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Master's degrees at Spanish public universities: An explanatory efficiency model

Másteres en universidades públicas españolas: Un modelo explicativo de su eficiencia

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ABSTRACT

Competition between universities is increasing and master's degrees are in the spotlight. The efficiency of such degrees undoubtedly affects the success of a university, so it has important implications for their prestige and the rest of university's´ actions and strategies. This paper aims to identify which variables (both managerial and contextual) serve to improve the efficiency of a university's Master's degree offer. To that end, we use a three-step research method: first, we apply a Delphi process to identify the inputs-outputs for determining efficiency. Based on the proposals made by experts, we have developed an specific indicator called Student oriented Economic Transient Efficiency adjusted for Quality (SETEQ), which includes quality as an output. Second, a Data Envelopment Analysis (DEA) is carried out as a tool to establish an efficiency ranking of universities in regard to their master´s degrees. Third, we propose a moderation model that allows us to relate the efficiency of Master's degrees with the different strategies followed by the

universities (direct management factors) in order to find out which strategies are more effective. This model includes moderating effects (contextual factors) that condition the effectiveness of these strategies Our findings show that master´s degrees are more efficient when the quality assurance system is flexible and regional authorities are proactive in education.

Keywords. efficiency, data envelopment analysis, higher education, master´s degrees, quality

RESUMEN

La competencia entre universidades es cada vez mayor y los Masters de las universidades están en el punto de mira. La eficiencia de estos títulos afecta sin duda al éxito de la universidad, ya que tiene importantes implicaciones para su prestigio y el resto de actuaciones y estrategias de la universidad. Este trabajo se propone identificar qué variables (tanto de gestión como de contexto) sirven para mejorar la eficiencia de la oferta de títulos de máster de una universidad. Para ello, utilizamos un método de investigación en tres pasos: en primer lugar, aplicamos un proceso Delphi para identificar los inputs-outputs para determinar la eficiencia. A partir de las propuestas realizadas por expertos desarrollamos un indicador específico denominado Eficiencia Económica Transitoria Orientada al Estudiante Ajustada a la Calidad (SETEQ), que incluye la calidad como un output, siendo una aportación metodológica frente a la literatura tradicional. En segundo lugar, se realiza un Análisis Envolvente de Datos (DEA) como metodología para establecer un ranking de eficiencia de las universidades con respecto a sus títulos de máster. En tercer lugar, proponemos un modelo de moderación que permite relacionar la eficiencia de los masters con las diferentes estrategias seguidas por las universidades (factores de gestión directa) para conocer aquellas estrategias que se muestran más efectivas. Este modelo recoge efectos moderadores (factores contextuales) que condicionan la efectividad de estas estrategias. Nuestros resultados muestran que los másteres son más eficientes cuando el sistema de garantía de calidad es flexible y las autoridades regionales son proactivas en materia de educación.

Palabras clave. *eficiencia, análisis envolvente de datos, educación superior, máster, calidad*

INTRODUCTION

Performance at public universities is usually assessed in terms of efficiency. Within the literature on universities as a whole there are papers that focus on the department level (Giménez & Martínez, 2006), others that focus on faculty and undergraduate level (Kashim et al., 2018, Mendoza-Mendoza, 2022) and others still that focus on MBAs (Ekiz & Şakar, 2020). However, there are no studies that consider the master´s degrees area as a whole for purposes of efficiency analysis. The competitive level of the master's degree market is forcing institutions to make significant efforts to differentiate themselves in order to attract students. It is necessary to assess whether these efforts are well focused and efficient. Furthermore, in master's degrees, differentiation between universities is more feasible.

Efficiency refers to how effectively resources (inputs) are used to produce desired results (outputs), both in terms of quantity and quality. The quality of master´s degrees may be assessed by external assessment agencies (e.g. ANECA in Spain), but these evaluations accredit a minimum level of quality; above the minimum standard of quality, there are various levels and not all universities have to compete to attain the highest quality. They may choose to offer lower quality but more affordable tuition fees, which may result in more efficient master´s degrees in financial terms. So it is not just a question of achieving the highest quality but also of assessing the use of inputs for this level of quality. The efficient use of financial, academic and other resources means

obtaining outputs with the lowest possible level of investment in resources (De Witte & López-Torres, 2017).

This paper sets out to identify what university-related variables (both management and context variables) for master´s degrees result in the greatest efficiency. To that end, we categorise universities by their master´s degrees in line with their levels of efficiency, taking quality as one of their outputs. The research method used involves three stages:

(i). Choosing the right inputs and outputs to construct a relative efficiency indicator for master´s degrees. This is done via the Delphi method: a process of open thinking and reflection with experts about the variables to be considered as determinants of efficiency.

(ii). Measuring the relative efficiency of universities via Data Envelopment Analysis (DEA). Specifically, this paper uses Student-oriented Transient Economic Efficiency adjusted for Quality (SETEQ). This process enables a map of relative efficiency of the universities in the area of master´s degrees to be drawn up.

(iii). Proposing a model that explains the effects of management and context variables on the relative efficiency of universities in the field of master´s degrees. An analysis of moderation is used. The model proposed is based on the papers of Holsapple & Lee-Post (2006) and OECD (2021); a two-level contrast is performed, on the one hand, management variables related to efficiency are identified: forms of learning (face-to-face vs. online), the type of teaching staff (sessional teachers vs. regular staff) and the flexibility of the quality assurance system are the management variables. On the other hand, context-based variables are included as moderators (regional proactivity in education –on the part of the government– and the specialist or generalist nature of universities).

This paper makes both a methodological and practical contribution in the field of efficiency in higher education. Regarding the first, we propose a type of efficiency called SETEQ as a proper way to assess master´s degrees and their inputs and outputs validated by experts. As a practical contribution, we propose an explanatory model that could give universities tools to improve their efficiency.

The rest of the paper is structured as follows. Section 2 outlines the efficiency issues: its concept adapted to master´s degrees, the Delphi method used to select the inputs and outputs that define the efficiency indicator used in this work (SETEQ) and the DEA as a method for measuring efficiency. Section 3 defends the hypothesis concerning the decisions made by universities on the management of master´s degrees and their context variables. Section 4 explains the working methodology. The results are then set out and discussed in Section 5. Section 6 concludes.

EFFICIENCY IN MASTER´S DEGREES IN HIGHER EDUCATION

The measurement of efficiency requires the prior definition of the type of efficiency that is going to be measured (Agasisti & Johnes, 2009). The concept of efficiency proposed here, which we call SETEQ (Student-oriented Economic Transient Efficiency adjusted for Quality), has five main characteristics:

(i). It is relative, i.e. the equilibrium between inputs and outputs is taken into account (Camanho, et al., 2024). That equilibrium is not static but rather depends on the efficiency of other universities.

(ii). It is student-oriented: assessing education performance is a challenge in which students' perceptions need to be taken into account (Thanassoulis, et al., 2017). The inputs and outputs for efficiency are linked to the generation of value for students, i.e. they are variables linked to the education received by students.

(iii). It is economic: managing for results in the public sector must be based on the concept of economic efficiency (Volchik & Maslyukova, 2017, Tran et al., 2023). As pointed out by

McMahon (2010), economic efficiency includes external efficiency (i.e. how well education serves the needs and demands of society) and not just internal efficiency.

(iv). It is transient: Badunenko et al. (2021) distinguish between transient and persistent inefficiencies in terms of the effect of time. The former are short-term, in general lasting a year, and reflect the context of the institutional level. The latter denote long-term operational problems, generally involving state-specific HE structures. They are constant and therefore focus on structural efficiency.

(v). It is adjusted for quality: quality is considered as an output. As pointed out by Salerno (2003), their failure to measure quality is the biggest weakness of studies of higher education efficiency. In the last ten years an effort has been made to fill this gap but, as stated by De Witte & Lopez-Torres (2017), there is a need to continue working so as to develop indicators that can capture teaching quality.

Once the concept of efficiency is defined, we identify the appropriate inputs and outputs for postgraduate degrees, through a Delphi process. Then, the efficiency level of each university is determined, using Data Envelopment Analysis.

Establishing inputs & outputs so as to calculate the efficiency of master´s degrees: Delphi.

Authors such as Ekiz & Sakar (2020) analyse the efficiency of various MBAs and propose specific inputs and outputs for such courses. However, there are no specific efficiency analyses with suitable inputs and outputs for master´s degrees. These degrees have features that distinguish them from analyses of universities as a whole, but at the same time they are more complex than individual programs such as MBAs, given that they share resources from various organisational units as interconnected and interdependent entities.

Given the importance of selecting the right inputs and outputs and the lack of previous studies, we decided that the Delphi method was a suitable way of approaching the matter. This method requires the participation of experts, and selecting them plays a vital role in achieving reliable results. For our case:

(i). The experts needed to be prominent in the field of master´s degrees, so we enlisted vice-rectors and area heads at each university.

(ii). Spain's leading universities in this field needed to be represented, so we contacted RUEPEP (University Network of Master´s degrees and Continuing Education), which put us in touch with those where master´s degrees are most highly developed.

(iii). Different sizes needed to be covered. The size of a university may be relevant in terms of its efficiency, so we selected small, medium and large universities in terms of the numbers of students enrolled.

On this basis, 15 Spanish public universities took part in the Delphi process (see Annex 1).

A pre-test is recommended before questionnaires are sent out. To this end, it used a sample of head for Postgraduate education at the Spanish universities attending at the 17th meeting of RUEPEP.

At the start of the process the experts were sent a letter introducing the study and its goals and inviting them to take part in it.

(i). Round One: A semi-structured questionnaire was drawn up based on the various proposals as to suitable inputs/outputs that emerged from the 17th meeting of RUEPEP. Experts were asked to use a 10-point Likert scale to assess the economic variables, and to propose any others that they considered appropriate. They were also asked to suggest variables for gauging the quality of master´s degrees as an output.

(ii). Round Two: Suggested inputs and outputs that received a score of less than 7 in round one were eliminated and some new proposals that emerged from that round were included. The experts were asked to assess the variables for measuring quality that they themselves had proposed in round one on a Likert scale.

(iii). Round Three: Once again those variables with scores of less than 7 were eliminated and feedback on the previous round was provided. The experts were then asked to rate the remaining variables again.

In round three there was a significant degree of consensus, so the Delphi process was brought to an end. The major statistics used in Delphi studies are measures of central tendency and level of dispersion, and both were more than acceptable here.

The figures obtained are listed in Annex 2. We accepted all inputs/outputs for which the IQR was 2 or less (Scheibe et al., 1975). The validity of items with scores of 2.5 is analysed using the proposed Group Convergence (GC). GC is governed by the interquartile range, which contains 50% of the respondents (Di Zio et al., 2017).

The results for the selected variables are shown in Table 1. They are discrete variables, but due to the difficulty of obtaining precise data the information was gathered through intervals.

Table 1. Selected inputs/outputs

	Variables	Scale
INPUTS	Revenue from tuition fees	Intervals (ranging from €500,000 to more than €7,000,000)
ECONOMIC OUTPUTS	Nº credits taught	Intervals (ranging from 1,000 to more than 7,000 credits)
	Nº postgraduate students	Intervals (ranging from 300 to more than 3,000 students)
QUALITY OUTPUTS	Nº educational cooperation agreements	Intervals (ranging from 50 to more than 400 cooperation agreements)
	Success rate (nº of postgraduates / students enrolled)	Intervals (ranging from less than 80% to more than 98%)
	Nº editions	Intervals (ranging from 2 to at least 11 editions)
	Would you recommend this master´s degree?	Intervals (ranging from less than 61% to more than 96%)
	Ranking according to the Spanish National Research Council (CSIC)	Intervals (ranging from 250 to more than 2,000 positions)

Determining the efficiency of universities regarding the master´s degrees: DEA

Once the most appropriate inputs and outputs for measuring the efficiency of master´s degrees were identified through the Delphi methodology, the next step was to measure efficiency. Data Envelopment Analysis (DEA) was used to empirically measure the efficiency (SETEQ in our case) of decision-making units (DMUs) (universities regarding their master´s degrees in our case). DEA is an appropriate methodology for analysing levels of efficiency in education: it is used in 70% of the 221 studies on educational efficiency analysed by De Witte & López-Torres (2017).

DEA enables a ranking of universities to be drawn up in line with their relative efficiency levels (SETEQ) (Table 2). In this paper, an orientation towards output is acquired: we seek to obtain the maximum output while maintaining inputs. We use the varying results option because we prioritise any link between inputs and outputs over any linear increase in them, taking on board the possibility of a law of diminishing returns as observed in papers such as Lee (2020). Resampling of DMUs gives similar results, confirming the robustness of DEA analysis. Specific results on inputs and outputs are shown in Section 5 “Results”.

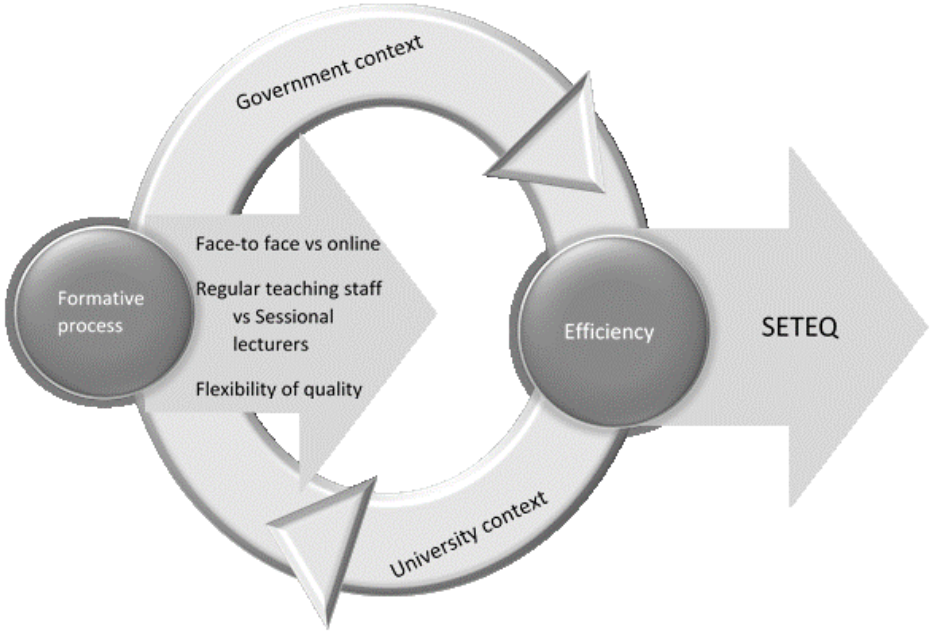
Table 2. Transient Economic Efficiency adjusted for the Quality (SETEQ) of master´s degrees

University	Acronym	SETEQ
Autonomous University of Madrid	UAM	86.556
Barcelona University	UB	100.0
Burgos University	UBU	56.211
Complutense University of Madrid	UCM	100.0
Extremadura University	Unex	100.0
Jaen University	Ujaen	100.0
Jaume I University	UJI	85.511
Malaga University	UMA	95.128
Murcia University	UM	87.097
Oviedo University	Uniovi	100.0
Pablo de Olavide	UPO	85.859
Polytechnic of Catalonia	UPC	100.0
Polytechnic University of Cartagena	UPCT	83.333
Pompeu Fabra University	UPF	98.848
Public University of Navarre	UPNA	94.737
Rey Juan Carlos University	URJC	80.509
Rovira i Virgili University	URV	100.0
UNED	UNED	100.0
Polytechnic University of Valencia	UPV	87.430
Carlos III University in Madrid	UC3M	97.396
University of Alcala	UAH	100.0
University of Almeria	UAL	93.548
University of Cantabria	Unican	100.0
University of Cordoba	UCO	87.097
University of Granada	UGR	100.0
University of Huelva	UHU	100.0
University of Leon	Unileon	78.637
University of Salamanca	Usal	85.714
University of the Balearic Islands	UIB	68.567
University of the Basque Country	UPV/EHU	98.067
University of Valencia	UV	100.0
University of Zaragoza	Unizar	88.969
SETEQ (mean and SD)		91.85 (30.96)

HYPOTHESES AND GROUNDING IN THEORY

Once the degree of efficiency of the masters ´degrees of the different universities has been established, it is necessary to analyse to what extent adequate management can improve this efficiency. The hypotheses put forward here seek to identify what university management variables are determinant for the efficiency of master´s degrees. To that end, we use two overlapping models: that of Holsapple & Lee-Post (2006), based on the management of formative-oriented systems and, and that of the OECD (2001), which takes contextual factors into account as determinant in the process (see Figure 1).

Figure 1. Conceptual model of university management of efficiency in master´s degrees

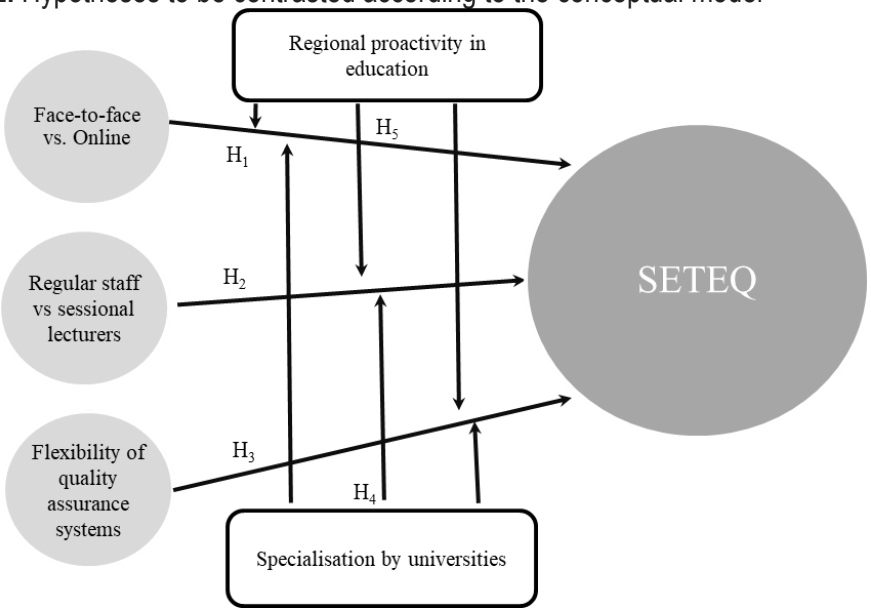


Source: adapted from Holsapple & Lee-Post (2006) and OECD (2021)

The model has two levels – process and context – as determinants of efficiency. The process includes decision-making variables that characterize the teaching process; we thus consider the form of learning (face-to-face vs. online), the type of teaching staff (sessional lecturers vs. regular staff) and the flexibility of the quality assurance system. At the context level, two variables are considered: the government context affecting the decision-making process in the university system –specifically, the level of proactivity of the regional government in education– and the university context –degree of specialisation at Higher Education Institutions (HEIs). These are unlikely to vary at least in the short or medium term.

Both are considered as moderating variables in the relationship between process and efficiency (Figure 2).

Figure 2. Hypotheses to be contrasted according to the conceptual model



The first hypothesis concerns the link between efficiency and the form of teaching. One of the primary motivations underlying the adoption of online learning is precisely its efficiency gains. The type of teaching given can affect three areas: costs (given that the resources required are reduced); the number of students that can be reached (given that geographically remote students can be taught); and the quality of the education provided. Online education enables economies of scale to be applied (Castro & Tumibay, 2021): it is less resource-intensive, and although it may entail a high initial outlay the investments required have already been made in most cases, given that online education is already supplementing face-to-face teaching. It is cost-effective in the sense that it offers opportunities for learning for the maximum number of learners with no need for many buildings (Arkorful & Abaidoo, 2015).

The reduction in costs also extends to students. Every student has the opportunity of choosing the place and time that best suits him/her (Arkorful & Abaidoo, 2015). This opens up education to students who are holding down a job but wish to supplement their education to further their careers. This asynchronous system permits each student to study at his or her own pace, however slow or quick (Klein & Ware, 2003). It therefore increases satisfaction and decreases stress (Klein& Ware, 2003). This is a key element in perceived quality. However, there is also research which indicates that learners have a preference for face-to-face because it facilitates social interaction and communication skills are acquired in a classroom environment (Osgerby, 2013). Many research studies to date indicate that distance education and traditional face-to-face teaching can yield equivalent learning outcomes (Arbaugh et al., 2010).

Postgraduate students tend to be highly motivated, which is a key factor for the success of online systems; indeed some studies find that greater efficiency is achieved in virtual learning environments (Lacka et al. 2021) so the following hypothesis can be put forward:

H1: A greater online component in the teaching offered increases SETEQ.

In master´s degrees it is common to enlist “sessional lecturers”, i.e. teachers who are not “regular faculty” and “not in permanent or tenured positions” (Percy et al., 2008). Within that category, the most common profile is that of specialists in a sector who maintain their jobs in that sector but concurrently teach subjects in which they have expertise. Such sessional lecturers can increase output in terms of both quality of education and numbers of graduates. However, their understanding of teaching and learning principles may often be limited. Granum (2004) finds that student satisfaction with sessional lecturers is greater in those cases where the knowledge sought is concerned with practical procedures, which is a common feature of master´s degrees.

Renowned specialists prominent in their fields can be brought in, because sessional lecturers are not subject to the rigorous recruitment and selection processes involved in obtaining permanent positions.

H2: More involvement of sessional lecturers increases SETEQ

Chen (2012, p. 1280) states that “educational sectors should learn from business”. University managers have increasingly adopted paradigms typical of business management to improve the quality of processes and the efficiency with which processes are implemented. But at the same time quality accreditation systems need to be flexible in order to be efficient (Bleiklie, 2005). The introduction of quality systems that recognise customer orientation and market orientation is a crucial step.

The master’s degrees taken into account in this study, self-funded master´s degrees, are not necessarily subject to accreditation from external assessment agencies: it is each university which determines the assessment procedure used. Universities may opt for more flexible quality assurance systems which enable them to increase their market share or for stricter systems that provide more assurances but make them less adaptable. The management of internal quality

assurance therefore directly influences quality processes and also the speed with which changes and adaptations in the range of education on offer are reflected.

Numerous studies (Welch, 2007) have found that universities with stricter systems offer higher quality. However, HEIs that have implemented more flexible quality systems have proven to be more capable of exploring new market opportunities and occupying market niches by using their greater administrative flexibility and financial motivation. To date the greater responsiveness of these HEIs has been regarded as a powerful force in driving institutions to supply qualifications better suited to labour market needs and with greater demand and satisfaction among graduates.

The following hypothesis is thus put forward:

H3: More flexible quality assurance systems increase SETEQ.

Teaching specialisation at universities may potentially influence the link between the teaching process in master´s degrees and their level of efficiency (Parellada & Duch, 2006). Teaching specialisation means that universities should only invest in those inputs which are specific to the services that they offer. This would avoid the redundant investments and unjustified excesses in resource use that can arise in non-specialised universities. Bruni et al. (2020) find that some degree of specialisation at HEIs enables them to use resources more efficiently. The study by Gómez-Sancho & Mancebón (2012) sorts Spain's 47 public universities into three groups: specialists that practically only offer technical qualifications, those which offer practically no technical qualifications and generalist universities that offer a wide range of qualifications. The same study finds that the highest proportion of efficient universities is in the first category. This may be due to their teaching processes being better adapted to the needs of students.

However, generalist universities could be conducive to cost savings as a result of economies of scope: they can use their resources to produce multiple outputs. But the results do not seem to bear out such savings from the joint production of outputs; indeed, some studies point to inefficiencies (Toutkoushian & Lee, 2018). We therefore consider as follows:

H4: Greater specialisation by universities moderates the link between the variables associated with the teaching process on master´s degrees and their efficiency.

Higher education has traditionally been governed hierarchically in many countries, with the state at the top of the hierarchy (Pham & Goyette, 2019), though there has been a gradual decentralisation, with universities becoming more autonomous. The main justification for this decentralisation is the need to adapt university education to the conditions of the immediate economic, social and cultural environment. Lehmann et al. (2018) highlight this in reference to Germany, acknowledging that federal states may have an advantage in terms of awareness of local interests. Along with this increased ability to adapt to local needs, decentralisation may also prove more efficient for a second reason: it gives universities more scope to negotiate with local governments, since their bargaining power is greater. These two arguments help make universities more autonomous from political authorities, and it has a positive effect. Autonomy enables universities to respond to changes year on year, e.g. to new teaching demands, thus making education systems more effective.

In Spain, authority for university education is devolved to the regional governments. In some regions this was done in the 1980s and in others in the 1990s. The transfer of authority was completed some time ago, but some authors (Agasisti & Pérez-Esparrells, 2010; Parellada & Duch, 2006) observe differences in behaviour between universities in regions where authority was handed over sooner or later. Regions that previously received full authority (e.g., those with regional status or more advanced statutes) had more time to design and implement their own models, which favors proactive and adaptive management. Parellada & Duch (2006) find that universities in regions to which authority was devolved before the 1990s show better indicators for resources, performance, quality and impact. Agasisti & Pérez-Esparrells (2010) state in regard to this group of regions that

"some of them have a more nationalistic identity"; they associate this with a more proactive attitude to managing things for themselves, not just in education but also in other areas. This more active management of devolved authority in education brings universities closer to the demands of society. This leads us to propose the following hypothesis:

H5: Greater regional proactivity in authority for education moderates the link between the variables associated with the teaching process on master´s degrees and their efficiency

METHOD FOR TESTING HYPOTHESES

Data and sample

The population analysed is limited to the subgroup comprising Spain's 48 publicly-run universities (the UIMP –Menéndez Pelayo International University– and UNIA –Andalusia International University– are excluded as they are classed as "special universities" by the Ministry of Education), because this is the largest group (75.6% of students studying postgraduate courses in Spain do so at public universities) and because mixing universities with different management criteria (public and private) may lead to heterogeneous findings.

The sample used comprises 32 universities, all of them public universities that have the data requested. At the remaining 16 universities, managers were unable to provide this information, because it was dispersed across different faculties and therefore not available in aggregate form. The data were collected between June and September 2019.

Scales of measurement

The variables used for the statistics are described in Table 3.

Table 3. Variables used in the explanatory model of efficiency in self-funded master´s degrees.

		Variables	Description	Scale
DEPENDENT VARIABLES		Efficiency (SETEQ)	Measure of the efficiency of the range of self-funded master´s degrees offered by public universities in Spain	Continuous variable extracted from the DEA
INDEPENDENT VARIABLES	DIRECT LINK	Sessional lecturers	% of sessional teaching staff compared to average % of sessional teaching staff at all other universities	Dichotomous 0 if below mean 1 if above mean
		Online education	% of online education provided compared to average % of online education at all other universities	Dichotomous 0 if below mean 1 if above mean
		Flexibility of quality assurance systems	An *ad-hoc* committee (low flexibility) or a standing committee (high flexibility) is set up to address a new master´s degree	Dichotomous 0 Low flexibility 1 High flexibility
	MODE RATIN	Specialist university	Whether the % of master´s degrees offered in a certain knowledge area is very low (less than difference of two	Dichotomous 0 Generalist 1 Specialist

		deviation) or higher than the average % of master´s degrees offered in that area at all other universities. Data are obtained from the Spanish National Institute of Statistics.	
	Regional proactivity in education	Proactivity in the autonomy of the regional government on matters of education, as per Agasisti & Pérez-Esparrells (2010)	Dichotomous 0 Low autonomy 1 High Autonomy

Econometric method

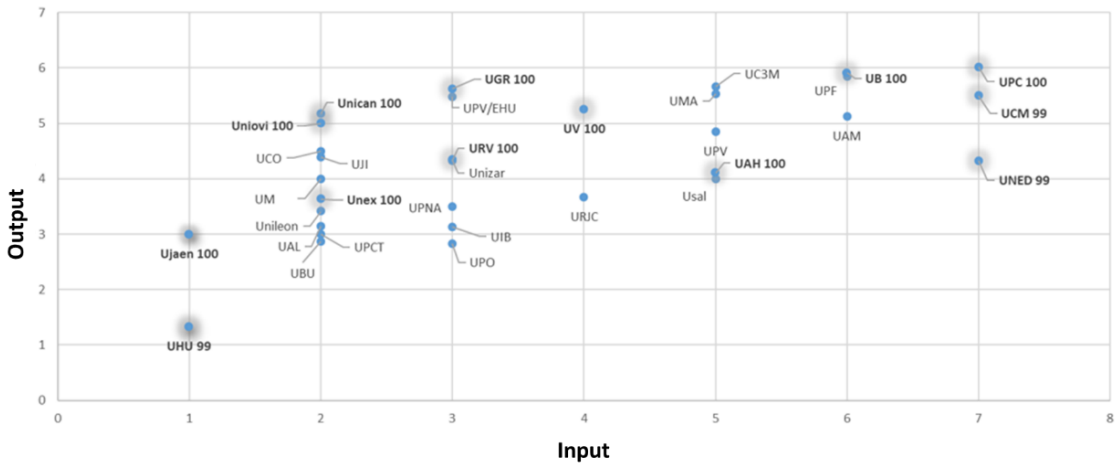
To test the above hypotheses, we first conducted a univariate analysis to determine which variables proved significant. Then we used a moderated regression analysis, being the management variables related to efficiency the independent variables and the contextual factors the moderators. Moderation analysis helps us understand when and under what conditions the relationship between management variables and efficiency changes.

RESULTS

We first present the results for efficiency at Spanish public universities based on their behaviour in master´s degrees, then go on to the results for the model proposed as a way of improving that efficiency.

An overall analysis based on SETEQ of self-funded master´s degrees shows that in general the mean score for efficiency levels is very high, at nearly 92 points out of 100. This is probably because all public universities obtain minimum efficiency scores in excess of 50 points, and almost a third get 100 points (see Table 2). For a given level of revenue from tuition fees (received from students), these universities offer a good balance between qualified students, credits awarded and academic quality: SETEQ. There are highly efficient universities in terms of SETEQ which have very low levels of revenue from tuition fees, but also others whose revenue levels are high, so this is not a size effect (see Figure 3).

Figure 3. SETEQ distribution in line with Inputs & Outputs.

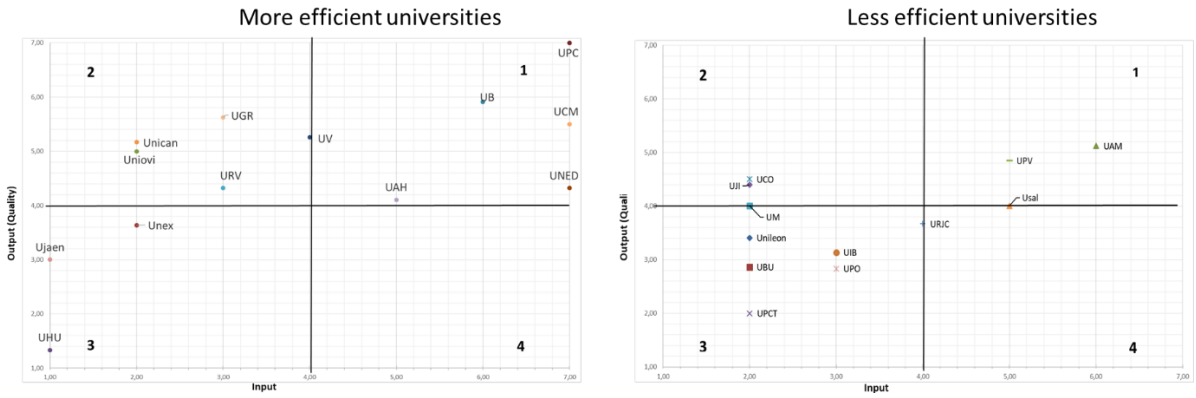


Outputs take two clearly distinct forms: quality-related and economic-related. Focusing only on the "quality" output with respect to revenue from tuition fees (input), Figure 4 shows that there are no university in the fourth quadrant. This means that most universities with high tuition fee revenues ensure that their quality is above average.

Most of the least efficient universities are in the first and third quadrants. In other words, if they do not obtain a minimum amount of resources, they cannot achieve sufficient levels of quality, although it is also the case that they allocate too many resources to improving quality, proving equally inefficient.

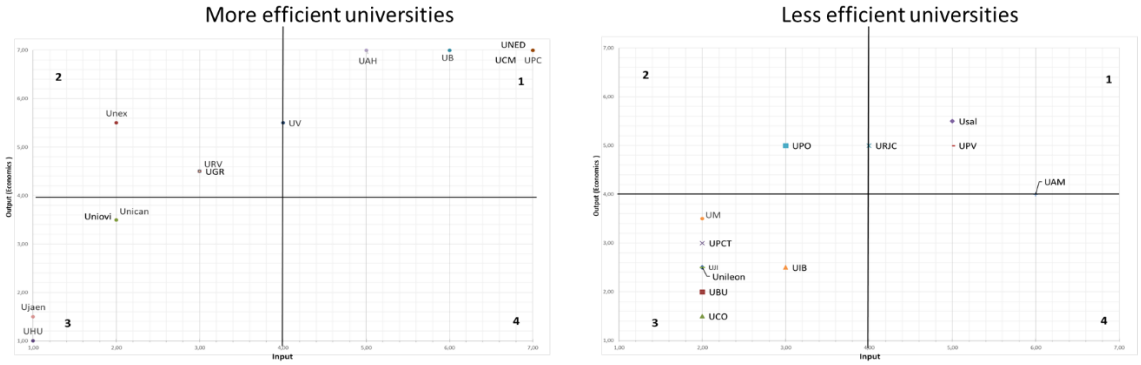
The most efficient universities are mainly found in quadrants 1 and 2. In other words, they achieve high levels of quality, in some cases with few resources, and in others with more resources but without being excessive. This is key, since universities with more resources and adequate management can achieve ideal levels of quality, but an excessive emphasis on resources can make them inefficient.

Figure 4. Inputs (Revenue from tuition fees), Outputs (Quality) and SETEQ.



A look at economic outputs (Figure 5) also shows there are few universities in the fourth quadrant or the second quadrant. Public universities share similar cost structures therefore there is little difference between them in tuition fees, so there are few which manage to educate large numbers of students with low revenues or which charge high enrolment fees but educate few students. The most widely recurring patterns of behaviour as regards efficiency are high input/high output (quadrant 1) and low input/low output (quadrant 3). This suggests that efficiency levels based solely on economic aspects tend to converge, so the key point lies in quality differences.

Figure 5. Inputs (tuition fee revenues), Outputs (Economic) and SETEQ.



After setting out our results on the efficiency of universities, we now report on our tests of the hypotheses put forward in regard to the various strategies used by self-funded master´s degree units and their effects on efficiency.

First of all, a single factor analysis of variance was run to check the hypotheses individually (Table 4).

Table 4. Results of univariate analysis.

	F-values (significance level)
Sessional lecturers	0.937 (0.343)
Online education	0.259 (0.615)
Flexibility of quality assurance systems	4.707** (0.038)
Specialist university	1.131 (0.296)
Regional proactivity in education	4.000* (0.055)

Note: t statistics in parentheses; * p < .1, **p < .05, *** p < .01

Two variables show significant differences: the flexibility of the quality assurance system and regional proactivity in education. In both cases the correlation is significant and positive. A more flexible quality assurance system that can help bring the education on offer into line with the educational needs of society is more efficient. Such systems assure suitable minimum quality standards, help to increase demand and reach out to more students. Regional governments that are more involved in education matters also help to ensure that the education offered is more in line with regional needs. In the case of master´s degrees, orientation towards employment is key, so efforts that help bring the qualifications on offer into line with demands for employment are determinant in terms of efficiency.

It is noteworthy that no significant links with efficiency are found for the rest of the variables. Bringing in more sessional lecturers has its advantages (they are practitioners and specialists in a sector, they have high levels of expertise, etc.), but does not result in an increase in efficiency. Such lecturers lack teaching experience, for instance. Moreover, when sessional lecturers make up a large proportion of the teaching staff, organisational issues may arise, with a greater lack of coordination, a lower sense of implication in the degree on the part of the lecturer, etc. Nor are sessional lecturers subject to the same wage structure as other teaching staff, which may increase the costs of the degree.

Online teaching saves on teaching costs, the number of students that can be reached is greater in general and the new methods and technologies available mean that quality need not suffer. However, the particular features of postgraduate education mean that the outcomes are not similar to those found in previous studies, most of which dealt with undergraduate degrees. In master´s degrees, students are seeking highly specific education, but knowledge is also generated in the classroom through discussions with classmates. Students on master´s degrees often have a wealth of knowledge and career experience, so sharing knowledge with fellow students is a highly enriching experience. The atmosphere created in a face-to-face class cannot necessarily be reproduced in online sessions.

Specialist universities are not found to be more efficient than generalist universities. This means that there are economies of both scale and scope and that neither of them dominates the other (Tran, 2021). For a high level of specialisation and concentration of resources in a specific knowledge area to attract students, there must be major investment and a high standard of quality in the education offered. Only then will brilliant students be attracted. By contrast, generalist universities may not manage to attract elite students but may manage to share costs across different knowledge areas and thus also attain good efficiency ratios.

Based on the significant variables in the one-way analysis (flexibility of quality assurance systems, regional proactivity in education), we used a moderation model to identify the links between these two variables and SETEQ. The results are shown in Table 5:

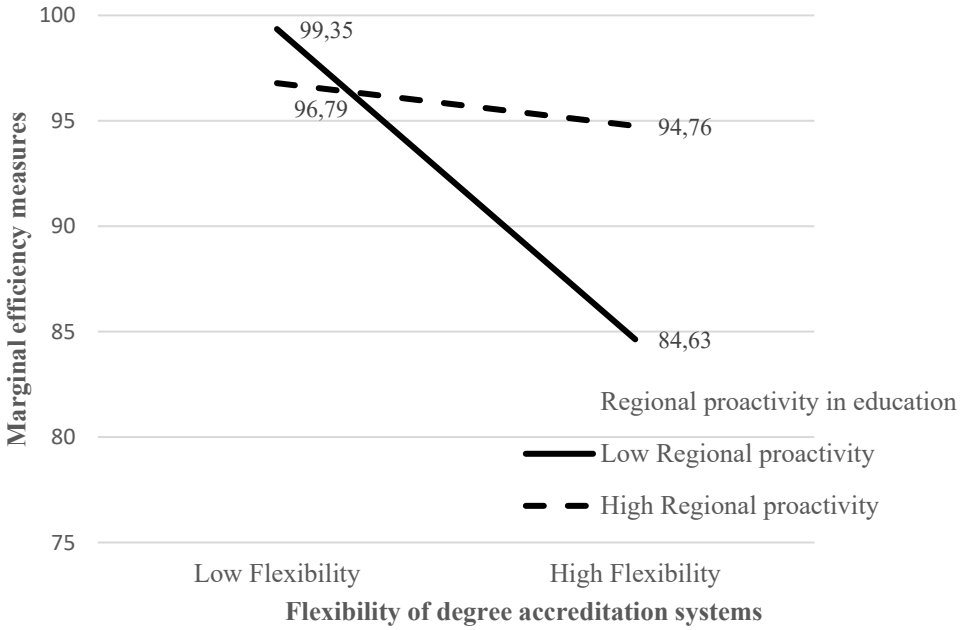
Table 5. Results of multivariate analysis.

	Type III Sum of Squares	df	F-values (significant level)	η^2
Regional proactivity in education	91.511	1	1.094 (0.305)	0.038
Flexibility of quality assurance systems	449.295	1	5.372** (0.028)	0.161
Regional proactivity in education x flexibility of quality assurance systems	257.813	1	3.082* (0.090)	0.099

Notes: t statistics in parentheses; * p < .1, **p < .05, *** p < .01
Levene's test enables quality of variances to be accepted, with F=2.579* (0.074)

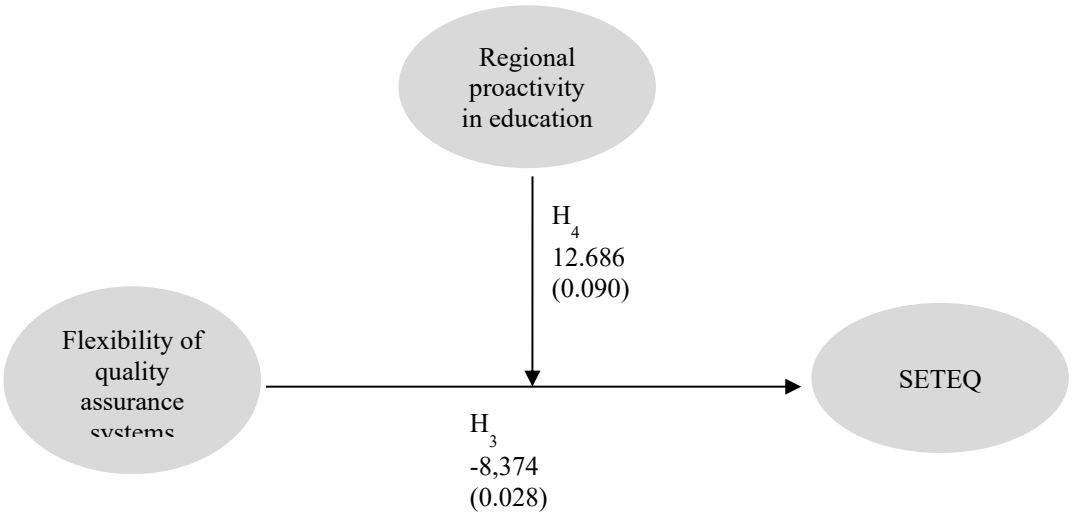
Proactivity in education interacts with the flexibility of quality assurance systems, indicating that there is a distinctive link between the two groups in which the "proactivity in education" variable acts as a moderator.
Figure 6 shows that although both these factors (flexibility in the quality assurance system and location in a region that is more proactive in matters of education) have positive effects on the efficiency of the system, those effects are very different. At universities in regions where the authorities are not proactive in matters of education, efficiency is 14.72% higher under more flexible quality systems than under less flexible ones. Thus, universities not based in regions which are proactive in education are forced to focus more on quality assurance systems.

Figure 6. Average efficiency of self-funded master´s degrees according to regional proactivity in education and quality assurance system flexibility.



The resulting model is shown in Figure 7.

Figure 7. Explanatory model for SETEQ in line with regional proactivity in education and quality assurance system flexibility



In short, the ability of universities to respond to the demand for education in society in the form of self-funded master´s degrees determine their efficiency. The level of flexibility of the quality assurance systems and the level of proactivity of regional authorities in education are two mechanisms that help to achieve this. These two mechanisms are partial substitutes, so having a flexible quality assurance system is more influential in those regions where the government is less involved in education matters. However, such systems have no significant effect in regions where the regional authorities are more proactive in education management.

CONCLUSIONS

Our paper seeks to draw up an explanatory model for efficiency in self-funded master´s degrees based on the various strategies applied by Spanish public universities, and makes three main contributions:

Firstly, it defines an indicator suited to this unit of analysis. We propose a relative measure that is student-oriented, economic, transient and adjusted for quality. The novelty of this indicator lies in its incorporation of the quality factor in assessing the outputs generated. Building up the indicator has entailed agreeing on and validating measures for both inputs and outputs. Those measures need to be not just valid, i.e. appropriate for the relevant concept, but also feasible, i.e. there must be information on them and similar records held by all universities. We note a lack of public information on significant aspects which are not segregated along the lines of the type of master´s degrees studied. This is detrimental to our analysis and to the implementing of improvements, so we suggest that certain data that cover all Spanish public universities be published in a consistent form.

Secondly, a frontier for efficiency is established in self-funded master´s degrees at Spanish universities. That frontier enables more efficient universities to be compared with less efficient ones. It is worth noting that no major differences are found in the efficiency of self-funded master´s degree units. This means that although universities have greater scope for differentiation in this area their different management models lead to similar levels of efficiency. The efficiency considered here is a relative measure, so it is possible to have an efficient range of self-funded master´s degrees by making good use of the resources available (however great or small they may be) with education oriented towards greater quality or greater quantity, with neither approach showing up as more efficient than the other. It is not necessary to be a great university or to have extraordinary quality:

it is simply a matter of making the most of the inputs used. The study is referred to public universities, in which case the quality of the offered degrees is not so different. When analyzing degrees at private universities, where greater heterogeneity is to be expected, this dilemma may break down and more efficient alternative may exist.

In the field of efficiency in higher education, it is useful not just to draw up a ranking of universities but also to help the less efficient ones to improve their management policies. And this is where our third contribution lies. We have now put forward a proposal for an explanatory model for helping university managers that takes into account what university policies characterise the most efficient universities in the area of self-funded master´s degrees. Our results enable us to assert that having an updated range of self-funded master´s degrees consistent with the educational needs of the relevant time is the main determinant factor for efficiency in such degrees (flexibility of quality assurance systems and regional government pro-activity in education). Those universities which are based in regions where there is less proactivity in education must ensure in particular that they have the best quality assurance systems. The other actions considered in association with providing education (online education, type of teaching staff and degree of specialisation) are less influential. They have both advantages and drawbacks and have no significant effect on efficiency.

The two main limitations of our study, and thus a pointer to where future research could take place, lies in the sample used. First, differences in behaviour between private and public universities should be analysed; one of the main limitations of this study is that it was conducted solely on public universities. Second, the low degree of variation in the behaviour of Spanish universities makes it advisable to extend the study to universities in other countries where there may be more difference in the levels of the inputs and outputs used. Third, this study includes only self-funded master´s degrees; master's degrees financed with public funds could have a different management, therefore, they should be analysed in another research. Undoubtedly, expanding the sample (private universities, universities in different countries or other degrees) will include greater data heterogeneity, which will enrich the results obtained.

The second limitation stems from the novel nature of the indicator. The used variables have been validated by university experts but could be validated based on student opinion and administrators. Further studies would be needed to validate the results achieved against simpler indicators, in order to demonstrate that the results improvement from those obtained by traditional literature.

REFERENCES

Agasisti, T., & Johnes, G. (2009). Beyond Frontiers: Comparing the Efficiency of Higher Education Decision-Making Units across More than One Country. *Education Economics*, 17(1), 59-79, doi.org/10.1080/09645290701523291.

Agasisti, T., & Pérez-Esparrells, C. (2010). Comparing efficiency in a cross-country perspective: the case of Italian and Spanish state universities. *Higher Education*, 59(1), 85-103, doi.org/10.1007/s10734-009-9235-8.

Arbaugh, J. B., Desai, A., Rau, B., & Sridhar, B. S. (2010). A review of research on online and blended learning in the management disciplines: 1994–2009. *Organization Management Journal*, *7*(1), 39-55, doi.org/10.1057/omj.2010.5.

Arkorful, V., & Abaidoo, N. (2015). The role of e-learning, advantages and disadvantages of its adoption in higher education. *International Journal of Instructional Technology and Distance Learning*, 12(1), 29-42.

Badunenko, O., Mazrekaj, D., Kumbhakar, S. C., & De Witte, K. (2021). Persistent and transient inefficiency in adult education. *Empirical Economics*, 60, 2925-2942, doi.org/10.1007/s00181-020-01998-x.

Bleiklie, I. (2005). Organizing higher education in a knowledge society. *Higher education*, 49(1-2), 31-59, doi.org/10.1007/s10734-004-2913-7.
Bruni, R., Catalano, G., Daraio, C., Gregori, M., & Moed, H. F. (2020). Studying the heterogeneity of European higher education institutions. *Scientometrics*, 125(2), 1117-1144, doi.org/10.1007/s11192-020-03717-w.
Camanho, A. S., Silva, M. C., Piran, F. S., & Lacerda, D. P. (2024). A literature review of economic efficiency assessments using Data Envelopment Analysis. *European Journal of Operational Research*, 315(1), 1-18, doi.org/10.1016/j.ejor.2023.07.027.
Castro, M. D. B., & Tumibay, G. M. (2021). A literature review: efficacy of online learning courses for higher education institution using meta-analysis. *Education and Information Technologies*, 26, 1367-1385.
Chen, S. H. (2012). The establishment of a quality management system for the higher education industry. *Quality & Quantity*, 46, 1279-1296, doi.org/10.1007/s11135-011-9441-1.
De Witte, K., & López-Torres, L. (2017). Efficiency in education: a review of literature and a way forward. *Journal of the Operational Research Society*, 68, 339-363, doi.org/10.1057/jors.2015.92.
Di Zio, S., Rosas, J. D. C., & Lamelza, L. (2017). Real Time Spatial Delphi: Fast convergence of experts' opinions on the territory. *Technological Forecasting and Social Change*,115, 143-154, doi.org/10.1016/j.techfore.2016.09.029.
Ekiz, M. K., & Şakar, C. T. (2020). A new DEA approach to fully rank DMUs with an application to MBA programs. *International Transactions in Operational Research*, 27(4), 1886-1910, doi.org/10.1111/itor.12635.
Giménez, V. M., & Martínez, J. L. (2006). Cost efficiency in the university: A departmental evaluation model. *Economics of Education Review*, 25(5), 543-553, doi.org/10.1016/j.econedurev.2005.05.006.
Gómez-Sancho, J. M., & Mancebón M. J. (2012). La evaluación de la eficiencia de las universidades públicas españolas: en busca de una evaluación neutral entre Áreas de conocimiento. *Presupuesto y Gasto Público*, 67, 43-70.
Granum, V. (2004). Nursing students' perceptions of nursing as a subject and a function. *Journal of Nursing Education*, 43(7), 297-304. https://doi.org/10.3928/01484834-20040701-08
Holsapple, C. W., & Lee-Post, A. (2006). Defining, assessing, and promoting e-learning success: An information systems perspective. *Decision Sciences Journal of Innovative Education*, 4(1), 67-85. https://doi.org/10.1111/j.1540-4609.2006.00102.x
Kashim, R., Kasim, M. M., & Abd Rahman, R. (2018). Measuring efficiency of a university faculty using a hierarchical network data envelopment analysis model. *Journal of Information and Communication Technology*, 17(4), 569-585. https://doi.org/10.32890/jict2018.17.4.3
Klein, D., & Ware, M. (2003). E-learning: New opportunities in continuing professional development. *Learned publishing*, 16(1), 34-46. https://doi.org/10.1087/095315103320995078
Lacka, E., Wong, T. C., & Haddoud, M. Y. (2021). Can digital technologies improve students' efficiency? Exploring the role of Virtual Learning Environment and Social Media use in Higher Education. *Computers & Education*, 163, doi.org/10.1016/j.compedu.2020.104099.
Lee, Y. H. (2020). Determinants of research productivity in Korean Universities: the role of research funding. *The Journal of Technology Transfer*, 1-25, doi.org/10.1007/s10961-020-09817-2.
Lehmann, E. E., Meoli, M., Paleari, S., & Stockinger, S. A. (2018). Approaching effects of the economic crisis on university efficiency: a comparative study of Germany and Italy. *Eurasian Business Review*, 8(1), 37-54, doi.org/10.1007/s40821-017-0091-7.
McMahon, W. W. (2010). The external benefits of education. In D. Brewer & P. McEwan (Eds.), *Economics of education*. San Diego, CA: Academic Press/Elsevier, 68-79. https://doi.org/10.1016/B978-0-08-044894-7.01226-4

Mendoza-Mendoza, A., De La Hoz-Domínguez, E., & Visbal-Cadavid, D. (2023). Classification of industrial engineering programs in Colombia based on state tests. *Heliyon*, *9*(5), e16002, doi.org/10.1016/j.heliyon.2023.e16002.

OECE (2021). *Education at a Glance 2021: OECD Indicators*, OECD Publishing, Paris, doi.org/10.1787/b35a14e5-en.

Osgerby, J. (2013). Students' perceptions of the introduction of a blended learning environment: An exploratory case study. *Accounting Education*, 22(1), 85-99, doi.org/10.1080/09639284.2012.729341.

Parellada, M., & Duch, N. (2006). Descentralización Autonómica y Sistema Universitario. Mediterráneo Económico. In Ferraro García, F. J. (coord.) *Colección Mediterráneo Económico: Un balance del estado de las Autonomías*, 10, El Ejido, Spain: Caja Rural Intermediterrámea y Fundación Cajamar Fundacion Cajamar, 10, 405-426.

Percy, A., Scoufis, M., Parry, S., Goody, A., Hicks, M., Macdonald, I., Martinez, K., Szorenyi-Reischl, N., Ryan, Y., Wills, S., & Sheridan, L. (2008). *The RED Report: Recognition, Enhancement, Development: The Contribution of Sessional Teachers to Higher Education*. Lismore, NSW, Australia: Council of Australian Directors of Academic Development.

Pham, T.N., & Goyette, K. (2019). Higher Education Governance in Vietnam: Statism Versus Institutional Autonomy. In: Jarvis, D., Mok, K. (eds.) *Transformations in Higher Education Governance in Asia. Higher Education in Asia: Quality, Excellence and Governance*. Springer, Singapore. doi.org/10.1007/978-981-13-9294-8_10.

Ray, S. C., & Jeon, Y. (2008). Reputation and efficiency: A non-parametric assessment of America's top-rated MBA programs. *European Journal of Operational Research*, 189(1), 245-268, doi.org/10.1016/j.ejor.2007.03.045.

Ruepep (2021). *Report on the general results of the survey on the situation of the self-funded master´s degrees of Spanish Universities*. https://ruepep.org/wp-content/uploads/2021/04/estudio_TTPP_2021.pdf

Salerno, C. (2003). *What we know about the efficiency of higher education institutions: The best evidence (Vol. 99)*. Den Haag: Ministerie van Onderwijs, Cultuur en Wetenschap.

Scheibe, M.; Skutsch M., & Schofer, J. (1975). Experiments in Delphi methodology. In Linestone H. & Turoff M. (eds.) *The Delphi Method: Techniques and Applications*, London, United Kingdom: Addison-Wesley.

Toutkoushian, R. K., & Lee, J. C. (2018). Revisiting economies of scale and scope in higher education. In Smart, J. C. (Ed.), *Higher Education: Handbook of Theory and Research* (Vol. 23) Springer Science & Business Media, 371-416, doi.org/10.1007/978-3-319-72490-4_8.

Tran, C. D. T. T. (2021). Cost efficiency–one size fits all? A university-level analysis of economies of scale and scope in Vietnamese higher education. *Asia Pacific Journal of Education*, *41*(2), 336-355, doi.org/10.1080/02188791.2020.1735996.

Tran, T. V., Pham, T. P., Nguyen, M. H., Do, L. T., & Pham, H. H. (2023). Economic efficiency of higher education institutions in Vietnam between 2012 and 2016: a DEA analysis. *Journal of Applied Research in Higher Education*, 15(1), 199-212, doi.org/10.1108/JARHE-06-2021-0238.

Volchik, V., & Maslyukova, E. (2017). Performance and sustainability of higher education: key indicators versus academic values. *Journal of security and sustainability issues*, 6(3), 501-512, doi.org/10.9770/jssi.2017.6.3(14).

Welch, A. R. (2007). Blurred vision?: Public and private higher education in Indonesia. *Higher Education*, 54(5), 665-687, doi.org/10.1007/s10734-006-9017-5

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Annex 1. Delphi data sheet

Data	From September 2018 to January 2019
Pre-test	Presentation to RUEPEP
Nº Rounds	3
Nº Interactions	43
Questionnaire Format	Online (Google Forms)
Participating Universities	University of Alcala; Barcelona University; Polytechnic University of Valencia; Complutense of Madrid; University of the Balearic Islands, Deusto University, Pablo de Olavide University; Rovira i Virgili University; University of Granada; Autonomous University of Barcelona; Pompeu Fabra University, University of Jaen, VIC University, University of the Basque Country

Source: Own work

Annex 2. IQR and CG analyses to decide the consensus levels of input-output variables.

	Variables	Description	Mean (StanDev)	Median	IQR= Q_3-Q_1	DECISION (2 or less accepted)	CG= $\frac{No.\ cases\ in\ IQR}{Total\ No.\ cases}$	DECISION (50% or more accept)
INPUTS	Revenue from registration	The fees paid by postgraduate students	9.38 (0.65)	9	1	Accept		
ECOMOMIC OUTPUTS	Central Services	Funds to cover general services at the university	7.69 (2.06)	8	3.5	Reject		
	No. Credits taught	Total credits studied for by postgraduate students in the last year (one credit is equivalent to 10 notional hours of study)	7.92 (1.89)	8	2.5		61.53%	Accept
	No. Graduate students	Total number of postgraduate students	9.00 (1.00)	9	2	Accept		
QUALITY OUTPUTS	No. Educational cooperation agreements	Total number of formal business documents that include terms of master's degree agreements with companies or public entities.	7.77 (1.77)	8	1.5	Accept		
	Success rate (no. of graduates / students enrolled)	Graduation rate for students studying university-accredited master's and postgraduate degrees.	7.77 (1.69)	8	2.5		69.23%	Accept
	No. Editions	Number of times the master's degree has been taught in full.	8.38 (1.19)	8	2.5		76.92%	Accept
	Would you recommend this postgraduate degree?	Satisfaction level of students.	9.38 (0.69)	9	1	Accept		