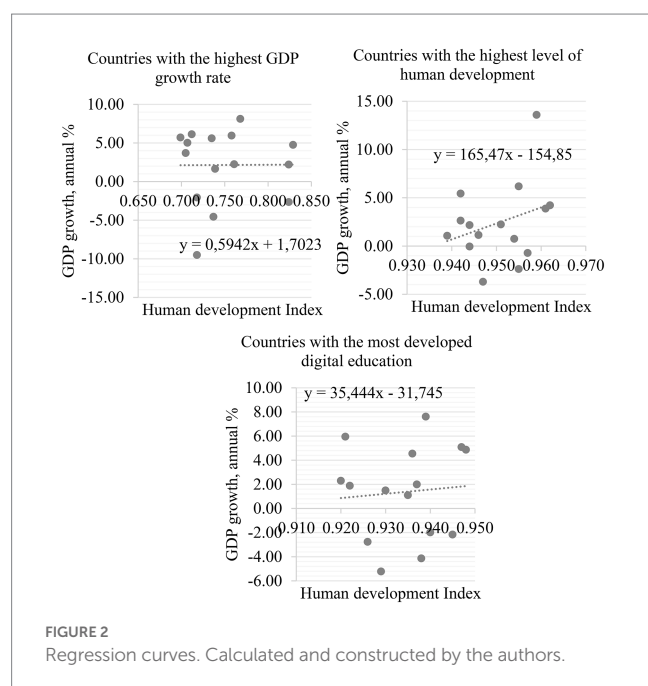
balancing human development in countries of the world based on digital education.

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

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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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The institutional approach to the development of education in the social and investment model of Russia's economic growth

Yuriy A. Krupnov[1]*, Veronika V. Yankovskaya[2], Elena I. Semenova[3] and Aleksandr V. Semenov[4]

[1]Faculty of Economics and Business, Financial University Under the Government of the Russian Federation, Moscow, Russia, [2]Department of Political Analysis and Socio-Psychological Processes, Plekhanov Russian University of Economics, Moscow, Russia, [3]Federal State Budgetary Scientific Institution "Federal Research Center of Agrarian Economy and Social Development of Rural Areas—All Russian Research Institute of Agricultural Economics", Moscow, Russia, [4]Department of Operation and Maintenance of Machines, Russian State Agrarian Correspondence University, Balashikha, Russia

The goal of this article is to develop an institutional approach to the development of education in the social and investment model of economic growth in developing countries by the example of Russia. The hypothetical and deductive principles and regression analysis are used in this research. The research results show that the social and investment model of economic growth is being implemented in the countries of the CIS and Russia, and—as of now—the development of education slows down economic growth, instead of accelerating it. To solve this problem, we offer an institutional approach to the development of education in the social and investment model of Russia's economic growth. The new approach allows for a flexible selection of measures of management depending on the needs of education's development: development of only current, only future, or all workforce. The developed approach is based on the institution of the legal framework's adaptability to digital business models. Since workforce and skills play a key supporting role in digital business, the development of the institution of legal framework's adaptability to digital business models will stimulate the development of higher education and will ensure Russia's transition to the social and investment model of economic growth. For the practical application of the new approach, we develop an optimization model of institutional management in the interests of the development of education and transition to the social and investment model of economic growth in Russia. The model has shown that an increase in the possibility of the legal framework's adaptability to digital business models up to 100 points with a stable level of development of other institutions allows increasing skills of the current workforce by 44.05% and the future workforce by 20.96%.

KEYWORDS

economic empowerment, educational governance, inclusive innovation, higher education, developing countries, CIS, Russia

1. Introduction

The social and investment model of economic growth is one of the most topical contradictions and manifestations of the differences between developed and developing countries. The socioeconomic systems of developed countries have by now (2021) achieved such a high level of progress and the gap between them and other participants of global economic relations has become so large that they could ignore the rate of economic growth (temporarily) to raise the quality of life (Kapetanovic et al., 2022). This is what takes place in the social and investment model of economic growth, which ensures its moderate rate but a serious contribution to human development and realization of intellectual and innovative potential (Brown et al., 2022; Salamzadeh et al., 2022).

In the long term, under the effect of the dialectical law of transition from quantity to quality, large-scale social investments will be accumulated in the volume that would ensure acceleration of economic growth rate based on the capabilities of the fourth technological mode (Industry 4.0), the transition to which has only started (Nja et al., 2022). Developing countries cannot allow for a reduction in economic growth rate, but they are also interested very much (as compared with developed countries) in social investments (Batchaev et al., 2021). Therefore, there emerges a problem in the search for a new, special approach to implementing the social and investment model of economic growth in developing countries, which would allow increasing social investments and preserving a high rate of economic growth, avoiding its reduction (Slišāne et al., 2022).

This article aims to contribute to the resolution of the problem of adjusting social development with economic growth in developing countries. The research question is as follows: how to increase social investments and preserve a high rate of economic growth, avoiding its reduction? Since the main difference between developed and developing countries is observed in the sphere of institutions, we offer the following hypothesis: managing the development of institutions could ensure a crisis-free transition of developing countries to the social and investment model of economic growth. The goal of this research is to develop an institutional approach to the development of education in the social and investment model of economic growth in Russia.

The importance of this article is that developing countries require specific social and investment models of economic growth, which would take into account the specifics of their institutes. This article contributes to the literature by presenting a prospective social and investment model of Russia's economic growth. By the example of this model, we demonstrated the critical importance of the development of institutes to accelerate economic growth in its social and investment model.

2. Literature review

The theoretical base of this research is the concept of social investments, which emphasizes the important role of education and, in particular, higher education in supporting social development (Wasino et al., 2020; Gómez Zermeño and Alemán de la Garza, 2021; Grisolia et al., 2022; Guijarro-Garvi et al., 2022;

Trong, 2022; MacKenzie et al., 2023). Thus, higher education lies based on the social and investment model of economic growth.

An institutional view of the development of the system of higher education is presented in the studies of Altinay et al. (2019), Anis and Islam (2019), Watson and McGowan (2019), Asiedu et al. (2020), Saqib et al. (2020), and Wright (2020). The selected observations in this sphere point to the positive link between social investments and economic growth (Xie, 2021; Bajraktari et al., 2022). This link makes the social and investment model of economic growth natural and organic in developed countries (Prada-Blanco and Sanchez-Fernandez, 2017; Marino et al., 2021).

Wong and Chu (2020), Lee et al. (2022), and Lima et al. (2022) point to the direct role of institutes in implementing the social and investment model of economic growth. This direct role consists of the direct stimulation of social investments, including state financing of higher education (Askari and El Refae, 2022; Fadda et al., 2022; Usman and Ab Rahman, 2023).

The accumulated experience of practical implementation of the social and investment model of economic growth and particular difficulties faced by developing countries is reflected in the studies of Hammami and Hendijani Zadeh (2019), Meng and Wang (2019), Oware and Mallikarjunappa (2019), and Vluggen et al. (2020).

As the literature overview has shown, the existing social and investment model of economic growth is based on the experience of developed countries and does not take into account the specifics of developing countries. The presented research is to fill this gap and to form an institutional approach to the development of education in the social and investment model of economic growth, adapted to the specifics and based on Russia's experience.

3. Materials and methodology

To obtain the most reliable and precise results, we use the method of regression analysis. The hypothesis is checked in two stages. At stage one, we determine the dependence ($z = a + b_1^* y_1 + b_2^* y_2$) of economic growth rate (z) on educational factors (skills of the current workforce: y_1 and skills of the future workforce: y_2).

At stage two, we determine the dependence of the given educational factors (y_1 and y_2) on the level of development of institutions: intellectual property protection (x_1), government ensuring policy stability (x_2), government's responsiveness to change (x_3), legal framework's adaptability to digital business models (x_4), and government's long-term vision (x_5), and compile equations of multiple linear regression: $y_1 = c + d_1^* x_1 + d_2^* x_2 + d_3^* x_3 + d_4^* x_4 + d_5^* x_5$ and $y_2 = e + f_1^* x_1 + f_2^* x_2 + f_3^* x_3 + f_4^* x_4 + f_5^* x_5$.

The choice of indicators for this research was predetermined, first, by the authority of statistical sources for these indicators: the World Bank (2020) and the World Economic Forum (2020), which guarantees the data reliability; second, by the accessibility of the values of the selected indicators for the CIS countries, for which there is a certain deficit of international statistics.

Third, by the advantage of the selected factor variables—in their totality, they allow for the most comprehensive characterization of the institutional support for the economy: intellectual property protection, government ensuring policy stability, government's responsiveness to change, legal framework's adaptability to digital business models, and government's long-term vision.

Fourth, the selected resulting variables reflect the close connection between education and social development and correctly show its central role in the social and investment model of economic growth. Therefore, an advantage of the selected indicators is that they reflect—not directly, but indirectly—education from the position of its results: skills of the current workforce and skills of the future workforce. They are supplemented by GDP growth—as the main indicator of the direct result of implementing any model, including the social and investment model of economic growth, according to the objective assessment of the World Bank (2020).

The hypothesis is deemed proved if there is reverse dependence ($b_1 < 0$, $b_2 < 0$), i.e., the development of education restrains the rate of economic growth, and if there is (at the same time) direct dependence ($d > 0$, $f > 0$) of at least several institutions on the development of education. As statistical accounting of the institutions in Russia is fragmentary and in the process of formation, and statistical accounting of the institutions and education in the international practice is changed annually (in terms of indicators), we cannot use the analysis of the development of institutions and higher education in Russia for a rather long period, and the use of the data for 1–2 years does not allow using the reliable methods of economic analysis.

Therefore, to obtain precise and correct results, we study the experience of Russia as a member of the Commonwealth of Independent States (CIS). This allows for determining common regularities, which are specific for the countries with similar geographical positions and similar levels and rates of socioeconomic development, and specifying these regularities based on Russia's experience. The statistical basis of the research is shown in Table 1.

The research sample reflects a group of countries (CIS), which have many similarities that include not only the same level of socioeconomic development but also geographical proximity and commonness of culture. This allows for minimizing the variation in countries, ensures a rather high homogeneity of the sample, and allows for the reduction of the probability of errors and distorted treatments. This enables us to determine—correctly and precisely—the influence of the factors of the institutes on the implementation of the social and investment model of economic growth, separately from the influence of other factors—e.g., climate—which is beyond the limits of this research.

The timeframe of the research was selected based on the desire to obtain the most precise results and to avoid the distorting influence of economic crises. Because the data in the article belong to 2020 (reflecting the results of 2019), the research and its results are not influenced by the COVID-19 pandemic and crisis and the following shocks in the world economic system.

4. Results

To find the contribution of higher education to economic growth in the CIS countries based on the data from Table 1, we compile the following regression equation:

$$z = 11.20 - 0.09y_1 - 0.03y_2, r^2 = 35.81\%.$$

According to this equation, the growth of skills of the current workforce by one point decreases the rate of economic growth by 0.09% per year, and the growth of skills of the future workforce by one point decreases the rate of economic growth by 0.03% per year. Multiple correlations are moderate: the change in the economic growth rate in countries of the CIS is explained by education's development by 35.81%.

To specify the correctness of the determined regularity in Russia, we find regression dependence of economic growth rate according to the World Bank (2020) on the education index from the Human Development Reports (UNDP, 2020) in 2010–2019 (Figure 1).

Regression analysis in Figure 1 has confirmed the determined regularity (based on the CIS countries) of the slowdown of economic growth rate in the course of education development in Russia. Therefore, the social and investment model of economic growth is not implemented in the CIS countries or Russia. To find the perspectives of applying the institutional approach to education's development, we used regression equations, which are created based on the data from Table 1. Regression dependence of skills of the current workforce on the institutions in the CIS countries in 2020 is as follows (as at the start of the year):

$$y_1 = 30.92 - 0.63x_1 - 0.90x_2 + 1.91x_3 + 0.47x_4 - 0.37x_5,$$
$$r^2 = 99.67\%.$$

The skills of the current workforce in the CIS countries grow by 1.91 points if the government's responsiveness to change grows by one point, and grows by 0.47 points if the legal framework's adaptability to digital business models grows by one point. Multiple correlation between the indicators is very high (99.67%), demonstrating the reliability of the obtained model. Regression dependence of skills of the future workforce on institutions in the CIS countries in 2020 is as follows (as at the start of the year):

$$y_2 + 46.98 - 0.09x_1 + 0.96x_2 - 0.15x_3 + 0.25x_4 - 0.60x_5,$$
$$r^2 = 88.28\%.$$

The skills of the current workforce in countries of the CIS grow by 0.96 points if the government ensures policy stability grows by one point, and grow by 0.25 points if the legal framework's adaptability to digital business models grows by one point. Multiple correlations between the indicators are very high (88.28%), demonstrating the reliability of the obtained model.

As the only common institutional factor that has a non-contradictory and clear influence on both manifestations of the development of higher education in the CIS countries is the legal framework's adaptability to digital business models, the optimization model (created based on the data from Table 1) of managing the institutions for the purpose of education's development and transition to the social and investment model of economic growth in Russia aims at this factor (Figure 2).

The model in Figure 2 shows that the growth of legal framework's adaptability to digital business models by 107.90% (up to 100 points), with the stable level of development of other institutions, allows increasing skills of the current workforce by

TABLE 1 Level of development of institutions, training of the workforce in the educational system, and rate of economic growth in the CIS countries in 2020 (data as of the beginning of the year, based on the results of the previous year), points 1−100.

Country	Level of the institutions' development					Education		GDP growth (annual %) (Rate of economic growth) %
	Intellectual property protection	Government ensuring policy stability	Government's responsiveness to change	Legal framework's adaptability to digital business models	Government long-term vision	Skills of the current workforce	Skills of the future workforce	
	x_1	x_2	x_3	x_4	x_5	y_1	y_2	z
Azerbaijan	70.4	73.6	75.4	60.1	72.1	65.6	72.3	2.2
Armenia	53.8	52.5	50.6	50.2	52.0	49.4	62.2	7.6
Kazakhstan	51.8	58.1	53.0	50.5	56.1	50.8	72.9	4.5
Kyrgyzstan	40.2	37.2	34.6	33.8	32.9	41.3	61.2	4.5
Moldova	47.1	33.4	35.2	37.4	32.2	44.4	62.1	3.5
Tajikistan	55.5	62.5	62.5	43.8	71.1	53.1	61.1	7.0
Russia	47.3	44.9	47.4	48.1	51.0	54.8	60.7	1.3

Source: Compiled by the authors based on the World Bank (2020) and the World Economic Forum (2020).

FIGURE 1
Rate of economic growth and the education index in Russia in 2010−2019 (data as of year-end) and their regression dependence. Source: Calculated and built by the authors based on the UNDP (2020) and the World Bank (2020).
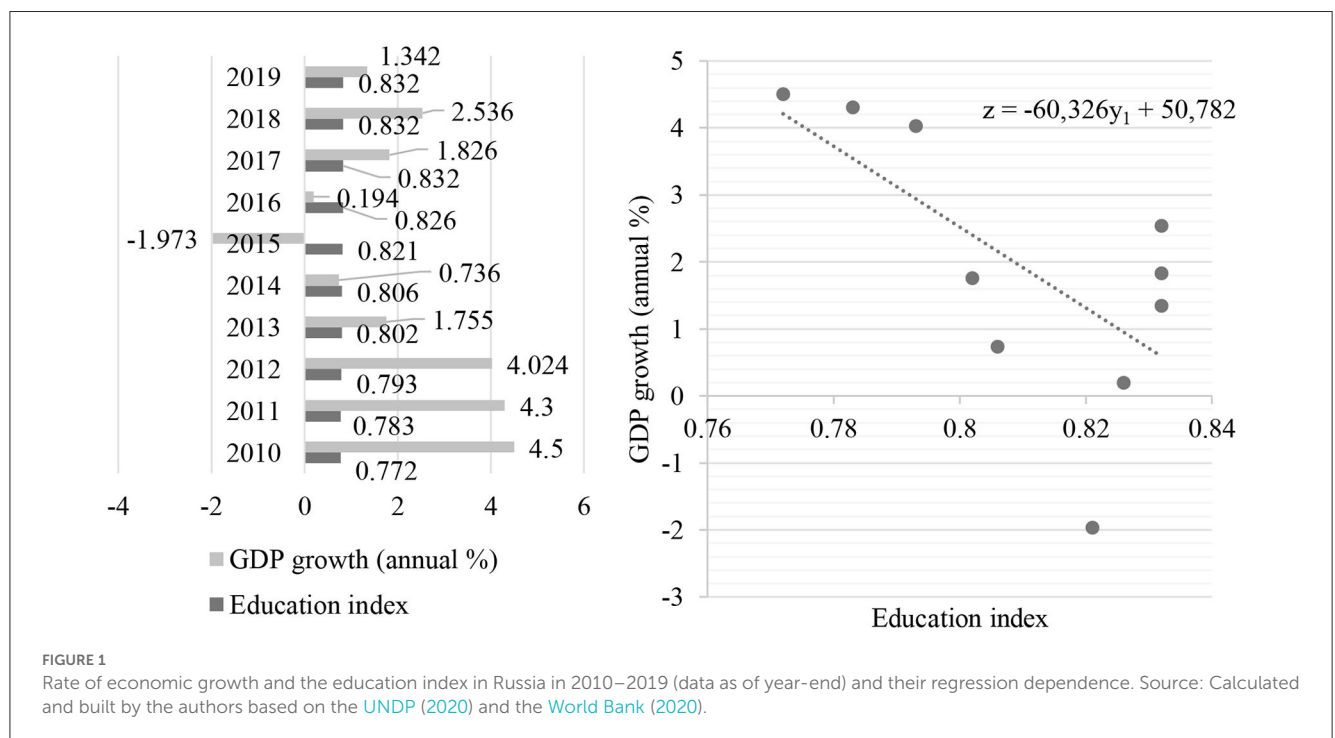
44.05% up to 78.94 points and increasing skills of future workforce by 20.96% up to 73.42 points (well-balanced management).

Situational management is oriented toward an increase in the skills of only the current workforce up to 100 points, which also requires an increase in the government's responsiveness to change up to 58.43 points. Strategic management is oriented at an increase in skills of only the future workforce up to 100 points, which requires an increase in government ensuring policy stability up to 73.07 points and an increase in government's responsiveness to change up to 50.95 points.

5. Discussion

This article contributes to the literature for the development of the scientific provisions of the concept of social investments by justifying the importance of institutional support for education, in particular higher education, in its facilitating social development. Due to this, it was specified—in the example of Russia—that higher education lies based on the social and investment model of economic growth—under the condition of high effectiveness of the institutes of state regulation
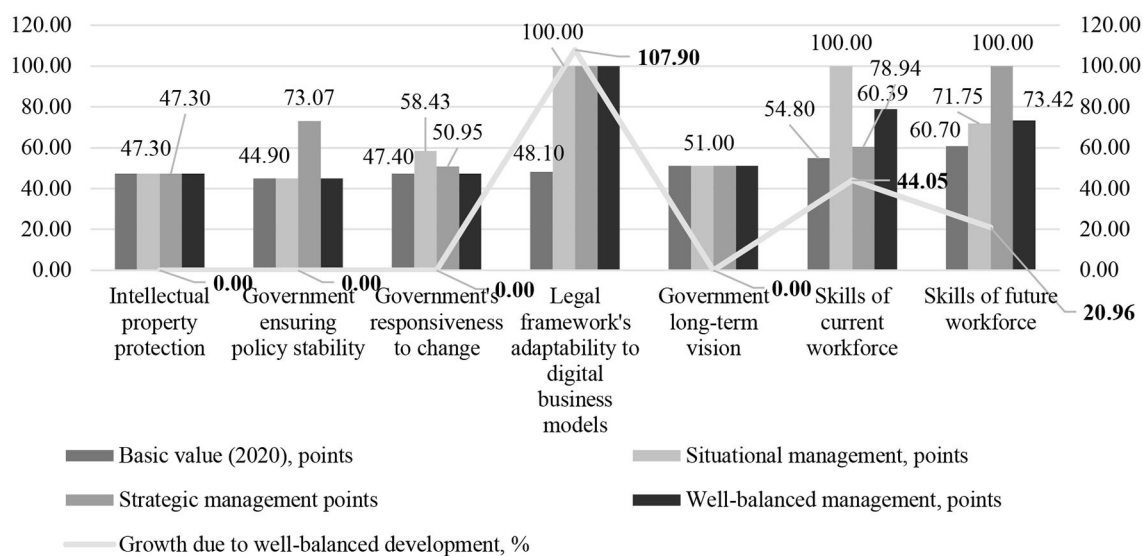
FIGURE 2
Optimization model of managing the institutions for the purpose of education's development and transition to the social and investment model of economic growth in Russia. Source: Calculated and built by the authors.

TABLE 2 Comparative analysis of the results obtained and the existing literature.

Criteria of comparison	Scientific provisions of the existing literature	New results and authors' conclusions that were made in the paper
The connection between social investments and economic growth	Positive connection, which makes the social and investment model of economic growth natural and organic in developed countries (Prada-Blanco and Sanchez-Fernandez, 2017; Marino et al., 2021; Xie, 2021; Bajraktari et al., 2022)	Negative connection, which hinders the developing countries' transitioning to the social and investment model of economic growth (proved by the example of the CIS countries)
Role of institutes in the implementation of the social and investment model of economic growth	Direct role: direct stimulation of social investments, including state financing of higher education (Wong and Chu, 2020; Askari and El Refae, 2022; Fadda et al., 2022; Lee et al., 2022; Lima et al., 2022; Usman and Ab Rahman, 2023)	Indirect role: the creation of a common stable macro-economic situation and favorable investment climate with the market self-regulation of social investments

Source: Authors.

of the economy and a favorable institutional environment on the whole.

Based on the example of the experience of the CIS countries, this article proved the hypothesis that managing the development of institutions could ensure a crisis-free transition of developing countries to the social and investment model of economic growth. The comparative analysis of the results obtained with the existing literature is presented in Table 1.

As shown in Table 2, unlike Prada-Blanco and Sanchez-Fernandez (2017), Marino et al. (2021), Xie (2021), and Bajraktari et al. (2022), we discovered not a positive (as in developed countries) but a negative link between social investments and economic growth, which hinders the developing countries' transitioning to the social and investment model of economic growth (proved by the example of countries in the CIS).

Unlike Askari and El Refae (2022), Fadda et al. (2022), Lee et al. (2022), Lima et al. (2022), Usman and Ab Rahman (2023), and Wong and Chu (2020), we justified that the role of institutes in the implementation of the social and investment model of economic growth is not direct but indirect. This indirect role consists of the creation of a common stable macro-economic situation and favorable investment climate with market self-regulation of social investments.

This scientific article is part of a line of research that is providing good results in the sphere of explanation of cause and effect links of economic growth in its social and investment model. In addition to the already known close connection between higher education and social progress, this article discovered a previously unknown important role of institutes in the strengthening of the considered link.

6. Conclusion

The research results have confirmed the offered hypothesis and have shown that the social and investment model of economic growth is only being implemented in the CIS countries and Russia; as of now, the development of education slows down economic growth, instead of accelerating it. To solve this problem, we offer the institutional approach to the development of education in the social and investment model of Russia's economic growth. The new approach allows for flexible selection of the management measures

depending on the needs of education's development: development of only the current workforce, only the future workforce, or all workforce.

The developed approach is based on the institution of the legal framework's adaptability to digital business models. Since workforce and skills play a key supporting role in digital business, the development of the institution of legal frameworks' adaptability to digital business models will stimulate the development of higher education and will ensure Russia's transition to the social and investment model of economic growth. Thanks to this development, the article provided an answer to the research question. To increase social investments and preserve a high rate of economic growth, avoiding its reduction, it is necessary to raise the effectiveness of institutes: (1) growth of legal framework's adaptability to digital business models, (2) increase in the government's responsiveness to change, and (3) increase in government ensuring policy stability.

For the analysis, we used a dichotomous scale, in which the positive influence of social investments on economic growth is opposed to their negative influence in developing countries (demonstrated by the example of the CIS countries). The research results, which consist of justifying the fact that the contribution of social investments to economic growth depends on the effectiveness of institutes, can help the statistical community in the explanation of the regularities of economic growth in its social and investment model.

The theoretical significance of this article is that it contributes to the search for a solution to the problem of implementing the social and investment model of economic growth in developing countries through the justification of the important role of institutes in this process. The practical significance of the authors' conclusions and results is due to Russia's model being a good alternative to the models of developed countries. Thus, the described experience of

Russia will be useful for developing social and investment models of economic growth in other developing countries given the specifics of their institutes. Further studies should be devoted to this.

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

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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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Strategic academic leadership and high-tech economic growth

Elena G. Popkova[1]* and Bruno S. Sergi[2,3]

[1]Peoples' Friendship University of Russia (RUDN University), Moscow, Russia, [2]Harvard University, Davis Center for Russian and Eurasian Studies and Harvard DCE, Cambridge, MA, United States, [3]Department of Economics, University of Messina, Messina, Italy

Considering the context of the Fourth Industrial Revolution, higher education must play a significant role in the social-investment model of economic growth. To what extent higher education supports strategic academic leadership and high-tech economic development is still being determined. The article proposes direct actions for improving university management through higher educational and technological functions. We establish the specific directions for university management in neo-industrialization 4.0 to ensure extensive accessibility of higher education and enhance university management efficiency.

KEYWORDS

higher education, strategic academic leadership, high-tech economic growth, neoindustrialization 4.0, socio-investment model of economic growth, universities, higher education management

1. Introduction

The adoption of the Sustainable Development Goals (SDGs) has accelerated the design of two university functions: educational (SDG 4) and technological (SDG 9). Government and societal requirements for universities were also specified.

The first requirement is for universities to support high-tech economic growth (Muljono and Setiyawati, 2022). In recent decades, higher education has been at the heart of economic growth that post-industrialization implies. The development of society depends on the service sector, where human resources fulfill a crucial role. With the advent of the Fourth Industrial Revolution and post-industrialization 4.0, economic growth has become increasingly dependent on various high-tech segments of industries (Popkova, 2022; Sergi and Popkova, 2022).

The second requirement supports strategic academic leadership, defined in this article as the advanced knowledge and technology of national universities and their standing in international universities rankings (Bellantuono et al., 2022; Elbawab, 2022; Véliz and Marshall, 2022).

The technological function of universities is essential for conforming to the two requirements since they are associated with technologies and innovations. However, while the 17 Sustainable Development Goals are equally important, it seems unacceptable to assign SDG 4 a secondary role, given that it can be performed exclusively by universities. Furthermore, there needs to be more clarity as to which function of universities contributes to high-tech economic growth and strategic academic leadership (Phiri and Tough, 2018; Saiti et al., 2018; Andrades et al., 2021; Wolhuter, 2022).

In the Decade of Action, it is unclear how universities should be managed and which function they should focus on the most. This article thinks of the university as an organization that carries out science and higher education activities where academic leadership wins and keeps leadership positions in the international university ratings.

Higher education faces a considerable challenge due to the change in economic systems. Universities have consistently carried out a crucial role in the past, but the nature of this role is changing. In the post-industrial era, universities served the vital function of providing higher education to train highly qualified personnel. In post-industrialization 4.0, universities have become more critical in creating knowledge and technology (Muktiyanto et al., 2020; Kim and Lee, 2021; Yusriana et al., 2021).

The extant literature, for example, Turginbayeva et al. (2018), Zarea et al. (2021), and Maxyutova et al. (2022), points to the importance of human and technological resources for neo-industrialization 4.0. Let us clarify which part of higher education is more substantial to fill the gap in the literature.

For achieving the neo-industrialization 4.0 goals, which university function is the most fundamental? It looks at universities' educational and technological processes and how they can help the country achieve external advantages. How university management affects the science and higher education system is also considered from a creative perspective.

After this introduction, we will look at the extant literature, find a literature gap, and look at how higher education can help academic leadership and high-tech economic growth. We examine higher education and technology separately to see how they contribute to neo-industrialization 4.0. Then, we sequentially address the two research objectives. First, we will perform a factor analysis of strategic academic leadership and high-tech economic growth. Another purpose is to provide suggestions for improving university management and explain why it is essential for strategic visionary leadership and high-tech economic development. It ends with a discussion and conclusion.

2. Literature review

The literature has extensively studied strategic academic leadership (Jahanmehr et al., 2022; Kaidesoja, 2022) and high-tech economic growth (Gil et al., 2019; Scott et al., 2021; Wang et al., 2022). These both shape the spheres of digital competitiveness and sustainability under neo-industrialization 4.0. Nevertheless, the significance of higher education and university management for neo-industrialization 4.0 is not well-researched and remains unclear.

This gap in the literature raises two research questions (RQs).

RQ1: What is the role of universities in supporting neo-industrialization 4.0? Chen et al. (2022), Doan et al. (2022), and Polidoro et al. (2022) link the role of universities to the creation of new knowledge and technology. This would apply through the automation of business processes. Human resources are becoming less important as machinery and technology are more critical (Ma and Li, 2022). Full-automated smart factories that operate autonomously using robots and artificial intelligence are an example of this process (Chen et al., 2022). Although automation is not a spontaneous process, it involves highly qualified personnel. In this regard, Alipanga and Kohrt (2022), Krassadaki et al. (2022), Nunfam et al. (2022), Siri et al. (2022), and Yu and Wang (2022) point to the importance of higher education for neo-industrialization 4.0. Based on this assumption, this article proposes hypothesis H$_1$, that higher education plays an

equally significant role in supporting the neo-industrialization 4.0 as it does in creating new knowledge and technology. Universities perform two equally valuable educational and scientific functions throughout this process.

RQ2: How can higher education be managed to be a leader in academics and high-tech economic growth? In Nawaz et al. (2020), Ruangpermpool et al. (2020), Gonzalez-Perez et al. (2021), Ismail et al. (2022), and Veltri et al. (2022), universities should generate new knowledge and technology and execute their technological function and support high-tech economic growth.

The causes and effects of universities' role in neo-industrialization 4.0 are not explained fully in the literature. After analyzing the literature and systematizing the accumulated knowledge, we highlighted three principal areas of university management that contribute to the development of higher education.

The first direction is the vastest availability of higher education (Alexander et al., 2022; Hassan et al., 2022; Suyadi et al., 2022). Implementing this direction means that the more highly qualified personnel in the economy, the greater its human potential (Al-Tammemi et al., 2022; Palmisano et al., 2022; Sanz and López-Iñesta, 2022). The second direction is the training of scientific and engineering staff by universities, most of whom are IT specialists (Btoush, 2022; Leible and Ludzay, 2022). This direction directly forms the staffing of neo-industrialization 4.0 (Karpefors and van Riemsdijk, 2020; Wasilah et al., 2021). The third direction is the establishment of mobility in higher education (Grant, 2018; Knight and Motala-Timol, 2021). Intercity and international internships for faculty and students and opportunities for students to choose and change majors as they pursue their higher education are relevant to the considered area (Burmann and Delius, 2017). This direction ensures the flexibility of universities and the higher education system and the system's openness, stimulating the quality of higher education and contributing new knowledge and technologies (Bobrytska et al., 2021).

Based on the extant literature review, we formulate hypothesis H$_2$: in the process of ensuring strategic academic leadership and supporting high-tech economic growth, university management should aim at (1) raising the mass availability of higher education, (2) training scientific and engineering & technical personnel, and (3) mobility in higher education and universities' accomplishment their educational function.

Undoubtedly, these management areas are essential for developing higher education. However, each highlighted area's contribution to strengthening strategic academic leadership and accelerating high-tech economic growth needs in-depth study. Due to the lack of scientific elaboration, RQ$_2$ requires further scientific search.

To test our hypothesis H$_1$, we compare the creation of new academic knowledge and technology with higher education services to strategic academic leadership and high-tech economic growth. This illustrates how universities' technological and educational function contributes to their goals in the Decade of Action: high-tech economic growth and progress in international university rankings.

To test hypothesis H$_2$, we model the prospects for strengthening strategic academic leadership and accelerating the high-tech economic growth rate based on higher education development. Our method models university management in the unity of its functions. High-tech economic growth (high-tech manufacturing) and strategic academic

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leadership (QS university ranking) are set by the performance of the educational function – in the unity of three directions: (1) Raising the mass accessibility of higher education (tertiary enrolment), (2) Training of scientific and engineering & technical personnel by universities, most of which are IT specialists (graduates in science and engineering), and (3) Mobility in higher education (tertiary inbound mobility) – and technological function: knowledge creation.

3. Materials and methods

In order to avoid significant gaps in the dataset, we employed a sample of 123 countries, for which most of the values of the studied indicators are available. Data for the whole totality of countries were initially collected from WIPO (2022). The countries with the most data were chosen, and a research sample was made with no gaps in the data. The data were taken from the WIPO report for 2022, but they show the results for 2021. The statistics are combined into a common dataset publicly available in Mendeley Data (Popkova, 2022). The indicators were sourced from the WIPO (2022) report and in the score (0–100, 100-the best; assigned scores by WIPO experts through international comparisons and reflect the country's efficiency and comparison with other countries). This simplifies the logical treatment of the results of econometric modeling and increases its precision.

A classification of local and leading universities was adopted. Local universities and their branches are oriented toward internal markets and rely on the government for support. These universities rank low in national ratings and are not usually included in international ratings. Leading universities actively attract foreign lecturers and students and are included in international and top national ratings. They can receive government support and benefit from high flexibility and entrepreneurial activity. This article focuses on universities of the second type.

A regression analysis of strategic academic leadership and high-tech economic growth is employed to model the dependence of strategic academic leadership and high-tech economic growth – high-tech manufacturing (HTM) and QS university ranking (QSR) – on the factors of higher education – tertiary enrolment (te), graduates in science and engineering (gs), tertiary inbound mobility (tm), and knowledge creation (kc).

The variables reflect the university management's corresponding direction. The variable "high-tech manufacturing" was selected because it allows for quantitative measuring of high-tech economic growth. The variable "QS university ranking" reflects the results of countries on their way to strategic academic leadership and "tertiary enrolment" university management's outcome in guaranteeing mass accessibility of higher education services. This variable is a statistical reflection of the first direction of university management. It considers highly qualified personnel and their human potential as described in several works (Alexander et al., 2022; Al-Tammemi et al., 2022; Hassan et al., 2022; Palmisano et al., 2022; Sanz and López-Iñesta, 2022; Suyadi et al., 2022).

The educational function's "graduates in science and engineering" reflects university management's results in training scientific and engineering & technical personnel, most of whom are IT specialists. This variable is a statistical reflection of the second direction of university management described in (Karpefors and van Riemsdijk, 2020; Wasilah et al., 2021; Btoush, 2022; Leible and Ludzay, 2022). The

logic of using this variable consists of staffing neo-industrialization 4.0, ensured by universities.

The variable "tertiary inbound mobility" reflects university management's result in mobility in higher education and the third direction of university management (Burmann and Delius, 2017; Turginbayeva et al., 2018; Bobrytska et al., 2021; Knight and Motala-Timol, 2021). This variable considers the flexibility of universities and the system of higher education overall, as well as its openness to increasing the quality of higher education and stimulating better creation of new knowledge and technologies.

The variable "knowledge creation" reflects university management's performance in the technological function by creating new knowledge, technologies, and other innovations.

The research model takes the form of the following system of multiple linear regression equations:

$$\begin{cases} HTM = a + b_{te(htm)}{}^{*}te + b_{gs(htm)}{}^{*}gs + b_{tm(htm)}{}^{*}tm + b_{kc(htm)}{}^{*}kc, \\ QSR = a + b_{te(qsr)}{}^{*}te + b_{gs(qsr)}{}^{*}gs + b_{tm(qsr)}{}^{*}tm + b_{kc(qsr)}{}^{*}kc. \end{cases} \quad (1)$$

Model (1) is tested with multiple correlation coefficients and Fisher's F-test. The factor variables te, gs, and tm reflect the educational function of universities. Variable kc reflects the technological function of universities.

To verify hypothesis H_1, the regression coefficients are compared to each other. Proving the hypothesis is expressed as $(b_{te(htm)} + b_{gs(htm)} + b_{tm(htm)})/3 > b_{kc(htm)}$ and simultaneously $(b_{te(qsr)} + b_{gs(qsr)} + b_{tm(qsr)})/3 > b_{kc(qsr)}$. This shows a higher significance of universities' educational function than their technological function.

Based on the model (1) results, we insert the maximum possible (100 points) values of the factor variables that characterize universities' educational function. We determine the forecasted growth of the resulting variables (ΔHTM and ΔQSR) with the maximization of factor variables: $b_{te} \to max$; $b_{gs} \to max$; $b_{tm} \to max$.

The benefits of strategic academic leadership and high-tech economic growth are determined using the least squares method based on the model (1). If the maximization in the following spheres is achieved, hypothesis H_2 is accepted: (1) tertiary enrolment, (2) graduates in science and engineering, and (3) tertiary inbound mobility will ensure an increase in high-tech manufacturing and growth of QS university ranking, top 3.

4. Results

4.1. Factor analysis of strategic academic leadership and high-tech economic growth

In the first step, statistics from the dataset (Popkova, 2022) were processed using regression analysis for factor analysis of strategic academic leadership and high-tech economic growth. This refines the following research model:

$$\begin{cases} HTM = 9.8729 + 0.4664^{*}te + 0.0270^{*}gs + 0.1513^{*}tm + 0.0851^{*}kc, \\ QSR = 2.0917 + 0.4297^{*}te + 0.0216^{*}gs + 0.1461^{*}tm + 0.0925^{*}kc. \end{cases} \quad (2)$$

TABLE 1 Regression analysis of the dependence of high-tech manufacturing on university management factors in 2022.

Regression statistics						
Multiple R	0.5779					
Standard error	20.8720					
Observations	123					
Variance analysis						
	Df	SS	MS	F	Significance of F	
Regression	4	25777.3903	6444.3476	14.7929	$8*10^{-10}$	
Residual	118	51405.4348	435.6393			
Total	122	77182.8250				
Parameters of the regression model						
	Coefficients	Standardized error	t-statistics	p-value	Lower 95%	Upper 95%
Constant	9.8729	3.5343	2.7934	0.0061	2.8739	16.8718
Tertiary enrolment	0.4664	0.0962	4.8455	$3.9*10^{-6}$	0.2758	0.6569
Graduates in science and engineering	0.0270	0.0287	0.9428	0.3477	−0.0298	0.0838
Tertiary inbound mobility	0.1513	0.0993	1.5243	0.1301	−0.0453	0.3479
Knowledge creation	0.0851	0.0248	3.4280	0.0008	0.0359	0.1342

Source: Authors.

TABLE 2 Regression analysis of QS university ranking, top 3, on university governance factors in 2022.

Regression statistics						
Multiple R	0.5299					
Standard error	23.0012					
Observations	123					
Variance analysis						
	Df	SS	MS	F	Significance of F	
Regression	4	24379.5391	6094.8848	11.5203	$6.3*10^{-8}$	
Residual	118	62428.7728	529.0574			
Total	122	86808.3119				
Parameters of the regression model						
	Coefficients	Standardized error	t-statistics	p-value	Lower 95%	Upper 95%
Constant	2.0917	3.8949	0.5370	0.5923	−5.6213	9.8046
Tertiary enrolment	0.4297	0.1061	4.0514	$9.2*10^{-5}$	0.2197	0.6397
Graduates in science and engineering	0.0216	0.0316	0.6840	0.4953	−0.0410	0.0842
Tertiary inbound mobility	0.1461	0.1094	1.3358	0.1842	−0.0705	0.3628
Knowledge creation	0.0925	0.0273	3.3835	0.0010	0.0384	0.1467

Source: Authors.

To check the reliability of model (2), we turn to the detailed regression analysis results in Tables 1, 2.

According to the results from Table 1, the 57.79% change in high-tech manufacturing in 2022 is explained by changes in the values of university management factors, indicating a reasonably strong relationship between the studied indicators. Thus, with a one-point increase in tertiary enrolment, high-tech manufacturing increases by 0.4664 points. A one-point increase in science and engineering increases high-tech manufacturing by 0.0270 points. If tertiary inbound mobility increases by one point, high-tech manufacturing

increases by 0.1513 points. A one-point increase in knowledge creation increases high-tech manufacturing by 0.0851 points.

According to the results in Table 2, the change in the QS university ranking, top 3, in 2022 by 52.99% is explained by changes in the values of university management factors, indicating a strong relationship between the employed indicators. If tertiary enrollment increases by one point, the QS university ranking point, top 3, increases by 0.4297 points. If graduates in science and engineering increase by one point, the QS university ranking, top 3, increases by 0.0216 points. If tertiary inbound mobility increases by one point, the QS university ranking,

top 3, increases by 0.1461 points. If knowledge creation increases by one point, the QS university ranking, top 3, increases by 0.0925 points.

In the function for high-tech manufacturing, the arithmetic mean of the regression coefficients for the factor variables that reflect the educational function of universities was $(0.4664 + 0.0270 + 0.1513)/3 = 0.2149$. The value exceeds the regression coefficient for the variable that reflects the technological function of universities (0.0851).

In the function for the QS university ranking, top 3, the arithmetic mean of the regression coefficients for the factor variables that reflect the educational function of universities was $(0.4297 + 0.0216 + 0.1461)/3 = 0.1992$. The value also exceeds the regression coefficient for the variable that reflects the technological function of universities (0.0925). Taken together, this confirms hypothesis H_1.

4.2. Recommendations for improving university management and benefits for strategic academic leadership and high-tech economic growth

The second task of this research is to examine the educational function of universities. We maximize the results of all three identified university governance areas within this function: a 223.17% increase in tertiary enrollment, a 107.06% increase in graduates in science and engineering, and a 552.21% increase in tertiary inbound mobility. This will open new prospects for higher education to strengthen its strategic academic leadership and accelerate high-tech economic growth through development (Figure 1).

As shown in Figure 1, our recommendations will increase high-tech manufacturing by 153.46% (from 30.25 points in 2022 to 76.66 points) and a 203.69% increase in the QS university ranking, top 3 (from 21.19 points in 2022 to 64.36 points). This confirms hypothesis H_2 and fits our recommendations in the Decade of Action. Suppose it is hard to maximize the results in all three areas of university management at once. In that case, it is advisable to focus on implementing the most significant area, tertiary enrollment (the regression coefficients are highest for it, at 0.4664 and 0.4297).

5. Discussion

This analysis addresses a literature gap at the interface between university governance and the Fourth Industrial Revolution. We argue that universities' educational functions are more important than the technological functions of neo-industrialization 4.0 (Table 3).

In contrast to Chen et al. (2022), Chen et al. (2022), Doan et al. (2022), Ma and Li (2022), and Polidoro et al. (2022), Table 3 shows that universities in neo-industrialization 4.0 are not the creation of new knowledge and technology, but the provision of educational services. Unlike Nawaz et al. (2020), Ruangpermpool et al. (2020), Gonzalez-Perez et al. (2021), Ismail et al. (2022), and Veltri et al. (2022), to ensure strategic academic leadership and high-tech economic growth higher education management must focus on the educational function.

To ensure strategic academic leadership and high-tech economic growth, management in higher education should focus on the most significant directions of university management for performing the
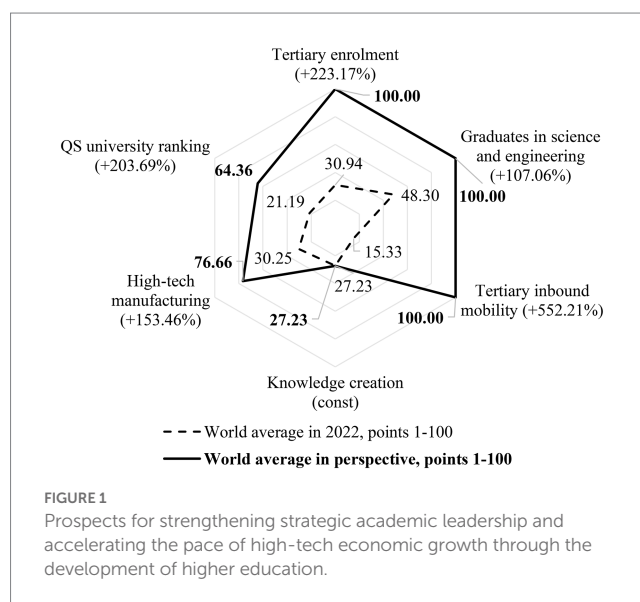

FIGURE 1
Prospects for strengthening strategic academic leadership and accelerating the pace of high-tech economic growth through the development of higher education.

TABLE 3 Comparative analysis of the obtained results with the existing literature in the context of the assigned RQs.

Research question (RQ)	Existing literature		New answer received
	Existing answer	References	
RQ₁: What is the role of universities in supporting the implementation of neo-industrialization 4.0?	Creation of new knowledge and technology (the technological function of universities is key)	Chen et al. (2022), Chen et al. (2022), Doan et al. (2022), Ma and Li (2022), Polidoro et al. (2022)	Provision of educational services (the key function of universities is an educational function)
RQ₂: How to manage higher education to ensure strategic academic leadership and high-tech economic growth?	Through the creation of new knowledge and technologies during the performance of the technical function by universities	Nawaz et al. (2020), Ruangpermpool et al. (2020), Gonzalez-Perez et al. (2021), Ismail et al. (2022), Veltri et al. (2022)	Through the implementation of the directions of university management for their performing the educational function: 1) Increase in mass accessibility of higher education; 2) Training of scientific and engineering & technical personnel by universities; Mobility in higher education.

Source: Authors.

educational function: an increase in mass accessibility of higher education, training of scientific and engineering & technical personnel by universities, and mobility in higher education.

The paper adds to the scientific knowledge of the increasingly rich literature on university management. It builds upon the analyzes of Alexander et al. (2022), Al-Tammemi et al. (2022), Hassan et al. (2022), Palmisano et al. (2022), Sanz and López-Iñesta (2022), and Suyadi et al. (2022) in raising mass accessibility of higher education. The paper also expands on Karpefors and van Riemsdijk (2020), Wasilah et al. (2021), Btoush (2022), and Leible and Ludzay (2022) in the sphere of training scientific and engineering & technical personnel by universities and the works of Burmann and Delius (2017), Grant (2018), Bobrytska et al. (2021), and Knight and Motala-Timol (2021) in the sphere of mobility in higher education.

The educational function of universities must be the subject of further examination. To assist neo-industrialization 4.0, the quality and availability of higher education services must enhance the educational function.

6. Conclusion

This article aims to find ways to make university management more efficient and implement SDGs 4 ("Quality education"), 8 ("Decent work and economic growth"), and 9 ("Industry, innovation, and infrastructure"). According to the findings of this article, neoindustrialization 4.0 must rely on a social and investment model of economic growth, in which higher education plays a key role. This new paradigm relies on universities because of their natural leadership in academics and high-tech economic growth. SDG 9 should be overseen by private businesses and the government, while SDG 4 should be focused on by universities. High-tech economic growth and easy access to higher education are recommended despite the association of the Fourth Industrial Revolution with automation. The quantitative benchmarks of university management should be refined in prospective studies.

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

EP and BS jointly developed the idea of the article and its design. EP created a dataset, on the basis of which EP and BS conducted a study and jointly wrote an article. 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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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2023.1108527/full#supplementary-material

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Public-private partnership as a mechanism of education management in the structure of the social and investment model of economic growth

Meri K. Dzhikiya[1]*, Marina V. Karp[2], Tatyana V. Bart[3] and
Sergey N. Kukushkin[4]

[1]Department of Statistics and Cybernetics, Moscow Timiryazev Agricultural Academy, Moscow, Russia,
[2]Department of Financial Accounting, Audit and Taxation, The State University of Management,
Moscow, Russia, [3]Department of Higher School of Management, Financial University under the
Government of the Russian Federation, Moscow, Russia, [4]Department of Corporate Management and
Innovatics, Plekhanov Russian University of Economics, Moscow, Russia

The goal of this research was to find the influence of each mechanism of financial management of education—in the structure of the social and investment model of economic growth—on the results in the sphere of its development: quality, quantitative accessibility, and development of digital skills with students. The study's methodological approach involved the economic and mathematical modelling of (with the help of regression analysis) of the contribution of alternative investment mechanisms to the development of digital skills of the economically active population. We compared the contribution of isolated public and private investments to public-private partnership and proved its preference. We determined the place of the mechanism of education management based on public-private partnership in the structure of the social and investment model of economic growth. It was determined that the only manifestation of higher education's development, which largely depends on financial support, is digital skills among the active population. The connection between digital skills among the active population and investments in higher education by the terms of public-private partnership is clear (regression—0.47 points). An increase in the share of public-private partnership in the structure of financing of the development of higher education by up to 90% allows increasing digital skills among the active population from 61.49 points to 94.54 points—i.e., by 53.75%. Therefore, practical implementation of the social and investment model of economic growth should envisage financing of the development of higher education based on the mechanism of public-private partnership. It was proved that public-private partnership is a perspective mechanism of education management, which has an important role in the structure of the social and investment model of economic growth.

KEYWORDS

inclusive innovation, higher education, public-private partnership, financing of education, investments in education

1. Introduction

The global economic crisis, which began in 2020 under the influence of the COVID-19 pandemic and which could last for several years, became a critical factor in the development of the knowledge economy. In the latest global innovation report, WIPO (2020) has formulated and considered the issue of the sources of financing for science and innovations. In the main conclusions of this report, the most recent factual statistical data are the 2019 data, but there is a negative forecast, which is connected to the reduction of GDP growth (up to −5%) and the manifestations of R&D growth.

Based on the data on innovations' cyclicity, experts of WIPO (2020) consider the reduction of investments to be the decisive factor in the innovative development of the economy in the conditions of the 2020 crisis. Since innovations are closely connected to higher education and are generated in the university environment, it is possible to expect—based on the given expert evaluations—limited financing of education and a decrease in investment support in the near future. Thus, there is a problem of search for the best financial mechanism of education management in the structure of the social and investment model of economic growth. This paper is aimed at contributing to the resolution of the problem posed and is focused on higher education as the central element of the social and investment model of economic growth.

At present, most countries of the world use one source of financing, which could be either the state budget (in this case educational services are financed by the government and are free for students) or students' payment for educational services. In many other sectors, which provide services at the intersection of economic and public benefits, the mechanism of public-private partnership is used effectively. Among the countries of the OECD and, in particular, the top 10 countries selected for this research by the criterion of the largest share of public-private partnerships in the structure of investments in education, the sources of financing of higher education are very differentiated.

In some countries, private financing of higher education dominates. Examples are Belgium (85%), Poland (81%), France (79%) and Ireland (72%) (OECD, 2019). Their experience was studied in detail by Alfarizi et al. (2023), Geryk (2023), Herrmann and Nagel (2023), Pangarso and Setyorini (2023) and Selim and Kee (2023). These authors note the advantages of private universities and paid services of higher education.

In other countries, investments in higher education are based on public financing from the national budget. Examples are Chile (54%), South Korea (47%) and the UK (39%) (OECD, 2019). Their experience was studied by Frei et al. (2023), He and Ismail (2023), Hong et al. (2023), Jaafar et al. (2023), Salman et al. (2023), and Zigmont et al. (2023). These authors elaborated on the advantages of state universities and proved the necessity for financial support for the development of higher education from the national budget.

Investments in higher education based on the mechanism of public-private partnership account for a small share of financing of higher education even in the top 10 countries of the world by the development of this mechanism (from 3% in France to 29% in the UK) (OECD, 2019). The mechanism of public-private partnership in the activity of universities was not studied or presented sufficiently in the existing literature. Due to this, the contribution of this mechanism

to the financing of higher education development was not clearly determined—which is a literature gap.

It is important to fill this gap and to study the phenomenon of public-private partnership in higher education because public-private partnership is a promising mechanism of managing education in these countries. It allows improving this management. Even with a small share of public-private partnership in the structure of investments in higher education, the considered top 10 countries are recognized world leaders by the competitiveness and effectiveness of universities, as well as by the quality of higher education services. Thus, it is important to study their experience, since it is useful for other countries of the world. These top 10 countries are progressive knowledge economies with progressive societies, in which digital skills are common among wide groups of the population.

This is important now in the sphere of educational management, for, under the conditions of the ongoing pandemics and long recession in the world economy, which is accompanied by the increased inflation and the reduction of real disposable incomes of the population, national budgets' assets are limited, similarly to the population's abilities to pay for the services of higher education in private universities. It is important to avoid the deficit of financing of universities, to prevent the slowdown of higher education development.

In this regard, a promising mechanism of public-private partnership is interesting. It allows unifying public and private financial resources and developing highly effective joint management of universities, which is based on public-private monitoring and independent control of quality, affordability and effectiveness of higher education services. Due to this, public-private partnership allows for the full realization of the potential of universities' development and an increase in the affordability and quality of higher education services.

The following hypothesis was offered here: this mechanism is in high demand in the system of higher education. The goal of this research was to determine the role of the mechanism of education management based on public-private partnership in the structure of the social and investment model of economic growth.

2. Literature review

This research is based on the existing concept of higher education as the core of the social and investment model of economic growth. The essence and specifics of using public-private partnerships in the modern economy, as well as specific experience of using this mechanism in education, are considered in the works Mitra (2020), Nayak (2019), Opawole and Jagboro (2018), Opawole et al. (2019), and Zhu et al. (2019). The financial aspects of education management in the structure of the social and investment model of economic growth are studied in the works Abildaeva et al. (2022), Annamalai (2022), Ashour et al. (2019), Dobrosotskiy et al. (2019), Ramaditya et al. (2022), Sanz and López-Iñesta (2022), Wright and Horta (2018).

The importance of public-private partnership is that it allows for a simultaneous increase in the investment support for higher education (due to joint public and private financing) and an increase in the effectiveness of university management—due to the flexibility of private investors and public control (Termes et al., 2020; Barrera-Osorio et al., 2022).

Results obtained in similar studies show that the development of higher education in the social and investment model of economic growth is determined by the quality of vocational training (Olmedo-Moreno et al., 2021; Vanderburg et al., 2022) and ease of finding skilled employees (Halili et al., 2022; Maddah et al., 2023) (quantitative accessibility of skilled employees).

Patrinos et al. (2021) and Piurcosky et al. (2022) indicate that the largest contribution to the development of higher education in the social and investment model of economic growth is made by private investments in universities. Contrary to them, Ojha et al. (2022), Pan et al. (2022) and Villela and Paredes (2022) note that public financing of universities makes the largest contribution to the development of higher education in the social and investment model of economic growth.

Under the conditions of the digital economy, the most important contribution of universities to the implementation of the social and investment model of economic growth is the training of digital personnel (Arslantas and Gul, 2022; Gómez-Poyato et al., 2022; Spada et al., 2022).

That is why we should focus on this result. Based on the works by Musenero et al. (2023) and Uddin et al. (2023), which note the advantages of public-private partnership, we propose the following hypothesis (H): for the development of digital skills among the active population, public-private partnership is more preferable than private investments and public investments separately.

It is possible to see that the given literature sources provide a detailed elaboration of the issues of using the mechanism of public-private partnership and the issues of financial education management. However, the issue of using the public-private partnership as a mechanism of education management in the structure of the social and investment model of economic growth needs further consideration and solution. We try to find this solution in the presented paper.

3. Materials and methodology

The experience of the development of higher education in the social and investment model of economic growth is studied in this paper. The methodological approach of the research involves the economic and mathematical modelling of the contribution of alternative investment mechanisms to the development of digital skills of the economically active population. We compare the contribution of isolated public and private investments to public-private partnership and prove its preference. To strengthen the verifiability of the suggested hypothesis, let us present it in economic and mathematical form. The research model is as follows:

$$D = a + b_1{}^*pr + b_2{}^*ppp + b_3{}^*pu$$

where
D—digital skills among the active population;
pr—private expenditure (private investments);
ppp—public-to-private transfers (public-private partnership);
pu—public expenditure (public investments);
a—constant;
b—coefficients of regression.

H: $b_2 > (b_1 + b_3)$. That is, public-to-private transfers (public-private partnership) make a larger contribution to the development of digital skills among the active population than private expenditure (private investments) and public expenditure (public investments) separately.

Verification of the offered hypothesis envisages determining the influence of each mechanism of financial management of education (in the structure of the social and investment model of economic growth) on the results in the sphere of its development: quality, quantitative accessibility, and development of digital skills with students—which is a new educational service, the popularity of which grows in the digital economy.

Regression analysis was used in this research. The hypothesis was deemed proven if coefficients of regression and correlation between the indicators of development of higher education and public-private partnership were larger compared to other mechanisms of financing of higher education—private and public investments. The data on the mechanisms of financing of higher education are materials of the report by OECD (2019), from which we selected the top 10 countries of the OECD with the largest share of public-private partnerships in the structure of investments in education. The indicators of the development of higher education in the social and investment model of economic growth were taken from World Economic Forum (2020). Statistics for the research are given in Table 1.

The procedure of selecting countries from the list of OECD countries in the context of public-private partnership was based on the choice of countries in which the share of this mechanism in the structure of financing of the activity of universities is the highest. Due to this, the formed sample allows for the most correct determination of the contribution of public-private partnership to the investment support of universities' activity and the increase in affordability and quality of higher education services.

4. Results

4.1. Modelling of the contribution of alternative mechanisms of financing of higher education to the development of digital skills among the economically active population

To identify the place of public-private partnership in the social and investment model of economic growth, let us perform the modelling of the contribution of alternative mechanisms of financing of higher education to the development of digital skills among the economically active population. To check the offered hypothesis and to determine the contribution of each accessible mechanism of financing of education to its development, we obtained (based on Table 1) the following equations of multiple linear regression:

$$- Q = 76.78 - 0.20{}^*pr - 0.26{}^*ppp + 0{}^*pu, \text{ multiple } r = 43.50\%;$$
$$- D = 52.36 + 0.04{}^*pr + 0.47{}^*ppp + 0{}^*pu, \text{ multiple } r = 56.88\%;$$
$$- E = 67.87 - 0.12{}^*pr - 0.04ppp + 0{}^*pu, \text{ multiple } r = 41.00\%.$$

The obtained regression equations show that the quality of vocational training and ease of finding skilled employees demonstrate inverse regression dependence on all mechanisms of financing.

TABLE 1 The structure of investments in higher education and the indicators of its development in the countries of the sample in 2020.

Country	Share of social investments of the given type in their general structure, %			Indicators of the development of higher education in the social and investment model of economic growth, points 1–100		
	Private expenditure (private investments)	Public-to-private transfers (Public-private partnership)	Public expenditure (public investments)	Quality of vocational training	Digital skills among the active population	Ease of finding skilled employees (Quantitative accessibility of skilled employees)
	pr	ppp	pu	Q	D	E
UK	32	29	39	64.7	65.6	67.5
Australia	39	24	37	63.8	67.0	59.6
New Zealand	51	18	31	63.2	65.5	52.5
Ireland	72	18	10	64.1	66.5	652.0
South Korea	38	15	47	63.9	66.5	65.1
Poland	81	12	7	42.2	54.5	51.6
Italy	63	11	26	58.4	52.9	54.6
Chile	36	10	54	65.3	54.4	64.4
Belgium	85	4	11	67.8	63.8	62.1
France	79	3	18	62.1	58.2	59.6

Source: compiled by the authors based on OECD (2019), and World Economic Forum (2020).

Therefore, these characteristics of higher education cannot be managed with the help of investments.

Digital skills among the active population are by 56.88% determined by the influence of investing. Growth of the share of private investments in the structure of social investments, aimed at the financing of higher education, by 1% leads to growth of digital skills among the active population by 0.04 points (small attention). Growth of the share of public-private partnership in the structure of social investments, aimed at the financing of higher education, by 1% leads to growth of digital skills among the active population by 0.47 points (large attention). The results obtained demonstrate that public-private partnership has an important place in the social and investment model of economic growth.

4.2. Alternative scenarios of education management in the social and investment model of economic growth

To determine the role of public-private partnership as a mechanism of education management in the structure of the social and investment model of economic growth, let us consider different scenarios of financing of higher education in the short term (until 2022) (Figures 1, 2).

As shown in Figure 1, the scenario of reliance on the mechanism of private investments envisages an increase in their share by up to 90% in the structure of investments in higher education. This will lead to a decrease in digital skills among the active population by 4.93% and a moderate deficit of digital personnel.

The scenario of reliance on the mechanism of public investments envisages an increase in their share of up to 90% in the structure of

investments in higher education. This will lead to a decrease in digital skills among the active population by 10.72% and a strong deficit of digital personnel.

As shown in Figure 2, the scenario of equal use of all mechanisms envisages the distribution of shares among them, each share constituting 33.33%. This will lead to the growth of digital skills among the active population by 12.70%.

The scenario of reliance on the mechanism of public-private partnership envisages an increase in the share of this investment mechanism up to 90%. This will lead to an increase in digital skills among the active population by 53.75% and will allow overcoming their deficit. Thus, the scenario that is based on the development of public-private partnership as a mechanism of education management in the social and investment model of economic growth is most promising and preferable.

5. Discussion

This paper's contribution to the literature was the clarification of the role of university management in the implementation of the social and investment model of economic growth. We proved that the development of higher education in the social and investment model of economic growth is determined not by the quality of vocational training (unlike Olmedo-Moreno et al., 2021; Vanderburg et al., 2022) and not by the ease of finding skilled employees (unlike Halili et al., 2022; Maddah et al., 2023) (that is, not by quantitative accessibility of skilled employees) but by digital skills among the active population.

We also proved that financial support of universities and the effectiveness of their management are the highest not in the case of
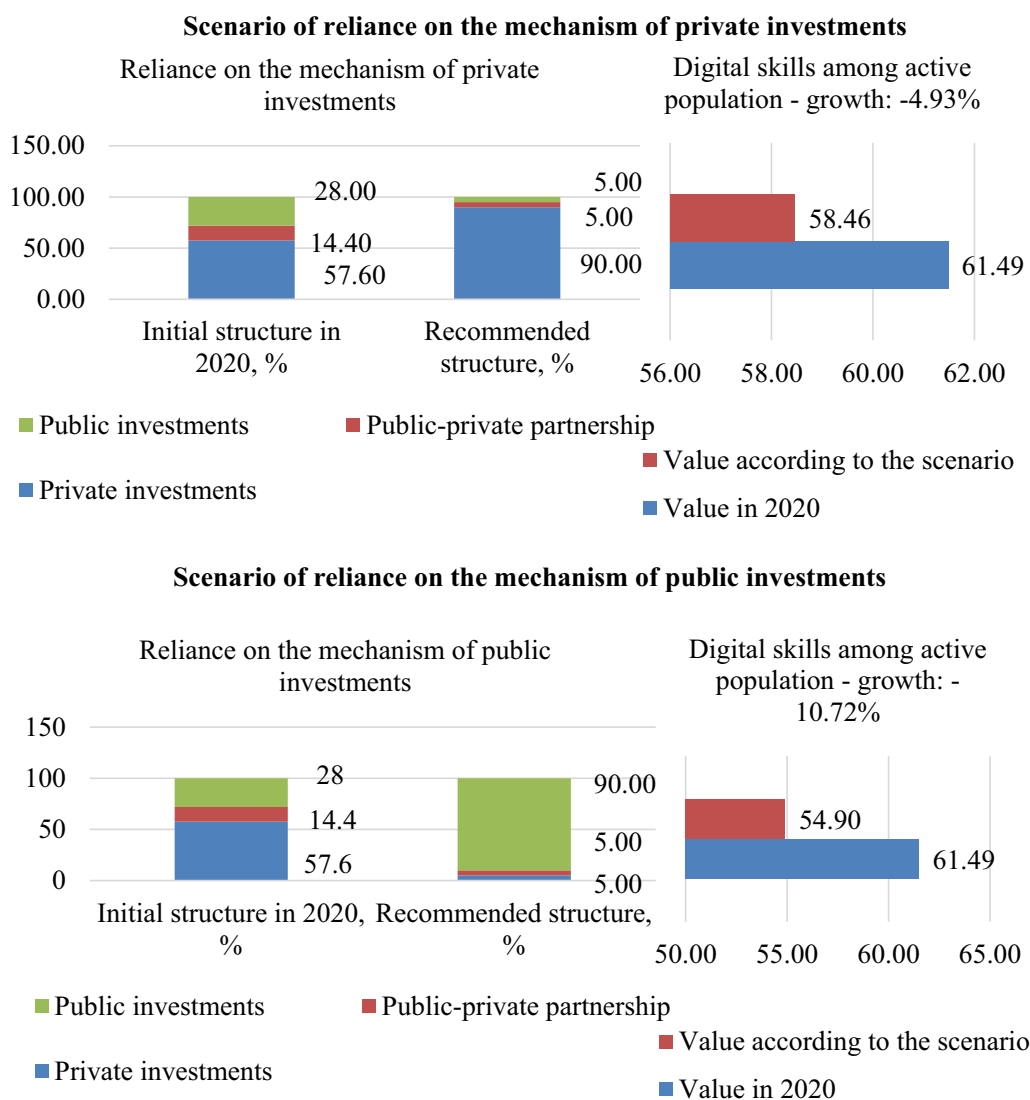
FIGURE 1
Education management in the social and investment model of economic growth according to the scenario of reliance on the mechanism of private investments and according to the scenario of reliance on the mechanism of public investments.
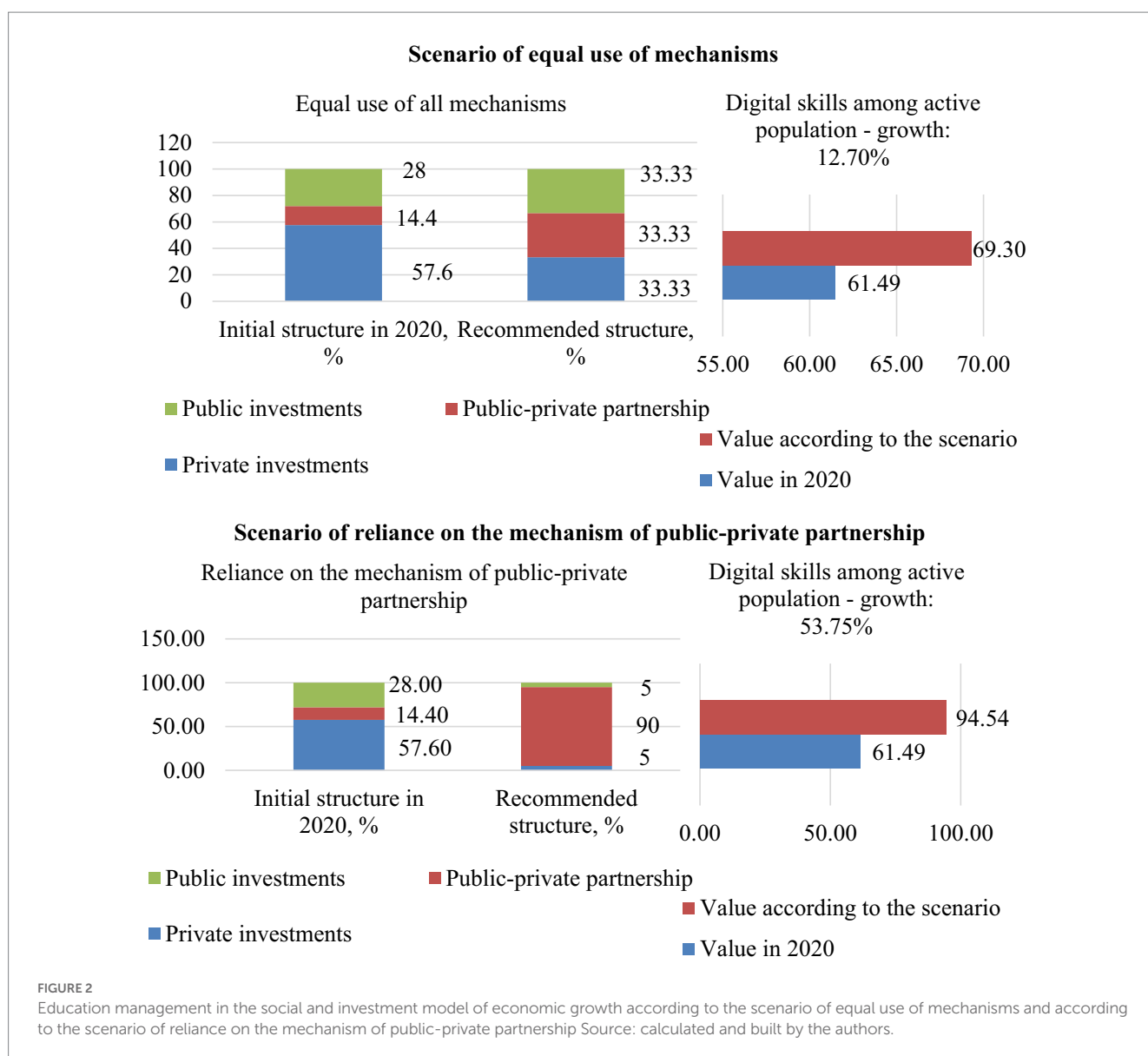
domination of private investments in universities (unlike Patrinos et al., 2021; Piurcosky et al., 2022) and not in the case of preferential public financing of universities' activities (unlike Ojha et al., 2022; Pan et al., 2022; Villela and Paredes, 2022) but in the case of public-private partnership, which ensures joint financing and control over the activities of universities by the government and by the public investors.

This paper is a part of the chain of productive scientific research on the social and investment model of economic growth; it strengthens the evidence base of Arslantas and Gul (2022), Gómez-Poyato et al. (2022) and Spada et al. (2022) with proofs of the key role of universities in the training of digital personnel based on public-private partnership. The novel contribution of this research and its theoretical significance consists in proving the important role of public-private partnership as a mechanism of education management in the implementation of the social and investment model of economic growth.

6. Conclusion

Thus, the research results confirm the hypothesis - public-private partnership is a perspective mechanism of education management, with an important place in the structure of the social and investment model of economic growth. It has been determined that contrary to the existing beliefs, the quality of higher education and quantitative accessibility of education and skilled employees do not depend on investments in higher education and thus are not subject to financial management.

The only manifestation of the development of higher education, which does depend a lot on financial support, is digital skills among the active population. Public investments have zero connection with this manifestation, and private investments have a weak connection (regression—0.04 points). The connection between digital skills among the active population and investments in higher

FIGURE 2
Education management in the social and investment model of economic growth according to the scenario of equal use of mechanisms and according to the scenario of reliance on the mechanism of public-private partnership Source: calculated and built by the authors.

education the terms of public-private partnership is very clear (regression—0.47 points).

Scenario analysis has shown that a combination of public and private investments ensures better results for the development of higher education than the domination of one type of investment. The public-private partnership allows combining not only financial resources but also management practices, thus providing the highest effectiveness.

It was proven that an increase in the share of public-private partnerships in the structure of financing of the development of higher education by up to 90% allows raising digital skills among the active population from 61.49 points to 94.54 points—i.e., by 53.75%. Therefore, practical implementation of the social and investment model of economic growth should envisage financing of the development of higher education based on the mechanism of public-private partnership.

Thus, the most important results of this research and its key factors are as follows. The most prospective vector of the development

of higher education in the social and investment model of economic growth is the increase in digital skills among the active population. The most promising scenario of this vector realization is the reliance on public-private partnership.

The implications of the results obtained for stakeholders are as follows: universities receive a clearer view of how to improve the management of universities—with the help of the mechanism of public-private partnership. The government gets the opportunity to increase the rate of economic growth in its social and investment model through the activation of the mechanism of public-private partnership in higher education. Private investors can increase return on investments in higher education due to the use of the public-private partnership mechanism in university management.

The managerial significance of the conclusions made and results obtained is that they demonstrated the prospects for an increase in the effectiveness of education management based on the mechanism of public-private partnership. Collectively, this paper's results

systemically support the implementation of the social and investment model of economic growth.

The social significance of the results obtained is that the better realization of the potential of the mechanism of public-private partnership based on the authors' recommendations will allow increasing the affordability and quality of higher education services for wide groups of the population and ensuring better mastering of digital skills by them. Due to this, the paper supports the practical achievement of SDG 4 (Quality education), SDG 8 (Decent work and economic growth) and SDG 9 (Industry, innovation and infrastructure).

Thus, the paper strengthened the scientific arguments in favor of public-private partnership being a prospective mechanism of education management in the structure of the social and investment model of economic growth. However, specific roles of the public and private partners in university management remained outside of the scope of this research, which is its limitation.

As is known, there are many models of public-private partnership, all of which can be used in higher education, but the specific investment project of a university requires an independent choice of the appropriate model given its specific features. Therefore, future scientific studies should pay attention to the issue of distribution of the roles of the public and private partners during university management based on the mechanism of public-private partnership, in particular, with the help of case studies based on the experience of specific universities.

Another promising area for future research in the continuation of this paper is the study of possibilities and perspectives for combining various mechanisms of university management during the implementation of investment projects in higher education. In particular, attention should be paid to the cluster mechanism, as well as the mechanism of collaboration of universities and businesses based on technological parks and innovative networks, which can be used in combination with the mechanism of public-private partnership,

acquiring new flexible and highly effective forms in practice. Thus, an in-depth elaboration of the issues of comprehensive activation of the integration mechanisms in higher education with various lists of participants is a prospective area for future scientific studies.

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

MD, MK, TB, and SK participated in the preparation of the manuscript. All authors contributed to the article and approved the submitted version.

Conflict of interest

Publisher's note

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The infrastructural role of education in the social and investment model of economic growth: the specifics of emerging markets

Galina N. Semenova[1,2]*, Yuriy A. Krupnov[3], Elena I. Kostyukova[4] and Tatiana P. Satsuk[5]

[1]Plekhanov Russian University of Economics, Moscow, Russia, [2]Moscow State Regional University, Moscow, Russia, [3]Financial University under the Government of the Russian Federation, Moscow, Russia, [4]Stavropol State Agrarian University, Stavropol, Russia, [5]St. Petersburg State University of Railways named after Emperor Alexander I, St. Petersburg, Russia

The purpose of this paper is to determine the directions and to specify the infrastructural role of higher education in the social and investment model of economic growth in view of the specifics and perspectives of emerging economies. Correlation analysis is used to determine the dependence between the directions of higher education's development and the target results of its contribution to the implementation of the social and investment model of economic growth in emerging economies. These connections are specified with the help of regression analysis. Then, the simplex method is used to determine target landmarks for the selected directions. According to the experience of the top emerging economies with the highest level of economic innovative development in 2020, maximization (up to 100%) of knowledge-intensive employment (+299.29%), medium-tech and hi-tech manufacturing (+223.42%) and e-participation (+19.98%) requires the increase in the number of students per 1 lecturer in higher education by 387.26%, growth of mobility in higher education by 1,116.27%, and increase in QS university ranking by 139.13%. It is proved that only three directions of higher education's development are significant and have to be implemented to support social and investment model of economic growth in emerging economies: increase in the number of students per 1 lecturer in higher education, growth of mobility in higher education, and increase in QS university ranking.

KEYWORDS

educational environment, educational governance, inclusive innovation, infrastructural role, higher education, emerging markets

1. Introduction

The social and investment model of economic growth has formed as a response to the three key challenges of the global economic system of recent years: formation of the "knowledge economy," which raised the value of the leading technologies and innovations; transition to the digital economy, which required the wide mastering of digital technologies in society and business and formed hi-tech markets; and the start of the process of formation of the social market economy, in which the most important milestone is quality of life, determined by the

creation of highly-efficient and highly-paid jobs that ensure the realization of human potential (Gevorgyan et al., 2021).

As the successful and leading experience of developed countries has shown, higher education plays the basic—infrastructural—role in the social and investment model of economic growth. However, the emerging economies' attempts to develop higher education to implement the social and investment model of economic growth do not bring the desired results. The problem is that higher education develops rapidly and in a systemic manner (in all directions at the same time) in developed countries—due to sufficient resources. In emerging economies, the deficit of resources allows implementing either certain directions of higher education's development or developing it systemically but slowly.

In both variants of higher education's development that are accessible for emerging economies, substantial results in the social and investment model of economic growth cannot be achieved. The essence of the problem posed consists in the uncertainty of the cause-and-effect relationships of higher education and the results of the implementation of the social and investment model of economic growth in developing countries. Traditional educational mechanisms, which are highly effective and are actively used by developed countries, demonstrate restrained effects in developing countries (Popkova, 2022).

This leads to the incorrectness of using the samples of developed countries during the implementation of the social and investment model of economic growth in developing countries (Zhang and Zhao, 2023). This model must take into account the specifics and be adapted to the unique experience of developing countries. Therefore, this paper strives to prove that, similarly to developed countries, education has an infrastructural (basic, system-forming) role in the implementation of the social and investment model of economic growth, but this role has its specific manifestations. That is why there is a need for an approach to university management in developing countries.

The hypothesis (H_0) of this research is as follows: the problem could be solved by high-precision and targeted development of higher education in emerging economies in the directions that contribute the most to the implementation of the social and investment model of economic growth. The purpose of this paper is to determine these directions and to specify the infrastructural role of higher education in the social and investment model of economic growth in view of the specifics and perspectives of emerging economies.

The novel aspect of this paper, compared to the existing studies, lies in the description of the poorly studied experience of developing countries in the implementation of the social and investment model of economic growth. Due to this, in this paper—for the first time—the specifics of the role of education in the implementation of this model are substantiated. The authors' recommendations for university management to support the social and investment model of economic growth given the specifics of developing countries are offered.

2. Literature review

The theoretical basis of this research is the concept of university management. According to this concept, the infrastructural role of education in the social and investment model of economic growth is substantiated and emphasized in the works Aleixo et al. (2020),

Finnveden et al. (2020), Neelam et al. (2020), and Pedro et al. (2020). The specifics of higher education's development in emerging markets are studied in the works Adeyinka-Ojo et al. (2020), Baartman et al. (2022), Fuchs (2022), Gonzales-Valdivia et al. (2022), Hassan (2020), Lohberger and Braun (2022), Saqib et al. (2020).

The following directions of higher education's development are distinguished in the existing literature:

- University/industry research collaboration for the improved mastering of applied competencies by university students, increase in the competitiveness of university graduates in the labor market, improvement of their employment opportunities and career building and creation of applied technologies and accelerated commercialization of university innovations (Fernandes and O'Sullivan, 2023; Zhuang and Zhou, 2023);
- Expenditure on education for the improvement of accessibility of higher education services, which, in particular, involves an increase in the scale of state order for the training of highly skilled and digital personnel by state-funded universities on budgetary places (Ali, 2022; Ojha et al., 2022);
- Pupil-teacher ratio for improvement of the quality of higher education services that are provided by universities (Pérez-Rodríguez et al., 2022; Valverde-Espinoza and Barja-Ore, 2022);
- Mobility in higher education for the free exchange of knowledge and technologies, international recognition of education diplomas, the attraction of foreign students and teachers, foreign internships, research by international scientific groups and strengthening of the international status of universities (Lo et al., 2022; Cuzzocrea and Krzaklewska, 2023);
- Gross expenditure on R&D, the centers of which are universities, for the acceleration of innovative development of the economy (Su et al., 2022; Weiyu et al., 2022);
- QS university ranking for strengthening of the global competitiveness of universities, which is demonstrated by their position in international university rankings, of which the QS ranking is one of the most respectable (Estrada-Real and Cantu-Ortiz, 2022; Moshtagh et al., 2023).

In the Decade of Action, the implementation of the social and investment model of economic growth should be considered through the lens of the sustainable development goals (SDGs), formulated by the UN. University management, which is aimed at the practical implementation of the five mentioned directions of higher education's development, supports SDG 4 (raises the quality of higher education). The target results of its contribution to the implementation of the social and investment model of economic growth are as follows:

- Increase in knowledge-intensive employment for the fullest unlocking of human potential to support SDG 8 (decent work and economic growth based on the "knowledge society"; Hrivnák et al., 2021; Markowska et al., 2022);
- Development of medium-tech and hi-tech manufacturing to strengthen the digital competitiveness of the economy and to improve its positions in the world markets under the conditions of the Fourth Industrial Revolution to support SDG 9 (Dyakov et al., 2022; Taleb and Pheniqi, 2023);
- Development of e-participation: more active involvement of wide groups of the population in the implementation of socially

important initiatives, development of civil society and development of responsible communities to support SDGs 10–12 and SDGs 16–17 (Quintana et al., 2022; Bouregh et al., 2023).

A large number of existing publications ensures a reliable theoretical base for this research. However, the existing literature is focused mainly on the experience of developed countries, while the experience of developing countries is poorly studied, and their specifics are unclear. This is a literature gap that this paper strives to fill. We can see the insufficient elaboration on the issue of implementing the infrastructural role of higher education in the social and investment model of economic growth in emerging economies. We try to fill this gap in the presented paper. For this, we study the experience of developing countries and clarify the specifics of the influence of university management on the implementation of the social and investment model of economic growth in developing countries.
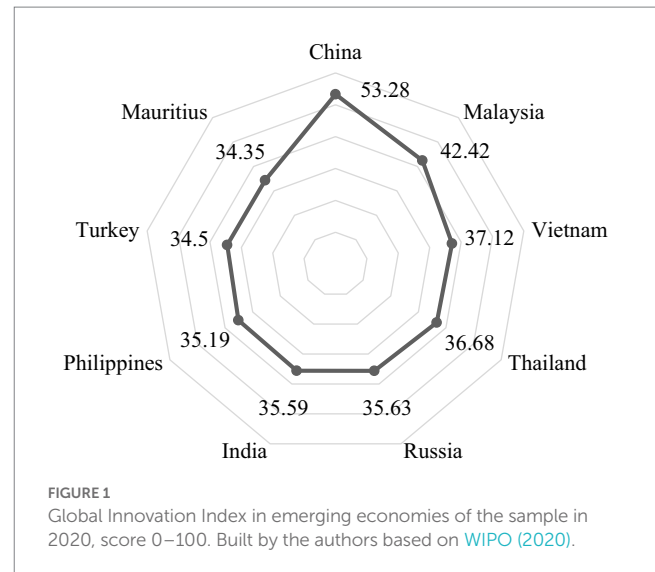
3. Materials and methodology

The economic and mathematical sense of the offered hypothesis (H_0) consists in the fact that only some (not all) directions of higher education's development contribute (in a serious way) to the implementation of the social and investment model of economic growth in emerging economies. To verify the offered hypothesis we use correlation analysis; we determine the dependence between the directions of higher education's development (university/industry research collaboration, expenditure on education, mobility in higher education, gross expenditure on R&D, and QS university ranking) and target results of its contribution to the implementation of the social and investment model of economic growth (knowledge-intensive employment, medium-tech and hi-tech manufacturing, and e-participation) in emerging economies.

In econometric analysis, the indicators of QS Ranking are used. QS Ranking is one of the leading international university rankings, which covers 1,500 universities around the world (as of 2023) and takes into account the characteristics of university management: from academic reputation to the number of international students enrolled (QS Quacquarelli Symonds Limited, 2023). The use of the QS ranking materials is important for this paper since it allows for the most correct determination of the global competitiveness of universities. Though there are many university rankings, the most authoritative ones are QS, THE, and QRWU.

We selected QS for this paper, not another ranking because the position of universities in the QS ranking is given as an individual indicator of WIPO (2020). This allows taking into account the data of the QS ranking with their full compatibility with other indicators that are studied in this paper. The role of the ranking in the studied context consists in the reflection of global competitiveness and world reputation of the top 3 universities of each considered developing country.

The hypothesis is deemed proven if the results have a higher (more than 45%) correlation with only certain directions. The research objects are the top emerging economies by the level of society and the economy's innovative development according to WIPO (2020). The values of the Global Innovation Index in the selected countries in 2020 are shown in Figure 1. In this paper, we studied the data for 2020, since

FIGURE 1
Global Innovation Index in emerging economies of the sample in 2020, score 0−100. Built by the authors based on WIPO (2020).

this period is the initial point for the Decade of Action and defines the state of affairs up until 2030. In addition to this, against the background of the start of the COVID-19 pandemic, the role of education and the significance of the social and investment model of economic growth grew significantly, which makes the experience of 2020 particularly interesting and useful in the context of this research.

During the selection of the data, we used, first, the criterion of completeness, to minimize the gaps in data and obtain the fullest possible picture of university management's contribution to the implementation of the social and investment model of economic growth in developing countries. Second, the criterion of the authority of data sources, to guarantee full objectivity, high precision and reliability of the research results.

As shown in Figure 1, the leader in the innovative development of the economy among developing countries is China (53.28 points). High level and rate of innovative development of the economy are demonstrated also by other countries of the sample: Malaysia (42.42 points), Vietnam (37.12 points), Thailand (36.68 points), Russia (35.63 points), India (35.59 points), the Philippines (35.19 points), Turkey (34.50 points) and Mauritius (34.35 points). The directions of higher education's development and the results for the social and investment model of economic growth in emerging economies of the sample in 2020 are presented in Table 1.

Systematization and generalization of data from Table 1 revealed high results of university management in support of the key directions of higher education's development in developing countries of the sample. Thus, on average for the sample, university/industry research collaboration equals 49.37% of involved universities. Expenditure on education is 3.89% of GDP. Number of students per 1 lecturer in higher education is 17.22. Mobility in higher education is 2.85%. Gross expenditure on R&D is 0.91% of GDP. QS university ranking, the average score of top 3 universities is 35.27 points. We also revealed high achieved serious target results of its contribution to the implementation of the social and investment model of economic growth. Thus, on average for the sample, knowledge-intensive employment is 25.04%. Medium-tech and hi-tech manufacturing equals 33.40%. E-participation is 88.34% of the economically active population.

TABLE 1 Directions of higher education's development and results for the social and investment model of economic growth in emerging economies in 2020.

Indicators' titles that are used in the paper	Knowledge-intensive employment, %	Medium-tech and hi-tech manufacturing, %	E-participation, % of the economically active population	University/industry research collaboration, % of involved universities	Expenditure on education, % of GDP	Number of students per 1 lecturer in higher education	Mobility in higher education, %	Gross expenditure on R&D, % of GDP	QS university ranking, average score of top 3 universities, points 1–100
Official indicators' titles	Knowledge-intensive employment	High- and medium-high-tech manufacturing	E-participation	University/industry research collaboration	Expenditure on education	Pupil-teacher ratio, secondary	Tertiary inbound mobility	Gross expenditure on R&D	QS university ranking, average score top 3
	y_1	y_2	y_3	x_1	x_2	x_3	x_4	x_5	x_6
China	39.0	46.4	90.5	560.5	3.3	13.3	0.4	2.2	83.8
Malaysia	27.2	43.1	88.8	68.3	4.5	11.4	9.6	1.4	54.6
Vietnam	13.5	40.0	69.1	42.0	4.2	17.6	0.2	0.5	9.2
Thailand	13.8	43.8	65.2	54.1	4.1	25.9	1.3	1.0	30.6
Russia	44.1	25.6	92.1	46.8	3.7	8.8	4.3	1.0	47.5
India	15.7	34.1	95.5	47.7	3.8	25.8	0.1	0.6	47.2
Philippines	25.5	38.6	93.8	57.5	2.7	23.9	-	0.2	20.6
Turkey	21.6	25.8	86.0	40.6	-	17.3	1.5	1.0	23.9
Mauritius	25.0	3.2	69.1	30.8	4.8	11.0	5.4	0.3	0

Compiled by the authors based on WIPO (2020).

As a result of correlation analysis, we determine the key directions of higher education's development, which are closely connected to the results for the social and investment model of economic growth in emerging economies in 2020. These connections are specified with the help of regression analysis (multiple and/or one-factor). Then, based on the determined regression dependencies, we use the simplex method to find the target landmarks (control values of the corresponding indicators) for the selected directions of higher education's development for the purpose of full-scale implementation (maximization of results) of all results for the social and investment model of economic growth in emerging economies.

4. Results

To verify the offered hypothesis and to specify the infrastructural role of higher education, we use the data from Table 1 to find the correlation between the directions of this development and the results for the social and investment model of economic growth in emerging economies in 2020 (Figure 2).

As shown in Figure 2, results in the sphere of knowledge-intensive employment (y_1) are determined by such directions as mobility in higher education (x_4, correlation—69.32%) and QS university ranking (x_6, correlation—55.00%). Results in the sphere of development of medium-tech and hi-tech manufacturing (y_2) are determined by such direction as the number of students per 1 lecturer in higher education (x_3, the correlation—46.79%). Results in the sphere of e-participation (y_3) are determined by QS university ranking (x_6, correlation—59.70%).

To specify the determined correlation connections, let us find regression dependencies of the considered results on the selected directions of higher education's development (x_3, x_4, and x_6), based on the data from Table 1. The regression dependence of knowledge-intensive employment (y_1) on mobility in higher education (x_4) and QS university ranking (x_6) is the following: $y_1 = 19.78 + 2.21x_4 - 0.1271x_6$.

In the multiple regression equation, the dependence of knowledge-intensive employment (y_1) on QS university ranking (x_6) is negative. Therefore, this direction shall not be further considered here. We build a regression curve that reflects the isolated (one-factor) dependence $y_1(x_4)$. Thus, an increase in mobility in higher education by 1% leads to growth of knowledge-intensive employment by 1.7307%, a correlation between the indicators is moderately high—48.05%.

Regression dependence of medium-tech and hi-tech manufacturing (y_2) on the number of students per 1 lecturer in higher education (x_3) is the following: $y_2 = 1.0733x_3 + 13.082$ and dependence of e-participation (y_3) on QS university ranking (x_6) is the following: $y_3 = 0.2786x_6 + 73.518$. An increase in the number of students per 1 lecturer in higher education (x_3) by 1 leads to growth of the share of medium-tech and hi-tech production (y_2) by 1.0733%, the correlation between the indicators is moderately high, constituting 21.90%.

An increase in QS university ranking (x_6) by 1 point leads to growth of the share of e-participation (y_3) by 0.2786%, the correlation between the indicators is moderately high, constituting 35.64%. Based on the determined regression dependencies, we find the perspective of improving the implementation of the infrastructural role of higher education in the social and investment model of economic growth in emerging economies (Figure 3).
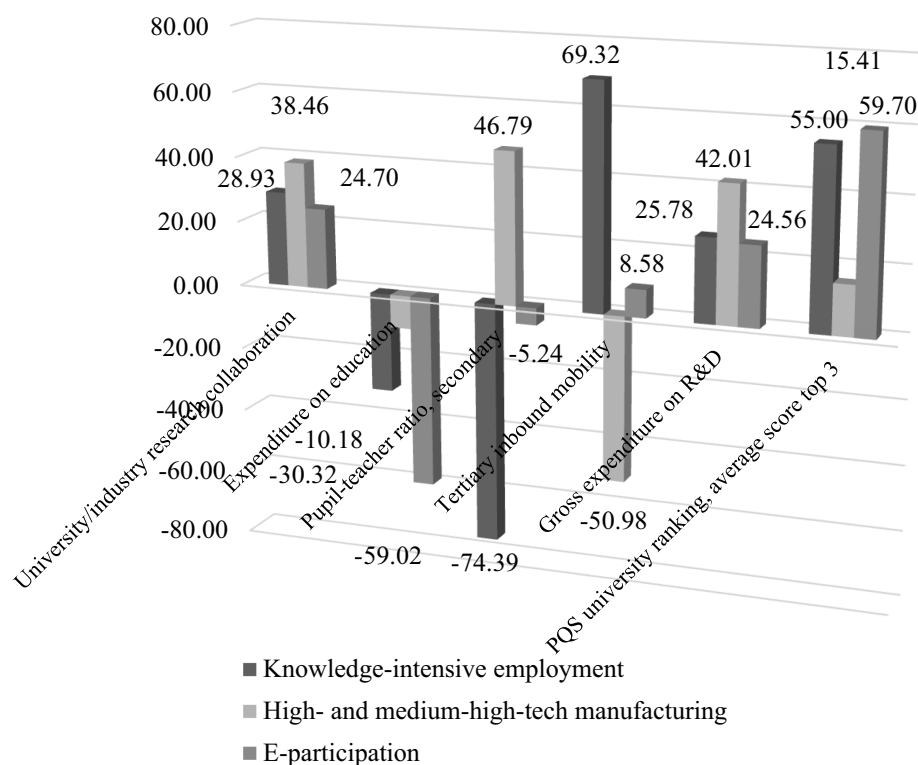

FIGURE 2
Correlation between the directions of higher education's development and the results for the social and investment model of economic growth in emerging economies in 2020, %. Calculated and built by the authors.
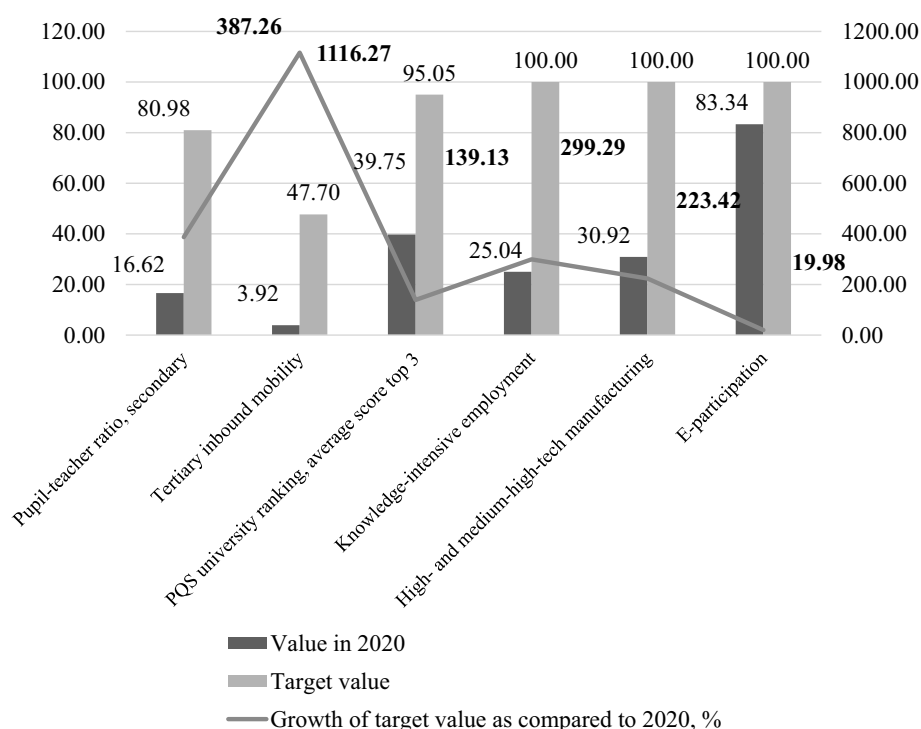
Perspectives of improving the implementation of the infrastructural role of education in the social and investment model of economic growth. Calculated and built by the authors.

As shown in Figure 3, improvement of university management will allow maximization of all results (up to 100%) of implementation of the social and investment model of economic growth in emerging economies. In the Decade of Action (until 2030), it is possible to achieve the growth of knowledge-intensive employment by 299.29%, medium-tech and hi-tech manufacturing—by 223.42% and e-participation—by 19.98%, compared to 2020. To achieve these advantages in the practice of developing countries in the Decade of Action, the authors' suggestions for public and social policy in higher education are as follows. First, to increase the number of students per 1 lecturer in higher education from 16.62 up to 80.98, i.e., by 387.26%. Second, the growth of mobility in higher education—from 3.92% up to 47.70%, i.e., by 1,116.27%. Third, an increase in QS university ranking from 39.75 points up to 95.05 points, i.e., by 139.3%.

5. Discussion

This paper's contribution to the literature consists in the development of the concept of university management by clarifying the specifics of the influence of university management on the implementation of the social and investment model of economic growth in developing countries. This paper rethought, from the position of the SDGs, and described the connection with education management and the target results of its contribution to the implementation of the social and investment model of economic growth: an increase in knowledge-intensive employment (in support of Hrivnák et al., 2021; Markowska et al., 2022); development of medium-tech and hi-tech manufacturing (strengthening the factual base Dyakov et al., 2022; Taleb and Pheniqi, 2023); development of

e-participation: (in support of Quintana et al., 2022; Bouregh et al., 2023).

This paper contributes to the ongoing scientific discussion on the issues of university management through the justification of the following directions of higher education's development: pupil-teacher ratio (in support of Pérez-Rodríguez et al., 2022; Valverde-Espinoza and Barja-Ore, 2022); mobility in higher education (in support of Lo et al., 2022; Cuzzocrea and Krzaklewska, 2023); QS university ranking (in support of Estrada-Real and Cantu-Ortiz, 2022; Moshtagh et al., 2023).

Contrary to the experience of developed countries, we did not reveal a significant contribution to the implementation of the social and investment model of economic growth in developing countries of such factors of university management as university/industry research collaboration (unlike Fernandes and O'Sullivan, 2023; Zhuang and Zhou, 2023), expenditure on education (unlike Ali, 2022; Ojha et al., 2022) and gross expenditure on R&D (unlike Su et al., 2022; Weiyu et al., 2022).

6. Conclusion

The main research result is that the infrastructural role of university management in developing countries is no less important implementing the social and investment model of economic growth, but it is different from this role in developing countries. Developed countries have a wider circle of effective tools of university management. Unlike them, the capabilities for university management in support of the implementation of the social and investment model of economic growth in developing countries are limited by such tools

as pupil-teacher ratio, mobility in higher education and QS university ranking.

Thus, hypothesis (H_0) has been proved as a result of the performed research; it has been shown that only three directions of higher education's development are significant and require implementation for the purpose of supporting the social and investment model of economic growth in emerging economies. According to the experience of the top emerging economies with the highest level of economic innovative development in 2020, to maximize (up to 100%) knowledge-intensive employment (+299.29%), medium-tech and hi-tech manufacturing (+223.42%), and e-participation (+19.98%) it is necessary to increase the number of students per 1 lecturer in higher education by 387.26%, growth of mobility in higher education by 1,116.27%, and QS university ranking by 139.13%.

The theoretical significance of the authors' conclusions is that they described the cause-and-effect relationships of the development of higher education and the results of implementing the social and investment model of economic growth in developing countries. The practical significance of this paper lies in its offering qualitative criteria and quantitative benchmarks for improvement of the public and social policy in higher education, pointing to three directions for higher education in developing countries in the Decade of Action: increase in the number of academic staff per number of students, increase in scientific and educational mobility and improvement of positions in international university rankings, in particular, in the ranking QS.

The managerial significance of the paper consists in offering applied recommendations for the improvement of university management. If the management of universities supports and starts the process of implementation of these recommendations now, the potential of the social and investment model of economic growth will be developed in full in developing countries by the end of the Decade of Action (2030). The social significance of the paper is its forming a theoretical vision, strengthening the scientific and methodological base and suggesting a range of applied recommendations for the systemic implementation of SDG 4, SDG 8, SDG 9, SDGs 10–12 and SDGs 16–17.

It should be concluded that developing countries are much more differentiated than developed countries. Therefore, the proposed quantitative benchmarks are of the framework character, while universities of each developing country should detail and specify these benchmarks given its specifics. A generalized view of developing countries, on the whole, is a limitation of this paper. Future scientific studies should embark on in-depth research of the experience of individual developing countries and offer unique recommendations for each of them for improvement of higher education management in support of the implementation of the social and investment model of economic growth.

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/s.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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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Perspectives of using the integration mechanisms of education's development for accelerating Russia's economic growth

Yuliya V. Chutcheva[1]*, Alexander V. Semenov[2],
Varvara G. Krasilnikova[3] and Suzana L. Balova[4]

[1]Russian State Agrarian University -Moscow Timiryazev Agricultural Academy (RSAU — MAA named after K. A. Timiryazev), Moscow, Russia, [2]Moscow Witte University, Moscow, Russia, [3]I. M. Sechenov First Moscow State Medical University, Moscow, Russia, [4]Financial University under the Government of the Russian Federation, Moscow, Russia

The article aims at selecting the most perspective mechanisms and finding the perspectives of using the integration mechanisms of education development for accelerating Russia's economic growth. The methods of correlation and regression analysis are used. It is proved — by the example of top universities in Russia in 2020 — that the development of higher education and maximization of its contribution to the acceleration of economic growth could be achieved based on the integration mechanisms with the participation of universities. It is determined that optimization should be applied to educational (quality of higher education), scientific (R&D), and international (globalization) activities of universities, which could reach its maximum in case of an increase in the number of incubators in each university up to 5units, number of centers of shared use of scientific equipment up to 40units, and number of small companies up to 41. It is determined that citations and profitability (effectiveness) of universities do not depend on integration mechanisms in higher education. Such integration mechanisms as employer-sponsored education, practice bases, and technological parks do not contribute to the improvement of the indicators of universities' activities and thus their development is inexpedient. The practical significance of the authors' conclusions and recommendations is that they allow raising the effectiveness of university management and optimizing the organizational and managerial conditions under which the potential of universities in the sphere of support for the implementation of the social and investment model of economic growth is unlocked in the most comprehensive way.

KEYWORDS

educational environment, educational governance, inclusive innovation, higher education, integration of universities, Russia

1. Introduction

In the post-industrial economy, the markets of higher education services are a perspective vector of economic growth based on the popularization of life-long learning, supported by quick technological progress, and internationalization of the educational markets, which leads to an

increase in its capacity. In addition to this, the development of higher education allows accelerating other accessible vectors of the economy's growth through the increase in personnel qualification and development of leading technologies, supporting the growth of labor efficiency and production capacities.

In the conditions of economic recession amid the COVID-19 pandemic, the development of education for accelerating economic growth becomes especially important. This is necessary for developing countries, which strategic plans of rapid progress were disrupted by the crisis. On a global scale, the slowdown of economic growth of developing countries in which its rate is very high means not only the reduction of global GDP but also the unattainability of sustainable development in the aspect of reduction of countries' inequality and reduction of disproportions in the global economy.

Thus, the search and activation of the mechanisms of education's development for accelerating emerging economies' economic growth are expedient. A vivid example of such economies is Russia, which has been demonstrating a high level of education and a moderate level of economic growth in recent years, which makes its experience useful for most of the other emerging economies. Education does not turn into economic growth because of the gap between the market of higher education services and the labor market and between universities and business (Bolshakov and Walker, 2022; Frolova et al., 2022; Yakovleva, 2022; Bogoviz et al., 2023; Isakova, 2023).

Russia is peculiar for delayed upgrade of educational programs of universities, which is slower compared to quick market transformations and quick technological progress, which accelerated during the Fourth Industrial Revolution (Adonina and Kokodey, 2022; Vatlina and Evdokimov, 2022). In the course of the growth of the gap between universities and business, the contribution of higher education to economic growth is limited, which slows down the implementation of its social and investment model (Kulikova et al., 2021; Pirogova et al., 2021).

While the substantial contribution of higher education to economic growth is confirmed by many publications (Boțoroga et al., 2022; Gruševá and Blašková, 2022; Zhang and Liu, 2022; Almutairi, 2023; Fahim et al., 2023; Li and Wye, 2023), which, in particular, are based on the experience of modern Russia (Agasisti et al., 2021; Gruzina et al., 2022; Krupnov et al., 2023), there is still uncertainty as to cause-and-effect links between university organization and management and their results, which accelerate economic growth; they include educational activities (quality), scientific activities (quality and effectiveness), scientometrics (citations), profitability (effectiveness), and international activities (globalization).

This paper strived toward filling this literature gap, through the determination of the influence of universities' participation in various integration mechanisms on the mentioned activities of universities, which are significant for economic growth. The initial point of this research is the hypothesis that the development of higher education could be achieved based on integration mechanisms with the participation of universities. The goal of this paper is to select the most perspective mechanisms and find the perspectives of activation of integration mechanisms of education's development for accelerating Russia's economic growth.

The paper's originality lies in its determining a new, previously unknown condition for the maximization of universities' contribution to economic growth in Russia: universities' involvement in the processes of integration with business. Due to this, the paper allows improving the organization and management of universities in Russia by including this condition in the programs of universities' development and as a criterion of assessment of the effectiveness of universities' activities.

2. Literature review

The theoretical framework of the conducted research is the concept of the development of higher education to support economic growth. According to this concept, universities perform a central role in the implementation of the social and investment model of economic growth. The essence of this modern model is that higher education and innovations facilitate the increase in economic growth rate.

The contribution of higher education to the acceleration of the rate of economic growth in view of the emerging economies' experience is analyzed in the works Anetor (2020), Karambakuwa et al. (2020), Liu (2020), and Tahir et al. (2020). An overview of the integration mechanisms of higher education's development and the international experience of using these mechanisms are given in Butt et al. (2020), Finnveden et al. (2020), Johler (2022), Letzel-Alt et al. (2022), Petousi et al. (2022), and Wallwey et al. (2022).

In the works by De los Ríos-Carmenado et al. (2021), Mok et al. (2022), Pan et al. (2022), and Veltri et al. (2022), the mechanism of the development of higher education to speed up the rate of economic growth is the independent development of universities through training of personnel and R&D. In the works by Li and Yin (2022), Paswan et al. (2022), Saleem et al. (2023), and Wijesundara and Prabodanie (2022), the prospective spheres of the development of higher education are the improvement of the indicators of scientometrics (citation) and growth of profitability (effectiveness) of universities.

In the works by Fernandes et al. (2023), Ismail et al. (2022), and Liu et al. (2022), the facultative bases of practice and technological parks are listed as the prospective integration mechanisms in higher education. It is possible to conclude that only certain aspects of the studied problem are considered in the existing works, which does not allow solving the problem. That's why the perspectives of activation of the integration mechanisms of education's development for accelerating economic growth require additional research – by the example of modern Russia – which is done in this paper.

In the concept of higher education development in support of economic growth, Al-Zoubi et al. (2023), Chaudhry (2023), and Huang et al. (2022) note the contribution of universities to economic growth through educational activities (quality), scientific activities (quality and effectiveness), scientometrics (citations), profitability (effectiveness) and international activities (globalization). Benson and Chau (2022), Borda-Rivera and Ortega-Paredes (2021), Damar et al. (2022), Marra et al. (2022), Ryazanova et al. (2021), Santos and Thune (2022), and Terán-Bustamante et al. (2021) state that results of universities' activities are largely determined by the degree of their connection with business. Based on this, we offer the following hypothesis: universities' involvement in the processes of integration with business determines the contribution of universities to economic growth.

3. Materials and methodology

This paper uses the econometric methodology to determine the degree of connection and character of the influence of alternative integration mechanisms on the results of universities' activities. To verify the offered hypothesis, we use correlation and regression analysis. The connection between the universities' characteristics and the integration mechanisms that are used in higher education in Russia is determined. A significant (more than 35%) positive correlation with at least certain mechanisms is proof of the hypothesis.

To obtain the results that would be of interest not only to Russia but also to other emerging economies we consider the top 10 universities according to World University Rankings 2020 (2020). The sample of this research includes the following universities: Lomonosov Moscow State University, Moscow Institute of Physics and Technology (MIPT), National Research University "Higher School of Economics," ITMO University, National Research Nuclear University MEPhI, Novosibirsk State University, Peter the Great St. Petersburg Polytechnic University, Tomsk State University, Kazan Federal University and National University of Science and Technology (MISiS). University's characteristics that reflect its potential contribution to the acceleration of Russia's economic growth are sub-indices of World University Rankings 2020 (2020):

  – educational activities (quality, indicator "Teaching");
  – scientific activities (quality and effectiveness, indicator "Research");
  – scientometrics (indicator "Citations");
  – profitability (effectiveness, indicator "Industry Income");
  – international activities (globalization, indicator "International Outlook").

The indicators that reflect the involvement of the integration mechanisms of development in universities are the indicators from the Ministry of Science and Higher Education of the Russian Federation (2020):

  – number of companies with contracts for specialists' training;
  – number of companies that are practice bases, with contracts;
  – number of business incubators;
  – number of technological parks;
  – number of centers of shared use of scientific equipment;
  – number of small companies.

The factual research materials are presented in Table 1.

This research consists of three consecutive stages. At the first stage, correlation analysis is used, based on the data from Table 1, to determine the connection (correlation coefficients are calculated) between various integration mechanisms of education development $(x_1–x_6)$ and results of universities' activities, which potentially increase the rate of economic growth in its social and investment model $(y_1–y_5)$ in Russia. We choose indicators for which statistically significant and expedient for further consideration connection is revealed: correlation coefficients exceed 35%. The presence of such indicators (with close connection) is the confirmation of the proposed hypothesis – proof that integration with business facilitates the increase in results of universities that support economic growth in its social and investment model in Russia.

At the second stage of the research, to specify the results of correlation analysis, we use the method of regression analysis, based on the data from Table 1, to compile models of multiple linear regression, which characterize the character of dependence of the selected resulting variables (y) on the selected (closely connected with them) factor variables (x). At the third stage of the research, based on the results of regression analysis, we use the simplex method to determine the perspectives (control values of the indicators) of activation of the integration mechanisms of education's development to accelerate (maximize) Russia's economic growth.

4. Results

To determine the contribution of various integration mechanisms of education's development to the acceleration of Russia's economic growth, let us use the results of the correlation analysis of data from Table 1 and Figure 1.

As shown in Figure 1, a connection that is statistically significant and expedient for further consideration is observed with the following indicators:

  – educational activities (y_1) – with business incubators $(x_3,$ correlation – 51.50%) and centers of shared use of scientific equipment $(x_5,$ the correlation – 52.72%);
  – scientific activities (y_2) – with business incubators $(x_3,$ correlation – 51.17%) and centers of shared use of scientific equipment $(x_5,$ the correlation – 38.57%)
  – international activities (y_5) – with centers of shared use of scientific equipment $(x_5,$ the correlation – 46.05%) and small companies $(x_6,$ the correlation – 41.06%).

To clarify the determined connections, which are characterized with the help of correlation coefficients, let us compile the equations of multiple linear regression. Regression dependence of educational activities (y_1) on business incubators (x_3) and centers of shared use (x_5):

$$y_1 = 24.55 + 13.80x_3 + 1.66x_5 \qquad (1)$$

According to the regression Equation 1, the effectiveness of educational activities (y_1) grows by 13.80 points due to an increase in the number of business incubators (x_3) by 1 and grows by 1.66 points due to an increase in the number of centers of shared use (x_5) by 1. Multiple correlation is rather large for confirming the statistical significance of the regression equation – 66.40%. Regression dependence of scientific activities (y_2) on business incubators (x_3) and centers of shared use (x_5):

$$y_2 = 20.98 + 12.88x_3 + 0.94x_5 \qquad (2)$$

As shown in the regression Equation 2, the effectiveness of scientific activities (y_2) grows by 12.88 points in case of an increase in the number of business incubators (x_3) by 1 and grows by 0.94 points in case of an increase in the number of centers of shared use (x_5) by 1. Multiple correlation is rather large to confirm the statistical
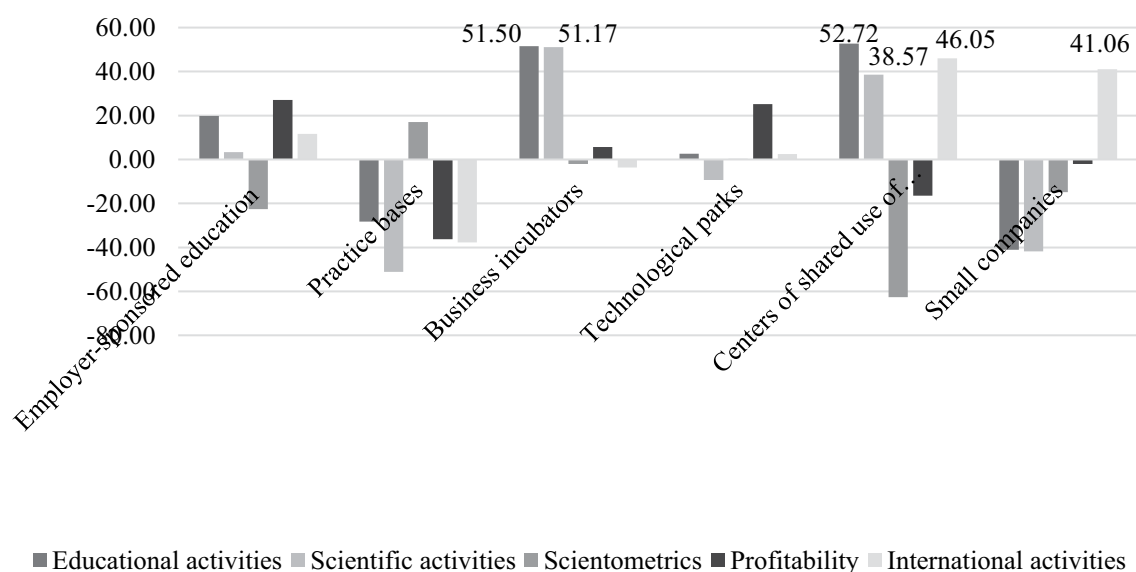
FIGURE 1
Correlation between the integration mechanisms in top universities of Russia in 2020 and their contribution to the acceleration of economic growth, %. Calculated and built by the authors.

significance of the regression equation – 58.08%. Regression dependence of international activities (y_5) on centers of shared use (x_5) and small companies (x_6):

$$y_3 = 48.26 + 1.04x_5 + 0.23x_6 \qquad (3)$$

According to the regression Equation 3, the effectiveness of scientific activities (y_5) grows by 1.04 points in case of an increase in the number of centers of shared use (x_5) by 1, and grows by 0.23 points in case of an increase in the number of small companies (x_6) by 1. Multiple correlation is rather large to confirm the statistical significance of the regression equation, constituting 55.64%.

Based on the identification regression dependencies, we use the simplex method to determine the target values of the indicators of activity of integration processes in higher education in Russia to reach a 100% (100 points for all indicators) contribution of universities to the acceleration of economic growth (Figure 2).

As shown in Figure 2, to maximize (bring up to 100%, and in case of certain indicators even exceed 100%) the effectiveness of educational (+307.56%), scientific (+277.363%), and international (+74.645) activities of universities in Russia, it is necessary to raise the number of incubators in each university up to 5, the number of centers of shared use of scientific equipment up to 40, and the number of small companies up to 41.

5. Discussion

This paper contributed to the literature through the development of scientific provisions of the concept of higher education development to support economic growth. The paper specified the organizational and managerial conditions under which the potential of universities in the sphere of support for the implementation of the social and

investment model of economic growth is unlocked in the most comprehensive way. The results obtained are compared with the existing literature in Table 2.

As shown in Table 2, unlike De los Ríos-Carmenado et al. (2021), Mok et al. (2022), Pan et al. (2022), and Veltri et al. (2022), this paper proved that the most prospective mechanism for higher education development to increase the rate of economic growth is not independent development of universities through training of personnel and R&D but universities' integration with business. This allows offering a new criterion of the optimality of organization and management of universities: their involvement in the processes of integration with business.

Unlike Li and Yin (2022), Paswan et al. (2022), Saleem et al. (2023), and Wijesundara and Prabodanie (2022), we proved that the most prospective spheres of higher education development are not the improvement of the indicators of scientometrics (citation) and growth of profitability (effectiveness) of universities but the development of educational (quality of higher education), scientific (R&D), and international (globalization) activity of universities.

Unlike Fernandes et al. (2023), Ismail et al. (2022), and Liu et al. (2022), we proved that the most promising integration mechanisms in higher education are not the facultative base of practice and technological parks but incubators in universities, centers of joint use of scientific equipment and small companies based on universities.

The theoretical significance of the research lies in its strengthening the evidence based on the assumption that the results of universities' activities are largely determined by the degree of their connection with business, in support of the works by Borda-Rivera and Ortega-Paredes (2021), Benson and Chau (2022), Damar et al. (2022), Marra et al. (2022), Ryazanova et al. (2021), Santos and Thune (2022), and Terán-Bustamante et al. (2021). The authors' conclusions and recommendations allow reducing in the short term and fully overcoming in the long-term the gap between the market of higher education services and the

FIGURE 2
Requirements to activation of the integration mechanisms of education's development for accelerating Russia's economic growth. Calculated and built by the authors.
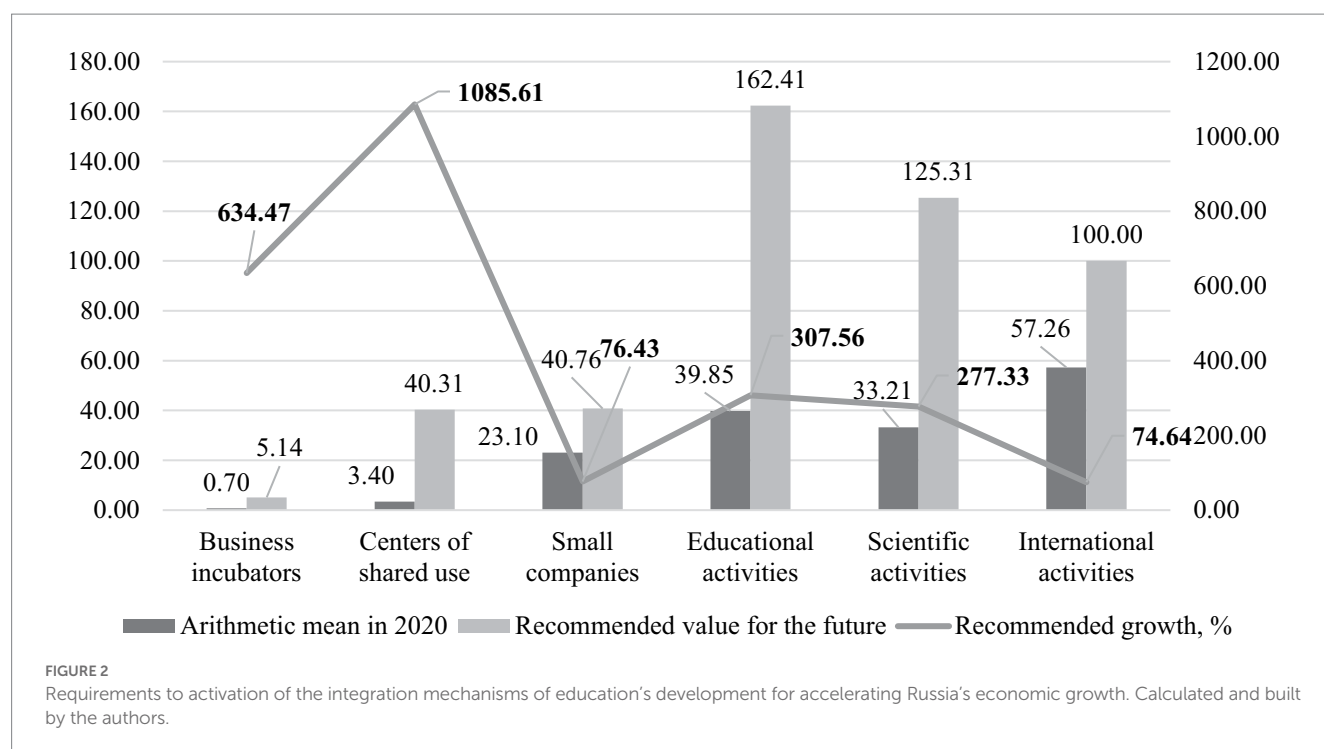
TABLE 2 Perspectives of using the integration mechanisms of education's development for accelerating Russia's economic growth: comparison of the results obtained with the existing literature.

Sphere of comparison	Existing literature		Results obtained in the paper
	Provisions	Sources	
Mechanism of higher education development to speed up the rate of economic growth	Independent development of universities through training of personnel and R&D	De los Ríos-Carmenado et al. (2021), Mok et al. (2022), Pan et al. (2022), and Veltri et al. (2022)	Integration of universities with business
Prospective spheres of higher education development	Improvement of the indicators of scientometrics (citation) and growth of profitability (effectiveness) of universities	Li and Yin (2022), Paswan et al. (2022), Saleem et al. (2023), and Wijesundara and Prabodanie (2022)	Development of educational (quality of higher education), scientific (R&D) and international (globalization) activity of universities
Prospective integration mechanisms in higher education	Facultative based of practice and technological parks	Ismail et al. (2022), Liu et al. (2022), and Fernandes et al. (2023)	Incubators in universities, centers of joint use of scientific equipment, small companies based on universities

Authors.

labor market in Russia. This can be achieved with the help of the integration of universities and business, which is recommended in this paper.

The advantages of this integration include a direct, clear and regular order of business for training of personnel in universities, for which practice-oriented educational programs will be developed. This will allow developing targeted training, creating guarantees of employment of university graduates and raising their opportunities in the development of human potential and career building. In its turn, business will receive promising young personnel from university graduates with the relevant set of competencies, who are ready to start performing their professional duties at once.

Integration of universities and business will also ensure the advantage that is connected with the order from business for the development of innovations by business. It is also possible to conduct joint R&D, by universities and business, and increased engineering support for implementing innovations from universities. This will accelerate the commercialisation of university innovations and will ensure the most complete and effective satisfaction of business needs for innovations.

Thus, closer cooperation of universities and business, which was substantiated in this paper, based on the recommended integration mechanisms will increase the contribution of universities to the implementation of the social and investment model of economic growth, since it guarantees the training and graduation of personnel who are in demand and competitive in the labor market, as well as universities' creating innovations that are required by business and are quickly commercialized. As a result, the educational and research results of universities will be most applied and will ensure a quick and maximum contribution to economic growth.

6. Conclusion

As a result of the performed research, the goal was achieved: we identified the most promising mechanisms – incubators in a university, centers for joint use of scientific equipment, small companies based on universities – and prospects for accelerating the integration mechanisms of education development to accelerate Russia's economic growth.

Thus, the hypothesis has been proved. It has been shown – by the example of top universities in Russia in 2020 – that the development of higher education and maximization of its contribution to the acceleration of economic growth could be achieved based on the integration mechanisms with the participation of universities. It has been determined that optimization should be applied to educational (quality of higher education), scientific (R&D), and international (globalization) activities of universities, which could reach their maximum in case of an increase in the number of incubators in each university by 634.47%, number of centers of shared use of scientific equipment by 1,085.61%, and number of small companies by 76.43%.

It has also been found that scientometrics (citations) and profitability (effectiveness) of universities do not depend on the integration mechanisms in higher education. Such integration mechanisms as employer-sponsored education practice bases and technological parks do not contribute to the improvement of the indicators of universities' activities and thus their development is inexpedient.

The theoretical significance of the results obtained is that they offered new – integration – mechanisms of education development for accelerating Russia's economic growth. The advantage of the integration mechanisms, compared to the independent development of universities, is universities' larger support for the implementation of the social and investment model of economic growth.

The practical significance of the authors' conclusions and recommendations is that they allow raising the effectiveness of university management and optimizing the organizational and managerial conditions under which the potential of universities in the sphere of support for the implementation of the social and investment model of economic growth is unlocked in the most comprehensive way.

The managerial significance of the authors' conclusions and recommendations is that they allow improving the methodology and practice of monitoring of the effectiveness of higher education organizations' activities, which is done annually by the Ministry of Science and Higher Education of the Russian Federation (2020). The proposed new criterion of assessing the optimality of the organization and management of universities – the degree of universities' involvement in the processes of integration with business – allows for

a more precise determination of the effectiveness of universities' activities.

The new criterion can be used for the rationalization of selecting the universities for participation in the program of strategic academic leadership and the following programs of higher education development in Russia. Due to this, the authors' recommendations, proposed in this paper, support the practical implementation of "Priority 2030" and allows for the fullest realization of the potential of universities' support for the social and investment model of economic growth in the Decade of science and technologies in the Russian Federation.

The new criterion may also be an additional benchmark and priority in the programs of Russian universities' development. The social significance of the paper's results is that they support the practical realization of the following Sustainable Development Goals: SDG 4, SDG 8, SDG 9, SDG 11, SDG 16, and SDG 17.

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

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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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*CORRESPONDENCE
Varvara G. Krasilnikova
✉ iggdrassil1@mail.ru

†These authors have contributed equally to this work

Alternative mechanisms of managing the education's development in the social investment model of Russia's economic growth: standardization versus deregulation

Valentina Yu Dianova[1†], Varvara G. Krasilnikova[2*†], Kirena G. Kelina[2†] and Anton V. Nazarenko[3†]

[1]Plekhanov Russian University of Economics, Moscow, Russia, [2]Sechenov First Moscow State Medical University of the Ministry of Health of the Russian Federation (Sechenov University), Moscow, Russia, [3]Moscow Polytechnic University, Moscow, Russia

Regression analysis is used to determine the contribution of the factors of managing the development of higher education – share of university branches – to increase the population's quality of life. To determine the optimal approach to managing education's development in the social investment model of Russia's economic growth with alternative mechanisms of standardization and deregulation. The results of the research show that absolute standardization, as well as absolute deregulation of higher education, does not allow achieving significant results in the sphere of increase in quality of life in Russia. The determined and substantiated optimal scenario of managing the development of higher education in Russia to increase the quality of life envisages a foundation on a flexible approach, which envisages the combination of standardization and deregulation. It is recommended to entirely refuse branches in favor of main universities, refuse government financing in favor of fee-based education and refuse diversification of education forms in favor of the intramural form of study. This allows raising the quality of life by 13.26% (up to 70.87 points). For practical implementation of this approach, it is offered to allow each region to form their own programs of development of higher education with the foundation of the main federal principles.

KEYWORDS

alternative mechanisms, management, development, higher education, social investment model, economic growth, Russia, standardization

Introduction

The transition to a new – social - investment model of Russia's economic growth envisages two key changes. The first one is connected to a new criterion of evaluating economic growth and its new landmark – the population's quality of life, due to which the economic growth rate is replaced by social progress (Iglesias et al., 2022). Acceleration of the economic growth rate is often accompanied by social costs. For example, industrialization and digital modernization of the economy were accompanied by the growth of unemployment and social tension, due to

which the influence of quick economic growth on quality of life was contradictory (Chang et al., 2022). Contrary to this, economic growth is not a goal in itself in the new model but is a task that is solved on the path to increase in quality of life, which forms a socially responsible approach to the acceleration of the rate of economic growth (Bilyalova et al., 2021).

The second change consists in selecting a new source of economic growth, which is higher education. In the social investment model of economic growth, an important role belongs (for the first time) not only to the achieved result but also to its source (Hadi et al., 2022). The advantages of economic growth, which is based on borrowed technologies and unskilled labor, are short-term (Khalifé et al., 2022). Long-term advantages are guaranteed in the case of the use of highly-skilled personnel, which can create and implement innovations (Ranjan et al., 2021). That's why the development of higher education, which stimulates mass lifelong learning and systemic increase in the level of qualification among the economically active population, is the top-priority source of modern economic growth (Wang and Cui, 2021).

Thus, the social investment model of Russia's economic growth is based on the principle of circularity, according to which economic growth is based on higher education, which stimulates the increase in quality of life. The result of economic growth is an increase in quality of life, which expands opportunities for raising the level of education in society. Practical implementation of the described conceptual model is difficult due to the uncertainty of the preferred mechanism of managing education's development in the social investment model of Russia's economic growth (Timchenko et al., 2021).

Chaotic simultaneous use of alternative mechanisms – standardization and deregulation – slows down the development of higher education in Russia. This paper aims to solve the formulated problem and to determine the optimal approach to managing education's development in the social investment model of Russia's economic growth with alternative mechanisms of standardization and deregulation. The hypothesis is as follows: it is necessary to combine these mechanisms in a certain proportion to achieve the best result in the sphere of increase in quality of life.

Literature review

The approach to managing the development of higher education, which envisages standardization, is described in the works Bentley-Gockmann (2020), Olivier and Burton (2020), Shams and Hasan (2020), and Wright and Horta (2018). The alternative approach to managing the development of higher education, which consists in deregulation, is studied by Goyal and Sergi (2015), Popkova and Zmiyak (2019), Langrafe et al. (2020), Rehman and Iqbal (2020), Ruiz et al. (2020), and Sciarelli et al. (2020).

The main parameters that define the outlines and differences between the mechanisms of managing education's development in the social investment model of economic growth are as follows:

- Share of university branches, the growth of which leads to flexibility of universities and expansion of geography of their presence, but also to reduction of possibilities to control the quality of education. Yang et al. (2020) and Zhang and You (2022) recommend increasing the branch network of universities during

the implementation of the social investment model of economic growth, to raise the accessibility of higher education in society;

- Share of intramural students, the growth of which leads to an increase in the quality of education, but also to the reduction of the flexibility of the educational process. Bilal et al. (2020) and Peng et al. (2022) recommend performing a transfer from the intramural form of study to more modern forms, in particular, to distance education, during the implementation of the social investment model of economic growth to raise the flexibility of higher education and convenience of its receipt;

- Share of state-subsidized students, the growth of which leads to an increase in accessibility of higher education services for wide groups of the population but also to the reduction of the opportunities for receipt of income by universities and the reduction of universities' entrepreneurial activity. Castro-Bedriñana et al. (2022) and Razak et al. (2022) recommend increasing investments in higher education, including budget financing of universities, during the implementation of the social investment model of economic growth.

Standardization in higher education implies a decrease in the share of university branches and reliance on leading universities, as well as the domination of state-subsidized intramural education (Piromalli, 2022). All three conditions are met simultaneously only in the case of absolute standardization (Liu, 2022).

Less strict and, accordingly, more flexible standardization allows for the development of distance education, which implies the almost complete refusal of the intramural form of education (Bağrıacık Yılmaz and Karataş, 2022; Segbenya et al., 2022; Turan et al., 2022; Toumpalidou and Konstantoulaki, 2023), and the development of entrepreneurial universities, which implies the reduction of state-subsidized education (Guerrero and Lira, 2023; Johnson et al., 2023). Here the key feature of the scenarios of standardization in higher education is the refusal of the development of a network of university branches.

Deregulation in higher education implies the expansion of the network of university branches, an increase in the volume of paid educational services provided by universities and the development of alternative – apart from intramural education – forms of education, including distance education. At that, the size of the network of university branches may vary (Wang and Crawford, 2019).

Alternative mechanisms of managing education's development – standardization and deregulation – have been thoroughly studied separately from each other. However, their contribution to the implementation of the social investment model of economic growth has not been studied sufficiently and requires further elaboration.

The main result of implementing the social investment model of economic growth is the growth of the quality of life, for it is actually the return on social investments. As a result of the performed literature review, it is possible to conclude that the issues of raising the quality of life with the help of social investments were thoroughly studied in the existing publications of Erdin and Ozkaya (2020), Litvintseva and Karelin (2020), Kakinuma (2022), Sollis et al. (2022), and Imbulana Arachchi and Managi (2023).

Alternative mechanisms of managing education's development in the social investment model of economic growth – standardization and deregulation – were also thoroughly researched. However, the cause-and-effect links of implementing the alternative mechanisms of

managing education's development and the quality of life remain uncertain, which is a literature gap.

The need to fill the discovered gap is explained by the fact that because of it, the implementation of the social investment model of economic growth is a "black box," at the input of which there are alternative mechanisms of managing the education's development: standardization and deregulation, and at the output – the quality of life. The contribution of alternative mechanisms to the quality of life is unknown, which hinders the management in the considered model. This paper strived toward filling the discovered gap and sets two following research questions (RQs).

RQ_1: What is the contribution of alternative mechanisms of managing education's development – standardization and deregulation – to the quality of life?

RQ_2: What is the perspective of increasing the quality of life based on the improvement of managing the education's development?

Based on the advantages of both mechanisms of managing education's development, which are noted in the literature, we propose the following hypothesis: it is necessary to combine these mechanisms in a certain proportion to achieve the best result in the sphere of improvement of the quality of life. To test this hypothesis, we perform the econometric modeling of the influence of implementing the alternative mechanisms of managing the education's development (standardization and deregulation) on the quality of life, by the examples of regions of Russia.

Research method

Regression analysis is used to check the offered hypothesis. Contribution of the factors of managing the development of higher education – shares of university branches (their increase means deregulation), the share of intramural students (their increase means standardization), and share of state-subsidized education students (their increase means standardization) to increase in population's quality of life is determined. Information on the factors is taken from the materials of the Ministry of Science and Higher Education of the Russian Federation (2020).

The data were collected by systematizing the materials of the Ministry of Science and Higher Education of the Russian Federation (2020) on the use of the mechanisms of managing education's development and the materials of RIA Rating (2020) on the quality of life in regions of Russia. The share of branches was determined according to the following formula:

$$SB = Nbr^{*}100\% / Nohe, \qquad (1)$$

where SB–Share of branches;
Nbr–Number of organizations of higher education;
Nohe–Number of their branches.

Share of intramural students was determined according to the following formula:

$$SInt = Nis^{*}100\% / Nus, \qquad (2)$$

where Sint–Share of intramural students;
Nus–Number of university students;
Nis–Number of intramural students.

Share of state-subsidized education students was determined according to the following formula:

$$Ssses = Nsses^{*}100\% / Nus, \qquad (3)$$

where Ssses–Share of state-subsidized education students;
Nsses–Number of state-subsidized education students.

The research objects are the top 10 regions of Russia by living standards in 2019, according to RIA Rating (2020). The sample includes the following regions of Russia: Moscow Oblast, Republic of Tatarstan, Belgorod Oblast, Krasnodar Krai, Voronezh Oblast, Leningrad Oblast, Kaliningrad Oblast, Khanty-Mansi Autonomous Okrug – Yugra, Lipetsk Oblast and Yamalo-Nenets Autonomous Okrug. The correctness of the sample is due to its including regions of Russia with the highest quality of life, i.e., regions that achieved the best results in implementing the social investment model of economic growth. This allows using their experience in other regions, to translate successful practices and systemically raise the quality of life in Russia. The empirical data for the research are systematized in Table 1.

The research model has the following form:

$$y = \alpha + \beta_1^{*}x_1 + \beta_2^{*}x_2 + \beta_3^{*}x_3 \qquad (4)$$

Where y–the quality of life index (RIA Rating, 2020), points 1–100.
x_1–share of branches (Ministry of Science and Higher Education of the Russian Federation, 2020), %.
x_2–share of intramural students (Ministry of Science and Higher Education of the Russian Federation, 2020), %.
x_3–share of state-subsidized education students (Ministry of Science and Higher Education of the Russian Federation, 2020), %.
α–constant;
β_{1-3}–coefficients of regression at factor variables.

To search for an answer to RQ_2, we set the first research task, which is determining the perspective of raising the quality of life based on the improvement of managing the education's development. To solve this task, based on the research model (4), we determine the consequences for the quality of life of seven alternative scenarios of managing education's development in the social investment model of Russia's economic growth. The first three scenarios imply standardization:

- The scenario of absolute standardization, which implies minimization of the share of university branches (10%) and maximization of the share of intramural students (90%) and the share of state-subsidized education (90%);
- The scenario of development of remote education, which implies minimization of the share of intramural students (10%);
- The scenario of the development of entrepreneurial universities, which implies minimization of the share of state-subsidized students (10%).

Other three scenarios envisage deregulation:

- The scenario of absolute deregulation, which implies maximization of the share of university branches (90%) and minimization of the share of intramural students (10%) and the share of state-subsidized students (10%);

TABLE 1 Statistics of higher education in regions of Russia in 2019 and their analysis from the positions of standardization and deregulation.

Region	Quality of life index, points 1−100	Number of organizations of higher education	Number of their branches	Share of branches, %	Number of university students	Number of intramural students	Share of intramural students %	Number of state-subsidized education students	Share of state-subsidized education students, %
	y	−	−	x_1	−	−	x_2	−	x_3
Moscow Oblast	74.500	57	37	64.91	82.670	37,397	45.24	36,263	43.86
Republic of Tatarstan	66.806	41	19	46.34	147,928	86,323	58.35	60,533	40.92
Belgorod Oblast	63.978	11	6	54.55	48,674	23,131	47.52	18,142	37.27
Krasnodar Krai	63.067	46	27	58.70	114,734	57,411	50.04	37,702	32.86
Voronezh Oblast	61.981	23	8	34.78	86,772	48,382	55.76	39,945	46.03
Leningrad Oblast	60.695	10	9	90.00	7,780	2,788	35.84	2,110	27.12
Kaliningrad Oblast	59.247	9	6	66.67	22,613	12,062	53.34	9,079	40.15
Khanty-Mansi Autonomous Okrug - Yugra	58.813	10	5	50.00	23,637	13,522	57.21	12,514	52.94
Lipetsk Oblast	58.466	11	7	63.64	21,185	10,096	47.66	11,299	53.33
Yamalo-Nenets Autonomous Okrug	58.180	3	3	100.00	756	64	8.47	64	8.47

Compiled by the authors based on Ministry of Science and Higher Education of the Russian Federation (2020) and RIA Rating (2020).

- The scenario of reduction of branches, which implies minimization of the share of university branches (10%);
- The scenario of the development of a network of branches, which implies maximization of the share of university branches (90%).

The seventh scenario involves the optimization with the simplex method for the maximization of the quality of life. The research logic is to determine whether any template scenario will coincide with the scenario of maximization of the quality of life. If this does not happen, the proposed hypothesis will be proven.

Results

To determine the contribution of the factors of managing higher education's development to the increase in the population's quality of life, we calculate (based on the data from Table 1) the regression dependence of the quality of life in Russia on the management of higher education's development:

$$y = 66.40 - 0.06x_1 + 0.04x_2 - 0.05x_3 \qquad (5)$$

As shown in Eq. 5, an increase in the share of university branches by 1% leads to a reduction of quality of life in Russia by 0.06 points. Growth of the share of intramural students by 1% leads to a growth of quality of life by 0.04 points. An increase in the share of state-subsidized education students by 1% leads to a reduction in quality of life by 0.05%. This is a sign of the contradictory influence of standardization and deregulation of higher education on the quality of life in Russia. Scenarios of quality of life in Russia depending on the standardization of higher education are shown in Table 2.

As shown in Table 2, absolute standardization, which envisages the reduction of the share of branches down to 10% and the transfer of 90% of students to the intramural form of government-financed study, ensures the growth of quality of life by 4.15% (from 62.57 points in 2020 to 65.17 points). Development of remote education, which envisages almost full refusal from the intramural form of study (its reduction down to 10%) decreases the quality of life by 2.56% (down to 60.7 points). Development of entrepreneurial universities, which envisages the reduction of government-financed study down to 10%, raises the quality of life by 2.33% (up to 64.03 points). Scenarios of quality of life in Russia depending on the deregulation of higher education are shown in Table 3.

As shown in Table 2, absolute deregulation, which envisages an increase in the share of branches up to 90% and a reduction of state-subsidized education students with the intramural form of study down to 10%, provides growth of quality of life by 2.93% (from 62.57 points in 2020 to 65.17 points). The reduction of branches (down to 0%) raises the quality of life by 5.25% (up to 65.86 points), and their development (up to 90%) decreases the quality of life by 2.69% (down to 60.89 points). The optimal scenario of managing the development of higher education in Russia in favor of an increase in quality of life, which is obtained with the help of the simplex method based on regression dependence from (1), is shown in Figure 1.

As shown in Figure 1, the optimal scenario of managing the development of higher education in Russia in favor of an increase in quality of life envisages full refusal from branches and the use of main universities only, full refusal from budget financing and transfer to fee-based education, and refusal from diversification of the forms of study with preservation of only the intramural form of study. This allows raising the quality of life by 13.26% (up to 70.87 points).

Discussion

The paper's contribution to the literature consists in the clarification of the cause-and-effect relationships of the management of universities (by the example of Russia) and the development of a new approach to managing education's development in the social investment model of Russia's economic growth. This paper filled the literature gap, strengthened the scientific base and developed the scientific provisions of the works by Erdin and Ozkaya (2020), Litvintseva and Karelin (2020), Kakinuma (2022), Sollis et al. (2022), and Imbulana Arachchi and Managi (2023), as well as answered both RQs.

We found an answer to RQ1: alternative mechanisms of managing education's development – standardization and deregulation – make a contradictory contribution to the quality of life. Growth of the quality of life is ensured during the reduction of the share of university branches (standardization), growth of the share of intramural students (standardization) and reduction of the share of state-subsidized education students (deregulation).

We found an answer to RQ2: we determine the perspective of increasing the quality of life based on the improvement of managing the education's development, manifested in the optimal scenario of managing the development of higher education in Russia in favor of an increase in quality of life. According to the scenario, a flexible combination of the mechanisms of higher education development management – standardization and

TABLE 2 Scenarios of quality of life in Russia depending on standardization of higher education.

Indicator	The initial value in 2020	Scenario of standardization		Scenario of development of remote education		Scenario of development of entrepreneurial universities	
		Value	Growth, %	Value	Growth, %	Value	Growth, %
Share of branches, %	62.96	10.00	−84.12	62.96	0.00	62.96	0.00
Share of intramural students %	45.94	90.00	95.90	10.00	−78.23	45.94	0.00
Share of state-subsidized education students	38.30	90.00	135.01	38.30	0.01	10.00	−73.89
Quality of life index, points 1–100	62.57	65.17	4.15	60.97	−2.56	64.03	2.33

Calculated and compiled by the authors.

TABLE 3 Scenarios of quality of life in Russia depending on the deregulation of higher education.

Indicator	Initial value in 2020	Scenario of deregulation		Scenario of reduction of branches		Scenario of development of a network of branches	
		Value	Growth, %	Value	Growth, %	Value	Growth, %
Share of branches, %	62.96	90	42.95	10.00	−84.12	90.00	42.95
Share of intramural students %	45.94	10	−78.23	45.94	0.00	45.94	0.00
Share of state-subsidized education students	38.30	10	−73.89	38.30	0.01	38.30	0.01
Quality of life index, points 1–100	62.57	60.74	−2.93	65.86	5.25	60.89	−2.69

Calculated and compiled by the authors.

FIGURE 1
The optimal scenario of managing the development of higher education in Russia in favor of an increase in quality of life. Calculated and built by the authors.
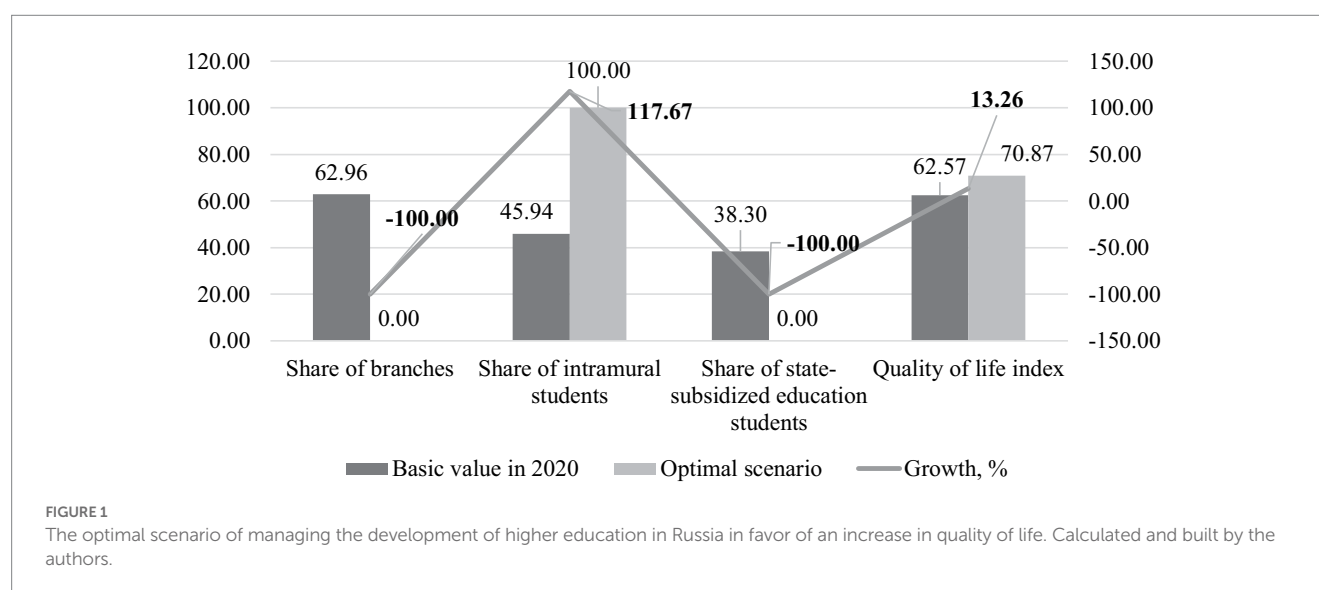
deregulation – allows raising the quality of life in regions of Russia by 13.26%.

It was proven that neither absolute standardization [unlike Wright and Horta (2018), Bentley-Gockmann (2020), Olivier and Burton (2020), and Shams and Hasan (2020)] nor absolute deregulation [unlike Goyal and Sergi (2015), Speight (2017), Popkova and Zmiyak (2019), Langrafe et al. (2020), Rehman and Iqbal (2020), Ruiz et al. (2020), and Sciarelli et al. (2020)] allows unlocking the potential of the implementation of the social investment model of Russia's economic growth.

The authors' approach involves a flexible combination of the mechanisms of standardization and deregulation, which maximizes their effectiveness. In the new approach to managing education's development in the social investment model of Russia's economic growth, the following is recommended:

- Refusing the expansion of the network of university branches, as opposed to its increase, given in the works by Yang et al. (2020) and Zhang and You (2022).
- Relying on intramural education with cautious implementation of modern forms, in particular distance education [as opposed to Bilal et al. (2020) and Peng et al. (2022)].
- Stimulating the entrepreneurial activity of universities, as opposed to Castro-Bedriñana et al. (2022) and Razak et al. (2022)

which describe an increase in investments in higher education, including budget financing of universities.

This scientific article is a significant step forward since it proves the limitations and inexpedience of the use of template mechanisms of managing education's development in the social investment model of economic growth. The advantage of the new proposed approach is its high flexibility, which allows for the most comprehensive unlocking of the potential of an increase in the quality of life in the social investment model of Russia's economic growth.

Conclusion

The task of developing the optimal approach to managing education's development in the social investment model of Russia's economic growth was solved. The key result of the research and its key implication are that it is necessary to pass from the use of the mechanisms of standardization and deregulation as alternatives to combining their elements during university management. For this, a new approach to managing education's development in the social investment model of Russia's economic growth was proposed.

Results of the performed research have proved the offered hypothesis and have shown that absolute standardization and

absolute deregulation of higher education do not allow achieving vivid results in the sphere of increase in quality of life in Russia. The determined and substantiated optimal scenario of managing the development of higher education in Russia in favor of an increase in quality of life envisages the use of the flexible approach, which, in its turn, envisages a combination of standardization and deregulation.

The required refusal from a network of branches of Russian universities will allow increasing the quality of higher education and will increase control over it. The transfer of all students to fee-based education is a contradictory measure since this will reduce the accessibility of higher education – similar to refusal from state-subsidized education and transfer to fee-based education, which, however, could be successfully replaced by employer-sponsored education. That's why it is recommended to allow each region to form their own programs of development of higher education with the foundation on the main federal principles.

Suggestions for practical use

It is recommended that the developed approach to managing education's development in the social investment model of Russia's economic growth be used in practice during the management of Russian universities. The critical values of indicators (Figure 1) are landmarks. This approach also allows improving the modern Russian practice of state regulation of higher education.

The practical recommendations for the most complete unlocking of the potential for improvement of the quality of life in the social investment model of Russia's economic growth are as follows. First, refuse the expansion of the network of branches and develop leading universities. Second, rely on intramural education with a cautious introduction of modern form, in particular distance education. Third, stimulate the entrepreneurial activity of universities and gradually reduce the budget financing of universities.

The advantage of the new approach in practice is the systemic increase in the effectiveness of state and corporate management of universities and the maximization of the contribution of higher education to the increase in the quality of life. The practical implementation of the authors' approach will allow acceleration of the implementation of the social investment model of economic growth в 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

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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

Vera V. Dvoretskaya[1], Irina S. Antonova[2], Galina N. Semenova[3,4]* and Elena N. Belkina[5]

[1]Financial University Under the Government of the Russian Federation, Moscow, Russia, [2]Institute of Linguistics and Intercultural Communication, I.M. Sechenov First Moscow State Medical University, Moscow, Russia, [3]Department of State and Municipal Finance, Plekhanov Russian University of Economics, Moscow, Russia, [4]Department of State and Municipal Finance, Moscow State Regional University, Moscow, Russia, [5]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 5years 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.

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), Batool (2022), Nguyễn et al. (2022), Parejo et al. (2022), and Prenger et al. (2022). ccording 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 1st 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:

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

Hypothesis H is deemed proven if three following conditions are observed simultaneously: (1) $r_{y2x1} > r_{y2x2}$, (2) $b_{z2} > 0$, and (3) $b_{y2} > 0$.

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:

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

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 ($x1$) 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 5years) 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 5years) 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).
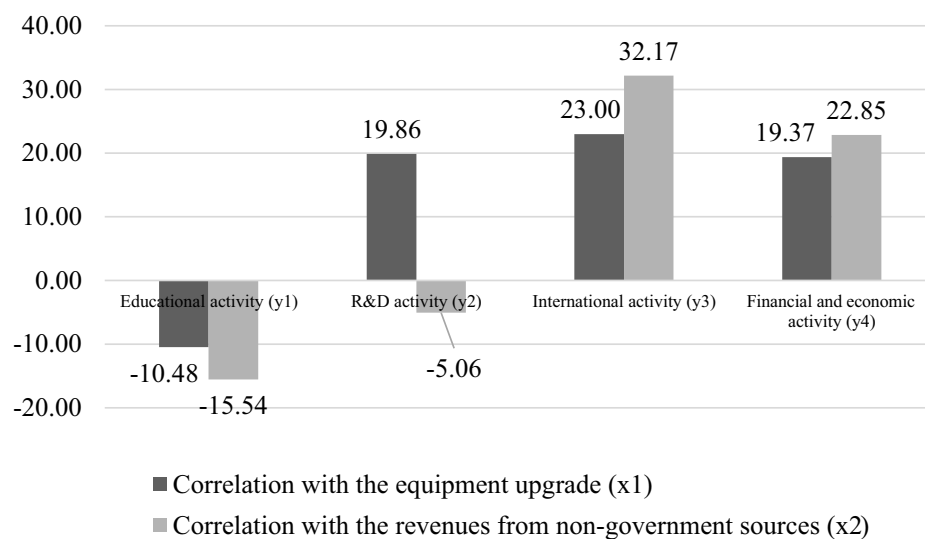
FIGURE 1
Correlation of the results of the higher education system with the contribution of the entrepreneurial and high-tech universities in Russia: calculated and constructed by the authors.
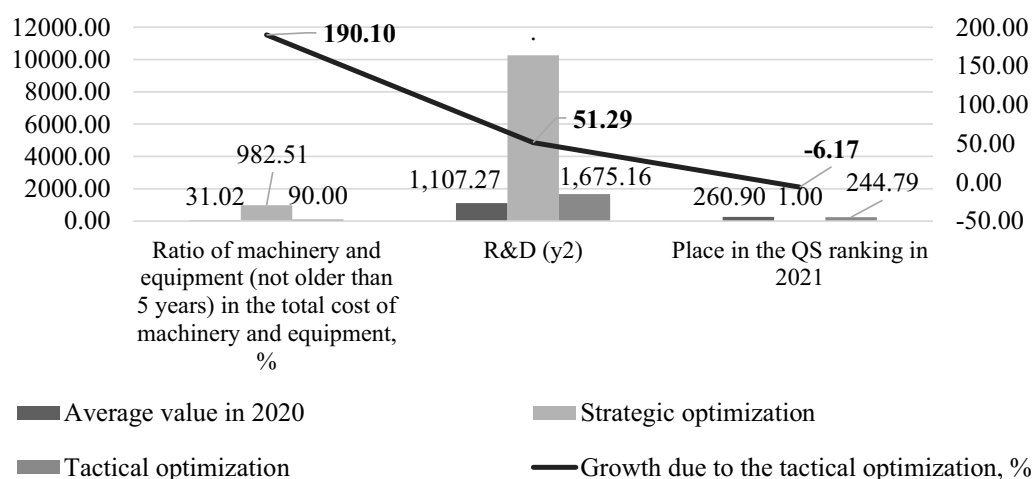

FIGURE 2
Scenarios of the innovative development of education in the context of the Russian economy's modernization: calculated and constructed by the authors.

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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