THE NEW SPANISH UNIVERSITY LAW: ECONOMIC AND FISCAL IMPACT

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Abstract

This paper simulates the potential economic and fiscal impacts of the new Spanish University Law. Based on its expected positive effects over the production factors (labour and human and technological capital) due to increases in the number of scholarships and dual mentions and higher R&D investment, among the main ones, we estimate its impact on Spanish GDP in 2018. Additionally, we estimate the fiscal return in terms of Social Security contributions and Personal Income Tax. The paper presents, as well, some concerns related to the political and fiscal implementation of the Law at the national and regional levels.

KEY WORDS: Higher Education, Public expenditure, Economic impact, Fiscal impact, Econometrics

JEL codes: C01, H52, H72, I23, O47.

1. Introduction

Government decision-making, and the implementation of certain public policies whose objective is to introduce improvements in the university system of a country, often have an impact on the budgets of the governments that promote them. Betting on an improvement in the working conditions of the teaching staff, encouraging greater access for young people to the university, increasing their investments in R+D+I, or achieving greater levels of equality among the university community, can hardly be achieved without increasing public spending on the university system. From the outset, therefore, the implementation of this type of policy has an impact on the spending budget of the governments responsible for carrying them out (higher personnel costs, higher investment costs, etc.), especially if a significant part of the resources of the universities comes from transfers made by said governments. However, it should be borne in mind that, in the short or medium term, these same policies can have a positive impact on the economy as a whole, specifically on the Gross Domestic Product (GDP), which will end up translating into economic growth. In turn, said growth will generate a positive impact on the revenue budgets of public administrations.

The objective of this article is to offer a methodology for simulate the impact that some of the measures contemplated in recently approved Organic Law of the University System (LOSU, is the Spanish acronym) could have for the Spanish economy.[2] This work aligns, therefore, the analysis of the incidence of the reforms that affect the university system in line of the ones carried out previously by De Pablos and Gil (2008, 2011) or Fernández-Santos et al (2013).

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[2] Official Gazette State (2023).

To achieve this objective, after this introduction, the second section delves into the role of the university as a potential agent generating economic impact. In the third section, the measures included in the LOSU are reviewed and, based on a review of the academic literature, their potential economic effects are noted. The fourth section explains the applied methodology. Finally, the fifth section presents the results obtained and the sixth concludes.

2. Universities and their economic impact: The economic literature.

For centuries, universities have played a significant societal role by fulfiling their educational mission, engaging in research activities, contributing to cultural and political movements, and facilitating the transfer of knowledge, among various other functions. Their presence has been instrumental in the growth and enrichment of the communities they serve, resulting in substantial positive economic effects at the national, regional and local level.

There are several channels through which universities generate an economic effect on a country. On the one hand, in the short term ("via demand" approach), the set of expenses and investments made by the agents directly related to them (especially, the university itself as an entity, the foundations and science and technology parks created in its environment, the business activity that is carried out, the expenses of students when changing habitual residence, as well as those of teachers, family members and visitors to congresses, seminars, etc.) generate a direct impact on the economy, which is multiplied given the sectoral relations that exist to provide all related goods and services, and for the expenses made by the personnel who work directly and indirectly for it. Examples of quantification of these short-term impacts are the works of BiGGAR Economics (2015), Suriñach et al (2017, 2023) or IVIE (2019).

Likewise, universities are generators of an impact in the medium and long term, the result of a greater and better endowment of productive factors, capital and work ("supply" approach). So, there are several ways in which the services provided by Universities can have an economic impact in the long term. One of them is the human capital resulting from the education provided to students attending the different programs supplied; another is the technological capital generated by R&D made in the universities.

It is worth mentioning that a highly qualified labour force is more productive and creates the necessary conditions to increase the country's economic growth, increasingly linked to knowledge industries. In addition, education has individual benefits linked to higher earnings throughout working life, which, in turn, increase tax and social contribution revenues and generate savings in social spending (Strauss and Maisonneuve, 2007; Pastor et al, 2007; and Pastor et al, 2016). Likewise, the higher qualification of university-qualified personnel manages to increase the activity rate and reduce the unemployment rate.

The educational results in Spain, however, are far from what would be desirable to ensure the participation of young people in society and in the labour market and, consequently, to ensure economic growth that guarantees minimum levels of well-being for the entire population. In 2019, the early school leaving rate was 17.3% (MEFP, 2020), the highest in Europe. The luck of the students who continue studying is not much more favourable. Only 40.9% of people between the ages of 30 and 34 completed their tertiary level studies in Spain. In addition, students who finish tertiary studies also lack certain basic skills, both in the field of knowledge and in the social and emotional field, which greatly limits their entry and progress in the labour market or in other spheres of life. In fact, in 2019, the unemployment rate of the population from 25 to 34 years with tertiary education was 12% compared to 5% in the EU-23 and OECD (MEFP, 2020).

According to the existing evidence, the quality of education largely explains the results of students throughout life, increasing their years of study and their continuation towards higher studies, increasing their salary gains (Dugan et al 1976; Bishop, 1991, 1992; Card and Krueger, 1992; Murnane et al, 2000; Pastor et al, 2007; Strauss and Maisonneuve, 2007; Mahnic, 2022) and reducing their probability of being unemployed (Bishop, 1992; OECD, 2020a; McIntosh, 2001; Medina et al, 2010; Pastor and Peraita, 2014). In this sense, the employability of university graduates affects the income benefits they receive compared to people with lower levels of education. Individuals with tertiary education receive higher incomes than individuals with upper secondary education, 54% on average for OECD countries and 49% in the EU23. In Spain in particular, there is a relationship between wages and educational level similar to that of the averages presented. The income of a graduate in tertiary education is 48% higher than that of a graduate of the second stage of secondary education (MEFP, 2020). In relation to the labour insertion of young people, a study by Serrano and Soler (2015) estimates that, in the Spanish case, years of education significantly increase the probability of employment by 24.4 points. According to the authors of the report, these differences are more pronounced during times of crisis than in the expansionary phases of the cycle.

In this way, education becomes the means to guarantee equal opportunities for the entire population, regardless of their socioeconomic origin, thus helping to mitigate the problem of inequality and poverty. More specifically, Nickell (2004) shows how most of the differences between countries in relation to their income distribution is explained by the distribution of skills among their population. Likewise, according to the results of Juhn et al (1993), it can be concluded that improving the quality of education contributes to improving income distribution, provided that it implies an improvement in cognitive skills. Molina et al (2013) show that the expenditure on education is a means which

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governments use to fight against inequality in income distributions; however, a higher share of people with tertiary education does not necessarily imply higher public investment in education. Del Rey and Racionero (2008) consider a dynamic framework where generations are linked to their educational background (individuals differ in ability to benefit from education, parental education, belonging to a minority group…) and provide an argument in favour of carrying out actions in higher education in the form of subsidies to individuals from minority groups based on efficiency considerations.

The individual gains surveyed above, in turn, generate benefits for society as a whole. In this sense, a study by the CyD Foundation calculated that in 2004 the Spanish university system generated a direct impact (through investment and consumption derived from the activity) of 5,567 million euros in the total production of the Spanish economy, equivalent to 0.7% of Gross Value Added (VAB), a figure that remained constant with respect to previous studies (CyD Foundation, 2007). This implies that public investment in higher education can even generate returns (Kurt and Gumus, 2021). On average for OECD countries, the net return on public investment for a person with higher education is around 37,000 euros, or 40,700 for the EU (23) (OECD, 2020b). In Spain, this value is estimated at almost 25,000 euros. This translates into an average internal rate of return for governments of between 3% and 6%. In Spain in particular, it is estimated that there is a cost-benefit ratio of 1.2, that is, that the total benefit is greater than the cost (OECD, 2020b).

3. The Organic Law of the University System (LOSU) and its economic impact.

3.1. Identification of possible changes in the Spanish university system with the LOSU.

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In the *Report on the Regulatory Impact Analysis of the Project for the Organic Law of the University System* prepared by the Ministry of Universities[3] includes a set of measures that, in addition to having a possible impact on the cost budgets of Spanish public universities and the central and regional administration, could also have an economic impact. Among them, the following ones stand out:

- Those whose objective is to achieve a more accessible and equitable university.

To achieve this objective, a series of measures are expected to be carried out, such as the following (see articles of the Title VIII of the LOSU): Clarify the admission system for students; grant greater publicity to the academic offer; develop the right to scholarships and aid for students at universities, introducing an important regulatory innovation by considering access to said scholarships and aid as a subjective right of students (the granting of scholarships and study aids must respond to socioeconomic criteria, without prejudice to academic criteria). All of this is established in articles such as 31 (right of access), 32 (scholarships and study aids), or 37 (equity and non-discrimination) of the new law. Among other aspects, the following stand out: facilitating training and professional reintegration by regulating procedures for access to the University for individuals who can demonstrate a certain work or professional experience even if they do not possess a legally required academic degree; the obligation on the part of the Autonomous Communities, which are responsible for programming the offer of university education, to communicate this offer to the General Conference on University Policy, and the Ministry of Universities will make it public (improvements in information); the requirement for universities to promote inclusive and accessible

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curriculum structures, including the adoption of affirmative action measures for students with disabilities.

These are measures that may imply the existence of a greater number of university students, as well as greater equity in access to university. These types of measures can generate incentives to change certain behaviours and dynamics that end up modifying the future conditions of employment, income, competitiveness, production, productivity and equity. Encouraging greater and better access to university can affect the intergenerational mobility of income. The maximum educational level attained by people largely determines the income of their descendants (D'Addio, 2007). Although the literature suggests that policies that encourage early entry into education have more effects than at the tertiary level, access to higher education is related to higher income, which may reinforce existing inequities in the levels of access to education. For this reason, it is important to ensure equitable levels of access in the population (OECD, 2008). When the volume of people with higher education expands, there are relative changes in the levels of participation of previously excluded groups, which must be taken into account when measuring the impact on equity caused by improvements in access to higher education (Clancy and Goastellec, 2007).

- Those that seek to guarantee that the human and financial resources of the university system are adequate and sufficient for the fulfilment of the functions entrusted to the university.

In order to fulfil this objective, different measures are expected to be carried out, among which the development of the concept of financial sufficiency of public universities stands out. Specifically, it establishes that the public powers must provide public universities with the necessary resources to fulfil the functions assigned to them

and provides that, in accordance with the Organic Law of Education[4], the central government and the regional governments must agree (in the framework of the General Conference on University Policy), a Plan to increase public spending on education that allows its progressive matching to the average of the Member States of the European Union. Specifically, it is established that public spending on university education will be at least 1 percent of GDP in the State as a whole (see article 55 of the LOSU).[5]

- Those whose objective is to achieve a university that produces knowledge at the service of society and that contributes to sustainable economic development.

The fulfilment of this objective is intended to be achieved by adopting different measures, among which the obligation of Universities to allocate a minimum of 5% of their budget to research stands out (Articles 57.7 and 100.3); the configuration of research as both a right and a duty of teaching and research staff, facilitating interdisciplinary research, establishing pathways between the research career and the university, encouraging the attraction of research personnel from excellence programs by reserving certain university positions, promoting the formation of knowledge networks within the university and with external entities, fostering open science as a field for generating shared knowledge between citizens and the university research system, promoting that public administrations and universities facilitate access to data, codes, and methodologies to ensure the communication and dissemination of research, requiring state and regional quality agencies to include accessibility of scientific results publication among their evaluation criteria, and promoting policies for patent creation and the establishment of entities or companies based on knowledge and their transformation into innovation

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[4] Law 3/2020, of December 29, on Education.
[5] According to Article 55 of the LOSU, it is stated that, in order to achieve this multi-year objective, the corresponding contributions will be established in the Budgets of the Autonomous Communities, in those of the group of universities, and in the General State Budgets, in accordance with the budgetary availability of each fiscal year.

processes in the productive system, etc. (all of this is outlined in articles 11, 12, and 13 of the LOSU).

- Those whose objective is to contribute to gender parity, greater stability and consolidation of the teaching staff or internationalization.[6]

The achievement of these objectives is intended to be reached by adopting various measures, among which the new law includes a set of actions aimed at improving the working conditions of teaching and research staff (Chapter IV). For example, it establishes a stable and predictable academic career by regulating both the teaching staff of tenured professors and chair professors (civil servants) and the staff of temporary contract employees (assistant professors with a doctorate, associate professors, substitute professors, permanent contract professors, visiting professors, and distinguished professors). The maximum percentage of temporary employment contracts for teaching and research staff is reduced to 8% (Article 64), whereas it was 40% in the previous law. It provides pathways for temporary contract teaching staff with a doctoral degree and a minimum of six years of employment with the university to enter the academic career (Article 78). It ensures the parity and academic duties of both tenured and contract teaching staff (Article 82). In competitive exams for tenured and contract teaching and research staff positions, measures can be established to promote the hiring of women. For instance, there may be reservations and preferences in hiring conditions, so that in cases of equal suitability, individuals of the underrepresented gender in the teaching staff or category in question would have preference in hiring (Article 65), and so on.

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[6] Literature provides evidence of a positive association between the internationalization of the university, the mobility of university teaching staff, the creation of research networks and the increase in innovation output (Jonkers and Tijssen, 2008; De Filippo et al, 2009; De Wit, 2009; Decramer et al, 2013). In this case, an increase in the level of innovation affects the growth of an economy.

All these measures can have an economic impact. Employment conditions are important for guaranteeing workers' rights and their quality of life and satisfaction, and therefore, they can be factors that influence productivity and the quality of work performed. For this reason, the regulation of academic career dynamics can determine both the productivity and quality of research, as well as the competitiveness of these positions, and the retention of talent in national academic institutions.

In this regard, changes that represent potential improvements in the academic career of faculty members can impact, as literature suggests, various economic variables. For example, the composition of the faculty by the level of education attained can affect both costs and the quality of production. The requirement for professionals with doctoral degrees can translate into higher production quality, given the necessary experience and training (OECD, 2020a). Furthermore, temporary employment is common in academia, especially among younger professionals in early career stages. In this context, labor market theory suggests that this can have a negative influence on job satisfaction. Different studies show that professionals with temporary contracts are less satisfied with their jobs, especially those without job security, and that this type of employment affects their quality of life in terms of stability, the ability to start a family, or access to credit (Waaijer et al., 2016 and Castellacci and Viñas-Bardolet, 2021). Additionally, the use of temporary contracts can have negative consequences on the quality of teaching and learning, depending on the types of institutions and levels of study, as some studies in the United States have found (Bettinger and Long, 2004; Ehrenberg and Zhang, 2005; and Baldwin and Wawrzynski, 2011). The type of temporary employment can also affect talent retention, motivation, and the quality and independence of work, as suggested by the OECD and some related studies (Klopper and Power, 2014; Aarnikoivu et al., 2019; and OECD, 2020a). Lastly, the existence of a clear teaching and research career path with

incentives for promotion or performance-based compensation can impact the quality of teaching and related services offered by universities (OECD, 2020a).

Regarding gender parity, in recent years, economic literature has debated whether gender diversity, in terms of the composition of work teams, has a positive or negative effect, or whether, on the contrary, the proportion of women and men has no influence on economic performance. One of the areas in which this question has been considered is that of the innovative activity of any institution. Proponents of a positive effect argue that differences among group members increase the availability of information, perspectives, and knowledge and skills. Thus, between men and women there can be differences in the ways of thinking and acting that can complement each other, fundamental for the success of the innovative process. Gender diversity can also increase the external relations of work teams, making it easier for the group as a whole to acquire knowledge and ideas through collaboration with external groups, which leads to an increase in the institution's capacity for innovation (Fenwick and Neal, 2001; Faems and Subramanian, 2013; Fernández Sastre, 2015). In addition, Brown et al (2002), Catalyst (2004, 2007, 2013) and Krishnan and Park (2005) obtained a positive association between a high presence of women in companies and their better economic and financial profitability. All of these channels would promote economic growth.

At the end, literature provides evidence of a positive association between the internationalization of the university, the mobility of university teaching staff, the creation of research networks and the increase in innovation output (Jonkers and Tijssen, 2008; De Filippo et al, 2009; De Wit, 2009; Decramer et al, 2013). In this case, as mentioned earlier, an increase in the level of innovation has an impact on the growth of an economy.

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3.2. Impact of the LOSU on public spending on university education.

As noted above, the LOSU predicts that public spending on university education will be at least 1 percent of GDP. Well, in 2019, the public universities as a whole spent an annual average of 9,207.38 million euros, which represents 0.810% of GDP, while university spending had grown at an annual rate of accumulated variation of 2.321% during the years 2014-2019.

If it were assumed that the precept established by the LOSU had to be reached by the year 2029, Figure 1 show what the evolution of the expenditure of the public universities as a whole should be until reaching it.

It is assumed that, if said precept were not applied, university spending would have evolved according to the same evolution rate as in the period prior to the pandemic, that is, at 2.321% per year, while to reach 1% of GDP it would have to grow at an annual rate of 4.541%.

The difference between the two magnitudes that appear in Figure 1 shows the budgetary impact that the application of the precept established by the LOSU would entail. This difference is the one that appears in Table 1 and shows that, for example, in 2029 the increase in university spending compared to the previous year should be 668.15 million euros if the objective of reaching 1% of the total GDP is met. On the other hand, without this objective, the increase in spending compared to the year 2028 is estimated at 281.45 million euros. Therefore, the application of the requirement of gradually equating ourselves to the average of the Member States of the European Union, would mean, in the year 2029, an additional cost of 386.70 million euros. Adding the additional expense

corresponding to the 10 years (2020-2029), it could be affirmed that the cost of applying said precept would be a total of 2,971.80 million euros.[7]

INSERT FIGURE 1

INSERT TABLE 1

4. Description of the methodology used to measure the potential economic impact of the LOSU.

Although the LOSU contemplates, as just indicated, a series of measures that have a probable socioeconomic impact, there are methodological difficulties in quantifying it, especially in terms of GDP. This is due to various reasons. On the one hand, not all of the economic impacts of the LOSU are quantitative, some may be of a qualitative nature. Likewise, and despite the fact that some have a quantitative impact, it may be difficult to measure. Additionally, the application of some LOSU precepts may have an impact in the medium and long term, but not in the short term. Finally, most of the articles of the LOSU do not define a translation of said objectives by means of a specific monetary quantification or by means of quantified objectives.

For all these reasons, in this article, we have chosen to approximate part of the potential effect that the LOSU would have, if applied, in terms of GDP and economic growth, by means of an economic modeling that links the impact of a change in the productive inputs of a country (labour factor, physical capital factor, human capital factor and technological capital factor), on the generation of wealth and its growth. Specifically, a methodology is proposed to quantify the economic impact of the measures described in

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[7] Borraz et al (2021) analyze the different social expenditures items of the autonomous governments in Spain, including expenditure on universities, and their projections until the year 2030.

the previous section and which are the ones that will allow the following two goals to be achieved:

- An increase in the number of university graduates. This will be a consequence of the implementation of the measures planned to achieve a more accessible and equitable University.

- A progressive increase in the expenses of public universities, a part of which will be allocated to R&D. This will be a consequence of the application, on the one hand, of the measures planned to guarantee that the human and financial resources of the university system are adequate and sufficient for the fulfilment of the functions entrusted to the university; and on the other hand, the application of the measures planned to achieve a university that produces knowledge at the service of society and that contributes to sustainable economic development.

In this way, between the two major possible approximations to the economic impact of universities already mentioned in the second section ("via demand" and "via supply"), the second one is used, both for the type of information available and because it is the one that collects the dynamic effects of the long term. Specifically, it is based on the estimation, for the Spanish economy, of what is known as the extended production function, from which the impact on GDP derived from potential increases in production factors linked to the increase in production will be simulated due to the LOSU.

Specifically, the extended production function to be estimated is:

$$Y_{it} = A K_{it}^{\alpha_1} L_{it}^{\alpha_2} K H_{it}^{\alpha_3} K T N U_{it}^{\alpha_4} K T U_{it}^{\alpha_5} \qquad (1)$$

where Y is the GDP, K refers to the stock of physical capital, L is the number of employed, KH is the human capital, KTNU the non-university technological capital (derived from R&D expenses excluding those carried out by Universities) and KTU the

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university technological capital (derived from the R&D expenses of the Universities). Likewise, coefficients α_2, α_3 and α_5 capture the marginal effects of the factors directly and indirectly influenced by Spending on Universities: in the Labor factor (in terms of quantity, L_{it} and quality, KH_{it}) and in the University Technological Capital factor (KTU_{it}). Likewise, the subscript i refers to the region i, while the subscript t indicates the time period. For details of the statistical sources used, see Annex 1.

The procedure followed consisted, first of all, in obtaining the database (for Spain and its 17 Autonomous Regions, AR, not counting Ceuta and Melilla) on the variables of the model 1.[8] Second, to estimate the expanded (linearized) production function for a data panel formed by the AR for the period 1977-2018, and, finally, to use the estimates to carry out a counterfactual analysis that allows simulating, for the year 2018, the results on the GDP of the Spanish economy as a result of the greater quantity of employment (L) and quality of employment (KH) (due to the potential greater number of university graduates), as well as the stock of university capital (KTU) thanks to the higher university spending on R&D.

4.1. Extended Production Function Estimation.

The model finally estimated is the following:

$$\ln\left(\frac{Y_{it}}{L_{it}}\right) = lnA + \beta_1 ln\left(\frac{Kpriv_{it}}{L_{it}}\right) + \beta_2 ln\left(\frac{Kpub_{it}}{L_{it}}\right) + \beta_3 ln\left(\frac{AME_{it}}{L_{it}}\right) + \beta_4 ln\left(\frac{KT_{it-1}}{L_{it}}\right) + U_{it} \qquad (2)$$

where "ln" is the logarithmic transformation of each variable, "$Kpriv_{it}$" is the Private Physical Capital Stock, "$Kpub_{it}$" is the Public Physical Capital Stock, "AEM_{it}" is the Average Years of Study, and "KT_{it-1}" is the Total Technological Capital Stock (university

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[8] Annex 1 present the statistical sources used and their characteristics.

and non-university delayed by a period to capture the non-immediate effects of investments in knowledge).

The estimation controls for unobserved heterogeneity, through a regional random effects model, and for unobserved temporal heterogeneity with the incorporation of temporal dummy variables which cover the four decades under analysis.[9] Likewise, to reduce the problems of multicollinearity that appear between some explanatory variables, the entire production function is relativized to the employment factor, and KTNU and KTU are combined into a single variable. In addition, through the Levin-Lin-Chu unit root test, the stationarity of the data panel variables was verified, since the null hypothesis that states that the panels contain unit roots are rejected for all the variables, confirming that the panels are stationary. Finally, we also run the Durbin-Wu-Hausman test to check for the exogeneity of the explanatory variables of the model. In all the cases, the null hypothesis that the regressor is uncorrelated with the error term is rejected, indicating the existence of a problem of endogeneity in our model. Therefore, the model is estimated by Instrumental Variables for the panel, using the time lags of the explanatory variables as instruments, and the robust standard errors are calculated in order to reduce possible problems of heteroskedasticity in the estimation of the model.[10]

Table 2 presents the estimation made with the STATA econometric program. As can be seen, the relevant variables, and with a positive effect on GDP per employed

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[9] We use data on all sectors in the economy in an aggregate way. As signalled by a reviewer, although it would have been interesting to use information for the different sectors, it is not so straightforward for such a long period as the one considered in this paper and with regional disaggregation. Such information is available for GDP, labour and physical capital. However, the sectorial disaggregation is not possible for the data on human capital, the non-university technological capital and the university technological capital.
[10] It is always a difficult task to find good instruments and, consequently, many papers use lagged explanatory variables as instrumental variables to address endogeneity concerns in empirical studies. Wang and Bellemare (2019), through the use of Monte Carlo simulations, show that the use of lagged variables may mitigate the endogeneity problem in some instances by reducing both bias and the root mean squared errors relative to the OLS case.

person, are the Stock of private and public capital, Human Capital and the Stock of technological capital (aggregation of university and non-university).

INSERT TABLE 2

4.2. Simulation of scenarios to carry out the counterfactual analysis.

The previous estimate is the basis for carrying out the counterfactual analysis, that is, proceeding to simulate what the regional GDP would have been in 2018 if the LOSU had been previously implemented and, from said application, both an increase in the number of university graduates (for twenty simulation scenarios), as an increase in university spending on R&D (for seven simulation scenarios). Based on the simulated regional GDP for 2018, the potential increase in GDP that would be derived from the LOSU associated with the different scenarios defined in the counterfactual analysis will be obtained.

In the case of university graduates, twenty scenarios have been simulated (see Figure 2): from a minimum increase of 1% in the number of university graduates compared to graduates of the 2017-2018 academic year (increase of 1,601 graduates), to an increase maximum of 20% (increase of 32,013 graduates).[11] The new graduates are added to the population with higher education, reducing the weight of the population with intermediate education.

INSERT FIGURE 2

If the assumption of inelasticity in the supply of places in public universities were established, it could be argued that the origin of this greater number of graduates came from a reduction in the number of students who dropped out of university (as a result of

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[11] The increase is justified by the potential increase in grants and study aids (which will potentially reduce the number of enrolled students who drop out of their university studies), the greater orientation of studies to market demands, through for example, the dual mentions (which could lead to greater future employability of their students, increasing the number of university graduates both by the higher incentive to enroll in university studies and the lower incentive to drop out).

the reduction of the incentive to drop out, mainly as a consequence of the greater allocation of scholarships and study aids[12] and, tangentially, due to the greater market orientation of Dual Mentions[13]). Figure 3 shows the new simulated overall university dropout rates for the 2014-2015 cohort.

INSERT FIGURE 3

In the case of university expenditure on R&D, it has been assumed that in 2017 a sufficient budgetary effort would have been made to achieve spending by Public Universities equal to 1% of GDP for that year. This assumption would implicitly entail an increase in said expenditure of 2,370.4 million euros, M€[14], with the regional distribution shown in Figure 4 (see Annex 2 for a detailed explanation of the procedure followed to obtain the increases in KT derived from scenarios of simulated increases in University Spending on R&D).

INSERT FIGURE 4

Based on the estimated increase in Public Universities Expenditure, seven different scenarios of public university expenditure on R&D have been simulated (see Figure 5). Each scenario is the result of assuming that a specific percentage of the

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[12] There is much research that finds positive relationship among college rates, vulnerable socioeconomic backgrounds and college dropout rates (Canales and De los Ríos, 2009; Mediavilla, 2010; Elias and Daza, 2014; Gairín et al, 2014; Berlanga et al, 2018; or Contini and Zotti, 2022). For this reason, one of the most common recommendations is to increase aid to students (see Feixas et at, 2015, and Fernández-Mellizo, 2022 for Spanish case). In addition, based on the statistics provided by the Ministerio de Universidades (2022), for instance, while the dropout rate for scholarship recipients in the first year of undergraduate studies for the 2014-2015 cohort was 15.3%, this percentage stood at 23.6% for non-scholarship students.
[13] In this regard, while both Germany and France have a long tradition of dual pathways, there are few universities in Spain where such programs are implemented (dual university education is already offered at universities in the Basque Country and Catalonia, where students can intern at companies while studying their degrees). As far as we know, there are no studies that quantify the economic impact of these dual pathways. In any case, as stated in the report "Promotion and development of dual training in the Catalan university system" prepared by ACUP in 2021, the goal is to improve the employability of university students and their education, more tailored to the skills demanded by companies and needed in their work.
[14] As mentioned in section 3, the expenditure settled by the Spanish Public Universities in the 2017 financial year was 9,248.26 million euros, which represented 0.796% of GDP for that year. In this way, to achieve the objective of having a weight of 1% of GDP, an estimated increase of 2,370.41 million euros would be necessary.

estimated increase in expenses of public universities[15] would be allocated to R&D expenditures. The lowest assumed percentage would be 5% (€118.5M, considering the requirement of allocating at least 5% of the universities' budget to research) and the highest would be 20% (€474.1 M).

INSERT FIGURE 5

Once the simulation scenarios associated with the increase in university graduates have been defined, we have proceeded to calculate the increases in the employed population (Figure 6) and the average years of study of said population derived from each scenario (Figure 7), variables that they correspond to the labour and human capital factors of the extended production function. Similarly, from the simulated scenarios of increased spending by universities in R&D, the increases in technological stock associated with each scenario have been obtained (a variable that corresponds to the technological capital factors of the production function enlarged).

INSERT FIGURE 6

INSERT FIGURE 7

Finally, and based on the estimation of the production function for Spain and the simulated scenarios of increases in the employed population, human capital and technological capital, the corresponding counterfactual analysis has been carried out. Based on said analysis, it has been estimated what the GDP would have been for 2018 in each scenario (last year available in the estimated model), thus being able to estimate the increase in GDP that would have occurred in each scenario as a consequence of the implementation of the LOSU.

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[15] Once the increase in the expenditure of the Public Universities necessary to reach the objective of 1% of the GDP has been estimated, at the level of all of Spain, its regional distribution has been carried out considering the weight of each Autonomous Region in the total expenditure of the public universities.

5. Results.

The results associated with the analysis proposed in the previous section conclude that the implementation of the LOSU would mean an increase in the number of university graduates from public universities, which would be between 1% more graduates than there were in the course 2017-2018 (1,601 more graduates) and 20% (32,013 more graduates). These new graduates are added to the population with higher education, reducing the weight of the population with intermediate education. This would generate an increase in the employed population in Spain between 361 and 7,210 employed persons. This increase in the employed population is due to the higher employment rate of the population with higher education (73%) compared to the population with medium education (50.4%). The increase in graduates would increase the average years of study of the employed population, from 12.6024 average years in 2018, to 12.6028 or 12.6101 (according to the scenarios contemplated in the study).

If the assumption of no variation in the offer of places in public universities is assumed, it could be considered that the increase in university graduates would come from a reduction in the university dropout rate (the economic benefits associated with scholarships are a factor that would affect in reducing such early university leaving, see footnote 12 for a review of the literature supporting this assumption). In this case, the overall dropout rate would go from 14.34% (2014-2015 new recruit cohort) to 14.17% in the least of cases or 11.08% in the most optimistic scenario.[16]

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[16] In the 2014-2015 academic year, the number of students enrolled in public universities in Spain who eventually dropped out of their studies was 218,129, according to statistics from the Ministry of Education and Professional Training on university education. Therefore, when simulating the potential increase in the number of higher graduates, it would involve assuming a dropout rate between 0.7% and 15% lower than the existing rate, reducing it from 14.34% to a maximum simulated reduction of 11.08%.

The increases in the employed population and in the average years of study would generate an increase in GDP that appear in Figure 8. This increase would range from a minimum of €16.0 M (0.001%) to a maximum of €319.7 M (0.027%).

INSERT FIGURE 8

As a consequence of the increase in the employed population and the better wages of those employed with higher education, it has been estimated that wage contributions (paid by employers) could increase between €1.0 M and €20.4 M. Similarly, it has been estimated that personal income tax collection[17] could increase between €0.8 million and €15.0 million.[18]

The implementation of the LOSU will suppose a progressive increase in the expenses of the public Universities, a part of which will be allocated to R&D. This would generate an increase in GDP that would oscillate between a minimum of €220.6 M (0.019%) and a maximum of €477.5 M (0.040%) depending on the chosen scenario (see Figure 9).

INSERT FIGURE 9

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[17] The increase in employee compensation has been estimated based on the information on average Salary Earnings according to level of studies (these remunerations increase in the simulation scenarios both due to the increase in the employed population and the relative increase in the weight of those employed with studies superiors who enjoy higher salaries). Based on said increases in estimated remunerations, the associated increases in Social Security contributions (paid by employers) and Personal Income Tax Collection (IRPF) have been estimated that would derive from the increase in simulated employed population in each scenario.

[18] The simulations obtained for the growth of the employed population, remuneration of employees and GDP growth assume stability in the ratios of activity, employability and salaries earned by levels of study. Thus, we simulate what the number of employed people (and their salaries) would have been if the figures for the population with higher education had not been the real ones for 2018 but rather those defined in the different scenarios of the article (assuming a ceteris paribus situation). In the same way, we assume linearity in the impact of human capital or the employed population on GDP (from the estimation of the extended production function). This procedure allows us to simulate the increase in GDP under different potential values of the factors of human capital and employed population. However, these assumptions (necessary for the proposed exercise) may not occur. Thus, for example, according to Birulin et al (2020), the college wage premium can be U-shaped in the share of the population with a college degree depending on a country's existing stock of college graduates and existing wage inequality.

If the impacts derived from both the potential increase in university graduates and university R&D expenditures are added, it is concluded that the increases in Spanish GDP as a consequence of the implementation of the estimated LOSU (conditional on the defined scenarios) would range between a minimum of €236.6 M (0.02% of 2018 GDP) and a maximum of €797.2 M (0.067% of 2018 GDP).

Table 3 summarizes the main results of the simulation exercise associated with an increase in university graduates, Table 4 those associated with an increase in university spending on R&D, and Table 5 the consideration of both.

It should be noted that the results obtained only show two ways of impact of the LOSU on the economy (increase in graduates and increased spending by Universities on R&D), but it is highly likely that the LOSU will have consequences that exceed those quantified in this analysis. There are other measures that would impact the country's socioeconomic environment, not only quantitatively but also qualitatively. For example, it has not been possible to quantify the effects of the LOSU on the quality of employment (human capital) beyond the mere increase in average years of education. In this case, we would expect to obtain improvements in the quality of the occupation that would be linked to the improvements in university quality that would derive from the LOSU associated, for example, with: greater interdisciplinarity; open itineraries; greater internationalization; greater link to market demands; more and better research, transfer and mobility; improvements in teaching quality thanks to the changes that the LOSU introduces in the type of contracting of the professors and researchers with the aim of reducing temporary employment and ending precariousness, etc.

INSERT TABLE 3, TABLE 4 and TABLE 5.

6. Conclusions

The main objective of the article is to simulate potential economic and fiscal impacts of the new LOSU on the Spanish economy.

On the one hand, in order to compute the estimation of the impact of the LOSU on the Spanish GDP, a methodological approximation has been proposed based on the estimation of an extended production function for the Spanish economy, from which the impact on GDP derived from potential increases in production factors linked to the start of the LOSU is simulated. These productive inputs (on which the LOSU is assumed to have an impact) are: labour factor (employed population), human capital factor (average years of study of the employed population) and technological capital factor.

The hypothesis on which the analysis is based is that the LOSU, through different channels (expected increase in spending in universities, increase in scholarships and study aid, dual mentions, increase in research and development effort by universities, among the most relevant) will generate a potential increase in the number of university graduates and in R&D expenditure. The increase in university graduates will therefore increase the employed population and its human capital, while the increase in R&D expenditure will increase the stock of technological capital. In this sense, we suppose that the increase in university graduates will increase the population with higher education, diminishing the population with secondary studies.[19]

Different scenarios are simulated in terms of potential increases in college graduates (twenty scenarios) and R&D expenditures (seven scenarios), assuming full

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[19] We assume that the population with primary studies will not change. An important part of the reasoning followed in the article is that the LOSU can contribute to reducing university dropouts (in addition to being able to offer more economic resources to access university studies after high school or making it interesting to continue with the higher studies to those students who want a more applied career through dual majors). This is why the increase in the population with higher education in exchange for a reduction in the population with secondary education is being supported.

operation of LOSU. From the simulation scenarios, a simulated potential increase in GDP is obtained (taking as a reference the GDP of the last year estimated in the model, the year 2018) that would oscillate between a minimum of €236.6 M (0.02% of GDP in 2018) and a maximum of €797.2 million (0.067% of GDP in 2018).

On the other hand, this paper has accounted for the fiscal impact derived from the LOSU. As a consequence of the increase in the employed population and the higher wages of those employed with higher education, the Spanish economy would benefit from increases in Social Security contributions as well as in the Personal Income Tax. The increase in Social Security contributions (by employers) due to an increase in university graduates would range from €1.0 million (0.001% of GDP in 2018) to €20.4 million (0.017%), and the increase in Personal Income Tax would be €0.8 million (0.001%) to €15.0 million (0.018%).

Given the findings surveyed above, we can say that the adoption of certain measures outlined in the LOSU would have an economic impact on the entire country, specifically on GDP. However, it is worth noting this will depend on how its implementation is carried out. In other words, the law envisions a set of measures that must be implemented by the central and regional government, and, of course, the universities themselves. Whether or not the estimated economic impact in this study actually occurs will depend on the full implementation of the articles in the law. In this regard, it is important to consider that some of these measures will lead to an increase in spending needs, primarily for regional governments, which, given the current distribution of competences in the Spanish state, are responsible for the main functions of the university system. The implementation of this law would, therefore, require adherence to one of the basic principles of decentralized fiscal management, which is institutional loyalty. This means that the central government approves a law whose "strict"

implementation should lead to increased spending by regional governments. Consequently, it should be ensured that they have the necessary resources to meet this potential increase in spending resulting from the mandates established by the new regulations. In other words, the enforcement of this law could alter the current distribution of revenues and expenses between the central and regional governments, potentially widening the existing vertical imbalance between the two administrations. The proper implementation of the LOSU could be an additional argument to add to the list of those already pointed out by numerous studies (Pérez and Cucarella, 2015; Lago and Martínez-Vázquez, 2015; AIReF, 2016; Ministerio de Hacienda y Función Pública, 2017; Bosch et al, 2022) highlighting the need to review the current financing model for the autonomous communities. The extent of the impact of the new university law on the Spanish economy may also depend on this.

At the end, although this article has provided a first attempt to simulate the possible effects of LOSU on GDP, it is important to note its limitations. Thus, firstly, the impacts have been estimated assuming a previous operation of the LOSU, prior to the year of simulation of the impact (2018). Secondly, all the results obtained are totally conditioned to the assumptions defined in each simulation scenario and some measures of the LOSU may have an impact in the medium and long term, not in the short term, as assumed in this paper. Thirdly, it has not been possible to start with a monetary quantification of the higher spending on scholarships and grants or the higher university spending on R&D since these measures did not appear economically quantified in the LOSU. Fourthly, the results obtained assume a partial vision of the impact of the LOSU to the extent that, for example, the consequences of higher R&D expenses on employment or physical capital are not assumed.

Fifthly, to say that the results obtained only include two ways of impact of the LOSU on the economy, but this has consequences that exceed those pointed out here, affecting the socioeconomic environment of the country and with an affectation not only quantitative but also qualitative. Thus, for example, it has not been possible to quantify the effects of an increase in the quality of employment (human capital), beyond the mere increase in average years of education, and which would be linked to improvements in university quality that would be derived from the LOSU (associated with greater interdisciplinarity, open itineraries, greater internationalization, greater link to market demands, improvements in teaching quality, greater research, transfer and mobility, etc.).

Finally, a potential crowding-out derived of the increase in the public expenses is not considered. It should be noted that the LOSU does not explain the way in which it plans to finance the increase in spending on university education until it reaches at least 1% of Spanish GDP. Therefore, it would be possible that this measure produced a certain crowding-out effect (Buiter, 1977), although its verification is beyond the scope of our article.[20]

Despite the above limitations, this article represents a first attempt at economic valuation of the Organic Law of the University System prior to its approval, opening the doors to possible subsequent investigations.

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[20] In any case, certain aspects should be considered that could reduce, at least in part, the risk of a notable crowding out effect derived from the LOSU. Thus, first of all, there is controversy in the empirical literature about this effect: while authors such as Mountford and Uhlig en 2009 or Gaona and Iglesias in 2017 find evidence of a crowding-out effect of public investments in the case of the North American economy or in a sample of Latin American countries respectively, other works such as Flores de Frutos et al (1998) or Roca and Pereira (1998) for the Spanish case, Ang (2010) for the case of Malaysia or Aquino (2018) for the case of Paraguay find crowding-in effects between public and private investment. Secondly, one of the ways in which LOSU is supposed to affect GDP would be the increase in R&D expenses, a fact that contributes to increasing innovation and technical progress, engines of growth. Considering the complementarity in many cases between public and private research, perhaps one could think of a lower risk of the expulsion effect analyzed.

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Figure 1. Projection of spending by public universities with and without a 1% of GDP requirement. 2020-2029. Millions of €.
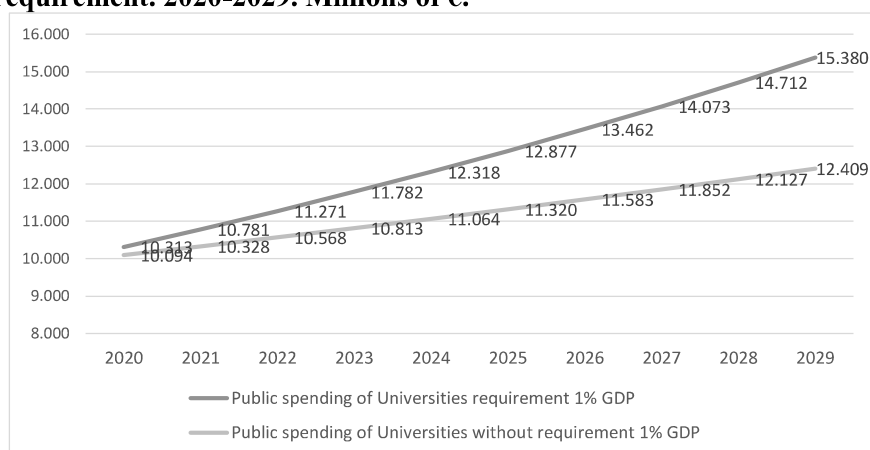
Table 1. Annual increase in spending by public universities during the period 2020-2029, with and without the 1% of GDP requirement. Millions of €.

	Increase scenario requirement 1% GDP (A)	Scenario increase without requirement 1% GDP (B)	Difference = (A) -(B) = BUDGETARY IMPACT
2020	448	228.9	219.1
2021	468.3	234.2	234.1
2022	489.6	239.7	249.9
2023	511.9	245.3	266.6
2024	535.1	250.9	284.2
2025	559.4	256.8	302.6
2026	584.8	262.7	322.1
2027	611.4	268.8	342.5
2028	639.1	275.1	364.1
2029	668.2	281.5	386.7
TOTAL	5515.7	2543.9	2971.8

Source: Own elaboration

Table 2. Extended Production Function Estimation

|	Coefficient
Ln(Kpriv $_{it}$ /L $_{it}$)	0.188*** (0.058)
Ln(Kpub $_{it}$ /L $_{it}$)	0.205*** (0.036)
Ln(AME $_{it}$ /L $_{it}$)	0.224*** (0.071)
Ln(KT $_{it-1}$ /L $_{it}$)	0.035** (0.016)
Number of observations	680
R2	0.9238

Source: Own elaboration. **p<0.05, ***p<0.01.

Figure 2. Simulated increase in the number of graduates from Spanish Public Universities
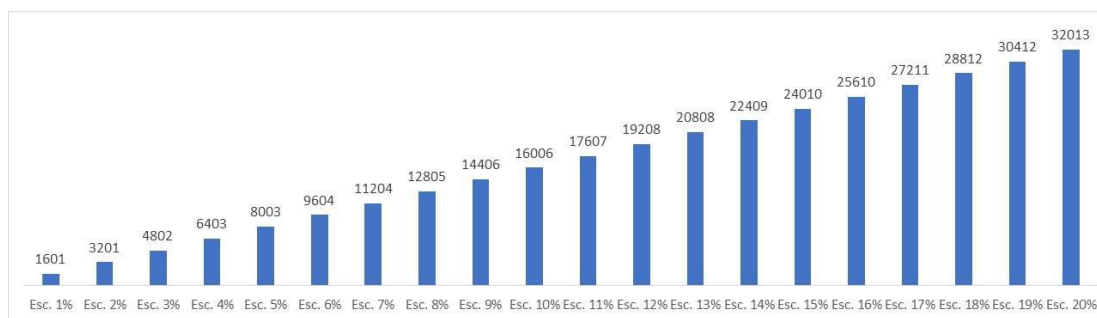

Source: Own elaboration based on data from the Ministry of Education and Vocational Training and the Ministry of Universities.
Note: Total number of graduates from Public Universities in Spain in the 2017-2018 academic year: 160,064

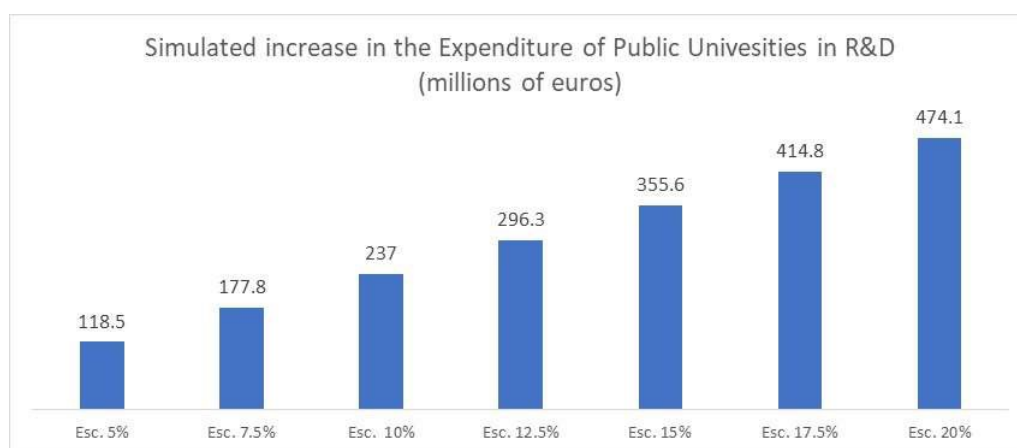**Figure 3. Simulated global dropout rates of the 2014-2015 Cohort.**
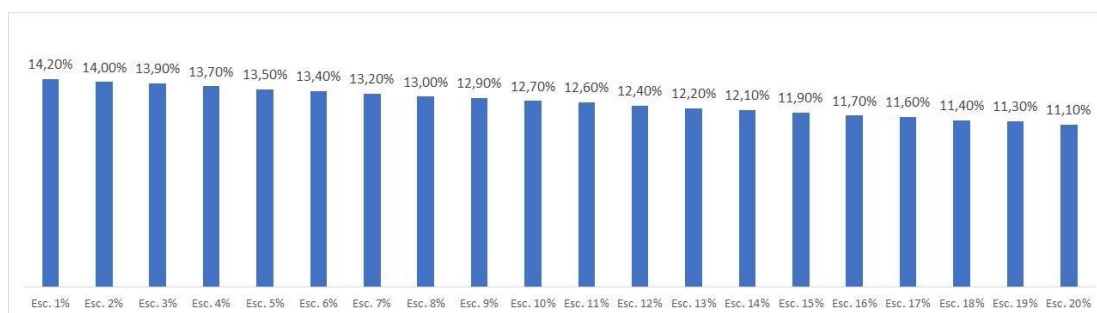
Source: Own elaboration. Note: The percentages refer to the simulated increase in the number of university graduates compared to the graduates of the 2017-2018 academic year. To calculate these dropout rates, both real and simulated, only face-to-face public universities have been considered. The national dropout rate cohort 2014-2015 was 14.3%.

Figure 4. Estimated increase in public spending by Universities (2017) in millions of euros.
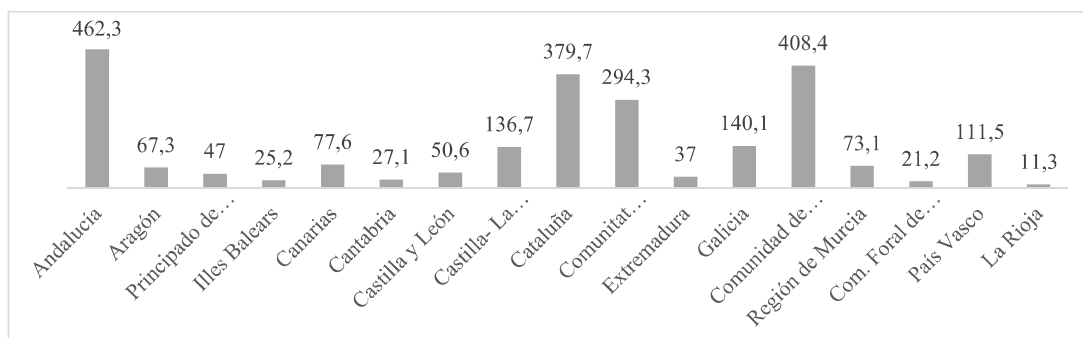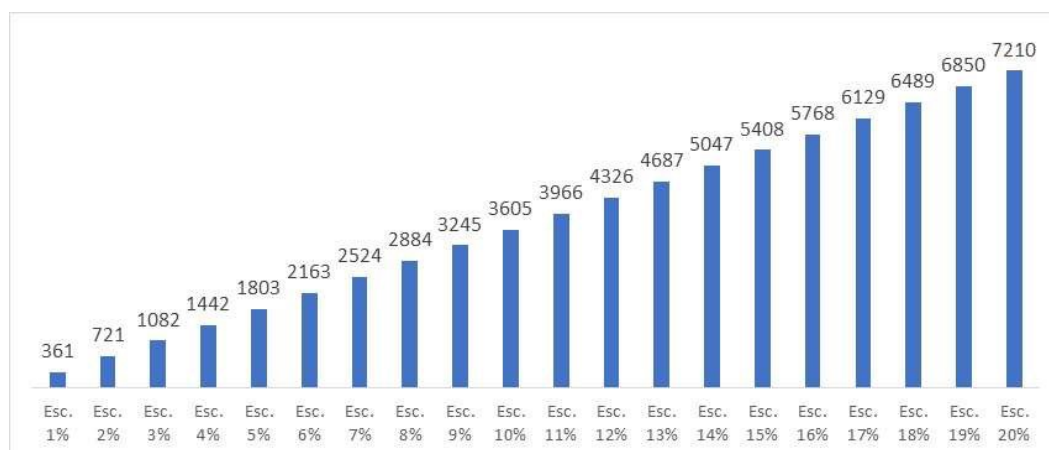

Source: Own elaboration.

Figure 5. Simulated increase in the Expenditure of Public Universities in R&D (millions of euros).
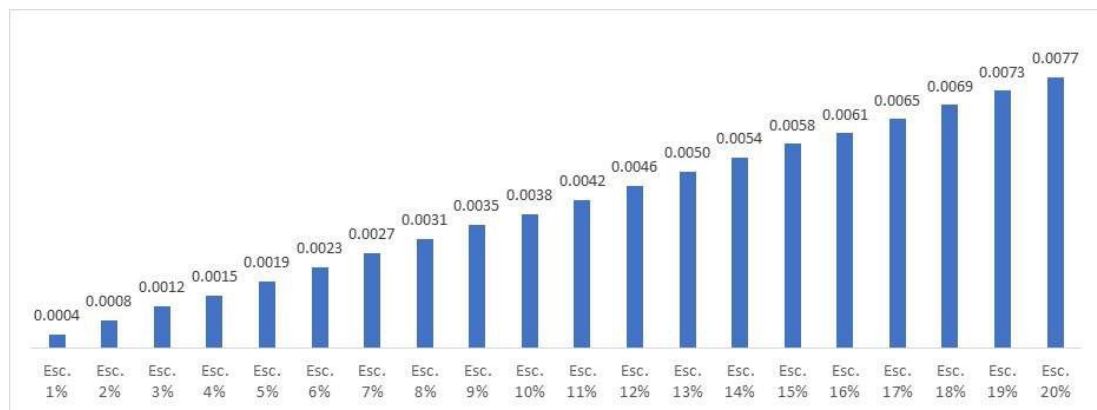

Source: Own elaboration.

Figure 6. Simulated increases in the employed population derived from the simulated increases in university graduates.

Source: Own elaboration. Note: The percentages refer to the simulated increase in the number of university graduates compared to the graduates of the 2017-2018 academic year.

Figure 7. Simulated increases in average Years if study of the employed population derived from simulated increases in university graduates.

Source: Own elaboration. Note: The percentages refer to the simulated increase in the number of university graduates compared to the graduates of the 2017-2018 academic year.

Figure 8. Estimated increase in GDP for the year 2018 in Millions of € associated with the different simulated scenarios of increase in university graduates.
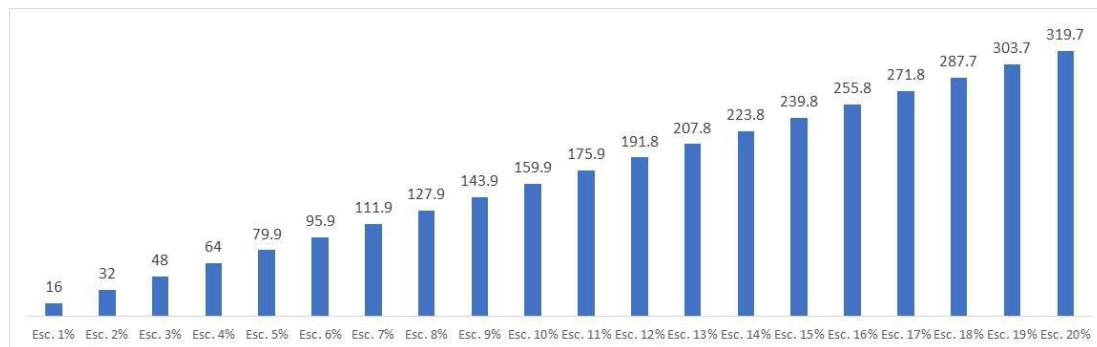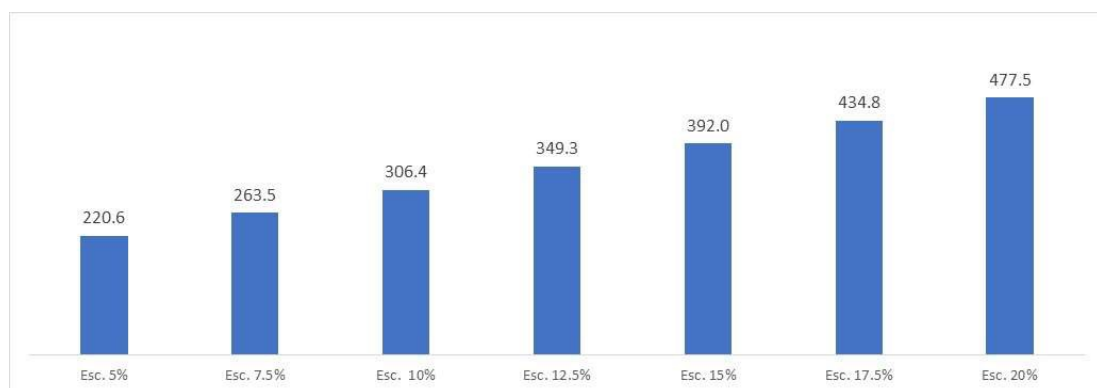

Source: Own elaboration. Note: The percentages refer to the simulated increase in the number of university graduates compared to the graduates of the 2017-2018 academic year.

Figure 9. Estimated increase in GDP for the year 2018 in Millions of € associated with the different simulated scenarios of increase in Expenditure of Universities in R&D.

Source: Own elaboration. Note: The percentages allude to the simulated increase in the R&D Expenditures of Universities in 2017.

Table 3. Summary of the results of the simulation exercise associated with an increase in university graduates.

	Scenario 1%	Scenario 5%	Scenario 10%	Scenario 15%	Scenario 20%
Increase university graduates	1,601 (1%)	8,003 (5%)	16,006 (10%)	24,010 (15%)	32,013 (20%)
Increase in employed population (L)	361 (0.002%)	1,803 (0.009%)	3,605 (0.019%)	5,408 (0.028%)	7,210 (0.037%)
Increase in years of average studies (HK)	0.0004	0.0019	0.0038	0.0058	0.0077
Increase in GDP	€16.0M (0.001%)	€79.9M (0.007%)	€159.9M (0.013%)	€239.8M (0.020%)	€319.7M (0.027%)
Increase in SS Contributions (by employers)	€1.0M (0.0008%)	€5.1M (0.004%)	€10.2M (0.008%)	€15.3M (0.013%)	€20.4 M (0.017%)
Increase in Personal Income Tax Collection	€0.8M (0.0009%)	€3.8M (0.0045%)	€7.5M (0.0091%)	€11.3M (0.014%)	€15.0M (0.018%)

Font. Own elaboration

Table 4. Summary of the results of the simulation exercise associated with an increase in university spending on R&D.

	Scenario 5%	Scenario 10%	Scenario 15%	Scenario 20%
GDP increase	€220.6 M (0.019%)	€306.4M (0.026%)	€392.0 M (0.033%)	€477.5M (0.040%)

Font. Own elaboration

Table 5. Summary of the results of the simulation exercise associated both with an increase in university graduates and in university expenditure on R&D.

	GDP increase
Lower limit: 1% increase in university graduates (1,601 graduates) and 5% increase in university spending on R&D (€220.6 M).	236.6M (0.02%)
Upper limit: 20 % increase in university graduates (32,013 graduates) and 20% increase in university spending on R&D (477.5 M€).	797.2M (0.067%)

Font. own elaboration

Annex 1. Databases used in the estimation of the extended production function (1977-2018)

VARIABLE	FONT	COMMENTS
Gross Domestic Product (GDP) at market prices at current prices (Y)	INE	The data at the regional level have been obtained by applying various information to obtain a long and homogeneous series (information from the Spanish National Accounts of the INE and the Spanish Regional Accounts of the INE).
GDP deflator	world Bank	Data at the national level have been obtained from the World Bank.
Employed population (L)	BBVA and IVIE Foundation INE	The Employed Population series from 1977 to 2013 has been obtained from the Human Capital database published by FBBVA and IVIE at national and regional level. The data from 2014-2018 have been approximated from the information on the employed population of the EPA (Active Population Survey) of the INE at the national and regional level.
Private and public physical capital stock (without housing or intangible assets associated with R&D) (K)	BBVA and IVIE Foundation INE	It has been obtained from the series published by FBBVA and IVIE of Stock and Capital Services. The stock in housing has been excluded from the capital stock series, as well as the stock linked to intangible assets derived from Investment in R&D. It supposes the aggregation of private and public capital. Information at national and regional level.
Non-University Technological Capital Stock (KTNU)	BBVA and IVIE Foundation INE	Not initially available. In the first place, the Technological Stock series has been calculated from the series published by the FBBVA and IVIE on Stock and Capital Services, considering only the stock linked to intangible assets derived from Investment in R&D. Subsequently, the non-university technological capital stock series has been estimated by applying, to the total technological stock, the weight of Internal R&D Expenditures Not executed by Universities with respect to Total Internal R&D Expenditures. The information on Internal R&D Expenditures (by execution sectors) has been obtained from the INE's Statistics on R&D Activities. Information at national and regional level.
Stock of University Technology Capital (KTU)	BBVA and IVIE Foundation INE	Not initially available. It has been estimated by applying, to the total technological Stock, the weight of the internal R&D Expenditures executed by the Universities with respect to the total internal R&D Expenditures. The information on Internal R&D Expenditures (by execution sectors) has been obtained from the INE's Statistics on R&D Activities. The Technological Stock has been obtained from the FBBVA and IVIE. Information at national and regional level.
Proxy variable Human Capital (KH): Average Years of Study of the Employed Population (AEM)	BBVA and IVIE Foundation INE	The series of Average Years of Study from 1977 to 2013 has been obtained from the Human Capital database published by FBBVA and IVIE. The data from 2014-2018 have been approximated from the information on the employed population by level of training achieved from the EPA (Active Population Survey) of the INE. Information at national and regional level.

Annex 2. Obtaining the KT increases derived from the scenarios of simulated increases in University Expenditure on R&D

The following procedure has been followed:

- To the R&D expenditure that occurred in each Autonomous Community in 2017, the amount of simulated R&D expenditure (in its different scenarios) associated with the increase in university expenditure on R&D is added to reach 1% of the GDP in 2017 (Simulated R&D expenditure for 2017).

- We pass the R&D investment data to stocks: The perpetual inventory method (MIP) is applied to the simulated R&D cost flow series (data from 1977 to 2017 where the cost data is changed in R&D of 2017 with the simulated) (Stock of technological capital simulated in the case of LOSU for the Autonomous Regions).

- Subsequently, the MIP is applied to the series of R&D expenses that actually occurred (without introducing additional R&D expenses thanks to the LOSU) (Stock of technological capital in the case of no LOSU, as detailed later.

- Based on the two previous series, the % increase in technological stock thanks to the application of the LOSU for the year 2017 is calculated (% increase in technological stock thanks to LOSU in 2017).

- Finally, the previous % is applied to the real data of technological capital stock in 2017 (simulated technological stock in 2017 thanks to LOSU).

Application of the perpetual inventory method (Puentes and Pérez, 2004; Pérez and Maudos, 2007). In order to obtain the technological capital stock data, the following expression is used:

$$KT_{i,t} = (1 - \delta)KT_{i,t-1} + I\&D_{i,t}$$

Stock estimation of initial technological capital is made with the following expression:

$KT = \frac{I\&D_{i,t-1}}{g+}$(where g is the average growth rate of investment in R&D and δ refers to the depreciation rate). Given that the obsolescence of technological capital is higher than that of the rest of the capital in the economy, the depreciation rates will also be higher than those of physical capital, although there is no unanimity regarding its value:

- Hall and Maraisse (1992), Puentes and Pérez (2004), Pérez and Maudos (2007) and Segarra et al (2011): 15%
- Pakes and Shankerman (1984) and Hall (1988): 25%

Following these studies, the present study uses a depreciation rate of 20%.