

MEASUREMENT OF THE RELATIVE EFFICIENCY IN THE ALGERIAN UNIVERSITY: EVIDENCE FOR ADRAR UNIVERSITY BASED ON DEA METHOD

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ABSTRACT

This study aims to measure the relative efficiency of the University of Adrar - Algeria, using the **Data Envelopment Analysis method (DEA)**. The total number of students and teachers, and net wages has been used as inputs for the model, in addition to the use of all graduating students as outputs for the model, with the use of available data from the year 2009 until the year 2014. The study found the existence of full relative efficiency in three out of five faculties.

Keywords: Higher education, relative efficiency, Data Envelopment Analysis method, inputs, outputs.

INTRODUCTION

Interest in education has increased in recent decades due to grasp its truth as a key to progress and control. In this context, states consider education as a long-term investment, and like any investment it must be taken into account the aspects of profit and the rationalization of expenditures and the proper utilization of resources. From this perspective, the economic outlook for education has emerged looking to maximize the education systems returns at the lowest cost. Thus, talking about the efficiency of the education systems has begun as an attempt to make them economic systems which realize maximum outputs with minimum inputs. The interest in the topic of efficiency in the field of education has increased as an investment contributing to the growth, development and advancement of communities. Algeria has just worked like any other developing country on the establishment of an educational system includes all primary, secondary and university stages, and has devoted to it all the necessary material and human resources.

With the beginning of the first decade of this century, the reform of the higher education system has been initiated in order to make the Algerian University respond to the requirements of local and national development. Through the above, this study is an attempt to measure the relative efficiency of the Algerian University using the Data Envelopment Analysis method applied on the case of the University of Adrar.

METHODOLOGICAL FRAMEWORK OF THE STUDY

The Problem of the Study

The higher education system in Algeria is characterized by the fact that all its institutions are public and funded by the government. The government has initiated since 2004 in the reform of the higher education system through the LMD system, which aims to link the University to its social and economic environment to contribute to local and national development, and to respond more to the needs of development. In front of this reform, the achievement of higher education efficiency remains a prerequisite to assess higher education institutions. This prerequisite makes the university take into account the expenditures rationalization aspects, maximize the quality and quantity of outputs and improve the working methods.

The aim of the education system efficiency is the rationalization of expenditures and reduction of costs and educational wastes by maximizing outputs and reducing inputs.

From the above, the issue of this paper is focused on the following main question:

- What is the level of relative efficiency in the University of Adrar – Algeria ?

THE IMPORTANCE OF THE STUDY

- The fundamental importance of the study stems from the pivotal role of universities and higher education as a key driver for economic development, through providing administrative staff and technical managers specialized in industry and necessary services for the community, as well as their role in the development of innovation and knowledge of the national intellectual capital.

- Increasing the efficiency of the education systems, through the rationalization of higher education inputs, the diminution of wastage rates in the resources, and raising their internal and external efficiency level to gain access to better quality and greater quantity of outputs at the lowest cost, time and effort.

- Taking advantage from the results of the study to improve the optimal use of material and human resources and facilities which are available for universities, thus reducing the cost of inputs, improving and increasing the quality and quantity of outputs.

THE OBJECTIVE OF THE STUDY

This study seeks to achieve the following objectives:

- Knowing the level of relative efficiency in Algerian universities.
- Identifying the faculties that have achieved full relative efficiency through the use of the least amount of inputs to produce a considerable amount of outputs.
- Identifying improvement coefficient and reference units for inefficient faculties.
- Identifying inefficient faculties which have broken resources, overabundant inputs and stagnant outputs.
- Determining the amount of inputs decreases and outputs increases needed to shift inefficient faculties to the full relative efficiency level.

THEORETICAL FRAMEWORK OF THE STUDY

The definition of efficiency goes far beyond the concept of effectiveness, since it does not content with objectives only, but it looks at the efficiency of achieving these objectives, in terms of reducing costs, effort and time, i.e., achieving the objectives with lower resources.

So efficiency is related to how to achieve the greatest possible outputs with minimal inputs, hence the education system or efficient educational institution is one that can achieve the greatest possible outputs with minimal inputs, considering the time, effort, methods of work, quality of inputs, type of technology and other factors.

Efficiency has two dimensions (Al-Shuaibi, 2004):

- a- Quantitative dimension: it expresses the rate between inputs and outputs.
- b- Qualitative dimension: it expresses the significations of the previous rate which carry the meanings of power and sufficiency.

For reference, efficiency has several types, most notable: internal efficiency and external efficiency; each type of them is divided in turn into two parts: quantitative and qualitative efficiency. There is also relative efficiency, technical efficiency, scale efficiency, functional efficiency and economic efficiency.

It is intended by the university efficiency in this study, its ability to use available resources to have access to the required level of outputs. University inputs are identified in teachers, students and the budget allocated for teachers' wages. The outputs are identified in the number of graduating students.

THE DEA METHOD

Relative effectiveness measurement method Data Envelopment Analysis (DEA) developed by A. Charnes, W. W. Cooper and E. Rhodes (Charnes et al. 1978). In the method, the effectiveness (E) of the analysed object (j), called Decision Making Unit (DMU) can be defined as a quotient of a weighted sum of the outputs to the weighted sum of the inputs:

$$E_j = \frac{\sum_{r=1}^s u_{rj} y_{rj}}{\sum_{i=1}^m v_{ij} x_{ij}} \dots \dots \dots (1)$$

y_{rj} – the amount of the product r generated by DMU $_j$, output;

x_{ij} – the amount of the resource i used by DMU $_j$, input;

u_{rj} – weight of the output y_{rj} ;

v_{ij} – weight of the input x_{ij} ;

$r = 1, 2, \dots, s$ – number of the generated products;

$i = 1, 2, \dots, m$ – number of resources used;

$j = 1, 2, \dots, n$ – number of DMUs.

Application of the DEA method does not require prior determination of weights. Optimization of weights is done for each object separately through solving linear programming task in order to maximize the relation output/input described in the equation (1) with taking into consideration the constraints given. This way, strengths of each unit are exposed:

$$Max h_{j0} = \frac{\sum_{r=1}^s u_{rj0} y_{rj0}}{\sum_{i=1}^m v_{ij0} x_{ij0}} \dots \dots \dots (2)$$

Subject to:

$$\begin{aligned} \frac{\sum_{r=1}^s u_{rj0} y_{rj0}}{\sum_{i=1}^m v_{ij0} x_{ij0}} &\leq 1, & j = 1, \dots, j_0, \dots, n; \\ u_{rj0} &\geq 0, & r = 1, \dots, s; \\ v_{ij0} &\geq 0, & i = 1, \dots, m. \end{aligned}$$

DEA models that require constant returns to the scale approach are called CCR models (the acronym of the first letters of the names of the method's authors - Charnes, Cooper and Rhodes (Charnes et al. 1978) or CRS (Constant Returns to Scale). The models used in variable returns to scale are called BCC models, the acronym of the names of the model's authors - Banker, Charnes, Cooper (Banker et al. 1984) or VRS (Variable Returns to Scale).

LITERATURE REVIEWS

Many studies have been conducted in this field. This section will discuss on the most important studies by considering the results' diversities across the countries. Coelli (1996), aimed to measure the efficiency of Australian universities using DEA. The author conducted his study on 36 universities. Three models were used to measure the efficiency (i.e. overall efficiency of universities' model, academic characteristics' model, and administrative efficiency's model). The results show that the average efficiency for the overall efficiency of universities' model reached 95.9 %, and the average efficiency for the academic characteristics' model is 93 %, and the average efficiency for the administrative efficiency's model is 90.7%. The results have shown that there is no efficiency in more than a model.

Another study by McMillan & Datta (1998), tested the relative efficiency of the Canadian universities. 45 universities were selected for this study for the years 1992 and 1993. The selected universities have been divided into three groups. The first group includes 15 universities with medicine faculties. The second group includes 10 universities with medicine faculties. The third group includes 10 universities with medicine faculties, but they provide only the first university degree. The study found that the average relative efficiency for the first group reached 94 %, while the average relative efficiency of second group reached 95 %. The average relative efficiency for the third group reached 93 %. In general, the results showed high level of relative efficiency for the selected universities.

In addition, NG & Li (2000), analyzed the efficiency and performance of the scientific research in high education institutions in China using DEA. The study's a sample includes 84 high education institutions from the east, west and center territories. The data were collected for years 1993, 1994 and 1995. The study found that there is low level of efficiency in the performance in scientific research in higher education institutions in China, and it did not exceed the threshold of 20 %. The level of such efficiency varies between the three territories in favor of the center territory.

Furthermore, a study by Moreno and Tadipalli (2002) tested the efficiency of the academic departments in the U.S. government universities. This study was applied on 42 departments under seven faculties: humanities and social science, human development, education, business management, agriculture, engineering, pharmacy, science and mathematics. The study concluded that there are 22 departments achieved the full efficiency. On the other hand, the art department recorded the lowest efficiency ratio (i.e. 70%). In terms of the efficiency in the engineering departments, Koksali and Nalcaci (2006), examined the relative efficiency in the Middle East University in Turkey. The study was conducted on 14 engineering departments. The outcomes of the study illustrated that there are four departments out of fourteen departments reached to the full efficiency.

In the British context, Johnes (2006), analyzed the efficiency of the high education in the British universities. 109 universities were selected for this study. The results show that 92 universities recorded the full efficiency, and the lowest recorded efficiency ratio was 63.45%. Staying in Europe, Fandel (2007), tested the efficiency in the German universities. The sample of this study was 15 universities. The study concluded that there are 10 universities with full efficiency. Nine universities marked the full efficiency in the natural sciences, and eight of them achieved full efficiency in the field of engineering science. Khan et al. (2008), aimed to assess the service quality in the technical institutions of high education in India using DEA. The study has been the applied on the 20 best technical institutes. The study found that the average efficiency of the studied institutes is 93 %, and there are only 8 institutes managed to achieve full efficiency.

Besides, the study by Fahmi (2008), aimed to test the relative internal efficiency for the Saudi universities using data envelope method of analysis. The study has been applied on 11 Universities. The researcher inputs were: the total members of the teaching staff, financial allocations from the State budget. The outputs were identified in: the total number of students enrolled, and the total number of students graduated in the previous year. The results show that the universities with relative internal efficiency are five out of 11 universities.

In the same country, Shae's (2009), study went to measure the relative efficiency in the universities of Saudi Arabia using DEA. The study was applied on three universities. The

findings of the study show that the highest average efficiency of were recorded by the King Saud University (i.e. 75 %). In terms of faculties, seven out of thirteen faculties of King Saud University showed high efficiency. The number of efficient faculties in King Abdul Aziz University are six out of twelve faculties, and the number of efficient faculties in King Faisal University are 4 out of 8 faculties. Also, the results showed that the less efficient faculties are in University of King Faisal (i.e. the Faculty of Science) which reached to 1% efficiency ratio.

APPLIED FRAMEWORK OF THE STUDY

The study is about the case of one public university which is the University of Adrar. To measure the relative efficiency, Data Envelopment Analysis method (DEA) has been used on data for five academic seasons beginning from (2009-2010) to (2013-2014).

INPUTS AND OUTPUTS OF THE MODEL

Inputs of the Model: three inputs have been identified for the model, as follows:

- **Students input:** It reflects the size and importance of the faculty, as it is one of the important elements, and it includes all new students enrolled in the first year in the graduation stage.
- **Teachers input:** it has active role in increasing the number of graduating students in addition to improving the quality of education. This input includes all permanent teachers of different ranks.
- **Net wages input:** it includes the total net annual wages of permanent teachers.

OUTPUTS OF THE MODEL

Graduating students output: it is the most important output, as the objective of the university is to maximize this output to the maximum possible extent within the available means and resources, and it includes all the successful students obtaining degrees in the graduation stage. The study population includes the faculties of the University of Adrar (Algeria), namely:

- 1- Faculty of Sciences and Technology.
- 2- Faculty of Social Sciences.
- 3- Faculty of Economic Sciences.
- 4- Faculty of Law and Political Science.
- 5- Faculty of Arts and languages.

The following table (1) shows the average of inputs which are registered students, permanent teachers, net annual wages, and the average of outputs successful students of Adrar University faculties for a period of five academic seasons:

Faculties	Inputs			Outputs
	Average of registered students	Average of permanent teachers	Average of net annual wages (AD)	Average of successful students
Faculty of Sciences and Technology	308.2	56.8	5606265.574	62.2
Faculty of Social Sciences.	581.2	57	7412781.786	424.4
Faculty of Economic Sciences	194.6	19.2	2065231.812	125.2
Faculty of Law and Political Science.	118.6	21	2462074.804	95.4
Faculty of Arts and languages	351.2	45.6	4949600.96	287.4

MEASUREMENT OF RELATIVE EFFICIENCY USING UNIVERSITY FACULTIES (CCR) MODEL**Measurement of relative efficiency for the faculties using input- oriented (CCR) model**

Faculties	Relative efficiency index	Inefficiency amount
Faculty of Sciences and Technology	0.2466	0.7534
Faculty of Social Sciences.	1.0000	0.0000
Faculty of Economic Sciences	1.0000	0.0000
Faculty of Law and Political Science.	0.9829	0.0171
Faculty of Arts and languages	1.0000	0.0000

We use the input-orientated constant returns-to-scale model to calculate relative efficiency, assuming that all the faculties operate at the optimum scale level, i.e., they transit the stage of constant returns-to-scale, we make it clear through the following table:

Through the results, we note that efficient faculties (or unities) are the Faculty of Social Sciences, the Faculty of Economic Sciences and the Faculty of Arts. The other faculties have not achieved efficiency.

The following table shows the reference units for the faculties that have not achieved full relative efficiency.

	Faculty of Social Sciences.	Faculty of Economic Sciences	Faculty of Arts and languages
Faculty of Sciences and Technology			0.2164
Faculty of Social Sciences.	1.0000		
Faculty of Economic Sciences		1.0000	
Faculty of Law and Political Science.			0.3319
Faculty of Arts and languages			1.0000

- The reference unit for the Faculty of Sciences is the Faculty of Arts, by a factor of improvement $\lambda_5 = 0.2164$

- The reference unit for the Faculty of Law is the Faculty of Arts, by a factor of improvement $\lambda_5 = 0.3319$

The following table shows the overabundant inputs and stagnant outputs for the faculties according to the input-oriented CCR model:

Faculties	Inputs			Outputs
	Registered students	Permanent teachers	Net annual wages (AD)	Successful students
Faculty of Sciences and Technology	0.00	4.1390	311400.300	0.000
Faculty of Social Sciences.	0.00	0.000	0.000	0.000
Faculty of Economic Sciences	0.00	0.000	0.000	0.000
Faculty of Law and Political Science.	0.00	5.5054	777118.250	0.000
Faculty of Arts and languages	0.00	0.000	0.000	0.000

In regard to the **Faculty of Sciences**, there are overabundant inputs in permanent teachers input estimated at 4 teachers, and in annual wages estimated at 311400.300 A.D. In regard to the **Faculty of Law**, there are overabundant inputs in permanent teachers input estimated at 6 teachers, and in annual wages estimated at 777118.250 AD. In regard to the **Faculty of Social Sciences**, the **Faculty of Economic Sciences** and the **Faculty of Arts**, there are no overabundant inputs or stagnant outputs.

The following table shows the improvement to be carried out from the inefficient faculties according to the input-oriented CCR model:

Faculties	Inputs						Outputs	
	Aimed number of registered students	Proposed rates to be reduced (%)	Aimed number of permanent teachers	Proposed rates to reduction (%)	Aimed net annual wages (AD)	Proposed rates to reduction (%)	Aimed number of successful students	Proposed rates to be increased (%)
Faculty of Sciences and Technology	76.007	75.33	9.868	82.62	1071208.00	80.89	62.200	0.00
Faculty of Social Sciences.	581.200	0.00	57.000	0.00	7412781.800	0.00	424.40	0.00
Faculty of Economic Sciences	194.600	0.00	19.200	0.00	2065231.800	0.00	125.200	0.00
Faculty of Law and Political Science.	116.577	1.70	15.136	27.92	1642978.200	33.26	95.400	0.00
Faculty of Arts and languages	351.200	0.00	45.600	0.00	4949601.00	0.00	287.400	0.00

The improvements to be carried out in order to shift the faculties into efficient units are as follows:

For the Faculty of Sciences: it can provide the same level of outputs, but with the reduction of inputs levels, so that the number of registered students can be reduced to 76 students, i.e., a reduction rate of 575.33%, the number of teachers can be reduced to 10 teachers by 83%, and the wages as well as can be reduced by 1071208.00 AD, i.e., 81%. With regard to the Faculty of Law, it can provide the same level of outputs, but with the reduction of input levels, so as the number of registered students can be reduced to 116 students, i.e., by a reduction rate of 1.7%, the number of teachers can be reduced to 15 teachers, i.e., 28%, and the wages as well as can be reduced by 1642978.200 AD which represents 33.26%. The other faculties are considered to have achieved full relative efficiency using the available inputs in the best way to achieve the outputs.

Measurement of relative efficiency of the faculties using the output-oriented (CCR) model

Relative efficiency in the case for the faculties is calculated using the output-oriented constant returns-to-scale model, in the sense of efficiency in terms of achieving the outputs assuming that all the faculties operate at the optimum scale level; i.e., they transit the constant returns-to-scale stage, the following table shows it.

Faculties	Relative efficiency index	Inefficiency amount
Faculty of Sciences and Technology	0.2466	0.7534
Faculty of Social Sciences.	1.0000	0.0000
Faculty of Economic Sciences	1.0000	0.0000
Faculty of Law and Political Science.	0.9829	0.0171
Faculty of Arts and languages	1.0000	0.0000

Through the results, we note that the efficient faculties (or unities) are the Faculty of Social Sciences, the Faculty of Economic Sciences and the Faculty of Arts. The other faculties have not achieved efficiency.

The following table shows the reference units for the faculties that have not achieved full relative efficiency:

	Faculty of Social Sciences.	Faculty of Economic Sciences	Faculty of Arts and languages
Faculty of Sciences and Technology			0.8776
Faculty of Social Sciences.	1.0000		
Faculty of Economic Sciences		1.0000	
Faculty of Law and Political Science.			0.3377
Faculty of Arts and languages			1.0000

- The reference unit for the Faculty of Sciences is the Faculty of Arts, by a factor of improvement $\lambda_5 = 0.8776$

- The reference unit to the Faculty of Law is the Faculty of Arts, by a factor of improvement $\lambda_5 = 0.3377$

The following table shows the overabundant inputs and stagnant outputs for the faculties according to the output-oriented CCR model:

Faculties	Inputs			Outputs
	Registered students	Permanent teachers	Net annual wages (AD)	Successful students
Faculty of Sciences and Technology	0.00	16.783	1262680.700	0.000
Faculty of Social Sciences.	0.00	0.000	0.000	0.000
Faculty of Economic Sciences	0.00	0.000	0.000	0.000
Faculty of Law and Political Science.	0.00	5.600	790597.940	0.000
Faculty of Arts and languages	0.00	0.000	0.000	0.000

In regard to the Faculty of Sciences, there are overabundant inputs in the permanent teachers input estimated at 17 teachers, and in annual wages estimated at 1262680.700 AD. In regard to the Faculty of Law, there are overabundant inputs in the permanent teachers input estimated at 6 teachers, and in annual wages estimated at 790597.940 AD. In regard to the Faculty of Social Sciences, the Faculty of Economic Sciences and the Faculty of Arts, there is no overabundant input or stagnant output.

The following table shows the improvement to be carried out by the inefficient faculties according to the output-oriented CCR model:

Faculties	Inputs						Outputs	
	Aimed number of registered students	Proposed rates to be reduced (%)	Aimed number of permanent teachers	Proposed rates to reduction (%)	Aimed net annual wages (AD)	Proposed rates to reduction (%)	Aimed number of successful students	Proposed rates to be increased (%)
Faculty of Sciences and Technology	308.200	0.00	40.0168	29.54	4343584.900	22.52	252.211	305.48
Faculty of Social Sciences.	581.200	0.00	57.000	0.00	7412781.800	0.00	424.40	0.00
Faculty of Economic Sciences	194.600	0.00	19.200	0.00	2065231.800	0.0	125.200	0.00
Faculty of Law and Political Science.	118.600	0.00	15.399	26.67	1671476.900	32.11	97.054	1.733
Faculty of Arts and languages	351.200	0.00	45.600	0.00	4949601.00	0.00	287.400	0.00

The improvements to be carried out in order to shift the faculties into efficient units are as follows:

In regard to the **Faculty of Sciences**: it can provide by the same or lower level of inputs, greater levels of outputs, so that the number of graduating students can be increased to 252.211 students, i.e., a rate of 306%, but with lower levels of two inputs which are the number of teachers to 40 teachers, i.e., 30% and the reduction of wages by 4343584.900 AD, i.e., 22.52%.

In regard to the Faculty of Law, it can provide by the same or lower level of inputs, greater levels of outputs, so that the number of graduating students can be increased to 97.054 students, i.e., 1.733%, but with lower levels of two inputs which are the number of teachers to 15.399 teachers, i.e., 26.67%, and the reduction of wages as well as by 1671476.900 AD, i.e., 32.11%.

MEASUREMENT OF RELATIVE EFFICIENCY USING UNIVERSITY FACULTIES (BCC) MODEL

Input-Oriented BCC Model

We calculate the relative efficiency index for the faculties using the input-oriented variable returns-to-scale model in the sense of efficiency in terms of the use of inputs taking into account the change in the returns-to-scale (increasing, constant or decreasing). We can, in this model, distinguish between two types of efficiency: technical efficiency and scale efficiency.

Faculties	efficiency index of Variable returns-to-scale	Scale efficiency index	Returns-to-scale	Efficiency index of constant returns-to-scale (CRS)	Efficiency index of non increasing returns-to-scale (NIRS)
Faculty of Sciences and Technology	0.4270	0.5775	Increasing	0.2466	0.2466
Faculty of Social Sciences.	1.0000	1.0000	Fixed	1.0000	1.0000
Faculty of Economic Sciences	1.0000	1.0000	Fixed	1.0000	1.0000
Faculty of Law and Political Science.	1.0000	0.9830	Increasing	0.9830	0.9830
Faculty of Arts and languages	1.0000	1.0000	Fixed	1.0000	1.0000

- The Faculty of Sciences has not achieved efficiency by the input orientation in the model of constant returns-to-scale (CRS) and variable returns-to-scale (VRS); the index of the scale efficiency is 57.75% which means the need to expansion by 42.25% to reach the optimum scale, while the returns-to-scale for the faculty are increasing which means that the increase in outputs will require less increase in inputs.

- Also the Faculty of Law has not achieved full relative efficiency in the input-oriented constant returns-to-scale model, but it has achieved efficiency in the input-oriented variable returns-to-scale model; the scale efficiency amounted to 98.30%. Therefore, we need, to reach the optimal scale, to 1.7%, while the returns-to-scale for the faculty are increasing which means that the increase in outputs will require less increase in inputs.

- The other faculties have achieved full relative efficiency by the input orientation in both models, which means that they use the available inputs in the best way they can to achieve the outputs; the scale efficiency index 100% indicates that these faculties have achieved the optimum scale and it is not in their interest currently to expand. The following table shows

the faculties that have not achieved the full relative efficiency according to the input-oriented (BCC) model:

	Faculty of Social Sciences.	Faculty of Economic Sciences	Faculty of Law and Political Science.	Faculty of Arts and languages
Faculty of Sciences and Technology		0.1712	0.8288	
Faculty of Social Sciences.	1.0000			
Faculty of Economic Sciences		1.0000		
Faculty of Law and Political Science.			1.0000	
Faculty of Arts and languages				1.0000

- The reference units for the Faculty of Sciences are the Faculty of Economy by a factor of improvement $\lambda_3=0.1712$, and the Faculty of Law by a factor of improvement $\lambda_4 = 0.8288$

The following table shows the overabundant inputs and stagnant outputs for the faculties in accordance with the input-oriented (BCC) model:

Faculties	Inputs			Outputs
	Registered students	Permanent teachers	Net annual wages (AD)	Successful students
Faculty of Sciences and Technology	0.00	3.56	0.00	38.30
Faculty of Social Sciences.	0.00	0.00	0.00	0.00
Faculty of Economic Sciences	0.00	0.00	0.00	0.00
Faculty of Law and Political Science.	0.00	0.00	0.00	0.00
Faculty of Arts and languages	0.00	0.00	0.00	0.00

In regard to the Faculty of Sciences, it has overabundant inputs in the permanent teachers input estimated at 3.56 teachers, and stagnant outputs in the number of successful students estimated at 38.30 students.

The other faculties have no overabundant inputs or stagnant outputs.

The following table shows the required improvements in inputs and outputs according to the input-oriented (BCC) model:

Faculties	Inputs						Outputs	
	Aimed number of registered students	Proposed rates to be reduced (%)	Aimed number of permanent teachers	Proposed rates to reduction (%)	Aimed net annual wages (AD)	Proposed rates to reduction (%)	Aimed number of successful students	Proposed rates to be increased (%)
Faculty of Sciences and Technology	131.61	57.30%	20.69	63.57%	2,394,116.98	57.30%	100.50	61.58%
Faculty of Social Sciences.	581.20	0.00%	57.00	0.00%	7,412,782.00	0.00%	424.40	0.00%
Faculty of Economic Sciences	194.60	0.00%	19.20	0.00%	2,065,231.75	0.00%	125.20	0.00%
Faculty of Law and Political Science.	118.60	0.00%	21.00	0.00%	2,462,074.75	0.00%	95.40	0.00%
Faculty of Arts and languages	351.20	0.00%	45.60	0.00%	4,949,601.00	0.00%	287.40	0.00%

The Faculty of Sciences can achieve greater level of outputs with lower level of inputs, increasing the number of successful students to 100.50 students, i.e., 61.58%, with lower level of students estimated at 131.61 students, i.e., 57.30%, and the reduction of the number of teachers to 20.69 teachers, i.e., 63.57%, and wages to 2,394,116.98 AD, i.e., 57.30%.

- The other faculties have achieved full relative efficiency of the input-oriented variable returns model, and therefore there is no need for improvements.

Output-Oriented BCC Model

We calculate the relative efficiency index for the faculties using the output-oriented variable returns-to-scale model (VRS), in the sense of efficiency in terms of achieving outputs taking into account the change in the returns-to-scale (increasing, constant, decreasing), where we can in this model distinguish between two types of efficiency: Technical efficiency and scale efficiency.

The following table shows the relative efficiency index of the faculties of Adrar University by the output-oriented BCC model.

Faculties	efficiency index of Variable returns-to-scale	Scale efficiency index	Returns-to-scale	Efficiency index of constant returns-to-scale (CRS)	Efficiency index of non increasing returns-to-scale (NIRS)
Faculty of Sciences and Technology	0.2469	0.9988	Increasing	0.2466	0.2466
Faculty of Social Sciences.	1.0000	1.0000	Fixed	1.0000	1.0000
Faculty of Economic Sciences	1.0000	1.0000	Fixed	1.0000	1.0000
Faculty of Law and Political Science.	1.0000	0.9830	Increasing	0.9830	0.9830
Faculty of Arts and languages	1.0000	1.0000	Fixed	1.0000	1.0000

The Faculty of Sciences has not achieved efficiency by the output-oriented constant returns-to-scale model (CRS) and the variable returns-to-scale; the scale efficiency index is 99.88% which means the need to expansion by 12% to reach the optimum scale, while the returns-to-scale for the faculty is increasing suggesting that the increase in outputs will require less increase in inputs.

Also, the Faculty of Law has not achieved full relative efficiency in the constant returns-to-scale model, but it has achieved efficiency in output-oriented variable returns-to-scale model, as scale efficiency amounted 98.30%. Therefore, we need to reach the optimum scale to 1.7%, while the returns-to-scale for the faculty is increasing which indicates that the increase in outputs will require less increase in inputs.

- The other faculties have achieved full relative efficiency by output orientation in both models, which indicates the use of available inputs in the best way they can to achieve the outputs; the scale efficiency index 100% indicates that these faculties have achieved the optimum scale and it is not in their interest currently to expand.

The following table shows the faculties that have not achieved full relative efficiency according to the output-oriented (BCC) model.

	Faculty of Social Sciences.	Faculty of Economic Sciences	Faculty of Law and Political Science	Faculty of Arts and languages
Faculty of Sciences and Technology			0.1849	0.8151
Faculty of Social Sciences.	1.0000			
Faculty of Economic Sciences		1.0000		
Faculty of Law and Political Science.			1.0000	
Faculty of Arts and languages				1.0000

The reference units for the Faculty of Sciences are the Faculty of Arts by a factor of improvement $\lambda_5 = 0.8151$, and the Faculty of Law by a factor of improvement $\lambda_4 = 0.1849$. The following table shows the overabundant inputs and the stagnant outputs for the faculties in accordance with the output-oriented (BCC) model.

Faculties	Inputs			Outputs
	Registered students	Permanent teachers	Net annual wages (AD)	Successful students
Faculty of Sciences and Technology	0.00	15.75	1,116,525.25	0.00
Faculty of Social Sciences.	0.00	0.00	0.00	0.00
Faculty of Economic Sciences	0.00	0.00	0.00	0.00
Faculty of Law and Political Science.	0.00	0.00	0.00	0.00
Faculty of Arts and languages	0.00	0.00	0.00	0.00

In regard to the Faculty of Sciences, it has overabundant inputs in the permanent teachers input estimated at 15.75 teachers, and in wages 1,116,525.25 AD, while there is no stagnant output.

The other faculties have no overabundant inputs or stagnant outputs.

The following table shows the required improvements in inputs and outputs depending on output-oriented (BCC) model.

Faculties	Inputs						Outputs	
	Aimed number of registered students	Proposed rates to be reduced (%)	Aimed number of permanent teachers	Proposed rates to reduction (%)	Aimed net annual wages (AD)	Proposed rates to reduction (%)	Aimed number of successful students	Proposed rates to be increased (%)
Faculty of Sciences and Technology	308.20	0.00%	41.05	27.72%	4,489,740.23	19.92%	251.91	304.99%
Faculty of Social Sciences.	581.20	0.00%	57.00	0.00%	7,412,782.00	0.00%	424.40	0.00%
Faculty of Economic Sciences	194.60	0.00%	19.20	0.00%	2,065,231.75	0.00%	125.20	0.00%
Faculty of Law and Political Science.	118.60	0.00%	21.00	0.00%	2,462,074.75	0.00%	95.40	0.00%
Faculty of Arts and languages	351.20	0.00%	45.60	0.00%	4,949,601.00	0.00%	287.40	0.00%

The faculty of Sciences can achieve greater level of outputs with lower level of inputs, increasing the number of successful students to 251.91 students, i.e., 304.99%, with lower level of teachers 41.05, i.e. 27.72%, and wages to 4,489,740.23 AD, i.e., 19.92%.

The other faculties have achieved full relative efficiency of the input-oriented variable returns, and therefore there is no need to improvements.

CONCLUSIONS

The developments occurring in the university sector in Algeria, both in terms of spending or the number of registered and graduating students, imposed on us the need to assess the use of resources that are placed under the hands of the university, and how to use them optimally, as this sector plays a pivotal role in achieving development. This study is an attempt to evaluate this sensitive sector in Algeria, to come up with ideas using the data envelopment analysis to measure the extent of the Algerian University in the exploitation of the available resources and facilities. Among the results obtained in this study what follows:

1. By using the model of relative efficiency measurement in accordance with the university faculties input and output oriented (CCR) model, we found that the Faculty of Sciences and Technology and the Faculty of Law have not achieved relative efficiency, while the other faculties have achieved full relative efficiency.
2. By measuring relative efficiency using the faculty universities input and output oriented (BCC) model, we found that the Faculty of Sciences and Technology and the Faculty of Law have not achieved relative efficiency, while the other faculties have achieved full relative efficiency.
3. In this model, the Faculty of Economic Sciences, the Faculty of Arts and the Faculty of Social Sciences were as reference faculties for the Faculty of Sciences and the Faculty of Law. Thus, the latter should follow them, and benefit from them in achieving their efficiency, and improving the use of their available resources or the achievement of outputs.

The most important recommendations of the study:

1. Developing the use of the data envelopment analysis method through the use of outputs reflects the quality of higher education in Algeria.
2. The need for a data base that includes all educational variables related to universities and which is accessible to researchers, and serve to develop and improve the quality of higher education.

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