Торайғыров университетінің ХАБАРШЫСЫ

Экономикалық сериясы
1997 жылдан бастап шығады

TORAIGHYROV UNIVERSITY

ВЕСТНИК
Торайгыров университета

Экономическая серия
Издается с 1997 года

***D. Kelesbayev[1], B. Rasulova[2], A. Mukhamedkhanova[3],
V. Seitova[4], A. Abishova[5]***

[1,2]Akhmet Yassawi University, Republic of Kazakhstan, Turkestan;
[3,4,5]M.Auezov South Kazakhstan University,
Republic of Kazakhstan, Shymkent.
[1]ORCID: https://orcid.org/0000-0002-4193-8121
[2]ORCID: https://orcid.org/0009-0006-1723-3494
[3]ORCID: https://orcid.org/0000-0003-2685-6125
[4]ORCID: https://orcid.org/0000-0002-4404-4916
[5]ORCID: https://orcid.org/0000-0002-2514-6351
*e-mail: dinmukhamed.kelesbayev@ayu.edu.kz

MEASURING AND ANALYZING THE EFFICIENCY OF UNIVERSITY WORK USING THE DEA METHOD

Most of the universities in our country work in the fields of education, scientific research and social service, and allocate their resources to these three fields. This situation, in turn, creates difficulties in the allocation of university resources, their efficient and productive use. Determining the areas in which universities are active and focusing on their active and effective areas will not only strengthen them in the global competition, but also cause effective and productive use of their resources. However, a university focused on the wrong or ineffective field can do great damage to both the institution's image and its resources. For this reason, it is very important to analyze the effectiveness of universities. Purpose of this research work, prepared in this direction, is to measure and analyze the efficiency of higher educational institutions, that is, universities, using the DEA method. Also, it was aimed to determine whether universities should be restructured for various reasons and to determine which areas universities should address during this restructuring. In the course of the study, by analyzing the relative efficiency of the university, it was determined how much it should increase or decrease its income and how much it should increase or decrease its expenses in order for the university to be effective. Based on the results of the research, it was discussed how to achieve partial

differentiation of universities by looking at the indicators of education, scientific research and social service. Also, analyzes and measurements of the relative efficiency of these universities were conducted, and assessments were made regarding which of their input and output values are not efficient and ways to make them efficient. In order to maintain effective and current efficiency levels, idle capacities were identified and estimates were made for these idle capacities and increasing-decreasing-constant revenue scenarios were also considered.

Keywords: higher education, universities, data envelopment analysis, efficiency, measure efficiency.

Introduction

Due to the rapid growth of globalization in the 21st century, the importance of knowledge and information is also increasing moment by moment, and this has a strong impact on competition [1]. In modern times, it is impossible for an organization without knowledge and information to exist, but only having knowledge and information is not enough [2]. Knowledge and information must be continuously updated, updated knowledge and information must be quickly implemented, and the resulting knowledge and information must be integrated back into the system [3].

In this regard, from the past to the present, universities are considered as the most important organizations that produce knowledge and information [4]. And the three main activities of universities: education, scientific research and social (public) services constantly influence and change the society [5]: With educational services, the educational and cultural level of the society increases. At the same time, the knowledge and human resources necessary for both the private sector and the public sector are provided. In the framework of scientific research activities, innovations necessary for society and sectors are discovered and implemented. In this way, life and work will be easier. As for social services, various (social, public, sports, cultural, etc.) services are provided through university departments (clinic, printing house, sports fields and halls, entertainment centers, etc.).

Today, in addition to the increasing importance of universities as a source of knowledge and information, disappearing borders and fierce competition due to globalization have a great impact on universities [6]. Nowadays, universities face the problem of effective and productive use of their resources, in addition to producing useful and accurate knowledge and information [7]. Because global competition forces all universities in the world to fight for the best academic staff and students. One of the most important aspects of this struggle is to know exactly what you are fighting for and what you are fighting for [8]. The desire

to fight in all areas leads to the dispersion of resources and difficult situations. On the other hand, if all resources are directed to one area, resources can be used more efficiently and productively, and favorable conditions are created for the implementation of the strategies of the defined area [9]. Thus, your probability of winning this fight (competition) also increases.

In this regard, most of the universities in our country, especially state universities, compete in these three areas mentioned above: education, scientific research and social service, and allocate their resources to these three areas [10]. This situation creates difficulties both in providing the state's resources and in the effective and productive use of the universities' own resources. Identifying the areas in which universities are effective and productive, and focusing on these areas of effective and productive work, will strengthen them in global competition and facilitate the allocation of resources to the state. In this case, both universities and the state would use their resources efficiently and productively [11]. Therefore, it is now necessary to direct the universities to the specialized fields that will strengthen them in global competition and to focus on improving the quality of education. However, in the current situation, creating a new policy or designing a new system without determining in which fields the universities are effective poses great risks for both the universities and the state. A university located in or focused on the wrong industry can do great damage to both its organizational image and its resources. For this reason, it is very important and useful to analyze the effectiveness of universities before structuring them and their activities.

This research paper, prepared in this direction, aims to determine the need to restructure the universities due to the problems arising from various reasons and to give a recommendation on which areas the universities should focus on during this restructuring.

In this regard, before starting the restructuring process of universities, it is necessary to determine how efficient they are in the fields of education and scientific research, which are the main functions of universities [12]. In this way, it is possible to determine which areas universities are good at and which areas they should focus on in the future, and these results will provide significant benefits during the restructuring period.

Materials and methods

The main purpose of this research work is to measure and analyze the efficiency of higher educational institutions, that is, universities, using the DEA (Data Envelopment Analysis) method. With this approach, revenue-oriented analysis models were developed for decision-making units and efficiency analysis was also based on revenue. As a result, it identified the cases of missing and idle capacity in the context of input values, and also determined which of the positive

effects on efficiency in terms of the effect of one unit increase in input values on output values: decreasing returns to scale, constant returns to scale, and increasing returns to scale. Here, i.e. in this research work, the following were used as inputs: number of administrative staff, number of administrative staff, number of students, number of faculties, educational expenses. As output, the number of graduate students, the number of articles in journals indexed in international databases, the number of scientific projects and their funding were used. The data used is considered reliable as it is obtained from the official website of the universities and the reports of the university authorities.

From this point of view, it can be said that two main hypotheses have been tested.

H1: Inefficient universities have cases of missing or idle capacity in their input values.

H2: A 1-unit change in the input values of all universities affects their output values: in a ratio less than 1, i.e., decreasing profitability, or in a ratio equal to 1, i.e., constant profitability, or in a ratio greater than 1, i.e., increasing profitability.

In addition, it was determined that universities should be restructured according to the problems that arise due to various reasons, and what areas universities should turn to during this restructuring. In the course of the study, by analyzing the relative efficiency of the university, it was determined how much it should increase or decrease its income and how much it should increase or decrease its expenses in order for the university to be effective. During the restructuring of the higher education system, which was proposed as a solution, the data of 2023 universities were used. The comparative performance of these universities in relation to each other was analyzed under three main headings: general, education and scientific research. Using the DEA method, the computer program Win4DEAP, which can analyze many incomes and expenses, was used in the analysis of the activities of universities. Also, in the course of this work, various methods of socio-economic research were used: control, systematization method, comparative, expert assessment, analytical reporting, etc.

Results and discussion

Due to the need to select «homogeneous» units as Decision-Making Units (DMUs), which is one of the important conditions for data conversion analysis, two universities in the city of Turkestan were analyzed, and universities in other cities were not included in the analysis (see Table 1).

Table 1 – Universities and abbreviations used in analyses

№	Толық атауы	Қысқаша
1	Akhmet Yassawi University	AYU
2	International University of Tourism and Hospitality	IUTH

Note – Compiled by the authors

Income-oriented analyzes were used in the general and education and research topics analyses. The objective function of an income-oriented model is important to the public because it minimizes existing incomes and represents savings. Because this model aims to generate current output with minimum input. Also, the CCR and BCC models were used in the analyzes in an income-oriented manner. Total (global) technical efficiency of universities was measured by the CCR model, while net (local) technical efficiency was measured by the BCC model. In addition, the efficiency scores of the CCR and BCC models were also used to calculate the measurement efficiency.

In an overall analysis of 5 inputs and 4 outputs used in education and research subjects, input-oriented CCR, BCC, and measurement efficiency were calculated with Win4DEAP (see Table 2).

Table 2 – General analysis results

№	Университет	**CCR**	**BCC**	Size efficiency	Size feature
1	AYU	0,994	0,997	0,997	Decreasing
2	IUTH	0,730	0,788	0,923	Increasing
Average		0,862	0,893	0,960	

Note – Compiled by the authors

As can be seen in Table 2, in the overall analysis, no university was found to be fully efficient in the CCR and BCC analyses. As a result of the overall analysis, one university found CCR to be more effective, while the other university found BCC to be more effective, offering optimistic results. Among the universities that were not found to be fully efficient in the overall analysis, one university (IUTH) showed an increase in profitability with size. This situation is caused by the university producing below its capacity, and it can produce more than one unit with one unit of revenue. The fact that it shows profitability that increases with size shows that this university can improve its efficiency and is therefore open to investment and development. There is also a university (AYU) that is size inefficient and exhibits decreasing returns with size. This is because universities exhibit diminishing returns to scale because they produce less output as their

revenue increases. For this reason, the said university should use its resources more efficiently by reducing its capacity in order to be efficient at scale. Therefore, this university needs management efficiency to be effective. Also, this university, which exhibits diminishing returns to size, can achieve full efficiency if it shrinks in size while maintaining its pure technical efficiency.

In the education analysis, input-oriented CCR, BCC, and measurement efficiency were calculated using the Win4DEAP program using 5 inputs and 4 outputs (see Table 3).

Table 3 – Results of educational analyses

№	Университет	CCR	BCC	Size efficiency	Size feature
1	AYU	0,765	0,765	1,000	Stable
2	IUTH	0,991	1,000	0,991	Increasing
Average		0,878	0,883	0,996	

Note – Compiled by the authors

According to the results in Table 3, of the two universities used in the education analysis, one is efficient in terms of BCC, while the other is efficient in terms of size. As shown in this table, although AYU is inefficient in both CCR and BCC analyses, it is equally significant and inefficient in both analyses, thus it shows constant returns to scale. This is because, although the university is operating at the appropriate scale and size, it is experiencing major inefficiencies caused by internal factors. In order for this university to achieve full results, first of all it must solve its internal problems in the field of education. Well, this table is scalable and has an effective IUTH based on BCC analysis. Although this university does not have management problems, it is experiencing size inefficiency because it operates at the wrong size. In this case, the university can maintain management efficiency and become more profitable through further investment and expansion and size.

In the research analysis, input-oriented CCR, BCC, and measurement efficiency were also calculated using 5 inputs and 4 outputs using Win4DEAP (see Table 4).

Table 4 – Results of scientific research analyses

№	Университет	CCR	BCC	Size efficiency	Size feature
1	AYU	0,761	1,000	0,761	Decreasing
2	IUTH	0,709	0,804	0,881	Increasing
Average		0,735	0,902	0,821	

Note – Compiled by the authors

As a result of research analysis, one university (IUTH) that was not fully effective and one BCC effective university (AYU) was identified. Here, a university that was not found to be fully efficient (IUTH) showed a case of profitability that increased with size. Although this university can produce more than one unit of output per unit of revenue, it produces below its potential and cannot use research resources efficiently. This university should expand its scope by investing in research and identify and exploit the free returns in research resources. AYU, on the other hand, as a university with diminishing returns according to size, appeared to be effective in the BCC analysis because it did not experience administrative problems. It can be seen that the reason why AYU is not fully effective is mostly due to measurement inefficiency. This situation suggests that the university operates on an unnecessarily large scale and can operate more efficiently on a smaller scale if it maintains administrative efficiency.

Financing information

This article was published within the framework of the results of the Ministry of Science and Higher Education of the Republic of Kazakhstan «The best university teacher-2023»

Conclusions

As a generalization, it shows that the universities involved in the analysis are not making efficient use of the educational income and suggests that the universities should seriously review their educational performance. On the other hand, the situation is much worse in research, another branch of universities. The reason is that these research universities are not able to use their scientific resources effectively.

This research, which analyzed the effectiveness of two universities in Turkestan, is important in terms of evaluating universities separately for their educational and research functions, determining the need for resource use and investment, and identifying and showing which university is more effective in the field of education and which university is more effective in the field of scientific research. is found.

Thus, as a result of the generalized analysis, a positive and significant relationship between the efficiency of universities and their free capacities and a positive and significant relationship between the change in the income values of universities and their output values was determined. In other words, it can be said that hypotheses H1 and H2, which are the main hypotheses of the study, have been accepted.

Another finding of the study was that the average pure technical inefficiency (BCC) in the education and research sectors was higher than the usual average size inefficiency. The meaning of this conclusion is that the general technical

inefficiency of these universities is related to the pure technical inefficiency rather than the inefficiency of size and scope, which shows that the universities often have internal problems and are dealing with solving them, not external problems.

On the other hand, the analyzes in the study included only two universities in the same city and included results that were comparable to each other. The study does not provide any conclusions about how effectively any analyzed university uses its resources. Therefore, the obtained results are not absolute, but relative.

REFERENCES

1 **Carnoy, M.** Educational Policies in the Face of Globalization: Whither the Nation State // John Wiley & Sons. The Handbook of Global Education Policy. – 2016. – P. 27-42.

2 **Durrani, N. & Thibault, H.** The Political Economy of Education in Central Asia: Evidence from the Field // Singapore: Palgrave McMillan (Springer Nature). – 2023. – P. 251.

3 **Hickey, S. & Naomi, H.** The Politics of Education in Developing Countries: From Schooling to Learning // Oxford: Oxford Academic. – 2019. – P. 231.

4 **Kelesbayev, D., Kalykulov, K., Yertayev, Y., Turlybekova, A., Kamalov, A. A** Case Study for Using the Quality Function Deployment Method as a Quality Improvement Tool in the Universities // International Review of Management and Marketing. – 2016. – Vol. 6. № 3. – P. 569–576.

5 **Kretz, A., & Sá, C.** Third Stream, Fourth Mission: Perspectives on University Engagement with Economic Relevance // Higher Education Policy. – 2013. – Vol. 26. – № 4. – P. 497–506.

6 **Zhanga, G., Wua, J., Zhu, Q.** Performance Evaluation and Enrollment Quota Allocation for Higher Education Institutions in China // Evaluation and Program Planning. – 2020. – Vol. 81. – P. 101821.

7 **Acosta-Silva, A.** University today: Images, Practices and Representations // Revista Iberoamericana de Educacion Superior. – 2016. – Vol. 7. – № 18. – P. 99–108.

8 **Higgins, K., Kelly, G., Munck, R., Kelly, U., Grounds, A.** Exploring an Innovative Method for Objectively Assessing the Social Value of University-Community Engagement and Research // Methodological Innovations. – 2024. – Vol. 17. – № 1. – P. 19–30.

9 **Kelesbayev, D., Alibekova, Z., Izatullayeva, B., Dandayeva, B., Mombekova, G., Taizhanov, L.** Establishing a Quality Planning Scheme with Kano Model and a Case Study // Quality - Access to Success. – 2020. – Vol. 21. – № 176. – P. 56–64.

10 **Bekebayeva, M., Koptayeva, G., Zhadigerova, G., Nursoy, M., Tursyn, A.** Evaluating the University's Reputation as Part of the Interaction Between the University and the City // Scientific Herald of Uzhhorod University, Series Physics. – 2024. – Vol. 55. – P. 1813–1822.

11 **Kotosz, B.** Local Economic Impact of Universities // Analecta Technica Szegedinensia. – 2013. – Vol. 1. – № 2. – P. 22-26.

12 **Bosca, J. E., Liern,V., Sala, R., Martinez, A.** Ranking Decision Making Units By Means Of Soft Computing DEA Models // International Journal of Uncertainty, Fuzziness & Knowledge-Based Systems. – 2011. – Vol. 19. – № 1. – P. 115–134.

*Д. Келесбаев[1], Б. Расулова[2], А. Мухамедханова[3], В. Сейтова[4], А. Абишова[5]
[1,2]Ахмет Ясауи университеті, Қазақстан Республикасы, Түркістан қ.;
[3,4,5]М.Әуезов атындағы Оңтүстік Қазақстан университеті,
Қазақстан Республикасы, Шымкент қ.

УНИВЕРСИТЕТ ЖҰМЫСЫНЫҢ ТИІМДІЛІГІН DEA ӘДІСІМЕН ӨЛШЕУ ЖӘНЕ ТАЛДАУ

Еліміздегі университеттердің көпшілігі білім беру, ғылыми зерттеу және әлеуметтік қызмет салаларында жұмыс жүргізіп, ресурстарын осы үш салаға бөлуде. Бұл жағдай өз кезегінде университеттердің ресурстарын бөлуде, оларды тиімді және өнімді пайдалануында қиындықтар туғызады. Университеттердің қай салада белсенділік танытып (тиімді қызмет атқарып) жатқанын анықтап, олардың белсенді әрі тиімді жұмыс істейтін салаларына назар аударулары оларды жаһандық бәсекеде күшейтіп қана қоймай, өз ресурстарын тиімді әрі өнімді пайдалануына себеп болады. Дегенмен, дұрыс емес немесе тиімді емес салаға бағдарланған университет оқу орнының имиджіне де, оның ресурстарына да үлкен зиян келтіруі мүмкін. Осы себепті университеттердің тиімділігіне талдау жасау өте маңызды. Осы бағытта дайындалған бұл

зерттеу жұмысының негізгі мақсаты жоғары оқу орындарының, яғни университеттердің тиімділігін DEA әдісі арқылы өлшеу және талдау болып табылады. Сонымен қатар, әр түрлі себептерге байланысты университеттердің қайта құрылымдау керектігін анықтауға және осы қайта құрылымдау кезінде университеттердің қай салаға жүгінуі керектігін анықтауға бағытталды. Зерттеу барысында апробация жүргізілген университеттің салыстырмалы тиімділігін талдау арқылы университеттің тиімді болуы үшін кірістерін қаншалықты өсіру немесе төмендету және шығыстарын қаншалықты өсіру немесе төмендету керектігі де анықталды. Зерттеу нәтижесі бойынша университеттерді білім беру, ғылыми-зерттеу және әлеуметтік қызмет көрсеткіштеріне қарап, ішінара дифференциацияға қалай қол жеткізуге болатыны талқыланды. Сондай-ақ, бұл университеттердің салыстырмалы тиімділігіне талдаулар мен өлшеулер жүргізіліп, олардың қандай кіріс және шығыс мәндері тиімді емес екендігіне және оларды тиімді ету жолдарына қатысты бағалаулар жүргізілді. Тиімді және ағымдағы тиімділік деңгейін ұстап тұру үшін бос тұрған қуаттылықтар анықталды және бұл жұмыс істемей бос тұрған қуаттылықтарға қатысты бағалаулар жүргізілді әрі өсетін-кемитін-тұрақты кіріс жағдайлары да қарастырылды.

Кілтті сөздер: жоғары білім беру, университеттер, деректерді конверттеп талдау, тиімділік, тиімділікті өлшеу.

*Д. Келесбаев[1], Б. Расулова[2], А. Мухамедханова[3], В. Сейтова[4], А. Абишова[5]
[1,2]Университет Ахмеда Ясави, Республика Казахстан, г. Туркестан;
[3,4,5]Южно-Казахстанский университет имени М.Ауэзова,
Республика Казахстан, г. Шымкент

ИЗМЕРЕНИЕ И АНАЛИЗ ЭФФЕКТИВНОСТИ РАБОТЫ УНИВЕРСИТЕТА МЕТОДОМ DEA

Большинство университетов нашей страны работают в сфере образования, научных исследований и социального обслуживания и направляют свои ресурсы на эти три области. Такая ситуация,

в свою очередь, создает трудности в распределении ресурсов университета, их эффективном и продуктивном использовании. Определение областей, в которых университеты активны (осуществляют эффективную деятельность), и ориентация на их активные и результативные направления не только усилят их в глобальной конкуренции, но и вызовут эффективное и продуктивное использование их ресурсов. Однако университет, ориентированный на неправильную или неэффективную сферу деятельности, может нанести большой ущерб как имиджу вуза, так и его ресурсам. По этой причине очень важно анализировать эффективность университетов. Основной целью данной исследовательской работы, подготовленной в этом направлении, является измерение и анализ эффективности высших учебных заведений, то есть университетов, с использованием метода DEA. Кроме того, его целью было определить, следует ли проводить реструктуризацию университетов по тем или иным причинам, а также определить, какие области университеты должны решать в ходе этой реструктуризации. В ходе исследования путем анализа относительной эффективности вуза было определено, насколько ему следует увеличить или уменьшить свои доходы и насколько следует увеличить или уменьшить свои расходы, чтобы вуз был эффективным. По результатам исследования обсуждалось, как добиться частичной дифференциации вузов, глядя на показатели образования, научных исследований и социального обслуживания. Также были проведены анализы и измерения относительной эффективности этих университетов, а также сделаны оценки относительно того, какие из их входных и выходных значений не являются эффективными и способы сделать их эффективными. Для поддержания эффективного и текущего уровня эффективности были определены простаивающие мощности и проведена оценка этих простаивающих мощностей, а также рассмотрены сценарии увеличения-уменьшения-постоянного дохода.

Ключевые слова: высшее образование, университеты, анализ охвата данных, эффективность, измерение эффективности.