DOI: 10.15587/978-617-7319-45-9.CH1

1 METHODOLOGICAL FUNDAMENTALS OF SUPPORT OF SCIENTIFIC AND EDUCATIONAL INSTITUTIONS THROUGH TARGETED CAPITAL INVESTMENTS

Ia. Levchenko, I. Dmytriiev, O. Dmytriieva, I. Shevchenko, I. Britchenko

ABSTRACT

It all starts with learning. From the very beginning of its existence, a person learns to talk, walk… Education is a titan, on which the existence of an intelligent person is based. The decline in the quality of education leads to its collapse, which in turn leads to the collapse of the nation. Therefore, the task of ensuring the quality of education is a priority for every state. The combination of education and innovation is the undisputed driving force behind the vector of development in the era of ephemerality. This section discusses the problem of supporting research and educational institutions. The method of selective financing of scientific and educational institutions, which create innovative technologies taking into account their investments in innovative developments, is offered. On the basis of statistical data on indicators of an estimation of activity of scientific and educational institutions and an indicator of innovative potential of a scientific and educational institution from implementation of innovations, a calculation of their rating has been carried out. In order to stimulate scientific and educational institutions to create innovative technologies, the introduction of targeted investment is proposed.

The problem of quantitative assessment of the rate of targeted investment on the basis of the comprehensive approach to the indicators of innovation potential from innovation and the rating of research and educational institutions has been solved. The approbation of the offered technique by an experimental method has been carried out, the targeted capital investments on the basis of the complex approach have been defined.

KEYWORDS

Scientific and educational institution, allowance, innovative technologies, selective financing, targeted investments, rating.

1.1 FINANCING OF SCIENTIFIC AND EDUCATIONAL INSTITUTIONS: PROBLEMS AND SOLUTIONS

A modern world-class educational institution provides for a real and tangible stay of a correspondent research, production and educational institution in the global space. Therefore, successful internationalization is a necessary prerequisite for joining the elite club of leaders of modern education and science. Until recently, the level of internationalization was measured by the percentage of foreign teachers and students. Currently, a system of international university rankings is emerging and being actively formed, which simultaneously plays the role of both a judge and

a mediator. Indeed, the instrumental mission of rankings is to compare the teaching and research potential of educational institutions and thus identify ways to reform and further develop them. More importantly, in the process of this comparison, the ratings state the substantive field of the «ideal type» of a modern educational institution as an educational, research and innovation center of the knowledge society [1]. The issue of internationalization is also actualized by the innovation vector. According to [2], the elimination of regional imbalances in the state is possible only with the provision of innovative development. All sectors of the economy need new ideas and the introduction of new technologies, where the carriers of ideas for the implementation of the latter and the development of startups are research and educational institutions [3, 4]. Startups or innovation and technological solutions in this case solve a number of problematic issues of all sectors of the economy. However, financial resources are needed to implement such ideas.

Some researchers see the solution to the problem of funding only through government intervention, emphasizing the need for significant capital investment [5]. The COVID crisis has revealed a huge number of research and educational institutions capable of creating technology and innovation. All countries, the UN, donors, founders are ready to finance such institutions and subsidize them through incentive allowances. Each stakeholder should invest (finance, support, subsidize) in educational institutions [6]. In support of this [7, 8]. This raises some scientific questions: how and to whom to allocate financial resources to ensure the implementation of research and educational institutions startup projects? The state administration of investment processes of scientific and educational institutions aims to obtain new solutions and startup projects for the country's enterprises as a result. Those that have the potential to implement and aim to increase competitiveness through the introduction of high-tech quality products are the need of the XXI century.

In turn, the latest techniques should indicate the need for funding and provide additional motivation for research and educational institutions through targeted investments in the development of innovative technologies. Summing up, on the one hand we have the need to ensure innovative development, on the other – research and educational institutions, which in providing a vector of innovation, need to provide new forms of funding [9], and the latest author's methods to provide additional motivation for funding – the need for research today.

1.2 INTRODUCTION OF METHODS OF SELECTIVE FINANCING OF SCIENTIFIC AND EDUCATIONAL INSTITUTIONS THROUGH TARGETED INVESTMENTS IN THE DEVELOPMENT OF INNOVATIVE TECHNOLOGIES

Ensuring an innovative vector of development is a driving factor for industry productivity and its competitiveness [10]. In an era of turbulence, only the development of innovation is the key to economic growth [11]. Innovation is a tool for transforming not only the past but also the present to the highest level. Innovative investments in a broad sense are long-term and, very often,

one-time infusions in order to stimulate the generation, support the development and ensure the implementation of innovations for their practical application. How to generate, manage and finance innovations more effectively is an issue that is still relevant. It is also extremely important when it comes to education and science, because investing in them to ensure innovative development is a powerful engine for the growth of all mankind [12]. It is here that the question of the key role of scientific and educational institutions in the development of the economy of individual regions and the state as a whole becomes relevant [13]. Based on its research, Oxford University creates innovative products every 2 months [14]. The creation of such new products provides university research with finances, contributes to local economic development and the creation of many new jobs in the region. The benefits are obvious to all participants. However, such a system of financing is acceptable in the conditions of a well-established process in the chain «educational institution – state – stakeholder». At present, it is hardly acceptable to talk about nationwide funding of the innovation vector of scientific and educational institutions in the conditions of turbulence. In the context of economy, integrated in technological innovation [15], selective and equitable financing is within the power of each state. Therefore, there is a need to develop a comprehensive methodology for selective financing of research and educational institutions through targeted investments in the development of innovative technologies.

Modern methods do not provide a specific answer to the question of how to conduct a ranking from the standpoint of the innovation component and identify research and educational institutions for funding.

In the study [16], the authors conducted a sample analysis of modern financing methods. The conclusions of the study emphasized that the financing of large projects (including innovative ones) should be carried out not only by the state, but also by the regions. However, this study does not say what underlies selective financing (indicators, ratings, or anything else) and how to conduct such a sample.

In part, the answer to this question is provided in the study [17], which proposed a rating method based on the indicator of investment attractiveness, which is identified as key. The methodology has a practical value due to the comprehensive approach to assessing investment attractiveness. Based on the rating, the authors of the study [17] proposed to conduct funding. This technique is theoretical in nature and can be adapted to assess the investment attractiveness of research and educational institutions. However, it does not offer selective financing of the studied objects through targeted investments and does not solve the problem of quantifying the allowance rate.

The study [18] is devoted to the development of a methodology that proposes the structure and mechanisms of financial flows. However, the study has the specificity – the focus on financing in the housing stock. At the same time, the influence of such a component as innovation and, accordingly, its influence on decision-making regarding funding are also completely ignored.

All of the above studies are unanimous that funding should be based on a preliminary assessment. Researchers also supported selective financing based on the rating [19]. They proved the need for

the comprehensive approach to such an assessment. The agreement with this vector of innovation financing can be traced in the study [20], which deals with the comprehensive approach to the financing of innovation in the state of Poland. It is also emphasized the need to support a branched vector of innovation support, instead of narrowly focused. This approach to complexity is inherent and of practical interest to countries in Europe and around the world.

The above methods are based on an integrated indicator (as a complex), which certifies the quality of the object under study. Such an integral indicator in the assessment of scientific and educational institutions is the indicator of their rating.

The annual ranking of universities «Top 200 Ukraine» is presented by the Center for International Projects «Euroeducation» and the international group of experts IREG Observatory on Academic Ranking and Excellence [21]. The compilers of the rating take into account the comprehensiveness and versatility of universities. The rating is calculated according to ten indicators: six indicators are international, four – national. It should also be noted, that the weights of international performance indicators of universities (results in world rankings, participation of universities in Erasmus+ programs of the European Union) are set higher than the weights of national indicators. However, it should be noted, that this rating does not say anything about innovation and scientific investment.

The most famous in the circle of educational institutions is the world ranking of universities QS [22]. It uses an extremely consistent methodological framework, compiled using a methodology based on six simple indicators [23]:

1. Academic reputation.
2. Reputation of an employer.
3. Ratio of teachers/students.
4. Quotes for a faculty.
5. International coefficient of a faculty.
6. International student ratio.

Each of these six indicators has its own weight. However, it is also worth noting the lack of innovation and scientific investment.

Academic Ranking of World Universities (ARWU) [24] is recognized as the forerunner of the world ranking of universities and the most reliable. ARWU annually represents the top 1,000 research universities based on a transparent methodology and objective third-party data. It is more complex and multicomponent in terms of ranking, as it is an integrated model, which is based on a large number of indicators [25], which are grouped into 4 groups. However, among such a variety of indicators, the innovation and science component is absent.

Another method of global ranking of educational institutions is worth noting – Global Ranking of Academic Subjects (GRAS). GRAS rankings use a number of objective academic indicators and external data to measure the performance of world universities in relevant subjects [26]. However, such a rating is interesting from the standpoint of assessing the quality of education, and not from the standpoint of the innovative vector of scientific and educational institutions.

However, what exactly are the indicators to be used in determining the priority institution in the investment project to obtain financing? The conducted analysis gives grounds to assert that the problem of support of scientific and educational institutions taking into account the innovative component has not been considered by other researchers. There is also a lack of a unified methodological approach in this direction, which indicates the need for appropriate research. This stimulates the need to develop a comprehensive methodology for selective financing of research and educational institutions through targeted investments in the development of innovative technologies.

1.3 THE RESULTS OF THE ELABORATION OF METHODS FOR SELECTIVE FINANCING OF SCIENTIFIC AND EDUCATIONAL INSTITUTIONS THROUGH TARGETED INVESTMENTS IN THE DEVELOPMENT OF INNOVATIVE TECHNOLOGIES

The object of the research is scientific and educational institutions, and the subject is the existing methods of their financing. In order to solve the problem of selective financing of scientific and educational institutions through targeted investments in the development of innovative technologies, the use of modern computer technology using mathematical models is proposed [27].

The whole set of statistical information should contain a small number of indicators that are informative about the state of an educational institution [1].

To determine the additional funding of higher education institutions, two most important indicators will be needed, namely:

1. Index of rating of a scientific and educational institution.

2. Indicator of innovative potential of a scientific and educational institution from innovation.

1. The index of rating of a scientific and educational institution

The rating of scientific and educational institutions in the «Top 200 Ukraine» is taken as a basis – it is an annual open access rating. The method of calculating this indicator is presented in [21].

The compilers of the rating take into account the indicators of comprehensive activity and versatility of universities. The rating is calculated according to ten indicators: six international and four local (**Table 1.1**) [21].

The rating of Ukrainian universities was conducted in accordance with the methodology, presented in [21].

External independent organizations determined the ratings of N scientific and educational institutions on the indicator (nomination) K ($K=1,\ldots, 10$). If the rating of an institution was not carried out on some indicator, it was assigned a conditional place in the rating table ($N+1$).

The next step was to calculate the weighted average value of the Index of the institution by the group of nominations.

All values are presented in conventional units.

Table 1.1 The indicators for evaluating the activities of scientific and educational institutions in 2019

No.	Indicator	Indicator weight
1	QS World University Rankings	0.135
2	Scopus	0.135
3	Webometrics	0.135
4	Participation in Erasmus+ of the European Union	0.135
5	Google Scholar Citations	0.135
6	UniRank	0.10
7	Results of All-Ukrainian student Olympiads and competitions of scientific works (by the sum of points)	0.065
8	Scholarships of the President of Ukraine and the Cabinet of Ministers of Ukraine for young scientists	0.065
9	Average weighted value for HEI ratings by the number of applications submitted by entrants and the average competitive score	0.03

2. The indicator of innovative potential of a scientific and educational institution from innovation

Next, the calculation of the indicator of the innovative potential of a research and educational institution from the implementation of innovations based on the classification of educational institutions by level of efficiency and amount of property, to assess the implementation of innovation potential was conducted [28].

The classification is based on the method [28], which states that for each research and educational institution n innovation potential of the research and educational institution from innovation PN_n is determined based on the revenue of the special fund Dsf_n and expenditures of the budget institution V_n. Formula for calculation:

$$PN_n = Dsf_n / V_n. \quad (1.1)$$

According to the proposed methodology, scientific and educational institutions are further grouped into categories according to the efficiency of financing, ownership and clustered on the basis of the obtained data [28].

The basis for the analysis was the statistical data of scientific and educational institutions of Ukraine. Taking into account confidential information for scientific and educational institutions, 20 educational institutions of Ukraine were selected and given symbols, the parameters of which are presented in **Table 1.2**.

In order to abstract from the specifics to simplify the judgments, the names of scientific and educational institutions (adopted by the letters A–T) and the meaning of their fixed assets and budget allocations are accepted conditionally.

Table 1.2 The main indicators of twenty selected scientific and educational institutions

Conventional name of the scientific and educational institution	Main funds, mln USD	Budget allocations, mln USD	Indicator of the innovative potential of the scientific and educational institution from the implementation of innovations
A	47,910	57,598	0.26
B	37,884	48,371	0.36
C	28,390	80,595	0.02
D	24,800	10,261	0.22
E	3,880	47,762	0.22
F	24,000	16,537	0.23
G	1,174	29,602	0.33
H	10,041	28,127	0.68
I	26,338	22,140	0.06
J	2,164	3,110	0
K	2,007	42,504	0.83
L	7,780	5,729	0
M	4,534	1,396	0.24
N	3,700	13,590	0.42
O	42,860	8,661	0.02
P	2,944	4,329	0.37
Q	41,805	19,368	0
R	1,859	9,667	0.05
S	6,052	1,852	0.11
T	8,000	1,539	0.02

The method of selective financing of scientific and educational institutions by targeted investments in the development of innovative technologies is proposed, which is based on the obtained indicators of the rating of scientific and educational institutions and the indicator of innovative potential of scientific and educational institutions from innovation.

1.4 PROPOSALS FOR THE INTRODUCTION OF THE CONCEPT OF TARGETED INVESTMENT IN ORDER TO STIMULATE SCIENTIFIC AND EDUCATIONAL INSTITUTIONS TO CREATE INNOVATIVE TECHNOLOGIES

In order to stimulate scientific and educational institutions to create innovative technologies, it is proposed to introduce targeted investment.

Targeted investment, according to the author's definition, is a certain part of financial resources that is directed to the recipient in order to stimulate scientific and educational institutions to

create innovative technologies based on the comprehensive approach to innovation potential and ranking of the latter.

We hypothesize that the program of development of scientific and educational institutions consists of n number of scientific and educational institutions that require targeted investment. The index of a scientific and educational institution, involved in the funding process, will be marked $i = \overline{1,n}$. Let the return on investment of the scientific and educational institution per unit of financial resources spent be a_i (a_i cannot be <1).

A formalized description of the model of effective cooperation between a scientific and educational institution and an investor (state, financial donor, etc.) is proposed, which can be presented as follows:

$$Z_i(S_i,x_i) = \varphi_i(S_i) - y_i = \varphi_i(S_i) - (S_i - x_i),\ i = \overline{1,n}, \tag{1.2}$$

where S_i – total amount of funding for the creation of innovative technologies; $\varphi_i(S_i)$ – income of the i-th scientific and educational institution from the implementation of innovative technologies; x_i – financial resources of the scientific and educational institution for the creation of innovative technologies – borrowed funds; y_i – own financial resources of the scientific and educational institution for the creation of innovative technologies; z_i – investments (state, financial donor, etc.), which take into account the amount of targeted funding; Z_i – net profit of the institution as part of the institution's own funds (as part of y_i).

Under conditions $\varphi_i(S_i) > x_i + y_i + z_i$ or $\varphi_i(S_i)/(x_i + y_i + z_i) > 1$ the model of cooperation between scientific and educational institutions and an investor (state, financial donor, etc.) is considered effective. The use of targeted investment optimizes the financing process, helps to increase efficiency.

Also for calculations according to the offered author's technique, the synthetic (artificial) indicator q_i, which is calculated by formula (1.3), will be required:

$$(1 - a_i)/l_i = q_i, \tag{1.3}$$

where a_i – efficiency, which is assessed by the return from a scientific and educational institution per unit of financial resources spent; l_i – priority.

Substituting for formula (1.3) the indicator of innovation potential of the scientific and educational institution from innovation – r instead of the efficiency indicator, and the rating of the scientific and educational institution – R instead of the priority indicator, the calculation of artificial (synthetic) q_i is carried out according to formula (1.4):

$$(1 - r_i)/R_i = q_i, \tag{1.4}$$

where r_i – indicator of innovation potential from innovation of the i-th scientific and educational institution, con.un; R_i – indicator of the rating of the i-th scientific and educational institution, con.un.

To determine the number of scientific and educational institutions that can claim the allowance, the maximum value of n is determined, which would satisfy the following inequality:

$$q_i < Q_n/(n-1), \quad (1.5)$$

where Q_n – sum of synthetic indicators q_i of the corresponding scientific and educational institutions n.

When condition (1.5) is not met, the calculation ends and the following scientific and educational institutions are excluded from the list of candidates for the allowance.

1.5 DETERMINATION OF TARGETED INVESTMENT BASED ON THE INTEGRATED APPROACH TO INDICATORS OF INNOVATION POTENTIAL AND RATING OF SCIENTIFIC AND EDUCATIONAL INSTITUTIONS

On the basis of statistical data on indicators of the estimation of activity of scientific and educational institutions, presented in **Table 1.2**, the rating of scientific and educational institutions was calculated. Taking into account confidential information for scientific and educational institutions, symbols are provided, the parameters of which are presented in **Table 1.3**.

Table 1.3 The rating

Rating of the scientific and educational institution	Conventional name of the scientific and educational institution	Sum of indexes of the scientific and educational institution, *R*
1	A	0.9625
2	B	0.9619
3	C	0.9211
4	D	0.9200
5	E	0.8554
6	F	0.8486
7	G	0.8443
8	H	0.8360
9	I	0.8293
10	J	0.8282
11	K	0.8216
12	L	0.8078
13	M	0.8052
14	N	0.7986
15	O	0.7925
16	P	0.7874
17	Q	0.7760
18	R	0.7750
19	S	0.7678
20	T	0.7675

Next, the calculation of the indicator of the innovation potential of scientific and educational institutions from the implementation of innovations on the basis of their classification according to (1.1) is carried out.

In **Table 1.4** the calculation information is presented.

Table 1.4 The indicator of the innovation potential of the scientific and educational institution from innovation

Rating of the scientific and educational institution	Conventional name of the scientific and educational institution	Indicator of the innovation potential of the scientific and educational institution from innovation, *r*
1	A	0.26
2	B	0.36
3	C	0.02
4	D	0.22
5	E	0.22
6	F	0.23
7	G	0.33
8	H	0.68
9	I	0.06
10	J	0
11	K	0.83
12	L	0
13	M	0.24
14	N	0.42
15	O	0.02
16	P	0.37
17	Q	0
18	R	0.05
19	S	0.11
20	T	0.02

Calculated and formed by the author based on data [21]

The calculations, presented in **Table 1.4**, indicate the following: the indicator of the innovation potential of a scientific and educational institution from the implementation of innovations does not depend on the previous rating of the scientific and educational institutions or vice versa. This is the basis for determining targeted investments based on the integrated approach.

1.6 FORMULATION AND SOLUTION OF THE PROBLEM OF QUANTITATIVE ASSESSMENT OF THE RATE OF TARGETED INVESTMENT

To determine the rate of targeted investment, the calculation procedure of which is represented by formulas (1.2)–(1.5), it is necessary to calculate the synthetic indicator q_i. The initial data for the calculation are presented in **Tables 1.3, 1.4**.

The calculation of q_i is performed by formula (1.4). When determining the share of additional funding for scientific and educational institutions, in accordance with the proposed methodology, it is necessary to sort the latter from the smallest to the largest value q_i. The results of the calculations in ascending order are presented in **Table 1.5**.

Table 1.5 The value of q_i in ascending order

Rating of the scientific and educational institution	Conventional name of the scientific and educational institution	Sum of indexes of the scientific and educational institution, *R*	Indicator of the innovation potential of the scientific and educational institution from innovation, *r*	Value q_i
11	K	0.8216	0.83	0.2069
8	H	0.836	0.68	0.3828
2	B	0.9619	0.36	0.6653
14	N	0.7986	0.42	0.7263
1	A	0.9625	0.26	0.7688
7	G	0.8443	0.33	0.7936
16	P	0.7874	0.37	0.8001
4	D	0.92	0.22	0.8478
6	F	0.8486	0.23	0.9074
5	E	0.8554	0.22	0.9119
13	M	0.8052	0.24	0.9439
3	C	0.9211	0.02	1.0639
9	I	0.8293	0.06	1.1335
19	S	0.7678	0.11	1.1592
10	J	0.8282	0	1.2074
18	R	0.775	0.05	1.2258
15	O	0.7925	0.02	1.2366
12	L	0.8078	0	1.2379
20	T	0.7675	0.02	1.2769
17	Q	0.776	0	1.2887

The whole algorithm of the procedure for determining the number of scientific and educational institutions – candidates for the allowance, can be represented by the inequality (1.5).

Let us check the fulfillment of the given condition for the set of obtained values of q_i. The test must be performed as long as condition (1.5) is met. If the condition is not met, the calculations should be terminated, and subsequent scientific and educational institutions are excluded from the list of applicants for the allowance.

The results of the calculations are presented in **Table 1.6**.

Since condition (1.5) is not satisfied at $n=3$, the calculations are complete. Scientific and educational institutions were identified to receive targeted investments. Such are the institution *K* and *H* with the values of the preliminary rating of 11 and 8 places, respectively. This proves the significant influence of the innovation component on the determination of targeted investment.

Next, the calculated values of the shares of targeted investment, with allocated funds equal to 1, in proportion to the obtained $Q_n/(n-1)$ and the results are presented in **Table 1.7**.

● **Table 1.6** Checking the fulfillment of condition (1.5)

Number of scientific and educational institutions, n	q_i	$\sum q_i$ corresponding to n, Q_n	$Q_n/(n-1)$	Checking the fulfillment of condition (1.5)
2	0.3828	0.5897	0.5897	$0.5897>q_2$
3	0.6653	1.2550	0.6275	$0.6275<q_3$

● **Table 1.7** Allowance of the scientific and educational institution with the allocated funds ($S=1$)

Scientific and educational institution	Targeted investment at $S=1$
K	0.5623
H	0.4376

According to the calculations, 2 scientific and educational institutions (namely: *K* and *H*) will receive targeted investment. Institution *K* will receive a higher allowance, and institution *H* will receive a smaller allowance, the value of which will be 56.23 % and 43.76 %, respectively, from 100 % *S*. It should also be noted, that the final rating of educational institutions differs significantly from the initial rating [21], because it is adjusted to the indicator of the potential of the scientific and educational institution from carrying out innovations.

1.7 DISCUSSION OF THE RESULTS OF DETERMINING THE TARGETED INVESTMENT ON THE BASIS OF THE INTEGRATED APPROACH TO THE INDICATORS OF INNOVATION POTENTIAL FROM INNOVATION AND THE RATING OF SCIENTIFIC AND EDUCATIONAL INSTITUTIONS

A large number of methods of financing innovative vectors of scientific and educational institutions were proposed by modern researchers [16–26]. All of them are integral and complex:

some contain more indicators, others – less. In contrast, the proposed author's definition of targeted investment based on the integrated approach to the indicators of innovation potential and rating of scientific and educational institutions, which is also comprehensive, contains a crucial component – targeted investment. The proposed methodology allows to determine the best scientific and educational institutions on the basis of the integrated approach.

In contrast to the existing methods, the author's is aimed at supporting the most important component – innovative development [29] of both the region and the state as a whole. It is determined that scientific and educational institutions that effectively use the innovation and scientific potential receive targeted investment. The presence of a mathematical justification for targeted investment is also an excellent and latest characteristic of the proposed method from a number of existing ones.

Targeted investment, according to the author's definition, is a certain part of financial resources that is directed to the recipient in order to stimulate scientific and educational institutions to create innovative technologies based on the comprehensive approach to innovation potential and ranking of the latter. In order to stimulate scientific and educational institutions to create innovative technologies, it is proposed to introduce targeted investment, the entire calculation procedure of which is represented by formulas (1.2)–(1.5), and the calculation has been carried out.

The problem of quantitative assessment of the rate of targeted investment on the basis of the comprehensive approach to the indicators of innovation potential from innovation and the rating of scientific and educational institutions for 2 institutions has been solved, the results of which are presented in **Table 1.7**. The main provisions of the section are covered in [30].

The main limitation of this section is the lack of a clear methodology for determining the rating of educational institutions. The next section will be devoted just to filling this gap.

REFERENCES

1. Tatarinov, I. Ye., Herasymov, O. V. (2013). International experience in universities ratings formation:most objective criteria and assessing indicators determination. Ukrainskyi sotsium, 1 (44), 100–116.
2. Backward Regions Grant Fund. Available at: https://www.indiastat.com/social-and-welfare-schemes-data/27/backward-classes-schemes/27905/backward-regions-grant-fund-brgf/411976/stats.aspx
3. Keskin, G., Basal, T. (2014). Kazakhstan invests in science for economic growth. Available at: https://www.elsevier.com/connect/kazakhstan-invests-in-science-for-economic-growth
4. Kisjes, I. (2013). The Impact of Science: how research can be measured and spending maximized. Available at: https://www.elsevier.com/connect/the-impact-of-science-how-research-can-be-measured-and-spending-maximized
5. Levchenko, I., Britchenko, I. (2021). Estimation of state financial support for non-priority territorial units using the example of bridge construction. Eastern-European Journal

of Enterprise Technologies, 1 (13 (109)), 26–34. doi: http://doi.org/10.15587/1729-4061.2021.225524

6. Maximizing Investments & Accelerating The Journey To Research Innovation. Elsevier R&D Solutions. Available at: https://www.elsevier.com/__data/assets/pdf_file/0010/259435/Maximizing-Investments-and-Accelerating-The-Journey-To-Research-Innovation.pdf
7. Investing in innovation. Technology promises a brighter, more productive future (2016). OppenheimerFunds Distributor, Inc. Available at: https://www.washingtonpost.com/sf/brand-connect/oppenheimerfunds/investing-in-innovation/
8. Clement, D. (2019). Investing in innovation. Available at: https://www.minneapolisfed.org/article/2019/investing-in-innovation
9. Kukacka, J., Kristoufek, L. (2020). Do «complex» financial models really lead to complex dynamics? Agent-based models and multifractality. Journal of Economic Dynamics and Control, 113, 103855. doi: http://doi.org/10.1016/j.jedc.2020.103855
10. Grosse Kathoefer, D., Leker, J. (2010). Knowledge transfer in academia: an exploratory study on the Not-Invented-Here Syndrome. The Journal of Technology Transfer, 37 (5), 658–675. doi: http://doi.org/10.1007/s10961-010-9204-5
11. Lopes, A. P. V. B. V., Kissimoto, K. O., Salerno, M. S., Carvalho, M. M. de, Laurindo, F. J. B. (2016). Innovation management: a systematic literature analysis of the innovation management evolution. Brazilian Journal of Operations & Production Management, 13 (1), 16–30. doi: http://doi.org/10.14488/bjopm.2016.v13.n1.a2
12. Yordanova, Z. (2019). A model for evaluation of innovative universities. Educational Innovations and Applications, 459–462. doi: http://doi.org/10.35745/ecei2019v2.117
13. Reichert, S. (2019). The role of universities in regional innovation ecosystems. European University Association, 102. Available at: https://www.eua.eu/downloads/publications/eua innovation ecosystem report_final_digital.pdf
14. Investments. Available at: https://innovation.ox.ac.uk/portfolio/
15. Smyrnov, O., Borysenko, A., Trynova, I., Levchenko, I., Marchenko, A. (2020). Determining the technical and economic parameters for designing hybrid power units for the budget segment. Eastern-European Journal of Enterprise Technologies, 1 (8 (103)), 43–49. doi: http://doi.org/10.15587/1729-4061.2020.194642
16. Backward Region Grant Fund for all Arunachal districts (2013). Available at: https://timesofindia.indiatimes.com/city/guwahati/Backward-Region-Grant-Fund-for-all-Arunachal-districts/articleshow/27236041.cms
17. Snieska, V., Zykiene, I. (2015). City Attractiveness for Investment: Characteristics and Underlying Factors. Procedia – Social and Behavioral Sciences, 213, 48–54. doi: http://doi.org/10.1016/j.sbspro.2015.11.402
18. Muczyński, A. (2020). Financial flow models in municipal housing stock management in Poland. Land Use Policy, 91, 104429. doi: http://doi.org/10.1016/j.landusepol.2019.104429

19. Angelis-Dimakis, A., Dimaki, K. (2016). Identifying Clusters of Regions in the European South, based on their Economic, Social and Environmental Characteristics. REGION, 3 (2), 71. doi: http://doi.org/10.18335/region.v3i2.81
20. Breznitz, D., Ornston, D. EU financing and innovation in Poland. Available at: https://www.ebrd.com/publications/working-papers/eu-financing-and-innovation-in-poland
21. Nezalezhne otsiniuvannia universytetiv: Akademichnyi reitynh «TOP-200 UKRAINA 2020». (2020). Yevroosvita. Available at: http://www.euroosvita.net/index.php/?category=1&id=6556
22. QS World University Rankings. Available at: https://www.topuniversities.com/qs-world-university-rankings
23. Writer, S. (2021). QS World University Rankings – Methodology. Available at: https://www.topuniversities.com/qs-world-university-rankings/methodology
24. The Academic Ranking of World Universities (2021). Available at: http://www.shanghairanking.com/index.html
25. Academic Ranking of World Universities. http://archive.shanghairanking.com/grup/ranking-by-indicator.jsp
26. Global Ranking of Academic Subjects. Available at: http://www.shanghairanking.com/rankings/gras/2021
27. Domin, D. (2013). Artificial orthogonalization in searching of optimal control of technological processes under uncertainty conditions. Eastern-European Journal of Enterprise Technologies, 5 (9 (65)), 45–53. doi: http://doi.org/10.15587/1729-4061.2013.18452
28. Tripak, M. (2021). Paradigm of economic and mathematical model of rating of educational institutions. Innovative Economy, 1–2, 140–146. doi: http://doi.org/10.37332/2309-1533.2021.1-2.20
29. Simeonova, T. (2019). Horizon 2020 program – Europe with a focus on innovations. VUZF Review, 3, 29–39. Available at: https://papersvuzf.net/index.php/VUZF/article/view/86
30. Levchenko, I., Dmytriieva, O., Shevchenko, I., Britchenko, I., Kruhlov, V., Avanesova, N. et. al. (2021). Development of a method for selected financing of scientific and educational institutions through targeted capital investment in the development of innovative technologies. Eastern-European Journal of Enterprise Technologies, 3 (13 (111)), 55–62. doi: http://doi.org/10.15587/1729-4061.2021.235930