

ARTIGO <https://doi.org/10.22481/praxisedu.v15i36.5952>**THE FORMALIZED ASSESSMENT OF EFFICIENCY OF THE REGIONAL
HIGHER SCHOOL THROUGH THE PRISM OF THE RATIO OF ENTRANCE AND
OUTPUT STREAM SIZES****LA EVALUACIÓN FORMALIZADA DE LA EFICIENCIA DE LA ESCUELA SUPERIOR
REGIONAL A TRAVÉS DEL PRISMA DE LA PROPORCIÓN DE TAMAÑOS DE FLUJO
DE ENTRADA Y SALIDA****AVALIAÇÃO FORMALIZADA DA EFICIÊNCIA DA ESCOLA SUPERIOR REGIONAL
ATRAVÉS DO PRISMA DA PROPORÇÃO DE TAMANHOS DE ENTRADA E DE
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Abstract: In the context of globalization, the growth of the competitive environment at the interregional, national levels in the field of innovation development, the role of higher education as the main source of human resources and the formation of the innovation environment increases. The low level of development of higher education deprives the region of a certain independence, placing it in additional dependence on other systems - regional, national, economic, etc. In this regard, the study of trends in the development of higher education at the interregional level is an extremely urgent task, the solution of which will provide a process of monitoring and forecasting the prospects for the development of socio-economic systems in the medium and long term. At the same time, despite a wide range of scientific works devoted to the problem, there is still no unity in the scientific space in the sphere of formal evaluation of the effectiveness of the development of regional higher education systems. In this regard, this study proposes approaches aimed at methodological support of solving the problem. The main feature of the work is the use of methods of comparison of input and output stream values, characterizing the parameters of the regional higher school. Using the approaches of rationing of the analyzed indicators and the subsequent development on this basis of the efficiency indices, multicomponent calculations are carried out, evaluating the indicators, characterizing the return on invested capital of regional higher education systems in the form of an integrated assessment of their effectiveness per 1 ruble of financial costs. As a result of the implemented assessments, the regions of the Volga Federal district are identified, characterized by moderate and strong positions in the field of generating effects, characterizing their effectiveness in comparison with the invested financial resources.

Key words: Regional higher school; Efficiency; Input/output stream indicators; State regulation; Return on invested resources.

Resumen: En el contexto de la globalización, aumenta el crecimiento del entorno competitivo a nivel nacional e interregional en el campo del desarrollo de la innovación, el papel de la educación superior como la principal fuente de recursos humanos y la formación del entorno de innovación. El bajo nivel de desarrollo de la educación superior priva a la región de una cierta independencia, colocándola en una dependencia adicional de otros sistemas: regional, nacional, económico, etc. En este sentido, el estudio de las tendencias en el desarrollo de la educación superior en el interregional level es una tarea extremadamente urgente, cuya solución proporcionará un proceso de monitoreo y pronóstico de las perspectivas para el desarrollo de sistemas socioeconómicos a mediano y largo plazo. Al mismo tiempo, a pesar de una amplia gama de trabajos científicos dedicados al problema, todavía no hay unidad en el espacio científico en la esfera de la evaluación formal de la efectividad del desarrollo de los sistemas regionales de educación superior. En este sentido, este estudio propone enfoques dirigidos al apoyo metodológico para resolver el problema. La característica principal del trabajo es el uso de métodos de comparación de valores de flujo de entrada y salida, que caracterizan los parámetros de la escuela superior regional. Utilizando los enfoques de racionamiento de los indicadores analizados y el desarrollo posterior sobre la base de los índices de eficiencia, se llevan a cabo cálculos multicomponentes, evaluando los indicadores, caracterizando el rendimiento del capital invertido de los sistemas regionales de educación superior en forma de una evaluación integrada de su efectividad por 1 rublo de costos financieros. Como resultado de las evaluaciones implementadas, se identifican las regiones del distrito Volga Federal, caracterizadas por posiciones moderadas y fuertes en el campo de la generación de efectos, caracterizando su efectividad en comparación con los recursos financieros invertidos.

Palabras clave: Escuela superior regional; Eficiencia; Indicadores de flujo de entrada/salida; Regulación estatal; Retorno de los recursos invertidos.

Resumo: No contexto da globalização, aumenta o crescimento do ambiente competitivo nos níveis nacional inter-regional no campo do desenvolvimento da inovação, o papel do ensino superior como principal fonte de recursos humanos e a formação do ambiente de inovação. O baixo nível de desenvolvimento do ensino superior priva a região de uma certa independência, colocando-a em dependência adicional de outros sistemas - regional, nacional, econômico etc. A esse respeito, o estudo de tendências no desenvolvimento do ensino superior no nível inter-regional O nível é uma tarefa extremamente urgente, cuja solução proporcionará um processo de monitoramento e previsão das perspectivas para o desenvolvimento de sistemas socioeconômicos a médio e longo prazo. Ao mesmo tempo, apesar de uma ampla gama de trabalhos científicos dedicados ao problema, ainda não há unidade no espaço científico na esfera da avaliação formal da efetividade do desenvolvimento dos sistemas regionais de ensino superior. Nesse sentido, este estudo propõe abordagens voltadas ao suporte metodológico da solução do problema. A principal característica do trabalho é o uso de métodos de comparação dos valores dos fluxos de entrada e saída, caracterizando os parâmetros do ensino superior regional. Utilizando as abordagens de racionamento dos indicadores analisados e o subsequente desenvolvimento com base nos índices de eficiência, são realizados cálculos multicomponentes, avaliando os indicadores, caracterizando o retorno sobre o capital investido dos sistemas regionais de ensino superior na forma de uma avaliação integrada de sua eficácia por 1 rublo de custos financeiros. Como resultado das avaliações implementadas, são identificadas as regiões do distrito Federal do Volga, caracterizadas por posições moderadas e fortes no campo de geração de efeitos, caracterizando sua efetividade em comparação aos recursos financeiros investidos.

Palavras-chave: Ensino superior regional; Eficiência; Indicadores de fluxo de entrada/saída; Regulamentação estadual; Retorno sobre os recursos investidos.

Introduction

The development of higher education is a process closely related to the process of development of society, reflecting the spirituality of the latter and its capabilities in the system of global competition (not only economic, but also political, social, cultural, etc.). It is the higher school that supplies the society with knowledge and forms the basis for its spiritual development, which directly determines the goals to which the society aspires and the values for which it exists. That is why the development of higher education, the formation of effective mechanisms for the use of its potential - is largely a function of the state as a guarantor of strategic priorities of the national system.

Weak development of higher education or its complete absence, in fact, deprive the region of a certain independence, putting it in additional dependence on other systems - regional, national, economic, etc (Salmi, 2009; Gube, 2009). At the same time, it is also necessary to involve Federal state bodies, whose coordinating role should be to form a balanced development of all regional systems of the country.

At the same time, the state bodies should pay special attention to the quality of functioning of higher education institutions, both in terms of the correspondence of knowledge, received by students to the real needs of the national (regional) economic system, and in terms of the effectiveness of their main operational and research activities (Classification of learning activities (CLA), 2016; Millot, 2015). The latter, in turn, can be expressed in the ability of the University to achieve significant results in various functional areas, including in terms of their balanced and adequate compliance with the generating costs in the form of funding from public and non-budgetary sources.

In this regard, public authorities in the course of implementing the policy of development of higher education should form certain "orders" for higher education, which should take into account the performance of higher education institutions in various directions and areas (Safiullin et al., 2013). These include:

- Number of citations in Scopus per 100 NPR;
- Total amount of scientific-research and experimental-construction works (NIOKR));
- The volume of NIOKR per one NPR, thousand rubles;
- The proportion of young scientists (without a degree – up to 30 years, candidates of Sciences – up to 35 years, doctors of Sciences – up to 40 years) in the total number of NPR;

- University income from income-generating activities per NPR;
- The ratio of the average earnings of NPRs in the University (from all sources) to the average wage in the economy of the region;
- The total area of training and laboratory facilities per student (given contingent);
- Share of graduates of 2012 full-time education who applied for assistance in finding a suitable job and recognized as unemployed; etc.

Methods

The above system of indicators is formed on the basis of the current world practice used in assessing the effectiveness of the functioning of higher education institutions, which is reflected in the various ratings. The most popular of them are QS, THE, ARWU, Webometrics, etc. (Global Entrepreneurial University Metrics; Abilgazyeva et al., 2018). Each of them is focused on the assessment of key components of the effectiveness of Universities, such as: resources, outputs, environment and (The Global Entrepreneurial University Metrics initiative. ; Kord et al., 2017).

At the same time, it is undoubtedly necessary to understand clearly that the achievement of high values of the considered system of performance indicators is largely based on the financial base. In this connection, the main effective mechanism for regulating the activities of higher education for the state should be considered the use of financial instruments. However, targeted public funding (in the form of grants and special programs) is carried out only for the most promising areas, while the remaining areas remain within the budget funding, which is characterized as insufficient (Agranovich et al., 2009; Kuzminov & Frumin, 2018). However, in addition to funding for higher education by public authorities, there is another source of funding-various funds. It is necessary to distinguish between domestic and international funds (Nelleman et al., 2015; Freitas & Mira da Silva, 2018; Rincon-Flores et al., 2018). Domestic funds can be both Federal and regional, their activities are associated with the accumulation of financial resources of certain organizations (for example, enterprises of a certain industry) for the purpose of their further use for research in a particular direction.

In order to solve the question in this study, an attempt is made in a formalized form to assess the qualitative parameters of the ratio of input and output flows of higher education in the context of individual regions. This will not only determine the effectiveness of regional systems of higher education, but also to identify a set of mechanisms of point and adaptive

regulation, depending on emerging trends that demonstrate individual indicators of functional efficiency.

As a basis for such an analysis, the above-mentioned indicators were used, as well as indicators characterizing the "financial leverage" that ensures the development of the higher school system in the regions of the Federation (for example, the regions of the Volga Federal district). Table 1 shows the main values of the considered and analyzed indicators in the context of the regions of the Volga Federal district.

Table 1 - The main values of the considered and analyzed indicators that assess the quality and efficiency of regional higher education systems (input parameters of the black box) (developed by the authors on the basis of aggregation of data published by Universities) (compiled by the authors on the basis of statistical data)

	Indicators	Republic of Bashkortostan	Kirov region	Republic of Mari El	Republic of Mordovia	Nizhny Novgorod region	Orenburg region	Penza region	Perm region	Samarra region	Saratov region	Republic of Tatarstan	Udmurt Republic	Ulyanovsk region	CChuvash Republic
OUTPUT STREAMING VALUES															
Scientific efficiency	Average score of the exam of students enrolled in undergraduate and specialist programs in all forms of education	61,01	63,37	58,68	59,44	64,35	64,69	59,44	62,45	57,52	63,99	59,56	52,63	61,89	665,49

Number of citations per 100 NPR in Scopus	67,63	30,14	53,80	59,49	125,17	48,81	61,42	86,80	46,80	133,56	124,69	92,43	76,88	225,28
The total area of training and laboratory facilities per student (given contingent)	27,75	24,83	13,18	17,82	13,43	19,17	29,82	17,75	25,79	29,15	49,70	66,98	15,74	24,01
The percentage of students not provided with their own Dorm of the University, the num	48,46	36,62	0,65	17,69	15,23	21,10	17,27	11,27	18,50	14,58	15,30	6,58	35,72	22,06

ber of stud ents in need of Dor m															
The ratio of the aver age earn ings of NPIs in high er educ ation (fro m all sour ces) to the aver age wag e in the econ omy of the regio n	190, 33	18 0,0 1	20 4,7 2	17 9,5 1	18 7,5 5	18 2,7 9	14 2,3 6	18 0,4 8	18 0,0 4	19 0,6 7	22 2,8 7	16 4,2 5	19 3,2 8	118 7,0 5	
The total amo unt of rese arch and deve lopm	1012 59,7 0	30 99 1,1 8	33 67 2,7 5	94 45 1,3 3	18 73 44, 73	45 85 4,0 8	31 48 8,9 5	15 57 75, 05	97 11 3,2 1	10 20 02, 99	16 99 89, 56	26 41 6,2 6	73 96 6,5 0	295 85, 15	

	ent work (hereinafter – NIOKR)														
	NIOKR volume per one NPR, thousand rubles	117,55	41,25	99,12	101,37	158,13	62,67	69,81	186,06	103,66	100,14	169,94	239,61	128,72	1106,85
INPUT STREAM VALUES															
The income of Universities	University Income from the funds from income-generating activities per NPR	1348,76	828,31	1110,21	960,03	458,18	458,18	593,63	1066,26	1316,82	1328,64	1503,83	1264,44	780,78	6632,66
	The income of the University from the Federal	553389,44	4765,19,25	4693,81,32	7233,44,79	5831,36,35	5093,51,41	7474,74,31	4682,81,54	3983,30,31	8251,79,03	5366,36,60	3292,39,58	7124,84,56	332253,39

due to the need for subsequent comparison between them, including in the framework of determining the integral indicator of the effectiveness of regional higher education on the basis of comparing the indicators of I-out to I-in. In fact, the definition of the value of this indicator will allow, if we use the terminology of economic analysis here, to obtain the value of profitability/relative efficiency. However, if in the economic sense profitability is understood as return on invested capital in the form of profit, in our case, the profitability of higher education should be understood as return on invested capital in the form of an integrated assessment of its effectiveness per 1 ruble of financial costs. In this case, as an integral assessment here is the sum of the values of the subindexes characterizing the efficiency of the higher school in the context of individual components. Their reflection is precisely the set of indicators discussed above.

The peculiarity of this study is also that the aggregated values of indicators for each subject of the Federation are determined on the basis of the sum of their values for each University in the region. This step is due to the fact that in some cases the statistical system does not have the necessary data in the regional context.

In a concentrated form, the algorithm for determining the indicator of the effectiveness of regional higher education (I_{ef}) is presented below and includes the implementation of 4 stages.

Phase 1. Data selection. It is carried out on the basis of monitoring the effectiveness of educational institutions of higher education.

[<http://indicators.miccedu.ru/monitoring/>]

Phase 2. Time series analysis.

Phase 3. Standardization of indicators.

For comparability of data, standardization of baseline indicators (normalization) was carried out.

For indicators-stimulants, i.e. indicators, the growth of the values of which leads to the improvement of the state of the region in the indicated direction, the following formula is applied:

$x_i = (x_i - x_{min}) / (x_{max} - x_{min})$, where

x_i - the current value of the time series,

x_{max} - the maximum value of a number,

x_{min} - minimum value.

For indicators of destimulation, whose growth, on the contrary, leads to deterioration of the general condition were calculated according to the formula:

$x_i = (x_{\max} - x_i) / (x_{\max} - x_{\min})$, where

x_i - the current value of the time series,

x_{\max} - the maximum value of a number,

x_{\min} - minimum value.

Step 4. Calculation of profitability index

Profitability is calculated by the formula:

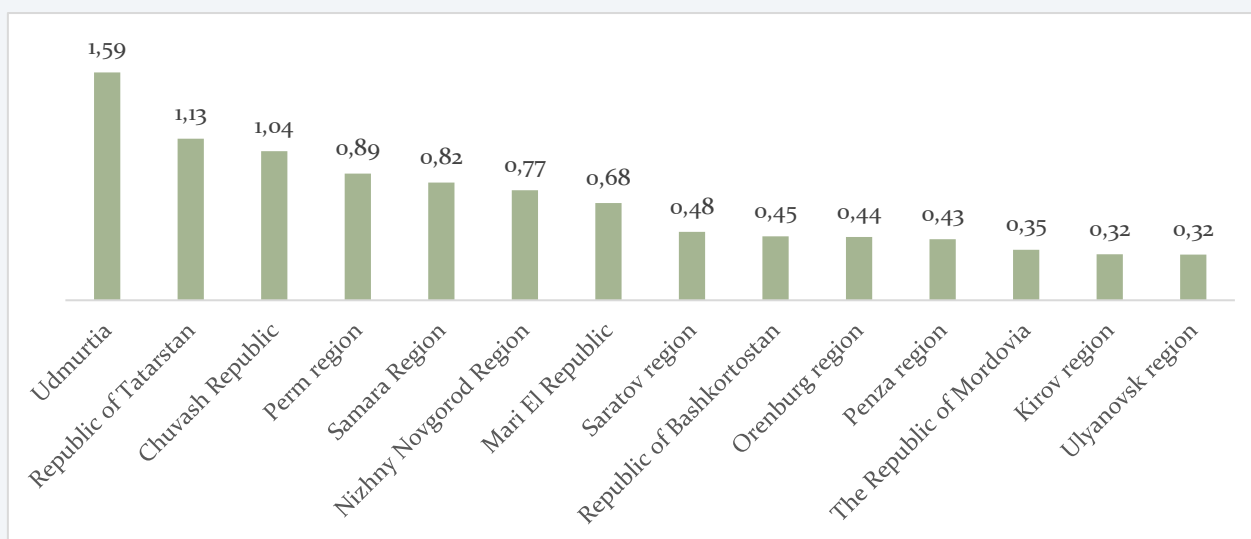
$R = I(\text{eff. edu}) / I(\text{finance})$, where

$I(\text{eff. edu})$ - the average of the standardized indicators, reflecting the efficiency of activity of higher educational institutions.

$I(\text{finance})$ - normalized value of the indicators, reflecting the income of higher education institutions in the region.

Results And Discussion

Guided by the above methodological approaches, on the example of the regions of the Volga Federal district, the calculated estimates are presented that determine the effectiveness of the development of higher education in the context of individual indicators for 2018. (Picture 1)



Pic. 1 - Efficiency of regional higher education systems, estimated on the basis of the ratio of output and input stream values

Summary

Implemented estimates largely indicate a fairly differentiated nature of the effectiveness of the development of higher education in the framework of the considered set of regions.

It is important to note that the interpretation of the results contributes to the understanding of the prospects of strategic regional development in the context of the prospects of global/interregional competition. Taking into account that higher education in general and its individual functional areas form the quality of human capital, the effectiveness of the development of the innovative environment, acting at the present stage of development, as a priority factor in the competitiveness of territories, the fundamental and structural analysis of its effectiveness can largely indicate the long-term prospects of socio-economic development of the region [9, 10]. The developed tools make it possible to identify very effectively weak and strong regional positions in the system of higher education development and on this basis to develop appropriate corrective measures at the state level.

Conclusion

In conclusion, it should be noted that the activities of regional government agencies in the framework of research on the use of higher education as a regional resource should be in the formation of the "vector" of scientific activity of the region and ensure the most rapid development of regional higher education in a given direction.

Planning the development of the regional system implies the need for the formation of the trajectory of the transition of the regional system from the "current" state of the system to the "desired" with the existing restrictions on the regional resources used in the process of this "transition". It is obvious that certain trajectories of "system movement" of both extensive and intensive (innovative) nature will be formed as solutions to this problem. Of course, an intensive development path is preferable for any system, which, in turn, is not always possible for the system, since the resource of knowledge possessed by the region and the mechanisms for its use are not always sufficient to form such a path of development. The resolution of this problem implies the active participation of regional authorities in the development of the higher education system, as well as more intensive implementation of the results of scientific and educational activities of higher education in the social and economic life of the region.

The weak development of higher education or its complete absence, in fact, deprive the region of a certain independence, putting it in additional dependence on other systems - regional, national, economic, etc. At the same time, the necessary condition is also the involvement of Federal state bodies, the coordinating role of which should be to form a balanced development of all regional systems of the country.

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