Formation of efficiency of scientific activities of universities in Russia

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Abstract: Today scientific papers pay a lot of attention to the issues of innovation potential evaluation in different economic systems. The issues of evaluation of university scientific and research potential correspond to the objectives of the National Research University Program when educating higher qualification specialists. The article presents the research result of economic efficiency of university.

Introduction

When assessing economic efficiency of universities and their scientific potential, there appears a problem concerning methodological tools for analysis and assessment of scientific and educational work on the basis of a set of indices, which makes it possible to assess how efficiently the budget funds are used in the educational system. In the international practice, the potential of universities is commonly assessed by ratings, which evaluate the criteria that either have an excessive degree of aggregation or reflect, rather superficially, the current conceptual part of the universities' work. Although the rating approach has methodological weaknesses, no decent alternative has been offered yet and most techniques for rating formation are based on finding out how important the valued indices are and on scaling each of them. Let us look into the issues of university scientific and educational potential assessment on the basis of principles for creation of economic value added (value-oriented approach).

The issues the article examines are:

− How can economic efficiency of a university be defined in case of budget financing and how does scientific potential of a university form?

− How can investment (government and private one) be attracted into educational process?

At the same time, one of the objectives for the potential evaluation is to increase motivation, which would stimulate investors (and the government) to support universities financially. Such motivation will become much more convincing if, following the results of the public assessment, it will be possible to build up university ratings according to their investment attractiveness and, consequently, value. The problems of R&D cost-effectiveness and forms of R&D funding and taxing have been researched in different times by famous scientists, such as: I.

Blank, D. Bugrov, S. Valdaitsev, A. Viktorov, P. Vilensky, V. Volkova, V. Galasyuk, V. Glukhov, A. Gryaznova, E. Egereva, I. Eliseeva, V. Zherebina, I. Ivashkovskaya, A. Karlik, V. Kovalev, V. Livshits, M. Limitovsky, G. Malinetsky, A. Chkhartishvili.

Definition of efficiency for scientific potential of university

In Russian and international practice, performance of a university is determined with rating assessment data. These data are used to assess economic efficiency of a university and, in particular, to analyze how rationally and efficiently the budget and private funds obtained by the university are spent. Current methods do not consider such indices among those reflecting universities' scientific performance as relation between the university's own money spent on R&D and the number of teachers and researchers, the volume of scientific work and development, its intellectual value, attitudinal capital while organizational structure of the university is formed, which, in the long run, results in formation of the university's value. In order to have a clearer view, the definitions of the terms «index» and «criterion» are given. Index is a generalized characteristic of properties of an object or process. There are:

• Quality indices, which register presence or lack of a certain property;

• Quantity indices, which register the degree of manifestation or development of a certain property.

Criterion is a factor or feature, on the basis of which quality of an object or process is assessed, a measure of such assessment. When composing a rating, it is essential to understand clearly who it is meant for, since, after all, it is the target audience which determines the type of rating and the way the

results are presented. The definition of «efficiency» (Russian term – «effectivnost») in relation to the university work: let us review general definitions of «efficiency» and, summarizing the reviewed definitions, attribute a definite notion with regard to the university work. Definition of efficiency. «Efficiency is the most general, defining quality of any purpose-oriented activity, which, from the cognitive (gnoseological) point of view, is revealed through the category of goal and is objectively expressed with a degree the goal has been reached to, considering the resources and time that have been spent [1, p.59]. Efficiency of a system cannot be judged only by the properties of the system. Properties of the super-system must be taken into account as well [2, p.14]. Efficiency cannot be seen straightforwardly, it can be measured only with indirect methods [3, p.56]. There are two English terms, corresponding to the Russian term «effectivnost»: «effectiveness» and «efficiency». The first one implies ability to set desirable goals and reach them. The second term refers to correlation of the benefits obtained and resources that have been spent in order to get these benefits [4, p.66].
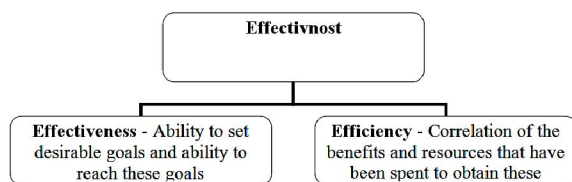
Fig. 1. Correlation of the Russian term «effectivnost»

Currently a whole number of scientific works say about the theory of efficiency [4, 5, 6]. Some sources claim that this theory has not become an independent science yet [7, p. 5]. Other ones express an opinion that this theory has become quite set: «the object of study in the theory of efficiency is results-oriented activities or operations, whereas the subject is conformities, which connect efficiency of an operation with the quality of the system, conditions and methods of its use in the operation» [1, p. 66]. «The theory of efficiency is also called a tool for operations research». In the West, there is an analogous research trend, Efficiency and Productivity Analysis [9, 10].

Efficiency, as any quality of a system, has a certain intensity of manifestation. The degree of manifestation is called the intensity index W [3 p. 61]. Let us give a more detailed definition [7, p. 71]: «the efficiency index of a system is a quantitative characteristic of the final result of its functioning and development within a certain period of time in

comparison with the relevant normative standard and consumption of resources under specific characteristics of the system's condition and external factors' impact, plus under the predetermined control vector». It is suggested that such an index of efficiency should be called an overall efficiency index of the system. In the most common form, it is suggested that the overall efficiency index of a big system should be built as a certain function or functional [7, p. 71-72]:

$$W = \Phi\left(Y_K, Y_H, U_K, U_H\right), \quad (2)$$

where Y_K – is a possible or actually obtained positive effect (final result) of the system's functioning and development; Y_H – is a target effect (the necessary final result) of the system's functioning and development; U_K – potential or actual expenses of labour (current and overpast) necessary to get Y_K; U_H – is minimal labour inputs (current and overpast) necessary to get Y_H.

If $\left(Y_K, U_K\right)$ are viewed as possible values, the issue is efficiency. In case $\left(Y_K, U_K\right)$ are actually obtained, the W index will reflect the actual efficiency obtained within a certain period of time in which the system has been functioning. The efficiency criterion is needed to take a decision about reaching the wanted goal. This is a rule that makes it possible to compare strategies, resulting in a different degree to which a goal is reached, and consciously choosing strategies out of a possible set [1, p. 37]. The efficiency criterion is concluded on the basis of a certain concept of rational behavior (decision-making): suitability, optimization, adaptation [7, p. 37-38].

1. The concept of suitability.

Any strategy u is believed to be rational in case the efficiency value W is not lower than a certain wanted level

$$W^{mp}: W(u) \geq W^{mp}, u \in U,$$

where U – is a set of acceptable strategies. If the efficiency index is vector, this condition is recorded for every individual index W_i, which is part of the index W:

$$W_i(u) \geq W_i^{mp}, \forall i.$$

2. The optimization concept.

The strategies $u \in U$, are believed to be rational if they provide maximal effect:

$$W\left(u^*\right) = \max_{u \in U} W(u).$$

The solution may be a set of equivalent optimal strategies $U^* \in U$. Herewith, the efficiency index $W(u)$ is scalar.

3. The adaptation concept.

With this concept, the strategy u can change while the system is in operation. Moreover, the concept of strategy also includes the parameters and structure of the system. Changes are made not only on the basis of aprioristic information, but on current and projected information as well. A set of acceptable strategies U and the goal of the system can also change. This concept implies that an adaptive strategy $u(t)$ out of the set $U(t,\tau)$ is believed to be rational if it guarantees that the following condition is met:

$$W_t\left(u^*(t),\tau\right) \geq W_i^{mp}\left(u(t),\tau\right), u(t) \in U(t,\tau),$$

where t – is time, τ – anticipation of the projection. The notation W_t means that the efficiency index can change through time [7, p. 37-38].

The most important rule when choosing the efficiency criterion is consistency of the goal of an operation and the chosen criterion [7, p.40]. Thus, the efficiency criterion cannot be built without normative standards, whereas normative standards are not strictly necessary for building up the efficiency indices [7, p. 84]. These explanations make it clear that the concepts of «efficiency» and «goal» are interrelated. The quantitative study of systems is carried out with the concept of purpose in mind. There is even such a term as purposeful system, which was used in the paper by Akoff [8] for the first time. Further on, we are going to explain the meaning of the notion «efficiency» in relation to the work of a university. Efficient resource management is one of the key conditions which ensure competitiveness of a university in the context of the market economy. This objective is closely connected with offering due quality in the major scopes of the university's activities. Moreover, efficient management of resources (financial, human, information, material and technical ones, etc.) and quality management have to base on the up-to-date corporate management information system of the university.

The quality control and resource management system is to be implemented in accordance with the international standards of the series GOST R ISO 9000:2001 [11]. According to the process approach principle by GOST R ISO 9000:2001 «the desirable result is obtained more efficiently in case operations and corresponding resources are managed as a process». The process implies «any activity or complex of activities which uses resources to transfer inputs into outputs». The elaborated model for system management of the university is grounded on the process approach. The processes are seen as a set of interrelated resources and activities which change incoming elements into outgoing ones. The major activities of the university are: educational process, development of syllabuses, training of specialists with higher qualification, scientific research and innovative activities. Each of the stipulated activities is marked with specifics of the process which is used to transform inputs into outputs. For instance, pedagogic and educational activity, being the most common for a university, implies that there is a group to be taught (school leavers) «at the input» and bachelors, diploma graduates, masters «at the output». Pedagogic and educational process is oriented on acquisition, by each student, of certain knowledge, competences and skills which are defined by the State Educational Standards (GOS) for corresponding branches of study and qualifications. So, the product of pedagogical and educational activity (according to GOST R ISO 9000:2001 «the product is the result of a process») is bachelors, diploma graduates, masters with a set of knowledge, competences and skills which are defined by the GOS standards for corresponding branches of study and qualifications. Efficiency, according to GOST R ISO 9000:2001, is «relation between the result obtained and resources used». The main problem for development of education is to increase efficiency of universities, which requires financial and time resources. Efficiency of universities is determined by adequate identification of target markets of education consumers. Eventually, efficiency of universities is defined by their scientific and educational potential. An educational system can be run efficiently only in case there is unanimity and interaction in application of current educational technologies, innovational methods of teaching and learning, in creation of relevant organizational structures and forms, in development of new economic methods. That is why the most important principle in university education management should be consistency. The basis for solving the problems lies in analysis of the efficiency

indices of an educational institution. Assessment of such efficiency is a fundamental social and economic problem of education management in the present-day world. Efficiency of an educational institution's operation is a goal, stimulus and, at the same time, criterion for its organizational formation. That is why it is essential to understand how exactly this efficiency manifests itself. Economic and technological efficiencies are analyzed through research of methods which make costs transform into results. These methods are generalized in economics into the concept of a production function, which sets a maximum volume of products that can be made with a certain range of resources. However, today, obviously, production function of education is not studied enough. This, most probably, can be explained by the fact that analysis of such type of production as education is extremely complicated, because the result of education depends on a number of variables, which are considerably different by nature.

Efficiency is an integral and structured characteristic of a university's operation, which reflects comprehensively its successfulness and compliance with the mission, goals and objectives. Integrated efficiency of operations of an educational enterprise can be viewed as combination of interrelated, but qualitatively different functional components of efficiency elements: productivity, performance, cost-effectiveness, operability, innovation, profitability, quality of personnel's working life and quality of educational products [9, 12, 13, 14].

Finally, approaches to research of efficiency in various sectors have a large diversification. As an example, one can mention methods of efficiency assessment of innovative projects. The issues of technological efficiency evaluation of projects and programs are examined in the paper by Bagrinovskij [14]. An approach to efficiency assessment of military products is suggested in the paper by Burenok [2]. This approach uses not only determinate indices, but also probabilistic ones. However, there are more general approaches, which are applicable for assessment of quite a wide range of complex objects. So, one can raise questions of systematic analysis and assessment of the value of a university's scientific and educational potential, since the intellectual property factor plays an important role in formation of the value and market price of an organization or socioeconomic system. The essence of efficiency of any economic phenomenon is to gain considerable increase in the result of certain operation on every unit of costs: labor, material and financial ones. Therefore, the higher is the balance between the results of operation and costs, the higher

is the efficiency. Efficiency is interpreted as a characteristic of a system's ability to produce economic effect which is equal to the difference between the results of the economic operation and costs, borne in order to both gain this effect and use it or operate it.

Conclusions

In order to describe the approaches to efficiency assessment, it is necessary to define the conceptual framework. An index will imply quantitative characteristics of the units of some elements' multitudes and multitudes as a whole. Indices can be absolute and relative units. The system of indices will refer to a list of interrelated indices, which characterize a certain field of activities of a person or group of people. **Scientific and educational potential** (SEP) is, primarily, the potential, belonging to the system of education and enclosed into educational structures, which is directed (oriented) on development of science, advancement of scientific knowledge and enhancement of scientific research work. Primarily, this concept fixes capacities and resources of an educational system which can be used to ensure generation, reproduction and development of science and scientific work. Thus, in the restricted sense of the word, the scientific and educational potential is an educational potential whose main forms of implementation are image formation and evolvement of science, training of scientists, production of scientific products, organization and performance of scientific research work. In the broad sense of the word, scientific and educational potential is the complex of available resources of science and education. The statistical book «Scientific potential of universities and scientific organizations of the Ministry of Education of Russia» presents the following contents of the scientific potential elements:

- structure of universities and their distribution in the economic regions and by activity profiles plus structure of scientific subdivisions of universities and scientific organizations;

- personnel potential of universities and scientific organizations;

- personnel training in universities and scientific organizations (number and distribution of students, training of higher qualification specialists);

- completion and financing of scientific research in universities and scientific organizations (compliance with the editorial calendar of research work together with distribution of finance amounts by finance sources);

- international activities of universities and scientific organizations with indication of contents and volume of financing of international projects;

- material and technical base of universities and scientific organizations;

- results of research and development work of universities and scientific organizations of the Ministry of Education of Russia.

So, the scientific potential includes the whole complex of scientific knowledge, personnel, material and technical, financial, informational and organizational means, which are used (or can be used) for development of science. When selecting indices it is reasonable to be guided by general efficiency (does the index really characterize the aspect it has to characterize?), reliability (is the index free of error?) and ability to compare (is the index understood uniquely, independently on the type of program or university?). Another approach to the selection of indices takes into account investment, process and results. All other conditions being equal, preference is given to indices which describe the process (i.e. quality of teaching, innovation in teaching) and the results (for example, successfulness of working career of the university graduates, presence of intellectual property). Indices which describe a process are more difficult to select and it is more costly to collect information about them. However, if they are available, very important information can be obtained about such aspects as educational environment and efficiency of teaching. For example, at one time, ratings of the British universities, according to the Times, included the «quality of teaching» index at different departments of universities in the UK. Also, it is worth assessing objectiveness and subjectivity of indices. The major indices are the ones which do not depend on the person involved in assessment, whereas the subjective ones are the opposite. That is why the reliability of the efficiency assessment depends a lot on the use of subjective indices. At the same time one can try economic approaches for efficiency assessment of a university. These are models of the value-oriented approach. Unfortunately, until now the government has not taken steps in order to transfer scientific and technical activity into a full-fledged sector of the national economy. So far no definite mechanisms have been worked out for the use of scientific and technical activity results, i.e. intellectual property in economy. It is namely the government which must pay special attention to scientific and technical activity and create economic, legal framework which will enable exchange of scientific information, commercialization of scientific research and development results. Commercialization in the information system and technology market, intellectual property items cannot be studied without understanding the essence of economic and information relationships and looking into their specifics. This is exactly the major scientific result of the declared research.

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