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Budget Allocation: Impact on The Technical Efficiency of Academic Units of a Brazilian Federal University

Dotação Orçamentária: Impacto na Eficiência Técnica das Unidades Acadêmicas de uma Universidade Federal Brasileira

Asignación Presupuestaria: Impacto en la Eficiencia Técnica de las Unidades Académicas de una Universidad Federal Brasileña

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KEYWORDS

Federal University;
Academic units;
Efficiency.

Abstract: Seeking to add to the discussion about accountability and efficiency in academic units, this work investigated the impact of budget allocation on the technical efficiency of academic units of a Brazilian federal university. The method used, in the first stage, was the Data Envelopment Analysis (DEA), in its input-oriented CCR version, in the second stage, the LOGIT regression model was used, in order to answer the research hypothesis. The findings indicate that, from a total of 27 academic units at the Federal University of Goiás, 6 were efficient, representing a total of 22% of the sample, with the large area called Exact and Earth Sciences presenting the lowest average efficiency, while the area of Applied Social Sciences presented the highest efficiency average. The unit that most appeared as a benchmark reference was the School of Agronomy (EO). The findings, in the second



stage, point out that the variables budget allocation, management time and age of the institution influence the chance of technical efficiency of the academic units. It is believed that this work can add data to the discussion about the internal efficiency control of a complex institution, especially regarding the distribution of resources.

PALAVRAS-CHAVE

Universidade federal;
Unidades acadêmicas;
Eficiência.

Resumo: Buscando agregar a discussão sobre accountability e eficiência em unidades acadêmicas, este trabalho investigou o impacto da dotação orçamentária na eficiência técnica das unidades acadêmicas de uma universidade federal brasileira. O método utilizado, em primeiro estágio foi o Data Envelopment Analysis (DEA), na sua versão CCR orientada por input, no segundo estágio, foi utilizado o modelo de regressão LOGIT, a fim de responder a hipótese de pesquisa. Os achados apontam que, de um total de 27 unidades acadêmicas da Universidade Federal de Goiás, 6 foram eficientes, representando um total de 22% da amostra, sendo que a grande área denominada Ciências Exatas e da Terra apresentou a menor média de eficiência, enquanto a área de Ciências Sociais Aplicadas apresentou a maior média de eficiência. A unidade que mais apareceu como referência benchmark foi a Escola de Agronomia (EO). Os achados, em segundo estágio, apontam que as variáveis dotação orçamentária, tempo de gestão e idade da instituição influenciam na chance de eficiência técnica das unidades acadêmicas. Acredita-se que este trabalho possa agregar dados na discussão sobre o controle de eficiência interna de uma instituição complexa, especialmente no que tange a distribuição de recursos.

PALABRAS CLAVE

Universidad Federal;
unidades académicas;
Eficiència

Resumen: Buscando contribuir a la discusión sobre la rendición de cuentas y la eficiencia en las unidades académicas, este trabajo investigó el impacto de la asignación presupuestaria en la eficiencia técnica de las unidades académicas de una universidad federal brasileña. El método utilizado, en la primera etapa, fue el Análisis Envolvente de Datos (DEA), en su versión CCR guiado por input, en la segunda etapa, se utilizó el modelo de regresión LOGIT, con el fin de dar respuesta a la hipótesis de investigación. Los hallazgos indican que, de un total de 27 unidades académicas de la Universidad Federal de Goiás, 6 fueron eficientes, representando un total de 22% de la muestra, siendo el área grande denominada Ciencias Exactas y de la Tierra la que mostró la eficiencia promedio más baja, mientras que la El área de Ciencias Sociales Aplicadas presentó el mayor promedio de eficiencia. La unidad que más apareció como referente de referencia fue la Escola de Agronomia (EO). Los hallazgos, en la segunda etapa, indican que las variables asignación presupuestaria, tiempo de gestión y antigüedad de la institución influyen en la probabilidad de eficiencia técnica de las unidades académicas. Se cree que este trabajo puede agregar datos en la discusión sobre el control de la eficiencia interna de una institución compleja, especialmente en lo que respecta a la distribución de recursos.

Introduction

Pressure on public accounts exposes the need for a performance-based public funding system, including federal universities (Afonso, Schuknecht & Tanzi 2010; Johnes, 2020). Doing more with less, internal resource allocation policies based on efficiency, good decision-making and accountability are some of the assumptions required by governments around the world (Nenovsky & Tochkov, 2012).

In higher education institutions financed with public resources, performance must be monitored at all levels, since, in most countries, university autonomy occurs, that is, the government transfers the resources that are applied by universities in accordance with internal norms, decided by the collegiate (Ball & Halwachi, 1987; Braga, Peixoto & Bogutchi, 2001; Peña, 2008; Denicol, Schneider & Andrade, 2015; Johnes, 2020).

Despite autonomy, universities tend to copy the general resource allocation model, adapting some points to their reality. This practice affects the quality of the internal distribution of resources, since each institution has internal specificities that are not covered by a general model (Caetano & Campos, 2019). The internal specificities of universities are linked to organizational culture, people management, employee qualification and other factors that occur specifically in the institution (Hoed, 2016; Margon & Poubel, 2016; Rhaïem, 2017).

According to Mainardes and Raposo (2014), it is inevitable that universities act in the process of managerialism, even to minimize internal conflicts. The authors consider managerialism a set of processes aimed at achieving efficiency standards through robust management control systems.

The studies by Kao (2008), Moreno and Tadeballi (2002) and Kounetas, Anastasiou and Mitropoulos (2011) sought to measure the

efficiency of departments within a university through the method called Data Development Analysis (DEA), which consists of measuring the production optimal outputs (outputs), with a certain amount of inputs (inputs), allowing to identify and analyze the technical efficiency of an institution (Kounetas et al. 2011). The exposure of performance, as well as the measurement of efficiency and its disclosure to society, is part of the Accountability concepts.

Accountability is not simply limited to rendering accounts. The shallow view of the accounts without information subsidies to the evaluators

it does not produce the necessary effect for proper monitoring of the use of resources (Bovens, 2007). According to Schillemans and Bovens (2018), accountability occurs intensely at micro levels, with, in most cases, councils or collegiate bodies responsible for overseeing, demanding justifications, punishing or giving bonuses.

Faced with technical efficiency and accountability in academic units, the following research problem arises: What is the impact of budget allocation on the technical efficiency of academic units in a Brazilian federal university?

The general objective of the research is to investigate the impact of the budget allocation on the technical efficiency of the academic units of a Brazilian federal university.

The Kao Studies (2008); Moreno and Tadeballi (2002) and Kounetas, Anastasiou and Mitropoulos (2011) identified the technical efficiency of academic units, but the relationship between the efficiency found and the budget allocation of academic units was not verified, in the light of accountability theory. For Johnes (2020), performance must be compared, rewarded or punished, therefore, responsible agencies must act in favor of and in accordance with performance. Therefore, this study is justified by filling this gap in studies between the value received by

academic units and their efficiency, bringing reflections to the theory of accountability. In the view of Schillemans and Bovens (2018), accountability in internal councils is little investigated by researchers and other public bodies and this negligence has serious consequences for the quality of internal governance of institutions that are managed via councils.

As a practical justification, there is the opportunity to compare (benchmarking) academic units, since, despite differing in several aspects, the core activities of research, teaching and extension are the same. Another practical justification is to help managers look more critically and analytically at the performance of these units, corroborating performance-based policies.

Theoretical Framework and Construction of a Hypothesis

Accountability at Universities

Although there is a range of meanings surrounding the term accountability, what defines it most is the limitation of power (O'Donnell, 1994). For Schedler (1997), controlling power means imposing limits on those who consider themselves unlimited, and this limit becomes crucial for the gears of democracy to work.

The contemporary view of management in the public sector considers management based on governance to be paramount, due to the scarcity of resources and the non-congruence between what is being carried out by the public machine and the aspirations of society (Ball & Halwachi, 1987; Abbott & Doucouliagos, 2003; Michelotto, Coelho & Zainko 2006; Kounetas, Mitropoulos & Mitropoulos, 2007; Giancomello & Oliveira, 2014; Schillemans, 2015). Schillemans (2015) adds that interest in accountability has more than doubled in recent

times, due to combinations of factors such as: charging public spending, the need to optimize resources, as well as implementing the concept of efficiency for all public processes.

The interest in accountability and especially how to use it should be carefully investigated, as accountability has become the main icon of good governance in the public sector. However, in many situations this term is used in a simplistic, generic and confusing way, presenting objectives that do not match the genuine concept of the expression (Shore, 2004; Bovens, 2007; Schillemans, 2015).

O'Donnell (1994) pointed out that accountability, when it occurs between government agencies, in which agencies and ministries receive power to inspect, monitor, charge and punish, is called horizontal accountability.

Horizontal accountability represents a set of fixed dimensions and a constant act of monitoring, rendering of accounts and charging for justifications, generating a variable called learning. The audited body learns from mistakes and increasingly improves its mechanisms, generating organizational learning in the process (Bovens, 2007).

However, Shore (2004) says that accountability does not generate learning, but exacerbated pressure, which threatens the autonomy of public bodies. This occurs due to its distorted use, through excessive accountability for everything and everyone, plastered goals aimed at particular interests, and even an excess of punishment for those who did not meet these goals.

The criticisms presented by Shore (2004) are focused on the lack of understanding of the heterogeneity of several sectors that integrate the public machine. When certain bodies are monitored, their role in society must be understood, what they must account for and, above all, that their reports are interpreted and measured with performance indicators capable

of encompassing all the functions of that institution or body; in turn, this process is called upon to calibrate accountability (Koppell, 2005; Schillemans, 2015).

For Koppell (2005), everyone understands the benefits of accountability, but the ambiguity that surrounds it creates inconvenience for both institutions and society. It is observed, therefore, that the wrong choice of what to measure can lead the institution to the opposite path of management quality. The author also points out an even worse loss, which consists of making institutions too responsible, causing managers to try to respond to everything and achieving nothing.

Accountability occurs intensely at micro levels and precisely these levels are neglected by researchers, due to the difficulty in understanding what happens within institutions, especially in terms of accountability. Internal boards suffer from the imitation of models external to the institution, which do not consider their specificities, including people management, organizational culture and technology management (Schillemans & Bovens, 2018).

Studies, such as those by Afonso, Schuknecht and Tanzi (2010) and Wolszczack-Derlacz (2017), point out that richer bodies and institutions tend to be more efficient. Within a university, this premise must be dealt with in great depth. If one department is richer than the other, it tends to be more efficient because it has more resources available for use. However, university management needs to minimize the effect caused by resources, taking care not to create peripheries within the university itself (Tochkov & Nenovsky, 2012; Diniz, 2012; Giacomello & Oliveira, 2014; Margon & Poubel, 2016; Wolszczack- Derlacz, 2017).

Moreno and Tadepalli (2002), sought to test the technical efficiency of the academic units of an American university, using as

indicators: faculty salary; salaries of other employees; available budget for each unit; number of graduates, number of undergraduate courses and grants awarded to students. The findings indicate that most units are efficient.

Kao (2008) measured the technical efficiency of 41 academic units at a university in Taiwan. The inputs used were: number of servers, total expenses and physical space; the outputs used were: teaching load and number of publications. The findings indicate that 31% of the units operated inefficiently. Among the most efficient, the medical school had a high rate of expenses, and, on the other hand, a high rate of results.

The study by Kounetas et. al (2011) sought to measure the technical efficiency of 18 academic units at a Greek university, in the period from 2001 to 2004. The findings indicate that most units operate efficiently, and that variables such as, age of the academic unit and qualification of the employees positively impact the efficiency of the units.

Considering the studies by Moreno and Tadepalli (2002), Afonso, Schuknecht and Tanzi (2010) and Wolszczack-Derlacz (2017), the following research hypothesis arises:

H1 – The budget allocation of academic units positively influences their technical efficiency.

Methodological elements of the research

The study presents, via documentary research, a quantitative approach to a descriptive object. The quantitative approach will be performed using Data Envelopment Analysis (DEA) and statistical regression models. The period investigated corresponds to the year 2019.

The focus population of the research are the academic units of the Federal University of Goiás. UFG is located in the state of Goiás, founded in 1960 and has 102 on-site

undergraduate courses and 78 postgraduate courses, totaling 26 thousand and 200 students, distributed in two regions, City de Goiás and Goiânia (UFG, 2020).

UFG courses are divided into 27 academic units and 2 special academic units (UAE). According to UFG's 2013 statute, academic units are academic bodies composed of a board of directors, board of directors and coordinators of each area and course. These organizations are responsible for research, teaching and extension activities. The two UAEs were excluded from the sample because they were not considered academic units in their entirety and because they did not have enough data for the research, which reduces the sample to 27 academic units, all located in Goiânia-GO and the metropolitan region.

The DEA CCR model is only applied correctly if the inputs and outputs are congruent with the analyzed DMUs. The function of an academic unit constitutes: research, teaching and extension; therefore, inputs and outputs must robustly capture these three dimensions. The chosen input was the cost per student. The cost per student is calculated as follows:

$$CPA = \frac{DRD + DRT + DPE + VRU}{\text{Number of students}}$$

CPA = Cost per student;

DRD = Personnel expenses with teaching remuneration;

DRT = Personnel expenses with technical-administrative remuneration;

DPE = Personnel expenses with charges;

VRU = Value transferred to the unit;

Number of students = Total students per unit.

The outputs are: Number of publications, Number of articles in JCR, Number of courses per unit, Number of graduates, Number of actions per extension, Indicator of difference between observed and expected performance -

IDD, Number of graduates stricto sensu.

The second stage will be via the LOGIT econometric model. If the unit is efficient, its value will be 1, if it is not efficient, its value will be 0. Thus, this study will use the LOGIT regression model as the second stage of the analysis, using the efficiency score as the dependent variable, found in the DEA CCR and as independent variables, the variable that represents the budget allocation, together with exogenous variables that will control possible impacts on the efficiency of the academic units.

The dependent variable will be the efficiency score found in the first stage and the independent ones will be: Unit budget allocation, Academic unit age, Management time and Student equivalent. The equivalent student variable represents the number of students in the unit, multiplied by the weight of the course, recognized by CONSUNI UFG Resolution No. 02/2011.

Presentation and discussion of results

Of 27 units, 6 were efficient, ie 22% of the population. Giancomello and Oliveira (2014) analyzed the efficiency of 20 units of a Brazilian federal university. The findings indicate that only 1 unit was efficient in the investigated period. Despite the higher value than the value found by Giacomello and Oliveira (2014), the percentage of efficient units is low.

With regard to the result for large areas, it can be seen that the Exact and Earth Sciences area had the lowest average efficiency. Diniz (2012) states that efficiency can be linked to non-controllable factors that are independent of the unit or institution. However, this body may be performing well in areas not easily measured. For Denicol et al (2015), all beliefs built about exact science courses must be changed, as they impact performance and

consequently compromise the performance of the institution as a whole.

The Applied Social Sciences courses had the highest efficiency average. Braga, Peixoto and Bogutchi (2001) state that Applied Social Sciences courses have a large offer at night, which democratizes teaching, allowing the student to earn income through work during the day and study at night.

The three units that presented the worst efficiency indexes were the Institute of Mathematics and Statistics (IME) – 0.321906, Institute of Informatics (INF) – 0.34380 and Faculty of Dentistry (FO) – 0.390816.

The DEA CCR model is able to identify which efficient unit serves as a benchmark for inefficient units. Of the three least efficient units, their peers to benchmark are:

Institute of Chemistry - School of Agronomy (EA)

Institute of Mathematics and Statistics (IME) - School of Agronomy (EA)

School of Dentistry (FO) - School of Agronomy (EA)

One of the components of the cost per student is the number of enrolled students (undergraduate and stricto sensu graduate). The School of Agronomy (EA), despite having a weight of 4.5, has a high number of enrolled students, a total of 1643; while the Institute of Mathematics and Statistics (IME) has 732 students; the Institute of Informatics (INF) has 665 and the Faculty of Dentistry (FO) has 732 enrolled students. According to Kounetas et al (2011), courses that are related to the main economic activity of the region in which they are located tend to attract more attention from candidates. The state of Goiás has agribusiness in general as its main economic activity, which can make courses aimed at this area more attractive and attractive to potential candidates. Another possible explanation is given by Hoed (2016). For the author, courses involving a large amount of calculus subjects

require students to have a satisfactory framework of prior mathematical knowledge. When the student realizes that he has a deficit, he tends to drop out.

The three inefficient units also have a low number of publications, when compared to the benchmark efficient unit, pointing to a greater need to manage their research. However, EA has 213 students enrolled in stricto sensu programs, while FO has 79, INF has 108 and IME has 125, that is, EA has a greater number of stricto sensu productive workforce. Another factor is that EA has a unit-indexed journal. In a way, this factor facilitates the submission of papers.

The number of EA publications in JCR journals is higher than the others. Oliveira, Rodrigues and Matias (2017) point out that the area of agricultural sciences in Brazil has become one of the most efficient and with the highest international standard of scientific publications, which raises the scientific production of national agribusiness to a high level.

Table 1 presents the results of the adjusted LOGIT model.

Table 1 – LOGIT Model

efficiency score	Coefficient	P> z
budget allocation	00000	0.03 _
Management Time	3.143836	0.04 _
Academic unit age	0.2174779	0.08 _
LR chi2 (3)	14.79	000
problem > chi2	0.002 _ **	000 *
Pseudo R2	0.5172 _	000

Source : Research data (2021)

Note : *Significance level 0.1 **Significance level 0.05

It is noted that the variables Budget allocation and Student equivalent did not show statistical significance; however, according to Fávero and Belfiore (2017, p. 654), when a

variable, in the LOGIT model, is not significant at the established level, it is necessary to adjust the model through the Stepwise process. The Hosmer-Lemeshow test was performed in order to verify the adequacy of the adjusted model in relation to the original model. The value of Prob > chi2 of 0.27 indicates that the adjusted model does not present problems in terms of quality. According to Fávero and Belfiore (2017, p. 655), if the Prob > chi2 of the Hosmer-Lemeshow test is greater than 0.05, it does not reject the null hypothesis that the expected and observed frequencies are the same, thus making the proper fit.

Regarding the sensitivity of the model, the value presented was 88.89%, showing a high global efficiency of the same. For Fávero and Belfiore (2017, p. 663), global efficiency values above 0.70 can be considered very good for forecasting purposes.

The research hypothesis: – The budget allocation of the academic units positively influences their technical efficiency, was corroborated, given that the budget allocation variable showed statistical significance at the 0.05 level. The chance of a given unit being efficient when attributing 1 real more than budget allocation, keeping the other conditions constant is positive. According to Kounetas et al (2011), a high budget allocation can represent power within the academic community, and this power can be used in favor of the unit.

Silva et al (2012) point out that when the budget allocation reflects the performance of the academic units, that is, performance and budget go hand in hand, and, to a certain extent, it validates the university's budget matrix. According to Diniz (2012), the institution's autonomy becomes a strong ally of efficiency. For the author, when the budget distribution manages to be less conditioned, the unit or institution that receives that resource manages to allocate it according to its

needs.

The management time variable showed statistical significance. The chance of a given unit being efficient when assigning 1 year more time for the manager to remain in his position, keeping the other conditions constant is positive. For Kounetas et al (2011), a manager with a longer tenure has more experience in predicting and resolving adversities and tends to have high bargaining power, which would benefit his unit. Margon and Poubel (2016), on the other hand, emphasize that the management of the units is carried out by a manager teacher, resulting in a double journey that often overloads this professional, making him deficient in one of his functions, but when the managing professor has held this position for many years, through his experience, he becomes able to minimize this effect of the double journey.

The variable age of the academic unit was statistically significant. The chance of a given unit being efficient when assigning 1 year more age, keeping the other conditions constant is positive, in line with the findings of B Kounetas et al. (2011) and Rhaiem (2017). According to Bovens (2007), the greater the transparency and inspection mechanisms, the greater the learning over time and, consequently, old institutions or bodies that have already gone through several inspection processes, learn from their mistakes, improve their processes and improves your performance. For Rhaeim (2017), learning added over the years can be converted into better performance.

Final considerations

The frequent cuts in resources made available for higher public education in recent years, coupled with a strong demand and supervision of the use of these financial resources, brings to light the concepts of a new public administration, one of its pillars being

accountability.

This study focused on two paths: The technical efficiency of academic units and the determinants of this efficiency, in academic units of a Brazilian federal university. The findings indicate that 6 investigated units were efficient, totaling 22% of total efficiency. With regard to the major teaching areas, the Exact and Earth Sciences area had the lowest average efficiency, while the Applied Social Sciences area had the highest average efficiency. The academic unit with the highest number of benchmark interactions was the School of Agronomy.

Despite the low efficiency index found, it is not intended here to determine that the units did not reach the expected performance, given that exact and earth science courses can provide qualified labor that meets all the demands of the state and the country. . According to the institutional website of the investigated university, 95% of the active courses have a good or excellent score in the ENADE concept. However, courses in these areas suffer from chronic problems in Brazil, such as low background of students when entering university and high dropout rates, which increases management challenges in minimizing these effects.

The Applied Social Sciences courses present a strong democratization of teaching, as they are, in theory, courses that do not require a large infrastructure, in addition to providing a night class, allowing students to work during the day and attend a graduation at night, thus achieving a larger portion of the population that needs to work to maintain their studies.

Benchmark findings between units should not be used as a trigger for competitiveness, but as an opportunity to share knowledge between academic units, given that the main objective between units should be to promote research, always seek to improve teaching and maximize extension projects that benefit

society.

With regard to the determinants of efficiency, the budget allocation was statistically significant, indicating that in many academic units there is a probability of a positive influence of the budget allocation on efficiency. These findings show the importance and challenges of creating a budget matrix model capable of minimizing differences, boosting performance and efficiency, and also maintaining equity among units.

The unit age variables and the time the manager has been in charge of the academic unit were statistically significant, indicating a probability of positive influence between these variables and efficiency.

This article achieved its objective, however, the need to create an annual report for the academic units was identified, in which each unit reports its goals, actions, financial execution, limitations, collections and other information of interest to the academic community, in this way, researchers, students, society, management, government and other interested parties can verify everything that has been done of relevance within the unit, increasing its transparency and consonance with accountability.

A suggestion for future research would be to compare the efficiency levels of academic units from two or more federal universities in different regions, in order to verify whether the region affects the efficiency of the unit.

In view of all the contributions, analyzes and discussions raised, it is believed that this research contributes to the advances in transparency and the search for better results in higher education in the country.

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