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Efficiency of Polish Universities in the Area of Scientific Research

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Efficiency of Polish Universities in the Area of Scientific Research

Lenkijos universitetų efektyvumas mokslinių tyrimų kontekste

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Abstract

The goal of this paper is to estimate the technical efficiency of Polish universities in the area of scientific research. The research finding proved that the average technical efficiency of Polish universities is relatively high and Jagiellonian University in Kraków, Adam Mickiewicz University in Poznań, University of Wrocław and Cardinal Stefan Wyszyński University in Warsaw are the universities performing with the highest effectiveness.

Several parts are indicated in the structure of the paper. In the first part, the current state of scientific research in Poland is explored. In the next part, an evaluation of the quality of scientific or research and development activities conducted by the Committee for Evaluation of Scientific Units is presented. Afterwards, Data Envelopment Analysis (DEA) methodology was explained and applied to the evaluation of technical efficiency of basic organizational units of Polish universities in the area of scientific research. The paper ends with conclusions.

KEYWORDS: university, efficiency, scientific research, DEA.

Introduction

Governments in European countries are under pressure to improve public sector performance and at the same time contain expenditure growth. It is giving a rise to the need to operate public institutions as universities with higher efficiency. Also in Poland, the concerns about whether universities operate at the best possible level of cost efficiency appear and they cause the need to undertake an empirical analysis of the universities' performance.

The aim of this paper is to estimate the technical efficiency of Polish universities in the area of scientific research. The research problems are outlined in the questions how is the average technical efficiency of Polish universities and do Polish universities differ in this respect?

The hypothesis posed by the authors is: the average technical efficiency of Polish universities is relatively high and some universities perform with the higher effectiveness than others.

The authors conducted the quantitative research in order to estimate the technical efficiency of Polish universities in the area of scientific research. The main research method used by the authors was Data Envelopment Analysis (DEA), but statistical methods were also applied.

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Expenditures on research and development in Poland

In 2010, a package of six legal acts entitled 'Building on Knowledge – a Reform of Science for the Development of Poland' was created and introduced. This reform allowed the Ministry of Science and Higher Education to assume the role of the leading research policy-making body and coordinator of the activities in the area of science in Poland. The two executive agencies, National Centre of Science and the National Centre for Research and Development, assumed the tasks of programme drafting and financing projects related to basic and application research.

Pursuant to the Act on the Principles of Financing Science, the Council of Ministers adopted the National Research Programme, which formulates the strategic directions for research and development (R&D), sets the goals and guidelines for science, technology and innovation policy of the state.

The basic objective of the government for Polish science development, presented in the National Research Programme, is to use research to improve Poland's level of civilization. Achievement of that goal means reduction of the civilization gap between Poland and economically developed countries and improvement of the living conditions of Polish society.

Also the priority research areas, which are crucial for Poland's social and economic development, were indicated in the National Research Programme. The document comprises seven strategic, interdisciplinary R&D directions (National Research Programme, 2011):

- new energy-related technologies;
- diseases of affluence, new medicines and regenerative medicine;
- advanced information, telecommunications and mechatronic technologies;
- new materials technologies;
- natural environment, agriculture and forestry;
- Poland's social and economic development in the context of globalising markets;
- state security and defense.

The successful realization of the above goal will depend on an increasing amount of R&D funds as well as on establishing new rules for using these funds. These new rules mean that decisions on amounts to be transferred to scientific units are no longer taken by politicians, but by scientific authorities associated with the National Science Centre and the National Centre for Research and Development. The funds are divided between individual scientific units on the basis of competitions, which is the most objective method, eliminating nepotism and other unproductive attitudes.

In the opinion of the authors of the National Research Programme, an increasing amount of R&D funds and establishing new rules for using these funds will improve the quality and efficiency of Polish science in terms of supplying research results and products characterized by a high cognitive value and high social, economic and technological usefulness. Furthermore, these activities will result cumulatively in improved science efficiency in Poland, increased innovativeness of the economy and enhanced international importance and competitiveness of Polish science.

The National Research Programme not only defines the R&D directions, but also allows the R&D stream of funding to be channeled into priority research areas. Limited state budget funds should be used in an effective way and channeled towards those research units which are involved in priority and top-quality research.

In 2012, government-financed gross domestic expenditures on R&D in Poland (government-financed GERD) amounted to 3 431 679 617 EUR[1] and increased by 22,8 % and 93,8 %

1 Middle exchange rates of foreign currencies – table A, Table No. 178/A/NBP/2014 of 2014-09-15, http://www.nbp.pl/homen.aspx?f=/kursy/ratesa.html [7.10.2014].

in comparison with 2011 and 2008, respectively[2]. The highest expenditures fell on engineering and technology – 47,9% of the total gross domestic expenditures on R&D, natural sciences – 23,6%, medical sciences – 13,2%. The remaining sciences (agricultural, social and humanities) received about 15,3% of the total gross domestic expenditures on R&D (Science and technology in 2012, 2013).

According to the Act of 30 April 2010 on the Principles of Financing Science the financing of science covers the costs of activities that contribute to the pursuit of state scientific, scientific and technological and innovation policies as well as the performance of other tasks of particular importance for the civilization progress, economic and cultural development of the state (Act of Principles of Financing Science, 2010).

All government support for research is channeled entirely through the Ministry of Science and Higher Education. There are six ways of financing research activities (Ministry of Science and Higher Education, 2013):

- Core funding for statutory R&D activities, i.e. institutional finance provided selectively to designated research establishments, units and university departments to cover the costs of their own research activities.
- Investments in R&D infrastructure, such as buildings and equipment.
- Peer-reviewed research grants based on research proposals, presented by small research teams or individual researchers, no matter where they are employed or what scientific degrees they hold.
- Subsidies for R&D programmes of national importance commissioned by enterprises, state administrative bodies or local authorities. The financial means are allocated to the implementation of projects and the utilization of research findings.
- Subsidies for international scientific and technological cooperation resulting from intergovernmental agreements.
- Subsidies for selected R&D support activities (e.g. information services).

R&D intensity, which is defined as expenditures on R&D as a percentage of GDP, amounted to 0,77% in 2011 (Science and technology in 2011, 2012) and 0,90% in 2012 (Science and technology in 2012, 2013). Poland held the 19th position among the European Union Member States with regard to R&D intensity, which was 2,7 times lower than a score for the whole EU. R&D intensity (GERD/GDP) in selected European countries is presented in Table 1.

In 2011, R&D intensity for the European Union reached 2,03%. R&D expenditure varied from 0,5 % to 3,8 % across the EU. Northern European countries such as Finland, Sweden and Denmark generally shared a pattern of high expenditure. Countries with lower R&D expenditure levels were mostly in Eastern and Southern Europe, for instance Bulgaria, Romania and Cyprus. The research and development activities, and formed as their result innovations are one of the main factors conditioning sustainable economic growth. Therefore, research and innovation are one of the key priorities of the 'Europe 2020' strategy for economic growth.

'Europe 2020' is the European Union's ten-year growth strategy, describing the shortcomings of the growth model and creating the conditions for a different type of growth that is smarter, more sustainable and more inclusive. In the strategy, five key targets have been set for the EU to achieve by the end of the decade: employment, education, research/innovation, social inclusion/poverty reduction and climate/energy (Europe 2020, 2010).

2 Nominal values, without exchange rates adjustments.

In the area of the key target 'research and innovation', The European Commission proposes in the 'Europe 2020' strategy that 3% of the EU's GDP should be invested in R&D. For Poland this goal was established on the level of 1,7%. Poland (with Bulgaria, Latvia, Lithuania, Luxembourg, Portugal, Romania and Slovakia) is in the group of Member States which need to substantially raise their rate of increase in R&D intensity to reach their target and whose required efforts exceed the EU average (Europe 2020 Targets: Research and Development, 2014).

Poland's R&D intensity experienced an average annual growth of +1,6% between 2000 and 2011. Although on the background of the EU, with +0,8%, it was a better result, the average annual increase required to hit the 2020 target is considerably higher at +8,7% (Research and Innovation performance in Poland, 2013).

The main weakness remains underinvestment by the private sector. Therefore, further efforts towards increasing funds allocated for research by the business sector should be undertaken. Currently in Poland, there is only around 30% of funding by the business units, with 70% of institutional funding. The 'Europe 2020' strategy provides that by the year 2020 the share of research funding allocated by businesses should reach 50%.

Table 1
R&D intensity in selected European countries

Country	R&D intensity in 2011 (% of GDP)	Average annual growth of R&D intensity (%) between 2000 and 2011
Finland	3.78	+1.1
Sweden	3.37	-1.0
Denmark	3.09	+4.6
Germany	2.84	+1.3
Austria	2.75	+3.3
Slovenia	2.47	+12.5
Estonia	2.38	+13.5
France	2.25	+1.0
Belgium	2.04	+0.4
Netherlands	2.04	-0.5
Czech Republic	1.84	+4.2
United Kingdom	1.77	-0.2
Ireland	1.72	+4.1
Portugal	1.50	-0.2
Luxembourg	1.43	-1.3
Spain	1.33	+3.6
Italy	1.25	+1.7
Hungary	1.21	+4.6
Lithuania	0.92	+4.1
Poland	**0.77**	**+1.6**
Croatia	0.75	-2.7
Malta	0.73	+4.7
Latvia	0.70	+4.2
Slovakia	0.68	+0.4
Greece	0.60	+0.6
Bulgaria	0.57	+1.1
Romania	0.48	+2.5
Cyprus	0.48	+6.2
EU	**2.03**	**+0.8**

Note: Own elaboration based on: Europe 2020 Targets: Research and Development, http://ec.europa.eu/europe2020/pdf/themes/15_research__development.pdf [7.10.2014].

Since 2008, the amount of science funds from the state budget in Poland has grown considerably. The radical growth was attributable to an efficient use of the Structural Funds. European Commission funds and government funds assigned to joint co-financing of the EU projects had the biggest impact on expenditures on R&D in the higher education sector.

Research and development in Poland – institutional structure

R&D entities in Poland are all economic entities engaged in creative work undertaken on a systematic basis to increase the pool of knowledge and the use of this knowledge to devise new applications. They comprise of (Science and technology in 2011, 2012):

- public and private higher education institutions conducting R&D;
- state organisational entities – research institutes[3], scientific units of the Polish Academy of Sciences[4] and entities functioning on the basis of other legal forms; including capital companies, foundations, societies and natural persons conducting economic activity; these entities are referred to as scientific units and R&D units;
- entities conducting scientific activity and experimental development apart from their main economic activity on a systematic or incidental basis.

Higher education institutions in Poland include public and private entities, which function on the basis of Higher Education Act of 27 July 2005. In the academic year 2012/2013, among 453 higher education institutions, there were 132 public institutions (Higher Education Institutions and their Finances in 2012, 2013). Privately owned institutions do not focus on research and development activities (their main focus is teaching activity). The mentioned above 132 public institutions, especially universities, play a significant role in R&D area.

Public as well as private higher education institutions comprise basic organizational units within the meaning of the Figureers of those higher education institutions. These basic organizational units might act at the same time as scientific units – units that continuously engage in research or development work. Polish higher education institutions' R&D activities are carried out through their basic organizational units. There are 756 basic organizational units of higher education institutions (78,5%) in the total amount of 963 R&D entities in Poland (Table 2).

Organizational units of higher education institutions which are at the same time scientific units, undergo the procedure of evaluation of the quality of scientific or research and development activities.

Evaluation of the scientific units

Evaluation of the quality of scientific or research and development activities is conducted by the Committee for Evaluation of Scientific Units. The Committee was appointed in 2010 as a consultative and advisory body to the Minister. The Committee is divided into four collegial bodies:

- Commission for Humanities and Social Sciences;
- Commission for Sciences and Engineering;
- Commission for Life Sciences;
- Commission for Art Sciences and Artistic Production.

3 Research institutes (ministerial) encompass state organisational entities, singled out on legal, organisational, economic and financial basis, established to conduct research and development activities, results of which should be applied in certain fields of national economy and social life. Research institutes have legal personality, a minister responsible for the field of activities in which an institute operates is a supervisory authority. The Council of Ministers can establish, by way of an act, research institutes which have interministerial or multi-field scope of activities. Research institutes function on the basis of Research Institutes Act of 30 April 2010. Source: Science and technology in 2011, Central Statistical Office, Warsaw 2012, p. 31.

4 Scientific institutes of the Polish Academy of Sciences (PAS) are basic scientific units of the Polish Academy of Sciences with legal personality. They operates on the basis of the Polish Academy of Sciences Act of 30 IV 2010. Tasks of scientific institutes include, in particular, carrying out research significant to the development of country and disseminating its results. Scientific institutes can conduct experimental development in a given research field and implement outcome into the economy as well as organise guest workrooms in order to facilitate performing R&D by employees of higher education institutions and other scientific units. They also can conduct doctoral and postgraduate studies and other educational activities. Conformity of PAS activities with legislative provisions and statue is supervised by the Prime Minister. Source: Science and technology in 2011, Central Statistical Office, Warsaw 2012, p. 32.

- The main task of the Committee is to draw up the project of parameters and criteria for comprehensive evaluation of scientific units and to perform such evaluation. The Committee indicates to the Minister the leading scientific units which take into account the quality of their scientific activity in order to determine the level of financial support granted to fund their research potential.

According to the Act of 30 April 2010 on the Principles of Financing Science the tasks of the Scientific Unit Evaluation Committee include (Act on the Principles of Financing Science, 2010):

- conducting a comprehensive evaluation of the quality of scientific or research and development activities of scientific units;
- submitting applications to the Minister concerning the assignment of categories to individual scientific units;
- indicating to the Minister leading scientific units with respect to the quality of scientific or research and development activities that are outstanding;
- drafting detailed parameters and criteria for the evaluation of scientific units and the procedure for reevaluating units that have been assigned category C[5];
- drawing up an action plan for scientific unit evaluation teams;
- determining the number and composition of evaluation teams;
- analyzing the reports of evaluation teams;
- drawing up opinions and assessments.

The evaluation of the quality of scientific or R&D activities of scientific units is conducted on the basis of the results of the assessment of the scientific level of the research or development work and of their effects. International standards as well as development of science on an international scale are important issues considered in the evaluation process, as they can cause an increase in innovation on a national scale.

The parameters and criteria for the evaluation of scientific units depend on their size, type and scientific profile. They are adjusted to the characteristics of each of the four groups of sciences: Humanities and Social Sciences, Sciences and Engineering, Life Sciences and Art Sciences and Artistic Production. These parameters and criteria are created separately for The Polish Academy of Sciences, The Polish Academy of Arts and Sciences, basic organisational units of higher education institutions, research institutes and other scientific units.

The criteria for the evaluation of scientific units are provided by the evaluation of the following (Act on the Principles of Financing Science, 2010):

- the scientific level of the research or development work conducted;
- the results of scientific activity vis-a-vis international standards – including without limitation publications authored by scientific unit employees and published in renowned publications and scientific monographs, new technologies, materials, products, systems and services developed, implementations, patents, licences and protection rights for utility models;
- the significance of scientific unit activities for the development of science on an international scale and an increase in innovation on the national scale, and with respect to artistic works – active participation in international exhibitions, festivals, artistic, musical, theatrical and film events.

5 As a result of the evaluation of quality of scientific or R&D activities, the following categories might be assigned to scientific units: A+ – outstanding level, A – very good level, B – satisfactory level, with a recommendation to strengthen scientific or research and development activities or activities that stimulate economic innovation, C – unsatisfactory level.

In 2013, for the first time under the new rules, the Scientific Unit Evaluation Committee evaluated the potential of Polish scientific units. The Committee analysed and compared the scientific achievements of 963 scientific units. They have been given A+, A, B and C categories. An A+ category was awarded to the scientific elite, while the C category was a strong warning that forces improving research activities and restructuring of the scientific units.

The above categories are a measure of the research success of the scientific units as well as an important indicator affecting the amount of subsidies granted from the budget. The higher the category, the greater the subsidy for statutory research and opportunities to apply for EU funds are. This philosophy of financing scientific or R&D activities motivates scientific units to achieve better results and act in a more efficient way. This approach is especially important in times of heavy international competition in the R&D area and difficult budgetary situation.

The Committee for Evaluation of Scientific Units – the first evaluation

In 2013, Committee for Evaluation of Scientific Units conducted a comprehensive assessment of 963 research units. In this group, there were 70 research institutes of the Polish Academy of Sciences, 115 research institutes, 756 basic organizational units of higher education institutions and 22 other scientific units. Details of the assessment are shown in Table 2.

As shown in Table 2, more than 56% of research units obtained category B. Thirty seven most prestigious units obtained the A+ category (almost 4% of all research units). The lowest category C was granted to 8% of the assessed research units.

The largest group of the rated entities – the basic organizational units of higher education institutions, includes 219 basic organizational units of Polish universities[6]. Information about categories of research granted to them are presented in Table 3.

The basic organizational units of the universities on the background of basic organizational units of other higher education institutions in Poland look much better. Almost 6% received category A +, while the category C was granted to less than 2% of the assessed research units. Many more A categories were observed in the group of basic organizational units of the universities.

Table 2
Statement of categories of research by types of research units

Types of research units	Categories of research				
	A+	A	B	C	Total
Research institutes of the Polish Academy of Sciences	12	42	15	1	70
Research institutes	2	35	70	8	115
Basic organizational units of higher education institutions	23	225	451	57	756
Other scientific units	0	6	5	11	22
Total	**37**	**308**	**541**	**77**	**963**
%	**3.84**	**31.98**	**56.18**	**8.00**	**100.00**

Note: Ministry of Science and Higher Education, http://www.nauka.gov.pl/komunikaty/komunikat-o-wynikach-kompleksowej-oceny-dzialalnosci-naukowej-lub-badawczo-rozwojowej-jednostek-naukowych.html, [10.05.2014].

Table 3
Overview of the categories of research granted to universities' organizational units

	Categories of research				
	A+	A	B	C	Total
Total	**13**	**85**	**118**	**3**	**219**
%	**5.94**	**38.81**	**53.88**	**1.37**	**100.00**

Note: Own elaboration based on: Ministry of Science and Higher Education, http://www.nauka.gov.pl/g2/oryginal/2013_09/ab7f08e1f9b625d919d6e30df0d3f922.pdf, [10.05.2014].

6 Basic organisational units of The John Paul II Catholic University of Lublin are not included.

Estimation methodology and results

Efficiency measurement usually deals with the assessment of the relationship between given inputs and maximum possible outputs or between minimal possible inputs which might be used in order to get certain outputs. The differences between the methods of efficiency measurement are mainly caused by the fact that it is hard to define what are the inputs and outputs of particular organizations. The next problem deals with the definition of the so called "efficient benchmark". Is this a hypothetical or real unit which converts inputs into outputs in best efficient way? Another important issue is the method of efficiency measurement. There are two different approaches. The first, a parametric one, tries to define production function (for example Cobb-Douglas or CES) and estimate the parameters of this function. The second, a non - parametric one, is usually used when it is hard or even impossible to define the relationship between inputs and outputs, and hence to define production function. Non parametric methods are usually used for efficiency measurement of public sector institutions like hospitals, schools and also universities (Trojak, 2010).

In this piece of research, the most popular non-parametric method – Data Envelopment Analysis (Farell, 1957, Charnes, et al., 1978) was used. Due to specific characteristics of universities and regulation of research activities in Polish universities, the DEA output oriented method with variable return to scale assumption was applied. θ^* is a symbol of efficiency measure, which ranges from zero (totally inefficient unit) to one (fully efficient unit).

In the opinion of H. D. Sherman and J. Zhu DEA 'compares service units considering all resources used and services provided, and identifies the most efficient units or best practice units (branches, departments, individuals) and the inefficient units in which real efficiency improvements are possible' (Sherman, Zhu, 2006). The authors argue that DEA calculates the amount and type of cost and resource savings that can be achieved by making each inefficient unit as efficient as the most efficient (e.g. best practice units).

The method allows that changes in the inefficient units might be identified, which management can implement to achieve potential savings. Also, thanks to DEA method, 'management receives information about performance of units that can be used to help transfer system and managerial expertise from better-managed, relatively efficient units to the inefficient ones' (Sherman, Zhu, 2006). The authors also point another effects, which are improving the productivity of the inefficient units, reducing operating costs and increasing profitability.

Our Decision Making Units (DMU) were basic organizational units of Polish universities (faculties). In total, there were 219 units. The efficient units created the benchmark for the whole population. They build the best practice frontier. Those units which are below the frontier are inefficient. The closer to the frontier is a particular unit the more efficient it is.

Table 4 presents the applied inputs and outputs. Research potential (input), Scientific achievements (output 1), The material effects of scientific activity (output 2) and Other effects of scientific activity (output 3) were all converted into points measured by the Committee for Evaluation of Scientific Units.

Because of significant differences between particular characteristics of each group of sciences, as mentioned above, four groups were separated. These are the following:

- Humanities and Social Sciences (117 basic organizational units of Polish universities, units);
- Sciences and Engineering (43 units);
- Life Sciences (48 units);
- Art Sciences and Artistic Production (11 units).

Table 4
Input output description used in the DEA model

Input/output	
	INPUT
Research potential (I)	_ the power to award degrees; _ faculty development; _ achievements indicating the potential of scientific research units, including the functions performed by its employees, membership in expert groups; _ the status of a state research institute laboratories; _ acquired funds for research projects;
	OUTPUT
Scientific achievements (O1)	_ publications in scientific journals; _ publications in international conference proceedings; _ monographs; _ patents; _ artistic achievements;
The material effects of scientific activity (O2)	_ researchers gross salaries; _ financial expenditures incurred in the development of research infrastructure; _ implemented and realized research projects; _ new technologies, materials, products, methods, procedures, software, and varieties of plants prepared for external entities; _ licenses and transfer of know-how; _ expertise prepared for entrepreneurs, business organizations and state institutions, local, foreign or international; _ implementation of scientific research and development results by external entities;
Other effects of scientific activity (O3)	_ application of research results which are of significant public interest; _ effects resulting from the development of research infrastructure; _ organization or co-organization of national conferences; _ dissemination of knowledge and popularisation of science; _ publications or monographs of particular importance to the national heritage, the development of culture and education;

Note: Own elaboration based on Ministry of Science and Higher Education Regulation of 13. 07. 2012.

Efficiency of the basic organizational units of the Polish universities' in the area of scientific research

The efficiency of the organizational units of the Polish universities' in the area of scientific research were defined on the basis of the DEA method. The detailed results of the research were presented in another paper. In order to meet this research goal and to estimate the efficiency of Polish universities in the area of scientific research, the basic statistical measures were calculated and presented in Table 5 and Figure 1.

For Humanities and Social Sciences the mean θ^* was 0,73. Standard deviation equaled 0,16 and variability index was 22%. This means that evaluated units were not strongly differentiated. The Science and Engineering mean reached 0,79, standard deviation 0,21 and variability index 27%, which suggests that research units in this group was more differentiated than in Humanities and Social Sciences. The Life Science group mean equaled 0,72, standard deviation 0,23 and variability index 32%. This group was very strongly differentiated. Because of the small number of evaluated units in Art Sciences and Artistic Production (only 11) it was pointless to conduct deeper statistical analysis.

Table 5
Statistical measures used to estimate the efficiency of Polish universities

Name of the university	University code[7]	Mean	Standard deviation	Variability index (%)
Jagiellonian University in Kraków	UJK	0.845	0.143	.16.9
Adam Mickiewicz University in Poznań	UAMP	0.840	0.120	.14.3
University of Wrocław	UWr	0.820	0.185	.22.6
Cardinal Stefan Wyszyński University in Warsaw	UKSW	0.816	0.192	.23.6
University of Warsaw	UW	0.783	0.185	.23.6
Opole University	UO	0.775	0.123	.15.9
The University of Szczecin	US	0.740	0.197	.26.7
The Jan Kochanowski University in Kielce	UJKK	0.734	0.261	.35.5
University of Łódź	UL	0.733	0.209	.28.5
University of Rzeszów	UR	0.727	0.174	.23.9
Nicolaus Copernicus University in Toruń	UMK	0.727	0.183	.25.1
University of Gdańsk	UG	0.719	0.343	.47.7
University of Warmia and Mazury in Olsztyn	UWMO	0.705	0.198	.28.0
University of Białystok	UWB	0.701	0.185	.26.4
University of Silesia in Katowice	USK	0.678	0.149	.22.0
Kazimierz Wielki University in Bydgoszcz	UKWB	0.676	0.250	.37.0
Maria Curie-Skłodowska University in Lublin	UMCS	0.659	0.172	.26.1
University of Zielona Góra	UZ	0.603	0.240	.39.8

Note: Own calculations.

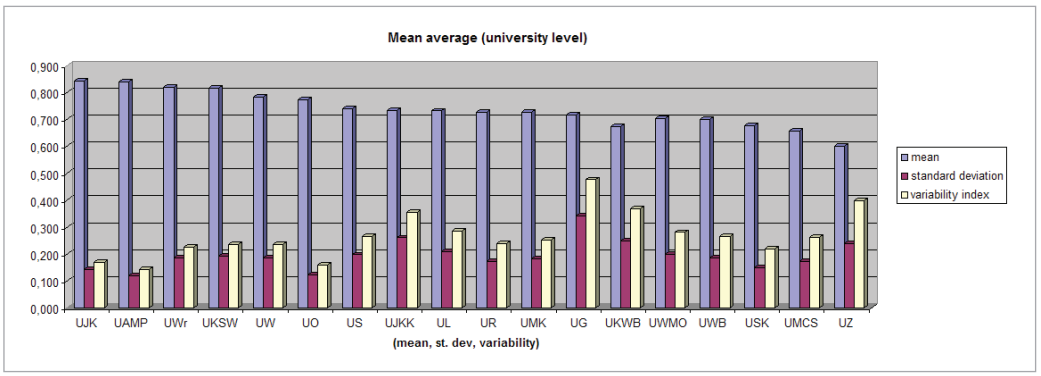

Figure 1
Universities' efficiency in the area of scientific research in 2013 in Poland

Conclusions

The above analysis omitted teaching activities, which strongly affects the results of the evaluation of effectiveness. From the results of the evaluation of effectiveness of research and development activities presented in the table 5 the following conclusions can be drawn:[7]

1 Average technical efficiency of Polish universities is relatively high and θ^* equals 0,74. Standard deviation of the θ^* values is small (0,06). This means that Polish universities do not differ too much in terms of efficiency, when the research field is concerned.

2 Standard deviation measures the amount of variation or dispersion from the average. A low standard deviation indicates that the data points tend to be very close to the mean

7 POL-on, https://polon.nauka.gov.pl/opi/aa/rejestry/szkolnictwo?execution=e1s1 [10.09.2014].

(in reference to Jagiellonian University in Kraków, Adam Mickiewicz University in Poznań, Opole University, University of Silesia in Katowice). A high standard deviation indicates that the data points are spread out over a large range of values (in reference to The Jan Kochanowski University in Kielce, University of Łódź, University of Gdańsk, Kazimierz Wielki University in Bydgoszcz, University of Zielona Góra). It is worth mentioning that units (mainly faculties), in particular universities differ very much. For example, at the University of Gdansk there are 11 faculties and the efficiency variability index equals 0,343 while at Adam Mickiewicz University in Poznan or Opole University the variability index of efficiency equals around 0,12. It may suggest that universities with a relatively high variability index of efficiency measure are not fully integrated, and some of their faculties do not use better practices proved by other units at the same university.

3 The most efficient universities in the fields of research activities are four universities whose mean effectiveness exceeds 0,8. Ten universities whose mean effectiveness ranges from 0,7 – 0,8 acquired average status. Four universities were the least efficient where the mean effectiveness is lower than 0,7. In conclusion, the Jagiellonian University in Kraków, Adam Mickiewicz University in Poznań, University of Wrocław and Cardinal Stefan Wyszyński University in Warsaw are the universities performing with the highest effectiveness. The lowest average values relate to the University of Silesia in Katowice, Kazimierz Wielki University in Bydgoszcz, Maria Curie-Skłodowska University in Lublin and University of Zielona Góra.

Thus one may note that the research aim was achieved. The quantitative research was conducted in order to estimate the technical efficiency of Polish universities in the area of scientific research. The authors are also aware of the limitation of conducted work. It omits important fields of universities activities like teaching and cooperation with external stakeholders. The authors see the need to conduct such research in the future.

References

Act of 30 April 2010 on the Principles of Financing Science, (2010). Journal of Laws [Dz. U.] of 4 June 2010.

Charnes, A., Cooper, W.W., and Rhodes, E. (1978). Measuring the efficiency of decision making units, *European Journal of Operational Research*. http://dx.doi.org/10.1016/0377-2217(78)90138-8

Europe 2020 Targets: Research And Development, (2014), from europa.eu/europe2020/pdf/themes/15_research__development.pdf

Europe 2020, A strategy for smart, sustainable and inclusive growth, (2010). Brussels: European Commission, from http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF.

Farell, M. J. (1957): Measurement of Productive Efficiency, *Journal of Royal Statistical Society*, Series A, Vol. 120, no 3. http://dx.doi.org/10.2307/2343100

Higher Education Institutions and their Finances in 2012, (2013). Warsaw: Central Statistical Office.

National Research Programme, Assumptions for the Science & Technology and Innovation Policy of the State, (2011). Attachment to Resolution of the Council of Ministers No. 164/2011 of 16. 08. 2011.

Research and Innovation performance in Poland, Country Profile 2013, (2013). Brussels: European Commission, Publications Office of the European Union.

Science and technology in 2011, (2012). Warsaw: Central Statistical Office.

Science and technology in 2012, (2013). Warsaw: Central Statistical Office.

Sherman, H. D., Zhu, J. (2006): Service Productivity Management. Improving Service Performance using Data Envelopment Analysis (DEA). New York: Springer US.

Trojak M. (2010). Metody oceny efektywności banków. In E. Miklaszewska (Ed.), *Bank na rynku finansowym* (pp. 271-302). Warszawa: Oficyna Wydawnicza Wolters Kluwer Business.

Santrauka

Mariusz Trojak, Marta Tutko. Lenkijos universitetų efektyvumas mokslinių tyrimų kontekste

Šio straipsnio tikslas – nustatyti Lenkijos universitetų techninį efektyvumą mokslinių tyrimų kontekste. Pirmojoje straipsnio dalyje pristatoma dabartinių mokslinių tyrimų situacija Lenkijoje. Pateikiama informacija apie išlaidas tyrimams ir vystymui. Nuo 2008-ųjų fondai moksliniams tyrimams iš valstybės biudžeto žymiai padidėjo. Radikalus padidėjimas susijęs su efektyviu ES struktūrinių fondų panaudojimu. Europinių fondų ir valstybinio finansavimo panaudojimas kofinansuojant europinius projektus, turėjo didžiausią įtaką investicijoms į tyrimus ir vystymą aukštajame moksle. Straipsnyje pristatoma tyrimų institucijų struktūra Lenkijoje. R&D vienetai Lenkijoje yra visi ūkio subjektai, įtraukti į kūrybinę veiklą, siekiant sistemiškai padidinti žinių bazę ir jas panaudoti naujai pritaikant. Šie vienetai yra aukštojo mokslo institucijos, atliekančios R&D, tyrimų institutai ir Lenkijos mokslų akademijos moksliniai dariniai.

Kitoje dalyje pristatomas tyrimų kokybės vertinimas, jis vyko 2013. Mokslinių vienetų vertinimų komitetas atliko 963 tyrimų vienetų vertinimą.

Pirmiausia pristatomas duomenų aprėpties (DEA) metodas, jis taikytas vertinant pagrindinių organizacinių vienetų, susijusių su moksliniais tyrimais Lenkijos universitetuose, techninį efektyvumą. DEA yra populiarus neparametrinis metodas, naudojamas norint nustatyti organizacijos techninį efektyvumą. Sprendimų priėmimo padaliniai (DMU) buvo pasirinkti kaip baziniai Lenkijos universitetų (fakultetų) vienetai.Iš viso buvo identifikuota 219 vienetų.

Vidutiniškai Lenkijos universitetų techninis efektyvumas buvo aukštas. Standartinis nuokrypis buvo mažas, tai reiškia, kad Lenkijos universitetai vienas nuo kito labai mažai skiriasi savo efektyvumu, ypač atsižvelgiant į tyrimų sritį. Moksliniuose tyrimuose efektyviausi keturi universitetai (M - 0,8). Dešimties universitetų statusas – vidutinis (M - 0,7 – 0,8). Keturių universitetų efektyvumas žemesnis (M žemesnis nei 0,7. Apibendrinant galima teigti, kad Krokuvos Jogailos universitetas, A.Mickevičiaus universitetas Poznanėje, Vroclavo universitetas ir kardinolo Wyšinskio universitetas Varšuvoje pasižymi efektyvia moksline veikla. Žemiausia įvertinta mokslinė veikla Katovicų Silezijos universitete, Bydgoščio Kazimiero Didžiojo universitete, Liublino Marijos Sklodowskos-Curie universitete Liubline bei Zielona Góra universitete.

Straipsnio autoriai taip pat apsibrėžė atlikto tyrimo ribotumus. Jie apima kitas svarbias universiteto veiklas, pvz., mokymas; taip pat bendradarbiavimas su išoriniais subjektais. Tai erdvė tolimesniems tyrimams.

REIKŠMINIAI ŽODŽIAI: universitetas, efektyvumas, moksliniai tyrimai, DEA.

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