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Measuring the local economic impact of universities: an approach that considers uncertainty

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The contribution of universities to society is due to the effects generated both in the supply and demand side, the latter being associated with the injection of demand as a result of the activities these institutions carry out. This paper focuses on the impact of the demand side by designing a methodology based on Monte Carlo simulations so as to introduce stochastic elements in calculating the economic impact of universities. We apply this methodology to the case of Valencian public universities, introducing stochastic elements in all the elements which imply assumptions with uncertainty. The results highlight the importance of considering uncertainty by generating multipliers which can vary around the average value by 18% in the case of output and employment, and 10% in the case of income.

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1 Introduction

It has long been recognized that human capital, innovation and investment in R & D and knowledge are fundamental for obtaining stable, sustained growth based on productivity improvements. Because universities have the twofold function of transmitting knowledge and research, they play a key role in the socio-economic development in the areas in which they are located.

But in addition to long-term benefits, these institutions contribute in the short term to the overall economic activity in a given area. Both investments, the current expenditure on goods and services as well as salaries and wages paid to employees, represent a significant economic impact on the local economy in which they are located. Furthermore, universities have the capacity to generate population movements, on the part of students, workers and others involved in university

activities (participants in congresses, seminars, conferences, etc). In terms of the socioeconomic environment universities also contribute by providing a range of intangible assets, such as cultural property, and by sustaining a cultural environment, reputation or image of the region in which they are located, etc. [1]

Given the different channels through which universities affect local economies, the numerous studies measuring the economic impact of these institutions often provide very different results, depending on which aspects they focus on. But in addition, the varying results can also be explained by the diverse methods and procedures used, such as the assumptions made. One of the most recurring themes in the literature is the evaluation of the effects of university expenditure on the local economy. This approach does not include medium and long-term benefits, such as the improvement in the population's level of education and how this affects the economy in terms of productivity, employment, economic growth, etc.

Since the pioneering work of Caffrey and Isaacs (1971), which defined the basic elements that should be included in the analysis, many studies have been devoted to the economic impact of various universities worldwide. In essence, the methodology consists of: 1) identifying the agents that generate the economic impact of universities (university spending on goods and services, their staff, the students and their visitors receive), 2) estimating their spending in the local economy, and 3) calculating the total economic impact on the economy by applying multipliers.

With regard this type of analysis, Siegfried, Sanderson, and McHenry (2007) explored the most significant factors affecting the robustness of the impact assessments normally carried out. Among these factors, the more important arr the clear definition of the counterfactual scenario, identifying the local area in which there is economic impact, measuring first round impacts, avoiding double counting, and the suitable selection of multipliers. However, among the limitations often attributed to these studies, there is one which is rarely mentioned but which is significant: the assumptions made. In general, all studies make assumptions on the values of certain variables when there is uncertainty. Thus, the results obtained are sensitive to the assumptions made and it would be more appropriate to include additional information about the uncertainty of the variables based on their observed probability distribution. For example, surveys are often used to estimate some of the variables needed for impact analysis so as to determine the expenditure patterns of students. The average value of expenditure, drawn from the conducted surveys, is normally used to determine the impact of student spending. In reality, however, all students do not make the same expenditure. Given that there is considerable dispersion, it is important to take into account the distribution of this variable in the data from the survey, since this dispersion can mean that results obtained by simply using the average values are inaccurate.

[1] For a detailed listing of individual and collective benefits of higher education see Chambers (2008).

The aim of this paper is to design a methodology for calculating the economic impact of universities, introducing stochastic aspects in the analysis in every element in which assumptions are made when there is uncertainty. The results obtained using this methodology not only refer to specific values (means) of the economic impact, but also provide their respective confidence intervals based on the probability of occurrence. The developed methodology is applied to estimate the impact of Valencian public universities (VPUS[2]) including all the factors that Siegfried et al (2007) point out as being crucial when conducting an impact analysis. First, the counterfactual scenario used is clearly defined, considering the alternative hypothesis in which Valencian public universities do not exist. The clear definition of this scenario allows the expenditure concepts included to be defined and to avoid the double counting of expenditure by different agents. Second, the choice of all Valencian public universities guarantees almost total correspondence between the geographical area in which the agent being studied is located (the VPUS) and the region in which impacts are assessed. It should be noted that the volume of VPUS activity is indeed significant, since it has more than 127,000 students per year (91.6% of whom receive higher education in the Valencian Community). Finally, on the basis of the available input-output tables for this Spanish region, we use multipliers that reflect the actual production and income generation of the Valencian Community (VC).

The evidence obtained shows that results are sensitive to the inclusion of uncertainty in the assumptions on which the impact analysis is based. When the expenditure of students and visitors (32% of total expenditure associated with VPUS) is considered as a random variable characterized by a given probability function with the observed mean and variance, the results vary considerably. In particular, the introduction of stochastic elements generates a multiplier with a confidence interval which can vary around the average value by 18% in the case of output and employment, and 10% for income. In the case of income impact, for example, this implies that for every euro spent by the university, students, visitors or conference attendees, the income generated in the Valencian economy fluctuates between 2.16 and 2.38 euros, around a central value of the multiplier of 2.25.

The rest of the paper is organized as follows. Section 2 explores the main conceptual issues regarding the studies of economic impact of higher education institutions. Section 3 presents the methodology of the impact analysis carried out, focusing on the definition of the vector of final demand according to the counterfactual scenario in which the VPUS do not exist, avoiding double counting and disregarding those impacts outside the VC. This section also describes the

[2] The VPUS is the collective of public universities in the Valencian Community (one of the 17 Spanish regions) which had more than 127,000 students last year. It consists of five universities of varying sizes: Universitat de València with over 46,000 students (35.5%) of the total, Universidad Politécnica de Valencia with more than 35,000 students (27.1%), Universitat d'Alacant with 26,000 students (20%), Universitat Jaume I, with 12,000 students (1.9%) and Universidad Miguel Hernández with 10,000 students (7.8).

probabilistic assumptions adopted, and the procedure for calculating multipliers. Section 4 presents the main results of the impact analysis while section 5 summarizes the findings of the work.

2 Economic impact of universities: conceptual factors

When analyzing university contributions to their local economy, the first step is to define which activities, of all those undertaken by these institutions, generate economic impacts. According to Leslie and Slaughter (1992), the university's task is directly related to investment: investment by students as they increase their human capital stock, and investment by universities as they increase their stock of knowledge and technological capital. From this point of view, the economic effects of these investments are the improvements in the quality of production factors and, therefore, productivity and the economic repercussions that will arise from it. But the economic impact of higher education institutions goes further than that. Universities use economic, financial and labour resources of the area in which they are located. They also produce other externalities such as generating cultural activities, location advantages for firms, environmental effects, etc. Goldstein, Maier, and Luger (1995) summarized and classified all the activities, not mutually exclusive, through which universities generate economic impacts: 1) knowledge creation and its infrastructure; 2) creation of human capital, 3) transfer of technology and know-how, 4) technological innovation; 5) investment in capital goods and increased local demand; 6) regional leadership, and 7) influence on the regional environment.

The first four activities are directly attributable to explaining the existence of universities as centers of education, research and dissemination of knowledge; their effects on the regional environment are caused by productivity gains and improving the quality of production factors, both physical and human. For example, knowledge creation and technological innovation, along with the transfer of technology and know-how, permit the productive sectors, businesses, the public sector, and other economic institutions to improve their production processes and develop new products. Improvements in the population's human capital lead to improvements in labor, which in turn lead to higher activity rates in the region, lower unemployment rates, etc., thus fostering greater long-term economic growth in the region.

Various methodologies have been used in the literature to estimate empirically the role universities play in generating knowledge, creating human capital and transferring technology. For the most part, studies are generally based on estimating knowledge production functions (Griliches, 1979). Jaffe (1989) established the formulation that has served as the basis for this type of analysis by selecting an indicator of innovation, generation and dissemination of knowledge (measured by indicators such as patents, the introduction of new products, etc.). This indicator is modalized as a function of the level of R&D investment by the industry producing this innovation, and also the R&D investment by the university. Ducker and Goldstein (2007) examined results from more than

twenty recent studies using this methodology for different universities. The results often differ from study to study, depending on the methodology used and which variable is considered as R & D output. But overall, universities are found to make a positive contribution to innovation, and to generating and transmitting knowledge, although the means through which the impact is generated varies from study to study. While some studies find that universities have a positive effect through their R & D expenditure (Jaffee, 1989; Varga, 1998, 2000 and 2001, among others), others find the most significant effects are attributable to university graduates (e.g. Riddel and Schwer, 2003 and Martin, 1998). Another strand of the literature focuses on the ability universities have to attract technology-intensive industries or new enterprises. But as shown in Ducker and Goldstein (2007), studies present varying results.

Of the seven contributions suggested by Goldstein et al. (1995), the last two include intangible assets that universities make available to society but which are, in general, difficult to quantify empirically. For example, university regional leadership is its capacity to contribute to the area in which it is located by guiding decision making and providing technical resources support, through the participation of its staff. This occurs in the relationships universities have with companies, and private or public institutions, thanks to the expertise of the university's human resources in many of the issues relevant to society. Universities also influence the regional environment by generating improvements as well as social, cultural and intellectual cohesion, thanks to all their activities in the area and the concentration of highly qualified and creative professionals.

However, among the university contributions listed by Goldstein et al. (1995), it is those related to the impact via the investment in capital goods and the increase in local demand that have received the interest of specialists and have been the focus of abundant literature[3]. These studies quantify the increased activity of a local economy resulting from the existence of the university. This requires defining all expenditure, investments and income generated by the university directly (direct or initial impact) and applying multipliers to obtain the total impact that its existence has on the local economy. Therefore, what is evaluated is the static effect of the university on the rest of the local economy, without the dynamic effects (Martin, 1998). The advantage of such studies is that they allow us to obtain a return rate of every euro spent on higher education, accounting for why they are often used to justify the public funding universities receive.

For the most part, university case studies usually consider the economic impact of an already existing higher education institution as the loss in production that the region would suffer if the institution ceased to exist (Goldstein, 1989). In general, most of the studies are based on the pioneering work of Caffrey and Isaacs (1971) conducted for the American Council of Education, in

3 See Leslie and Slaughter, (1992) for a thorough survey of work carried out until 1992, and Ducker and Goldstein (2007) for more recent studies.

which a framework for grouping the generators of impact was established. A university's economic activity can therefore be divided primarily into four categories: 1) university spending on goods and services, and investment, 2) direct generation of income through staff payments, 3) spending by students and 4) spending by visitors to the university. In order to include a broader range of initial expenditure, recent studies have expanded the sources of impact traditionally considered, based on the work of Caffrey and Isaacs (1971). For example, Brown and Heaney (1997) propose including (in addition to university expenditure and investments, and expenditure by students and visitors) the additional income that graduates have, which is above that which they would have obtained if they did not have a university education. But this proposal is empirically difficult to implement given that it requires making assumptions about the level of education that university graduates would have obtained if the university in question did not exist. It is also necessary to make assumptions about patterns of population movements: that is, students who have migrated from the local economy or the percentage of the population with higher education who graduated from other universities.

Siegfried, Sanderson and McHenry (2007) revised 138 economic impact studies on 241 universities. They highlighted the main methodological issues that should be considered when performing these studies and that in many cases results obtained vary from study to study in terms of average multipliers. According to these authors, the first issue to be clearly defined in the impact analysis is the counterfactual scenario under which the study is conducted, i.e. a situation where the university in question does not exist. Once this has been defined, we can consider the expenditure and investment that would not have been made in the counterfactual scenario as direct impact of the university in question. In this sense, if we consider the counterfactual scenario in which the university does not exist, its economic effect is not only the expenditure and investment that it no longer carries out in the local economy, but changes in population size must also be taken into consideration: students and visitors who stop coming, resident population who move to do their university studies outside the local economy and university staff from abroad. If possible, it is not only the effects of the rise in population because of the university existing that should be considered, but also all the externalities (positive and negative) that a larger population represents.

Siegfried et al (2007) raised a significant point in that impact studies are often used to demand more public funding for universities, presenting the average multiplier as a type of rate of return: for each euro invested in the university, it creates an impact on the rest of society, given by the multiplier. In other words, the average multiplier obtained is very often associated with the marginal multiplier (economic impact associated with the investment of an additional euro in the university). However, when the study is conducted on the basis of the counterfactual scenario in which the university does not exist, it is the average multiplier that is calculated, rather than the

marginal one. Moreover, as noted by Goldstein (1989) this effect is not valued by comparing it to its opportunity cost: i.e. that obtained with return by investing in an alternative activity.

The second factor to be considered, according to Siegfried et al (2007), is the suitable definition of the multipliers and the area in which the university is located. Defining the local area in which the analysis is performed is essential for two reasons: firstly, it dictates which part of a university's expenditure reverts to the local area, and which part has to be disregarded given that its imports are from outside the economy in question, and secondly, the bigger the area of analysis, the higher the value of the multipliers. If we analyze a university's economic impact on a municipality, the multiplier will be very small in comparison with if the analysis is performed for the region, or even the whole country. That is, multipliers are higher for a larger geographical area because there are fewer outflows via imports.

Regarding the methodology, the last point to highlight is the fact that impact studies have to always avoid double counting the expenditure concepts by different agents. For example, if the total budget implemented by the university (which is financed by its total income) is considered as expenditure, all tuition fees paid should be excluded from the pattern of student expenditure, as they are already considered in the university's budget.

For the Spanish case, there are papers that have examined the economic impact of of different Spanish universities. Segarra i Blasco (2003) estimated the impact of the Universitat Rovira i Virgili in Tarragona, Sala et al. (2003) focused on the University of Lleida, Morral (2004) for the University of Vic, San Martin and Sanjurjo (2005) for the University of Navarra, Pastor and Perez (2008 and 2009) for the University of the Basque Country and Valencian universities respectively, Garrido-Yserte and Gallo-Rivera (2009) for the University of Alcala de Henares and Luque et al. (2009) for the University of Granada[4].

3 Methodology: initial expenditure of agents and multipliers

This section focuses on examining the economic impact of the Valencian public university system on the economic environment. We follow the outline proposed by Caffrey and Isaacs (1971) and subsequently applied in several studies to define the sources of impact of higher education institutions. In particular, we consider four spending units in the region in question: university and staff expenditure, student expenditure, visitor expenditure and expenditure by conference attendees. University activity is separated from visitors attending because it is considered in itself a category of expenditure that generate economic impacts. In this section, we describe firstly the methodology and statistical sources used to determine the volume of each agent's initial expenditure. We also describe the statistical hypothesis adopted to introduce stochastic elements and how to estimate the density functions associated with these expenditure

4 An estimated economic impact of all Spanish universities can be found in CYD Foundation (2008).

categories. We then explain the multipliers used and the various steps taken to move agents' vector of expenditure to the final demand vector, which will be used to calculate the impacts.

Calculation of agents' vector of initial expenditure

Table 1 illustrates that the total expenditure of the four economic agents directly related to Valencian universities amounts to 1.7 billion euros in 2008. The majority of that expenditure, 68% of the total, corresponds directly to university activities, while students account for 25% of the total. The remaining expenditure is divided between visitors, (which is less than 7%) and conference attendees (less than 1%). The amount of each agent's expenditure was obtained using the sources and procedures outlined below.

University spending is obtained from data provided by the respective universities accounting services on the budget settlement. When classifying data by sector, it should be noted that the University Sector does not exist as such in the I/O Tables for the VC, but is included in education. We therefore have to reallocate the vector of initial demand. The part of wages and salaries of VPUS staff is directly assigned to the household sector[5]. The part corresponding to spending on investment and consumption of goods by VPUS universities is attributed to the various sectors, by making use of the detailed data on the industry allocation of expenditure of budgetary payments.

The calculation of student expenditure in the Valencian public university system is based on information using four variables: 1) the number of students in each of the VPUS universities, 2) their origin, 3) the average expenditure per student and 4) their behaviour in the case of the VPUS not existing.

The data with regard to the first two variables (number of students and their origin) comes directly from information provided by universities. Thus, the number of students enrolled in the VPUS in the year in question amounted to more than 127,000 and, on average, 7.9% of the students enrolled in all Valencian universities come from outside the Valencian Community.

The third variable needed is the average expenditure made by each student while carrying out their studies. A survey was conducted specifically for students from each of the VPUS universities on the volume and structure of their expenditure during the period in which they obtained their degree. This survey was conducted through personal interviews with a sample of about two thousand students from the five universities, in each of their campuses[6]. The students were questioned about the amount of their expenses while attending university in a wide variety of situations, as well as the expected duration of stay during the course for those students not staying at a family residence. By combining these data (amount of spending and length of stay), the average annual expenditure per student can be estimated.

[5] As seen further on, given that we are using type II multipliers, the Valencian Community I/O Table has ben extended to include households as an additional sector.
[6] Further details on the survey used and the main results can be obtained in Pastor and Pérez (2009).

Given the counterfactual scenario that is being used (a situation in which there are no Valencian public universities), not all expenditure made by the students should be considered as a generator of impact, but only that which arises from the existence of the VPUS universities. In other words, only the following are considered as expenditure of each university that generates impact:

a) All expenditure by students that come from outside the VC, under the assumption that these students would not have come to the Valencian Community, and their expenditure would not have been made in the local economy in the absence of the university. Of all the students residing in the VC, we consider only the total of spending made by those students who, in the case of the university not existing, would have studied outside the Valencian Community (38% of the total students).

b) Conversely, what is not considered in its totality is spending by those students who would have studied at another university in the community (60% of students), or spending by those students who would not have studied if there had been no university (2.3% of total students). The reason is that most of their expenditure (e.g. food, housing, etc.) and its possible impact would have occurred even without the existence universities. In these cases, we only consider as expenditure attributable to the existence of the university that which is directly related to the completion of university studies (residence halls, transportation, books and tuition, not including university fees).

After determining the relevant population subgroup to estimate the impact, the data needed to calculate the total expenditure is that related to the average expenditure made by students from local VPUS universities. The first part of Table 2 provides data on the average annual expenditure per student in the various questions students were asked about. These data were obtained taking into account the average stay stated by the students. The table distinguishes the expenditure patterns of students, depending on whether or not they are studying in a different province of residence. As reflected in the table, the average annual expenditure of students in Valencian public universities is 6,508 euros. The most significant expenditure items are spending on Food (973 euros per year), which is 14.9% of total spending, followed by Transport (842 euros), Leisure, travel, sports, cinema, concerts and culture (720 euros), Restaurants / Hotels (663 euros), Education (509 euros), Clothing / Shoes (508 euros), Housing, water, electricity, gas etc. (462 euros). These items mean an average expenditure of 4,677 per year for students, representing 72% of total expenditure.

For the most part, studies on the impact of higher education institutions tend to estimate the impact of student expenditure with the aid of surveys (face to face, by telephone or telematics) or similar procedures. However, it is generally not taken into account that studying a survey involves estimating population values; in this case the expenditure pattern of students from sample values.

Average values are often used as a point estimate of the average of the population, regardless of the dispersion associated with the distribution of student expenditure.

In addition to considering the average expenditure by all individuals in the sample, this paper draws on data from the survey to estimate the probability distribution of visitor expenditure. In particular, it is assumed that spending in each of the fourteen groups of expenditure, of which the students from each university were asked about in the survey, is distributed as a lognormal variable[7] with average and standard deviation[8] equal to that obtained in the sample. Furthermore, we assume different probability functions for the students who do not live in Valencia, for those who live in the region, and for those who do not live in the region. Recognizing the random component in student expenditure means that the estimate of the impact will not be a single value, but rather a confidence interval around this estimation. The estimation of the density function is performed by 100,000 Monte Carlo simulations of the probability distribution of student expenditure based on the distributional parameters (mean and standard deviation) observed in the sample. That is, fourteen density functions are estimated (one for each expenditure item) for each type of student (resident vs. non-resident in the Valencian Community) and for each university.

The second part of Table 2 presents the estimated average values of the total expenditure made by students of each public university in Valencia, as well as the total filtered spending (after having excluded those expenses which, for the reasons discussed in the previous paragraphs, are not attributable to the existence of universities because the students reside outside the Valencian Community). Once this filtered spending has been obtained, we can finally examine the effects of the impact estimation. According to data from the surveys on average expenditure per student and on length of stay, the annual expenditure of all VPUS university students is 765.2 million euros. This expenditure is, however, reduced as a result of excluding spending that is not attributable to the existence of universities. The results of filtering expenditure, reported in the same table, indicate that the expenditure by students would have amounted to 428.4 million euros in the Valencian Community, in the case of our counterfactual scenario in which VPUS universities do not exist.

The third agent that generates spending and economic impact in the Valencian Community as a result of the VPUS universities daily activities is visitors to the university students (who live outside their usual family home) during the academic year, mainly family and friends. In order to estimate spending by visitors, the survey included several questions relating to the visits received

[7] We use the lognormal distribution for two reasons. Firstly, because in the same way as the normal distribution, only the first two moments of the distribution are needed to characterize it. Secondly, this distribution is the one that best fits the histogram of the data obtained from student responses to the survey: asymmetric distribution (heavily concentrated in low values) and only with positive values.

[8] The means and standard deviations of each component of expenditure are calculated by eliminating the outliers from the sample obtained in the survey. As *outlier* we consider those observations that take a value below (above) 1.5 times the interquartilic range in relation to the percentile 0.25(0.75).

by the students during the year. The students were asked if they receive visits which entail spending on accommodation during the academic year. If the answer was affirmative, the student was asked three additional questions regarding the number of times they are visited, the number of people who visit and the duration. Table 3 illustrates the calculation process undertaken by the university and data regarding the volume of total expenditure of visits to students, amounting to 120.5 million euros in 2008. Industry disaggregation was carried out on the basis of the tourist spending structure in Spain, provided by the Egatur survey by the Instituto de Estudios Turísticos.

Given that part of the data comes from the student survey, uncertainty is included in the calculation of visitor spending in the local economy, as in the case of students. That is, we assume that the data on the number of visits, the visitors to each student and the length of visits are once again distributed as a lognormal variable with mean and standard deviation equal to that obtained from the survey. This implies a different density function for each of the three variables and for each of the five universities that make up the VPUS.

Finally, we have to calculate the expenditure in the local economy which includes the scientific meetings, seminars and conferences generally organized by the VPUS universities. Such activities have a significant direct economic impact given that expenditure made by attendees would not have occurred but for the universities and, therefore, its economic impact would not have occurred. Data on the number of events, average number of attendees, average stays and origin of the attendees are provided directly by the universities.

So as to estimate correctly the economic impact of conference attendees, we distinguish between those residing in the VC (probably linked in some way to one of the VPUS universities), and those residing outside the VC. This distinction is relevant given that both the volume and its spending pattern differ significantly in either case. According to the counterfactual scenario adopted in the case of conference attendees residing in Valencia, only their registration fee was counted as spending. Table 4 details the calculation of total expenditure by conference attendees, attributable to VPUS universities. As in the case of other visitors, the calculation is undertaken by the university.

As a collective, VPUS universities organize a total of 133 conferences per year, according to their own data. The average stay of those attending VPUS conferences is 3.3 days; in the case of UVEG and UJI, the average stay is about 4 days on average (4.2 for UVEG and 4 for UJI). If we combine these figures (number of conferences and number of attendees), VPUS universities receive a total of 16,445 conference attendees per year. Of this figure, 2,674 live in the Valencian Community (16.26%), while 13,771 (83.74%) are residents from outside the Valencian Community. We use data from the Egatur survey by the Instituto de Estudios Turísticos for the average expenditure data according to origin of participants, as well as the sector breakdown.

In sum, the findings show that the total expenditure by conference attendees directly attributable to Valencian public universities amounts to 14.2 million.

Multipliers

Once expenditure (direct impact) of the different units of analysis in the Valencian Community is defined, multipliers are needed to understand the impact on the overall economy. Among the various approaches available, we have chosen the input-output methodology, which is the most widely used estimation method in such studies given its advantages. We use the most recent Input-Output Table available for the Valencian Community (VC I/O Table) for 2000, and have chosen Type II multipliers, which allows the calculation of indirect impacts (associated with the inter-industry demand to meet the successive increases in demand associated with the initial shock), as well as induced effects. The latter also include the increases in demand in the given region, attributable to greater household consumption associated with the higher income generated in successive iterations.

In order to construct type II income multipliers, it is necessary to expand the matrix of inter-industry technical coefficients (A) of the input-output framework, including the household sector as if it were another productive sector. Thus, the matrix of inter-industry technical coefficients has an additional row and column. The households' column corresponds to the industry percentage distribution of total household final consumption, specified in the VC I/O Table. However, the row of households has to include all the income they receive. Therefore, for the value added of each industy shown in the VC I/O Table we should deduct all items that are not channelled to households (such as non-distributed benefits, savings, etc.). Given that the VC I/O Table does not provide this information, the elements of the rows have been estimated by redistributing household consumption in each sector, according to the percentage distribution of value added in each indsutry. The redistributed consumption in each industry is then divided by total industry output.

The items in the last row of the new matrix, A^*, indicate the household income directly generated by obtaining a production unit of sector j. The last column of the new matrix represents the direct needs of product i to obtain a final unit of private consumption.

Thus, the new Leontief inverse matrix is:

$$B^* = [I - A^*]^{-1} \quad (1)$$

Type II income multipliers are calculated using the last row of the new Leontief inverse matrix, B^*. In partitioned matrix form, the new matrix of inter-industry transactions can be expressed as

$$\begin{bmatrix} X \\ y \end{bmatrix} = \begin{bmatrix} A & cf \\ \omega' & 0 \end{bmatrix} \begin{bmatrix} X \\ y \end{bmatrix} + \begin{bmatrix} Y - CF \\ RE \end{bmatrix} \quad (7)$$

in which y is the value added, cf is the vector of coefficients corresponding to household consumption, CF is the vector of household consumption, Y is the household income, RE is the income received, $\square$ is the vector of income/product ratios

The Leontief inverse matrix B^* equals

$$B^* = \left[I - A^* \right]^{-1} = \left[I - \begin{pmatrix} A & cf \\ \omega' & 0 \end{pmatrix} \right]^{-1} \quad (8)$$

Therefore, the type II income multiplier for sector j can be written as

$$IM_j^{II} = b_{n+1,j}^* \quad (9)$$

As with the income multipliers, employment multipliers are obtained by considering the effects induced by increased income (type II employment multiplier). The type II employment multiplier equals:

$$EM_j^{II} = \sum_{i=1}^{n} l_i b_{ij}^* \quad (10)$$

in which l_i is the employment coefficient calculated as the ratio between the employment and value added of sector i drawing from the Regional Accounts data, and b_{ij}^* is the income multiplier defined above.

From the vector of initial expenditure to the vector of expenditure used to calculate impacts

Once expenditure has been assigned to industries, a vector of demand is available valued at purchaser's prices. This vector should be corrected so as to convert it to a vector valued at basic prices, thus making it consistent with the VC I/O Table. The adjustment is made by applying at industry level three margins calculated from the I/O Table at basic prices: tax margin (relative weight of each industry taxes on the total industry supply valued at purchaser's prices), trade margin (relative weight of trade margin on supply at purchaser's prices after tax), and transport margin (relative weight of transport margin on supply at purchaser's price after tax and trade margins). The part of the demand vector that is discounted in each industry by the trade and transport margin is allocated respectively to the trade and transport sectors, while the part subtracted because of taxes is allocated to Public Administration.

The geographic unit adopted for the analysis is the Valencian Community, corresponding exactly to the location area of the universities. The input-output table also corresponds to the same geographical unit. So as to guarantee that only VPUS effects on the local economy are included, two factors are taken into account. First, we use solely the matrix of domestic intermediate consumption of the I/O Table in the calculation of multipliers, discounting the effects of imports on the impact. Second, since the initial demand vector available is derived from the total consumption and investment of universities, students, visitors and conference attendees, we discount the volume

of imports of the expenditure vector discussed in the previous paragraph by using the import propensity. That is, we use the import propensity of household final consumption in the case of spending by visitors, students and conference attendees; and the import propensity in total final consumption in case of spending by universities. This vector of expenditure by industry, corrected for by valuation differences and in which the part corresponding to imports has been discounted, is what we effectively use for the calculation of impacts on output, income and employment.

4 Results

The economic impact of universities should be considered from two perspectives. First, the value of their production, the income they generate and the direct employment they create. The first column of Table 5 shows that VPUS production was 1.179 billion euros in 2008, generating revenues of 602 million euros that represented 0.56% of GDP in the Valencian Community. Direct employment generated by universities amounted to 16,124 workers, i.e. 0.72% of total employment in the Valencian economy. Furthermore, this activity carried out by VPUS representes an increase in demand in other productive sectors in the local economy. That is, the expenditure due to the daily activities associated with universities by the agents involved (universities, students, visitors and conference attendees) generates economic impacts on the remaining sectors. The results of the economic impact generated in the other sectors by each of the agents involved, according to the volume of expenditure and its industry distribution can be found below.

The remaining columns of table 5 report the economic impact on output, income and employment attributable to the expenditure made directly by the VPUS in the other economic sectors. Given that we have assumed the existence of uncertainty in the calculation of spending by students and visitors, the impact results of these two types of expenditure and of the aggregate are also random variables characterized by a probability function. Table 5 illustrates the average value of the distribution function. (The estimated probability distributions of these impacts are shown further on). As the table demonstrates, the total expenditure made by the VPUS implied an initial direct impact on the Valencian Community output (sales) of 487.3 million euros. This figure was obtained from the VPUS universities' budget, after discounting staff wages and salaries, and expenditure on the purchase of goods and services from outside the Valencian Community (imports). From that initial expenditure, indirect and induced effects on the other sectors of the Valencian Community amount to 1,768.3 million euros, and therefore the full impact of expenditure directly associated with Valencian public universities on the output (sales) in the remaining sectors is 2,255.6 million annually. In other words, without the activity associated with universities, the Valencian Community's output would be 2,255.6 million euros less than what is actually observed.

In terms of impact on the Valencian Community's income, Gross Value Added (GVA) would be 1,151.5 million euros less. Of this amount, 229 million is due to the income generated in those productive sectors in which universities directly purchase their goods and services and 992.5 million to the additional income generated through indirect and induced effects.

Finally, in the case of employment, the injection of demand via the purchase of goods and services by Valencian public universities directly allowed the creation/retention of 5,668 additional jobs per year in the sectors in which they make their purchases, and 22,839 indirect and induced jobs in other sectors. In sum, the purchase of goods and services by universities had an impact on employment amounting to 28,507 extra jobs. This employment figure refers to the additional jobs generated in other sectors of the economy associated (through direct, indirect and induced effects) with purchases made by universities, and therefore does not include Valencian public university staff which, as we have seen, amounts to 16,124 people.

The second column of Table 5 reports the impact on output, income, and employment attributed to the 428.4 million euros of student expenditure of the five VPUS universities. The estimations indicate that, once imports are discounted, student expenditure represented an initial direct impact on the Valencian Community's output of an additional 278.7 million euros. To this amount we have to add the increase in output to the value of 281.4 million, corresponding to the indirect and induced impacts that are needed to deal with the rise in initial demand, thus resulting in an increase in the Valencian community's output (sales) of 560.1 million euros in 2008.

In terms of income, if the Valencian public universities did not exist, income would be 142.4 million euros less in this region without the spending made by students. Of this amount, 72.4 million euros are direct impact, while 70 million are indirect and induced. In addition, student expenditure allows the increase/ retention of an additional 7,089 jobs per year.

However, we estimated the probability function associated with student expenditure. It can be observed (Graph 1) that by building a confidence interval at 95% probability, the results may differ significantly. For example, in the region of the average value of 560.1 million euros, the bounds of the confidence interval indicate that the impact could be between 457 million euros and 694. The graph also demonstrates the potential variability of results in terms of income and jobs. Thus, around the mean value of the impact on income of 142 million euros, the confidence interval is defined between 116 million and 177 million euros. In employment, the extremes of the confidence interval are delimited between 5,816 and 8,660 jobs. In sum, the changes seen in the economic impact of expenditure by VPUS students is remarkable, provided we do not assume that student spending is constant. The variation around the average values could be between 22% and 25% superior or inferior.

In the case of visitors to VPUS students, they generate an expenditure of 120.5 million euros per year. After import spending has been discounted, this involves an initial direct impact on the

Valencian Community's output of 100.5 million euros, to which 105.1 million euros must be added in indirect and induced impacts on the other sectors of the Valencian Community's economy. In total, the production of the VC would be 205.5 million euros less per year without spending by visitors. In addition, their expenditure increases income in the VC by 52.6 million euros per year, as well as generating 2,540 additional jobs annually. As in student expenditure, the inclusion of uncertainty means the results vary significantly, as can be seen in Figure 2. Thus, the confidence interval for the output impact is defined between 56 million and 482 million euros: that is, the upper limit of this confidence interval is 2.34 times the average value, while the lower limit is 3.64 times the average. The variation of the income and employment impact on the average values also presented considerable dispersion. The confidence interval at a significance level of 95% indicates that the income impact could fluctuate between 14 million and 123 million euros, with the average value discussed above being 52.6 million euros. The values that would be acceptable for the employment impact include 692 retained jobs and 5,954 jobs.

Finally, the expenditure made by those attending conferences organized by the five public universities in Valencia in 2008 amounts to 14.2 million. This figure represents an initial direct impact on output of 13.4 million euros per year, corresponding to the net expenditure for imports. Additionally, indirect and induced effects on other sectors of the Valencian Community amount to 13.7 million per year. As a result, the total impact of spending by those attending VPUS universities' conferences is 27.1 million per year in additional output in the Valencian Community. In terms of income, expenditure by conference attendees increased the Valencian Community's income by 7 million euros, allowing the increase/retention of 379 additional jobs per year.

In short, the Valencian Community's output would be 3,048.4 million euros less in the case of the VPUS not existing. This smaller volume of production is due to 879.8 million in direct impact and 2168.5 million in indirect and induced impact. In terms of value added, the results indicate that the Valencian Community's income was able to increase by 1,353.6 million (376.9 million associated with direct impact and 976.7 million with indirect and induced impact), which represents 1.83% of GDP in the VC. Finally, the increase in the total demand associated with the existence of VPUS universities allows the creation/retention of almost 39 thousand additional jobs per year (11 thousand direct jobs and in the region of 28 thousand indirect and induced jobs), i.e., 2.43% of total employment in the Valencian Community. However, as proposed in this work, the inclusion of stochastic elements reveals significant differences in the estimates of the impacts, thus highlighting the importance of considering uncertainty. In accordance with the Monte Carlo simulations performed, at 95% of significance the output impact associated with the overall spending by the VPUS (which is assumed to have an average of 3.048 million euros) could vary between 2.847 and 3,361 million euros (Graph 3). Although the average value of the income impact is estimated at 1,354 million euros, the introduction of uncertainty generates a variation in

the total impact of between 1,302 and 1,434 million euros. Finally, the confidence interval for the employment impact is estimated between 36,030 and 42,354 retained jobs.

In table 6, the effect of introducing stochastic elements in the calculation of economic impact is assessed. We calculate the value of the mean multipliers as the ratio between the initial expenditure (before imports and other factors) and the estimated impact, both on the average value of the estimate, and at the bounds of the confidence intervals. Before discussing the results, it should be noted that uncertainty in the calculation of impact has been introduced only in two of the expenditure agents: students and their visitors, representing only 32% of total spending. Nevertheless, considering the variability in spending by students and visitors has a significant effect on the aggregate impact of VPUS. Thus, in the case of output impact, increased initial expenditure is estimated at 1,743 million euros. The 3,048 million euros of impact imply that the average output multiplier is 1.75. The confidence intervals estimated, however, indicate that the average multiplier could be delimited between 1.63 and 1.93. In other words, there is a variation of 18% between the value of the upper and lower confidence interval.

In the case of the income and employment impact generated by the productive activity of the VPUS, students, visitors and conference attendees, multipliers are higher, with the average income and employment multipliers being 2.25 and 2.39, respectively. These multipliers are higher because the initial employment and income is due solely to universities, given that students, visitors and conference attendees do not generate initial employment or income. That is, the impact of their initial demand is indirect and induced. Although the values of these multipliers are higher, they also clearly indicate the importance of considering uncertainty when calculating economic impacts. Therefore the income multiplier, which on average is 2.25, could take a minimum value of 2.16 and a maximum of 2.38, i.e. a variation of 10%. In employment, the average multiplier varies between 2.23 and 2.63, with 2.39 being the average value. The variation between the upper and lower limit of the employment multiplier is 18%.

5 Conclusions

The contributions made by higher education institutions to society are diverse. In addition to forming graduates, universities make the geographic area where they are located more dynamic, generating other benefits through both the supply side (primarily linked to the rise in productivity induced by the increased human capital generated) and through the demand side, via the injection of demand because of the expenditure and investments made by universities in their daily activity and its multiplier effect on the economy. As a result of these contributions, universities become drivers of socioeconomic development in the area in which they are located.

This view of universities as instruments of local and regional development, revitalizing the productive fabric, has prompted a growing interest in studying the impacts of universities on the

area in which they are located, and thus demonstrate their contribution to society. Most of these studies are devoted to assessing the economic effects of the university: that is, the direct, indirect and induced economic impact that its activity generates in the community.

One conclusion to be drawn from the review of the previous literatures is that results vary from study to study, clearly because of the diverse methods and procedures used, as well as the assumptions made. The fact is that the varying results have undermined confidence in this type of study. Experts generally agree that the limitations of these studies are due to a lack of consensus on several issues: 1) in defining the counterfactual scenario, 2) in identifying the local area in which there is economic impact, 3) in measuring the first round impacts, avoiding double counting, and 4) in the selection of the multipliers.

However, there is one particular limitation that is not usually mentioned but which is, in our view, significant: the assumptions made. In general, all studies make some sort of occasional assumptions about the values of certain variables when there is uncertainty. The results obtained are therefore sensitive to the assumptions made and it would be more appropriate to include additional information about the uncertainty of variables, based on their empirical distribution.

The purpose of this paper is to design a methodology to calculate the economic impact of universities, introducing stochastic aspects in the analysis in every element in which assumptions are made when there is uncertainty. Unlike the traditional methodology, the findings obtained through this approach not only refer to specific values (mean) of the economic impact but also offer their respective confidence intervals based on the probability of occurrence. The developed methodology was applied to analyze the impact of Valencian public universities Valencia (VPUS).

The results indicate that the total expenditure made by the VPUS and its agents meant an increase in output of 3,048.4 billion, 1,353.6 billion in income and almost 39 thousand jobs per year (2.43% of total employment in the Valencian Community).

Moreover, the inclusion of stochastic elements reveals significant differences in the estimates of the impacts, thus highlighting the importance of considering uncertainty. In accordance with the Monte Carlo simulations performed, when there is a significance level of 95% the output impact associated with the overall spending by the VPUS (which is assumed to have an average of 3.048 million euros) could vary between 2,847 and 3,361 million euros, the impact on income between 1,302 and 1,434 million euros, and the employment impact between 36,030 and 42,354 jobs.

In terms of multipliers, the findings show that although the average output multiplier is 1.75, the income multiplier is 2.25 and that of employment is 2.39. These values can fluctuate between 1.63 and 1.93 for the case of the output multiplier, between 2.16 and 2.38 for the income multiplier and between 2.23 and 2.63 for the employment multiplier.

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Graph 1. Estimated probability distribution of the economic impacts of activity associated with students

(millions of euros and jobs)

Note: The shaded areas on the graph correspond to the tails of the distribution at a 5% level of significance (2.5% on each tail) and the average value of the distribution.
Source: Own elaboration.

Graph 2. Estimated probability distribution of the economic impacts of activity associated with visitors

(millions of euros and jobs)

Note: The shaded areas on the graph correspond to the tails of the distribution at a 5% level of significance (2.5% on each tail) and the average value of the distribution.
Source: Own elaboration.

Graph 3. Estimated probability distribution of the economic impacts of all activities related to the University (universities, students, visitors and conference visitors)

(millions of euros and jobs)

Note: The shaded areas on the graph correspond to the tails of the distribution at a 5% level of significance (2.5% on each tail) and the average value of the distribution.
Source: Own elaboration.

Table 1. Vectors of demand by expenditure agent of activity of the VPUS universities. Breakdown by activity. 2008
Euros

	University	Students	Visitors	Conference visitors	Total	Percentage distribucion by sector
Agriculture,livestock, game and forestry	-	32,715,136	4,884,827	-	37,599,962	2.16
Fishing	-	2,085,641	311,415	-	2,397,056	0.14
Extraction of energy products	-	-	-	-	-	-
Extraction of other minerals except energy products	-	-	-	-	-	-
Food, drink and tobacco	25,915	21,693,894	3,239,201	-	24,959,010	1.43
Textil industry	744,430	15,829,977	-	-	16,574,407	0.95
Leather and footwear industry	-	12,941,948	-	-	12,941,948	0.74
Timber and cork industry	-	-	-	-	-	-
Paper: publishing and graphic arts	23,886,248	48,612,902	-	809,410	73,308,560	4.21
Petroleum refining and processing of nuclear fuels	146,035	-	-	-	146,035	0.01
Chemical industry	2,448,353	-	-	-	2,448,353	0.14
Rubber and plastic	-	-	-	-	-	-
Other non-metallic mineral products	-	-	-	-	-	-
Metallurgy and manufacture of metal products	-	-	-	-	-	-
Machinery and mechanical equipment	49,660,781	-	-	-	49,660,781	2.85
Electical, electronic and optical equipment	43,390,544	3,551,268	-	-	46,941,811	2.69
Manufacture of transport material	-	50,482,572	-	-	50,482,572	2.90
Miscellaneous manufacturing industry	12,478,218	4,080,200	-	-	16,558,418	0.95
Production and distribution of electricity, gas and water	17,197,489	4,665,531	-	-	21,863,020	1.25
Construction	120,957,205	-	-	-	120,957,205	6.94
Retail and repair	5,378,191	-	-	1,463,123	6,841,314	0.39
Hotels and restaurants	8,543,567	46,243,276	54,227,850	8,637,147	117,651,841	6.75
Transport, storage and communication	10,997,195	80,517,123	46,656,307	1,003,141	139,173,766	7.99
Financial intermediation	31,572,469	10,342,426	-	-	41,914,896	2.40
Real estate activities and business services	233,134,872	50,152,839	2,410,127	1,331,097	287,028,935	16.47
Public administration, defence, and compulsory social security	12,589,609	-	-	-	12,589,609	0.72
Education	-	2,316,118	-	-	2,316,118	0.13
Health and social services	-	8,222,359	-	-	8,222,359	0.47
Other community, social and personal service activities	4,373,188	33,950,774	8,776,606	974,965	48,075,533	2.76
Households that employ domestic staff	-	-	-	-	-	-
Household economies[1]	602,264,848	-	-	-	602,264,848	34.55
TOTAL	**1,179,789,157**	**428,403,983**	**120,506,334**	**14,218,883**	**1,742,918,357**	**100.00**
Percentage distribution by agents	**67.69**	**24.58**	**6.91**	**0.82**	**100.00**	

[1] The row of household economies does not represent final demand and includes mainly wages and salaries paid to university staff
Source: Own elaboration

Table 2. Average student expenditure by province of residence and total expenditure of VPUS university students. 2008
(euros/year)

	Average student expenditure (Euros / year)			Total student expenditure (Euros)	
	Total[2]	Reside in the same province	Do not reside in the same province	Total	Filtered
Food and drink	973	878	1,416	125,135,505	56,494,670
Clothing/Shoes	508	522	444	67,838,894	28,771,925
Accomodation, water, electricity, gas, etc....	462	332	1,071	68,228,241	33,948,988
University residence halls/dormitories	58	30	188	11,913,291	11,913,291
Furniture, household appliances and maintenance costs	93	90	105	11,903,715	5,379,885
Health (Medication, doctors, dentists)	145	133	200	18,633,439	8,222,359
Transport (vehícles, fuel, public transport)	842	869	719	98,743,089	98,743,089
Leisure, travel, sport, cinema, concerts and culture	720	745	606	91,481,662	39,813,452
Books, photographs and stationary	376	371	400	44,579,923	44,579,923
Education (University fees, specialized courses, languages, IT, etc)[3]	509	497	561	2,316,118	2,316,118
Restaurants/Hotels (cafes, cafeterias, canteens, accomodation)	663	641	764	79,849,102	34,329,986
Mobile phone	426	433	391	52,456,415	22,783,212
Computers	376	338	554	49,848,113	23,120,966
Press (magazines, newspapers)	82	77	103	9,434,151	4,032,979
Miscellaneous (hairdresser/beautician, personal care, personal effects, insuranc	276	281	250	32,829,918	13,953,142
Total	**6,508**	**6,237**	**7,771**	**765,191,576**	**428,403,983**

[1]Calculated on the total of those polled from the VPUS universities.
[2]The average expenditure of residents in the VC has been weighted by the percentage of students who come from the same province in which they study and those who come from another province, according to data provided by the universities (different for each province).

[3]Excluding university fees.

Source: Own elaboration.

Table 3. Estimation of expenditure by visitors to VPUS university students. 2008

Calculation of visitor expenditure (euros)	**TOTAL SUPV**	**UVEG**	**UPV**	**UA**	**UMH**	**UJI**
1. During the academic year, are you visited by relatives who stay at a hotel? (%)	7.7	6.4	15.4	4.0	4.8	5.5
2. How often do they visit you?	8.3	11.7	7.9	3.7	7.0	9.1
3. How many people?	3.1	3.5	3.2	2.3	2.9	3.0
4. How many days do they stay?	3.1	3.4	2.8	4.9	2.3	3.3
5. Average number of days at hotel = (2)·(3)·(4)	80	139	69	42	47	89
6. Number of students enrolled 2006/2007 academic year	127,188	44,892	33,248	25,924	10,722	12,402
7. Number of students receiving visitors [total enrollment ·(1)]	9,747	2,869	5,108	1,033	515	680
8. Total number of days at hotel = (5)·(7)	776,447	399,881	354,591	43,200	24,213	60,298
9. Average daily expenditure by tourists on leisure/vacation [(1)]	136,6€/día	136,6€/día	136,6€/día	136,6€/día	136,6€/día	136,6€/día
10. Total visitor expenditure = (8)·(9)[(2)]	**120,506,334**	**54,623,799**	**48,437,155**	**5,901,160**	**3,307,489**	**8,236,732**

[1] Egatur Report 2007, updated to 2008 euros.
[2] The total expenditure by VPUS visitors corresponds to the sum of the total visitor expenditure attributed to each university.

Source: UVEG, UPV, UA, UMH, UJI, Egatur and own elaboration.

Table 4. Estimation of expenditure by attendees to VPUS universities' conferences. 2008

	(Euros)	TOTAL	UVEG	UPV	UA	UMH	UJI
1.	Number of events (congresses/conferences)	133	29	21	40	19	24
2.	Average number of attendees	127.1	83.0	86.3	140.0	232.0	94.0
3.	Average stay	3.3	4.2	3.0	2.5	3.0	4.0
4.	Total attendees[2]	16,445	2,407	1,774	5,600	4,408	2,256
	- from the VC (16,26%)	2,674	391	288	911	717	367
	- from outside the VC (83,74%)	13,771	2,016	1,486	4,689	3,691	1,889
5	Expenditure by attendees[3]						
	- attendees from the VC	602,042	117,768	62,008	163,091	154,051	105,124
	- attendees from outside the VC	13,616,841	2,663,649	1,402,479	3,688,754	3,484,292	2,377,666
6	**Total expenditure of conference attendees**	**14,218,883**	**2,781,418**	**1,464,487**	**3,851,845**	**3,638,343**	**2,482,790**

[1] VPUS data correspond to the sum or average of data from the 5 universties for each concept.
Accordidng to the 2006 Turismo de Reuniones statistical report by *Spain Convention Bureau* :
[2]16.26% of those attending meetings are local participants, while the remainder are overseas tourists (21.80%) and national tourists (61.94%)
[3] The average expenditure of those attending meetings is 294.61€ (314.64€ in 2008) per person per day. In the case of those residing in the VC, only the inscription fee was calculated of the total expenditure (22.77%) amounting to 67€/day(71.64€ in 2008)

Source: UVEG, UPV, UA, UMH, UJI, Spain Convention Bureau and own elaboration.

Table 5. Economic impacts of activity associated with the VPUS universities in other sectors. 2008
Euros and jobs

	Productive activity of the University	Economic impact of the productive activity of the University, students, visitors and conference attendees on the rest of the ecomomy					Total impact
		University	Students	Visitors	Conference attendees	Total	
Ouput impact	**1,179,789,157**	**2,255,594,682**	**560,128,157**	**205,546,884**	**27,090,465**	**3,048,360,188**	**4,228,149,345**
Direct	-	487,254,369	278,731,129	100,473,070	13,350,700	879,809,269	-
Indirect and induced	-	1,768,340,312	281,397,028	105,073,814	13,739,765	2,168,550,919	-
Income impact	**602,264,848**	**1,151,475,315**	**142,399,482**	**52,663,118**	**7,048,103**	**1,353,586,018**	**1,955,850,867**
Direct	-	228,957,790	72,441,041	25,727,977	3,875,605	376,876,660	-
Indirect and induced	-	922,517,525	69,958,440	26,935,141	3,172,498	976,709,359	-
Employment impact	**16,124**	**28,507**	**7,089**	**2,540**	**379**	**38,514**	**54,638**
Direct	-	5,668	3,606	1,241	208	10,723	-
Indirect and induced	-	22,839	3,483	1,299	170	27,791	-

Sourse: own elaboration

Table 5. Sensitivity of the impacts with the introduction of uncertainty
Thousands of euros and jobs

	Billion euros	Average multiplier
Output impact		
Initial expenditure	**1,743**	
Impact		
Lower confidence interval	2,847	1.63
Average	3,048	1.75
Upper confidence interval	3,361	1.93
Income impact		
Initial impact	**602**	
Impact		
Lower confidence interval	1,302	2.16
Average	1,354	2.25
Upper confidence interval	1,434	2.38
Employment impact		
Initial employment	**16,124**	
Impact		
Lower confidence interval	36,030	2.23
Average	38,514	2.39
Upper confidence interval	42,354	2.63