The Spanish Public University: A justified proposal to enhance its contribution to economic growth and positioning in international rankings

La Universidad pública española: Propuesta justificada para potenciar su contribución al crecimiento económico y al posicionamiento en los rankings internacionales

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Abstract

With the new millennium a legislative change in the Spanish University occured. The LOU (2001 and its modification in 2007) repealed the LRU and, thus the organization, objectives and instrumentalization in higher education.

The role of the University must promote technological progress and human and economic growth. However, any academic demand for results in teaching and research mechanism had been practically circumvented until the entry into force of the LOU, since there were no procedures of intrinsic and

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comparative measurement of each of them. For some years now, the individual and comparative information has made it possible to evaluate the progress and objectives achieved by each University.

From a strategic point of view and making use of institutional information, mainly the economic one, a quantitative analysis is carried out with panel data (2010-2017). Economic growth and budgetary items of the Spanish public university system are listed below to determine which variables would be more suitable to achieve greater efficiency both in national economic objectives and in international comparative academic improvement, measured with the existing rankings.

In order to achieve these objectives by means of this methodology, three hypotheses are put forward referring to the relationship between the University and economic growth and the identification of strategic variables to promote it, as well as an improvement in the positioning in the international rankings.

Therefore, this study aims to provide the institutional policymakers with instruments to boost support for public higher education institutions and achieve greater efficiency and results in the socio-economic environment and in the international positioning of Spanish public universities.

Keywords: public university, staff costs, master's degree, economic growth, rankings, panel data models.

Resumen

Con el nuevo milenio se produjo un cambio legislativo en la universidad española. La LOU (aprobada en 2001 y modificada en 2007) derogó la LRU y con ello, la organización, objetivos e instrumentalización en la enseñanza superior.

El papel de la universidad debe potenciar el progreso tecnológico y el crecimiento humano y económico. No obstante, cualquier mecanismo de exigencia académica de resultados en docencia e investigación, hasta la entrada en vigor de la LOU, había sido prácticamente eludible ya que no existían procedimientos de medida intrínseca y comparativa de cada una de ellas. Desde hace unos años, la información individual y comparativa, permite evaluar la marcha y objetivos alcanzados por cada Universidad.

Desde un punto de vista estratégico y haciendo uso de la información institucional, fundamentalmente la económica, se realiza un análisis cuantitativo con datos de panel (2010-2017), relacionando crecimiento económico y partidas presupuestarias del sistema universitario público español, para ver que variables serían más aconsejables para conseguir mayor eficiencia tanto en objetivos económicos nacionales, como en mejora académica comparativa internacional, medida con los rankings existentes.

Para conseguir esos objetivos, por medio de esa metodología, se plantean tres hipótesis referidas a la relación de la universidad y crecimiento económico

e identificación de variables estratégicas para impulsarlo, además de una mejora del posicionamiento en los rankings internacionales.

Por tanto, este estudio que pretende dotar a los decisores políticos de instrumentos para impulsar el apoyo a las instituciones públicas de enseñanza superior y conseguir una mayor eficiencia y resultados en el entorno socioeconómico y en el posicionamiento internacional de las universidades públicas españolas.

Palabras clave: universidad pública, gastos de personal, máster, crecimiento económico, rankings, modelos de panel.

Introduction

The Spanish public university, as well as carrying out the task of training qualified professionals for different skilled professional jobs, produces research output, in such a way it plays a fundamental role in the personal, social and innovative evolution and, therefore, in the economic growth of the country.

But, at the same time, the university system is fed back by the positioning of international rankings. Each country must pay annual attention to the situation of its universities in order to strategically support them and improve their positioning, giving clear signs of progress and improvement, leading to greater economic growth for the country and a better international image. In this way, public spending on higher education will be efficient and fully justified.

This analysis empirically justifies the relationship between the Spanish public university and economic growth for the Spanish case (hypothesis, H1). Once this direct relationship has been established, it will be determined which variable, of those that explain the above relationship, is the most efficient for increasing both economic growth (hypothesis, H2) and the improvement in international rankings (hypothesis, H3). Once the empirical study has been carried out, conclusions are drawn for H1 and H2 and, subsequently, for H3, taking into account the above hypotheses and other factors.

The methodology used for the empirical study was the estimation of an econometric model with panel data, considering all the budget items

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of the public universities by region. An aggregation of all the universities in each region is carried out, therefore, a sample of 17 regions or Autonomous Communities is available, with a period consisting of the academic years 2010-2011 to 2016-2017.

The aim of this study is to contribute to the definition of strategies that should be applied in the Spanish university system in order to achieve a greater impact on GDP and an improvement in international positioning.

To develop this work, theoretical contributions that support the relationship between university and economic growth will be collected, continuing with the evolution and current situation of the normative regulation and status of the Spanish university (from the OLU to the OLUR), and continuing with the empirical analysis that corroborates these relationships, in order to identify the variables or factors that can serve as an instrument for the public administration to support the university and, as a more relevant consequence, achieve greater economic growth derived from this relationship and improve the image and international positioning of the Spanish university.

The role of public universities in the growth of economies

Universities, rather than being seen as mere institutions of higher education, are increasingly recognised as an important engine of economic growth and development (Anselin, Varga and Acs, 1997; Drucker and Goldstein, 2007; Abel and Deitz 2011; Valero and Van Reenen, 2019). In 1900, only one in a hundred young people in the world was enrolled in universities, but over the course of the 20th century this figure rose to one in five (Valero and Reenen, 2016). Universities stimulate job creation, foster mobility and have an intrinsic social and cultural effect of a kind more commonly described as "quality of life" (OECD, 1982). Therefore, a first hypothesis that would be interesting to test is whether or not the Spanish public university is related to the country's economic growth (H1):

H1: Spain´s public universities contributes to the country's economic growth (GDP).

Countries cannot develop without investing in education perceived as a multidimensional process, as it contributes to reducing poverty by increasing productivity and competitive and economic growth (Sianesi and Van Reenen, 2003; Afzalet, Malik, Begum, Sarwar and Fatima, 2012; Bauer, Schweitzer and Shane, 2012). There are several channels through which universities can affect growth (Anselin et al., 1997; Abel and Deitz, 2011). Some of the most relevant are described below.

First, and most obvious, universities can facilitate an *increase in human capital* (Etzkowitz, 2003; Bauer et al., 2012; Barra and Zotti, 2016b; Valero and Van Reenen, 2019).

The term human capital is believed to have been first used in the 1960s and 1970s, when Mincer (1958), Goode (1959), Schultz (1961) and Becker (1975) gave different views on the concept and formation of human capital. However, there are studies that attribute the explicit use of the term to Pigou (1928) and acknowledge that classical economists already referred to the term human capital to describe the knowledge and skills that enable people to create economic value (Nahapiet, 2011). Subsequently, the term gained importance with the emergence of the endogenous growth theory given by Lucas (1988), Romer (1990) and Barro (1990), according to which, the long-term growth rate would also depend on other new factors such as investment in human capital (a factor added to the physical capital already considered previously by neoclassical models).

Universities can contribute to increasing both the supply (Florax, 1992; Shubert & Kroll, 2014; Valero & Van Reenen, 2019) and the demand for human capital by producing degrees and conducting research activities (Abel & Deitz, 2011).

Universities are encouraged to increase the supply of human capital by producing highly qualified graduates and, consequently, competent workers (Varghese, 2007; Bradley, Noonan, Nugent and Scales, 2008) who will contribute significantly to economic development (Florida, Mellander and Stolarick, 2008; Markusen, Wassall, DeNatale and Cohen, 2008; Sacchetti et al., 2009). This can occur in different ways. For example, a skilled worker can promote economic growth, e.g. through improvements in the labour force which, in turn, lead to higher activity rates and lower unemployment rates (Barra and Zotti, 2016a). Similarly, higher-skilled workers are more likely to be involved in the implementation of new technologies and innovative processes (Bartel and Lichtenberg, 1987;

Goldstein, Maier, Luger, 1995; Riddel and Schwer, 2003; Etzkowitz and Leydesdorff, 2000; Aghion, Boustan, Hoxby and Vandenbussche, 2009) that will drive productivity improvements and thus economic growth (Hanushek, 2016).

On the other hand, universities can increase the demand for human capital by engaging in research and development activities (Bessette, 2003). For example, universities often use local firms to develop and commercialise products resulting from their research activities. Indeed, as stated by Abel and Deitz (2011), most major research universities have established their own technology transfer offices in an effort to more effectively exploit synergies between university research and commercial product development. Thus, university research activities contribute to the creation of knowledge spillovers in the regional environment, leading to an improvement of local economies (Goldstein and Renault, 2004). In this sense, innovation through university research represents an important channel for creating economic growth (Del Barrio-Castro and García-Quevedo, 2005; Barra and Zotti, 2016b; Valero and Van Reenen, 2019), e.g. through long-term employment and wage increases in sectors closely linked to a local university's innovative strength (Hausman, 2012).

In addition to the generation of human capital, there are other channels through which universities can influence growth. Many authors agree that universities are seen as organisations that use financial and human resources as inputs to *produce different functions or outputs* that can potentially lead to economic development. For example, Goldstein et al., (1995) and Agasisti and Pérez-Esparrells (2010) identify a set of outputs: human capital (mentioned above), knowledge creation, transfer of existing knowledge, production of knowledge infrastructure, research outputs (publications, patents, new products for firms, etc.), services to the community (consultancy to public and private organisations, etc.), capital investment, regional leadership, creation of new firms and productivity gains for firms.

Finally, it is clear that the university teaching staff, through their *research and teaching* work, is a key player in the generation of all the outputs considered above and, consequently, in the generation of economic growth. Accordingly, and taking into account that economic policy makers increasingly identify the expansion of higher education as an attractive government policy (Browne, 2010), considering universities as an engine of local economic development (Abel and Deitz, 2011),

a second working hypothesis can be justified in such a way that the presence of qualified university faculty through increased spending on university staff will be a key tool for generating growth.

H2: Increased spending on university staff contributes to economic growth

Measuring the quality of the Spanish public university system.

The efficiency of higher education institutions has been widely explored in recent decades as a result of a growing interest in improving the performance of the public sector (Guccio, Martorana and Mónaco, 2016). A multitude of international rankings have emerged to measure the efficiency of universities and are becoming increasingly relevant and considered by various stakeholders (Johnes, 2018). However, despite their notorious and growing popularity, these university rankings have been heavily criticised by some authors on methodological grounds (Porter and Toutkoushian 2006; Cremonini, Westerheijden and Enders, 2008; Bornmann, Lutz and Daniel, 2013, among others), and are thus subject to a paradox: the more they are criticised by social scientists and experts on methodological grounds, the more attention they receive in policy-making and the media (Daraio, Bonaccorsi, Simarc, 2015).

Although university rankings first appeared in 1870 (Grewal, Dearden and Lilien, 2008), this phenomenon is relatively recent (Blanco, 2018). Today, one of the most popular rankings among experts is the Academic Ranking of World Universities (ARWU), which has been compiled annually by Shanghai Jiao Tong University since 2003 (Liu and Cheng, 2005). It is compiled from data related to research output and research excellence recognised by prestigious awards or a high number of citations. Initially, its purpose was to categorise world-class universities to assess the gaps in the advancement of Chinese universities and to provide information on the research quality of universities that were considered targets for students and decision-makers in China (Liu, 2009). The ARWU publishes annually accessible raw data, score reviews and rankings and generates a hierarchy, more or less aligned, with perceptions of elite research universities (Docampo and Cram, 2014), for all these reasons, it has been

recognised as the forerunner of global university rankings and the most trustworthy.

While rankings of higher education institutions have generally been targeted at external stakeholders, such as prospective students, in recent years the interest and use of rankings has broadened and they have become a reference tool that attracts the full attention of academics and the public. Today, it is common for staff and managers of higher education institutions to turn to them as an internal audit tool when making important decisions or management policies (Johnes, 2018), as well as governments for the regular publication of world university rankings (Bekhradnia 2016, p. 3).

Internationally, although there are a multitude of rankings, two of the most popular are, apart from the ARWU mentioned above, the QS World University Rankings, produced by Quacquarelli Symonds and published annually since 2004, and the Times Higher Education (THE) World University Rankings, which has been produced and published annually since 2004 in collaboration with Thomson Reuters since 2010 (Johnes, 2018).

One of the items considered to establish the positioning of universities in the aforementioned rankings is the student-teacher ratio, referring to the average number of students per teacher, i.e. the number of students attending a school or university divided by the number of teachers at the institution. The term can also be inverted to create a teacher-student ratio (OECD, 2019).

This ratio is paramount given the growing importance attached to excellence in university teaching as part of the "Scholarship in Teaching and Learning (SoTL)" discourse (e.g. Kreber and Cranton, 2000; Trigwell and Shale, 2004; Fanghanel et al., 2016). But it is important to bear in mind that it is not only the student-teacher ratio that matters in terms of quantity, but that excellence in teaching and teaching quality plays a key role in the success of a university (Klopper and Power, 2014).

EHEA (Bologna) and international rankings

The consideration of the teacher-student relationship, as well as the importance of excellence of teaching staff, takes on greater prominence with the creation of the European Higher Education Area (EHEA), also

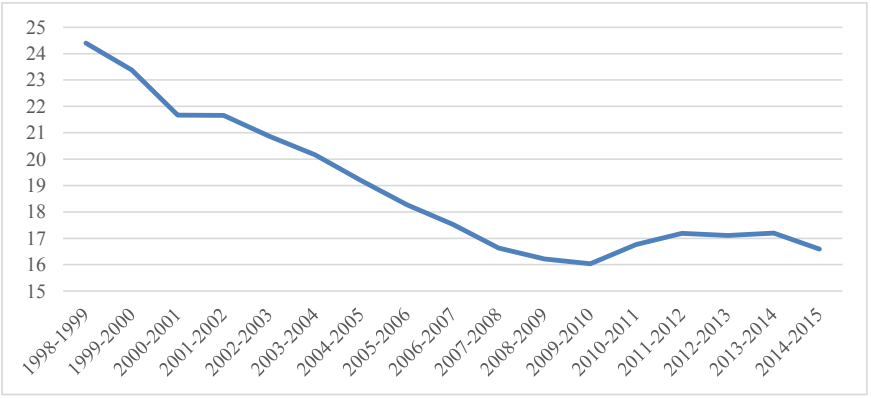
known as the "Bologna Process". The name derives from the meeting held in Bologna on 19 June 1999, where ministries from 39 European countries decided to launch a common process of restructuring the teaching activities of university systems.

One of the main achievements of the Bologna Process is the structure of curricula: from traditional courses, based on a Bachelor's degree after 4/5 years, to a Bachelor/Master (BA/MA) structure, more similar to the Anglo-Saxon tradition. In doing so, the Bologna reforms induce a better allocation of students to higher vocational and university courses. The aim of the Bologna Process was to increase the effectiveness and efficiency of undergraduate and postgraduate education in order for universities to pursue academic excellence and research (Agasisti and Dal Bianco, 2009).

In Spain, the Bologna Process materialised with the promulgation, on 21 December 2001, of the Organic Law 6/2001 on Universities (OLU), repealing the then existing Organic Law 11/1983 on University Reform (OLUR). Graph 1 shows that from 2001 onwards, with the implementation of Bologna, there was a growing trend in the number of teaching and research staff hired to adapt to the objectives of the process and to achieve an improvement in the efficiency of the university.

This trend increased until the academic year 2008-2009, when the trend was reversed. The global economic and financial crisis that began in the summer of 2007 also had a pernicious effect on university education, leading to a reduction in public spending on staff, which had an impact on the number of university teaching posts. Although there has been a slight recovery since the 2013-2014 academic year, the number of teaching and research staff is expected to grow further, especially from 2017 onwards, when a constant trend seems to be discernible.

GRAPH I. Student-faculty ratio in Spanish public universities



Source: Prepared by the authors on the basis of National Statistics Institute and Ministry of Education, Culture and Sport.

Graph 1 shows the evolution of the student-teacher ratio1 in Spanish public universities. The downward trend up to 2009 was favourable, which shows that the objectives set by the Bologna process and the Organic Law 6/2001 of 21 December on Spanish Universities (LOU) were being met. However, it is important to note that the fall in the ratio was accompanied by a decrease in the number of students enrolled.

From 2009 onwards, as a result of the global economic and financial crisis, the ratio began to rise due to a lower supply of teaching and research staff, moving away from the Bologna objectives. During this period, efforts should have been maintained so that the ratio continued to decrease as in previous years or, at least, remained constant but did not increase, as occurred. From 2014 onwards, the ratio decreased again, which is positive. However, from 2015 onwards, although the expected trend seems to be decreasing, it is observed that it will not be at the same level as in previous years, which is worrying.

As a result, in recent years the positions of Spanish universities have been decreasing. Thus, if in 2015 there were 13 Spanish universities among the top 500 in the world in the ARWU ranking, in 2016 they

[1] The student-teacher ratio represents the ratio of students per teacher and is obtained by dividing the number of students enrolled by the number of teachers at the same level. Thus, a high pupil-teacher ratio is considered negative as it means that the same teacher has to teach a high number of students at the same time, which has a negative impact on attention and efficiency.

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dropped to 12 and in 2017 and 2018 they fell to 11. Moreover, the best Spanish universities are below the middle of the table. In 2015 there were 5 among the best 250 universities in the world, in 2016 there were 4, and in 2017 and 2018 the number dropped to 3.

However, despite these data, a slight improvement can be glimpsed with respect to 2017. Thus, the best-ranked Spanish universities in the ARWU 2017 were ranked 239th, 261st and 268th, moving up to 179th, 212th and 239th in the ARWU 2018 (Blanco, 2018, p.183). This current improvement in the rankings occurs despite a decrease in the number of teaching staff, which may be due to the improvement in the productivity of the teaching and research staff, a consequence of the ANECA (National Agency for Quality Assessment) accreditation system for the promotion and stabilisation of university teaching and research staff. In other words, although the number of teaching staff is lower, the quality and commitment derived from the current accreditation system is not.

Despite everything described above, it should be borne in mind that the number of teaching staff is not the only element that ensures the effectiveness of the university and, therefore, its better positioning in world rankings, although it is the most efficient of all the possible decisions regarding support and promotion of the university, as is empirically demonstrated in the following section. In other words, there is no single formula or strategy common to all universities to ensure their success, but rather the particularities of each university and various determining factors must be taken into account. In the case of the ARWU, for example, universities are ranked on the basis of their scores on six indicators: students or former students, Nobel Prize and Fields Medal winning professors, highly cited researchers, articles published in Nature and Science, documents indexed in the main citation indexes (SCIE and SSCI), and an institution's per capita academic performance. These indicators are weighted to obtain a final overall score for an institution.

In short, following the above theoretical and empirical justifications, a third study hypothesis (H3) can be put forward by accepting that the effort in spending on university teaching and research staff, in addition to favouring economic growth, would help to improve the international positions of universities:

H3: Increasing spending on staff at Spanish public universities has a positive effect on improving their position in international rankings.

There are universities which, despite having a high student/teacher ratio (higher student/teacher ratio) than the European average, are well placed in the ARWU. This is the case of Greece (301-400th), the Czech

Republic (301-400th), Italy (151-200th) and France (ranked 40th with Pierre and Marie Curie University).

In contrast, there are countries where there is a relationship between the two indicators: Norway (ranked 62nd with the University of Oslo), Sweden (ranked 44th with Karolinska Institute), Germany (ranked 42nd with Heidelberg University), Finland (ranked 56th with the University of Helsinki), Netherlands (ranked 47th with Utrecht University), Estonia and Poland (ranked 301-400th) and Spain (ranked 201-300th). In Spain, with the implementation of ANECA since 2001, the objective requirements of scientific production and teaching experience and quality have placed our university among the world's leading universities in terms of quality scientific production.

In short, competition between universities can be seen visibly in the university rankings. These rankings are "inevitable and probably necessary" (Altbach, 2006, p. 80) and, at present, they have acquired great importance and interest both nationally and internationally (Blanco, 2018, p. 172). Therefore, the Spanish university needs to work actively to position itself correctly and become a university of reference. One of the key elements (although not the only one, nor the one common to all universities) to achieve this is, as has been argued, to optimise the quantity and quality of the teaching staff. Thus, by increasing the presence of teaching and research staff, the student-teacher ratio will be reduced, improving attention to students and, together with the accreditation system established for the professional career, will improve the university's productivity and efficiency.

An econometric study is then proposed to answer hypotheses H1, H2 and H3.

Empirical analysis. Results

This section aims to contrast all the theory presented in the previous sections, empirically demonstrating that the Spanish public university plays a decisive role in economic growth and that the work of the teaching staff is key in this relationship. In this way, the three hypotheses put forward will be answered:

H1. Spain´s public universities contribute to the economic growth (GDP) of the country.

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H2. Increased spending on university staff contributes to economic growth.

H3. Increasing spending on staff at Spanish public universities has a positive effect on improving their position in international rankings.

The empirical analysis is carried out for the period from 2010 to 2017 (academic years 2010-2011 to 2016-2017). Data are collected for Spanish public universities by aggregating all public universities in all the Autonomous Communities[2]. Specifically, the items included in the budget items of each university are collected in terms of income and expenditure chapters. In addition, other variables from the general environment, such as Gross Domestic Product, population and gross value added of the main sectors of the economy, and others from the specific environment, such as the number of students enrolled in bachelor's degrees, master's degrees and doctoral studies (Table 1), have also been included (Table 1). This analysis is based on the work of Trenado (2018).

TABLE 1. Variables considered in the empirical analysis.

Variable	Definition		Units	Database
RC3	Budgets: Revenue	Chap. 3. Fees and other revenue	Euros	From each university
RC4		Chap. 4. Current transfers	Euros	From each university
RC5		Chap. 5. Property income	Euros	From each university
RC6		Chap. 6. Disposal of real investments	Euros	From each university
RC7		Chap. 7. Financial assets	Euros	From each university
RC8		Chap. 8. Financial assets	Euros	From each university
RC9		Chap. 9. Financial liabilities	Euros	From each university
RT		Revenue	Euros	From each university

[2] Andalucía, Aragón, Asturias, Baleares, Canarias, Cantabria, Castilla-La Mancha, Castilla y León, Cataluña, Ceuta, Comunidad Valenciana, Extremadura, Galicia, La Rioja, Comunidad de Madrid, Melilla, Murcia, Navarra, País Vasco.

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EC1	Budgets: Expenditure	Chap. 1. Staff costs	Euros	From each university
EC2		Chap. 2. Expenditure on current goods and services	Euros	From each university
EC3		Chap. 3. Financial expenses	Euros	From each university
EC4		Chap. 4. Current transfers	Euros	From each university
EC5		Chap. 5. Contingency funds	Euros	From each university
EC6		Chap. 6. Real investments	Euros	From each university
EC7		Chap. 7. Capital transfers	Euros	From each university
EC8		Chap. 8. Financial assets	Euros	From each university
EC9		Chap. 9. Financial liabilities	Euros	From each university
ET		Expenditure	Euros	From each university
TE	Students	Total enrolled	No. of persons	Ministry of Education
TED		University degree	No. of persons	Ministry of Education
TE1y2		1st and 2nd cycle	No. of persons	Ministry of Education
TEM		Master	No. of persons	Ministry of Education
TEPHD		PhD	No. of persons	Ministry of Education
POP	Population		No. of persons	INE[1]
GVAA	Gross Value Added of Agriculture, Livestock and Fisheries		Euros	INE
GVAI	Gross Value Added of Industry (including Construction)		Euros	INE
GVAS	Gross Value Added of Servicies		Euros	INE
GVAT	Total Gross Value Added		Euros	INE
GDP	Gross Domestic Product		Euros	INE

Source: Elaborated by authors based on database of each university, the Ministry of Education and the National Institute of Statistics

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The methodology used for the estimation of the econometric models was multivariate regression using panel data estimation. All the possible regressions have been estimated using all the variables considered (Table 1) in order to be able to test the proposed hypotheses. Finally, the valid econometric model3, among all the possible ones, whose estimation is significant, i.e., the model in which the variables contribute significantly to the explanation of economic growth measured through GDP, is the following (Table 2):

TABLE 2. Estimated econometric model

Variable		Coefficient	t	l-p	R2-ajust.	N° Obs./ Groups
Dependent	*GDP*				0.9222	118 / 17
Explanatory	EC1	0.0499056	2.88	<0.05		
	EC6	0.0393649	3.27	<0.05		
	TEM	544.3171	3.29	<0.01		
	RC3	0.0560659	3.09	<0.05		
	Constant	0.000000346	5.04	<0.01		

Source: Own elaboration using Stata 10.

According to this estimated model, the variables of the Spanish public university system that provide a positive impulse to economic growth are EC1, EC6, TEM, RC3. In other words, in the 2010-2017 study period, GDP is directly influenced by increases in hiring or increased spending on staff (EC1), by spending on real investment in these public higher education institutions (EC6), by the increase in the professional specialisation of university graduates (TEM) and by the increase in the fees charged by universities to students (RC3).

In short, the empirical model corroborates the theory set out in the previous chapters by demonstrating that the public university has an impact on economic growth, since there is a relationship and correspondence between budget allocations and other university variables and GDP. Furthermore, it has been possible to identify the

[3] After performing correlation analyses between explanatory variables, individual statistical significance tests (t) and a sufficiently acceptable level of significance (p<0.05).

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most significant elements that could be related to this growth. This result obtained from this quantitative analysis means that H1 cannot be rejected.

However, it is advisable to carry out a sensitivity analysis of the estimated econometric model in order to determine which factors explain the behaviour of GDP for the established period to the greatest extent. In other words, to which variable is GDP most sensitive?

This is possible through the standardisation of coefficients[4]. Moreover, this calculation is important because it allows the design of specific policy strategies to optimise the impact of public universities on economic growth in Spain.

The standardised coefficients for each variable are shown in the following table (Table 3):

TABLE 3. Standardised coefficients of the model

Variable	Coefficient $(\widehat{\beta})$	Standardised coefficients $(\widehat{\beta^*})$
EC1	0.0499056	**0.285216043**
EC6	0.0393649	**0.063025282**
TEM	544.3171	**0.057849448**
RC3	0.0560659	**0.112891723**

Source: Own elaboration

According to the value of the standardised coefficients, the most efficient economic policy (concerning the public university) to achieve higher economic growth should be implemented through an increase in staff costs (EC1). Subsequently, an increase in university fees (RC3) would contribute to improve university productivity and efficiency and, consequently, economic growth. However, although also with a positive effect, investment in infrastructure (EC6) and the number of Master's

[4] The standardised coefficients have been calculated directly from the ratio formed by the unstandardised coefficients and the standard deviations of the variables involved:

$$\widehat{\beta_j}^* = \widehat{\beta_j} * \frac{\text{Desviación típica}(x_j)}{\text{Desviación típica}(y)}$$

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students (TEM) would have an impact of less than a quarter of that of EC1 in explaining GDP.

These results allow us not to reject H2 since it is shown that, for the Spanish case, teaching staff is the factor that contributes most to generating economic growth. This allows us to corroborate the theory that a low student-teacher ratio is important to improve university efficiency and productivity.

Conclusions and policy implications and future directions

Considering what has been developed above, a few comments of some relevance can be drawn:

1. The Spanish public university contributes to the economic growth (GDP) of the country. Therefore, H1 is not rejected.
2. There are some specific explanatory variables in the university environment that are related to economic growth: expenditure on personnel (EC1), expenditure on infrastructure (EC6), income from fees (RC3) and the number of students enrolled in official Master's degrees (TEM). All of them are directly related to economic growth.
3. It can be argued that, of these variables, human capital (EC1) is the factor with the largest positive effect on economic growth (i.e. it explains the variability of GDP to a greater extent than the other variables). H2 is not rejected.
4. Due to this relevance, an increase in EC1 may influence the better positioning of Spanish public universities in the rankings as it would lead to reductions in the student-faculty ratio (Figure 1). This is because a higher value of this ratio worsens the positioning of Spanish public universities in the ARWU and THE rankings. H3 is not rejected.
5. In the CRUE5 report, employability and teaching place Spanish public universities in quality positions, with 14 universities in the

[5] CRUE Universidades Españolas is a non-profit association set up in 1994 and made up of a total of 76 Spanish universities: 50 public and 26 private. It is the main interlocutor of the universities with the central government and plays a key role in all regulatory developments affecting higher education in Spain. It regularly produces studies and reports on a range of subjects for the benefit of the Spanish University System. Its reports "The Spanish University in Figures", which has been carried out since 2000, provides the main facts and figures of the Spanish University System and is a response to the institutional commitment to transparency and accountability to Spanish society (CRUE, 2019).

TOP 0-500 (Hernández and Pérez, 2018, p. 105), with 3 in the TOP 0-100, in the academic year 2016/2017. However, the quality indicator in the ARWU and THE rankings is much lower in terms of research (production and quality), which are the items that have the highest weighting for the overall ranking.

6. The same report shows that Spain, despite being the 13th world power (IMF, 2018), occupies an unadvantageous 13th place in the TOP 500 of the ARWU 2018 ranking, which is explained by its low investment in R&D expenditure, occupying 25th place (World Bank, 2018). The TOP 200 and 500 rankings show that "all countries with R&D expenditure of less than 1.3% only have 1 university in the TOP 200", which is precisely why Spain should improve its R&D expenditure in order to improve the position of its university system worldwide.
7. Therefore, as a final conclusion of this study, it could be stated that the Spanish public university should experience a growth in human capital, by increasing the number of Teaching and Research Staff (PDI), maintaining the requirements of the professional career system through accreditations (ANECA) to achieve greater economic growth (H1 and H2) and improvement in international rankings (H3), since any PDI working in the public university is obliged, in order to be promoted, to present a quality scientific production in a more than representative quantity (an item included in the reference rankings).

Based on the above conclusions and the considerations of the CRUE report for the period 2016-2017 (Hernández and Pérez, 2018), there is a direct way to improve university quality. This path has several components:

- Scientific production must continue as a requirement of ANECA for accreditation of research teaching staff, as it is beneficial for better teaching quality and more and better scientific production.
- Spending on R&D should be increased. The report refers to the relationship between "ranking position and R&D expenditure", going so far as to state explicitly that "it is also conclusive that Spain, given its size and the intensity of its R&D activity, could hardly place any more of its universities in the ARWU TOP 200. In fact, of all the countries with an R&D expenditure of less than

1.3%, it only places one" (Hernández and Pérez, 2018, p. 101). Therefore, an increase in R&D spending in public universities, through research projects and grants, is a way to increase the supply of teaching and research staff positions.

- Increasing the supply and quality of Master's programmes (MMT) is a complementary strategy to achieve higher and better quotas of growth and improvement of the system.
- Improve and increase real investments (EC6), taking into account that the fees paid by students (RC3) could be increased without being a major burden (Spanish university students are subsidised 90% of the cost of the first enrolment fee for all subjects, with no obligation to return this subsidised amount).

As a final reflection, the following recommendation could be summarised to the public authorities. If Spain wants a quality, internationally competitive and efficient university, it must increase, above all, the number of university teaching posts with the same system of accreditation established within the EHEA, in order to achieve more quality scientific production. One possible way would be through an increase in R&D, offering grants and contracts linked to research projects and assistant lecturer positions (lecturers in training to develop their professional careers). In short, the student-teacher ratio, investment in R&D for research, the improvement and expansion of teaching and research facilities and resources, together with a moderate increase in university fees and an improvement in the offer of master's degrees, will be the path towards a stronger, more competitive, efficient and better positioned university.

In addition, it is necessary to address this support from the public administration, as a negative gap is being created in the recruitment of young faculty that could have a very negative impact on the objectives described in this document in the future.

The evidence that this is the way forward is the reality set out in the QS World University Rankings: "while the top 3 North American universities invest around 100,000 euros per student per year, in Spain the investment is 6,000 euros". Among the causes of the decline of all the universities, one in particular has been singled out: research. The organisers of the QS warn of the fall in research and development funding and how this has led to a drop in citations per professor.

Considering all of the above, a necessary and profitable future line of research would be to specify the offer of Master's degrees per university, taking into account the socio-economic circumstances and needs of the environment. Consider the current offer and, after an analysis by productive sectors, draw up maps of excess and shortage of Master's degrees at each university. In this way, it will be possible to present a map of Bachelor's and Master's degrees suitable for each autonomous community so that the public university's contribution to regional and global development is much greater.

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