2015

ISSUE Rankings

Synthetic Indicators of Spanish Universities

Francisco Pérez (dir.)
Joaquín Aldás

Fundación BBVA

Ivie INSTITUTO VALENCIANO DE INVESTIGACIONES ECONÓMICAS

This project has been carried out by the following team:

Francisco Pérez (dir.) (Universitat de València and Ivie)
Joaquín Aldás (Universitat de València and Ivie)
Rodrigo Aragón (Ivie)
Juan Pérez (Ivie)
Irene Zaera (Ivie)

http://dx.medra.org/10.12842/RANKINGS_EN_ISSUE_2015

Table of contents

Acknowledgements

The U-Ranking project, developed by the Ivie (The Valencian Institute of Economic Research) and the BBVA Foundation, is an essential part of a program of activities carried out by both institutions to document and analyze the role of knowledge in social and economic development. This report presents one of the basic products of the project, the ISSUE Rankings (Synthetic Indicators of the Spanish Public University System), its methodology and results for the 2015 edition, the third version presented. The main new feature of this year's edition is the inclusion for the first time of private universities.

The approach of ISSUE, the selection of variables on which the rankings compiled are based and the methodology used when treating the data have been thoroughly discussed by the Ivie team with a large group of experts on the assessment of universities, university information and management. We would like to thank these specialists from fourteen universities for their invaluable collaboration.

We would also like to acknowledge the support of the Valencian public universities in the initial stages of the project and the suggestions made by members of different Spanish universities after the presentation of the first results in June 2013, which have been followed with interest by many people. From then until the end of February 2015, the U-Ranking website has received more than 220,000 hits, many of which have resulted in calculating personalized rankings (more than 66,000), as well as more than 12,200 downloads of the first editions of the report. In addition, the project is increasingly being followed with more interest from abroad: since the presentation of the 2014 edition in May, 31% of the visits to the website came from outside of Spain, the majority, 26%, from Latin America and the US. In addition, 3.4% of the visits were from major European countries such as United Kingdom, Germany, France, Italy and Portugal. These data provide a stimulus to maintain the continuity of the project while making improvements which have been added in this third edition.

We would like to give special thanks to the extensive collaboration of the IUNE Observatory[1] in regard to data research and innovation and technological development, particularly in the area of Bibliometrics.

As well as participating in meetings on the availability and suitability of various sources and the problems of their treatment, the IUNE Observatory, directed by Professor Elías Sanz-Casado, provided complete Bibliometric data regarding the research of all Spanish universities (source: Thomson-Reuters), from which many of the indicators relating to research have been calculated.

In addition, the Ivie team would like to acknowledge firstly the support of the Spanish Ministry of Economy and Competitiveness which, through the General Directorate of Scientific and Technical Research, has provided valuable information on the research resources available to universities; and secondly the Conference of Rectors of Spanish Universities (CRUE) for their invaluable collaboration, supplying data from different editions of the report *La Universidad en Cifras.*

The Ivie also acknowledges the contributions made by the following people who were part of the group of experts following the development of the project: Antonio Villar (Universidad Pablo Olavide and Ivie Research Professor), Antonio Ariño (Universitat de València), Álvaro Berenguer

[1] The IUNE Observatory is the result of work carried out by a group of researchers from the universities that make up the "Alianza 4U" (Universidad Carlos III de Madrid, Universidad Autónoma de Madrid, Universitat Autònoma de Barcelona and Universitat Pompeu Fabra). The general coordinator of IUNE is Elías Sanz-Casado, professor of Documentation at Universidad Carlos III de Madrid and director of the Laboratory for Metric Information Studies.

(Universidad de Alicante), Gualberto Buela-Casal (Universidad de Granada), José Miguel Carot (Universitat Politècnica de València), Fernando Casani (Universidad Autónoma de Madrid), Daniela De Filippo (Universidad Carlos III), M.ª Ángeles Fernández (Universitat Jaume I), José M.ª Gómez Sancho (Universidad de Zaragoza), Juan Hernández Armenteros (Universidad de Jaén), Joan Oltra (Universitat de València), Carmen Pérez Esparrells (Universidad Autónoma de Madrid), José Antonio Pérez (Universitat Politècnica de València), Fernando Vidal (Universidad Miguel Hernández) and Carlos García Zorita (Universidad Carlos III).

Also, a note of appreciation is extended to the group of Ivie researchers and technicians who have actively participated in preparing the methodology of ISSUE Rankings: Francisco Goerlich, José Manuel Pastor and Abel Fernandez. The team also counted on the indispensable collaboration of other members of the Ivie. Maria Llop, Jessica Piqueras, Susana Sabater, Julia Teschendorff and Erica Oliver carried out various communication, documentation and editing tasks. The U-Ranking team would like to thank them for their dedication and professionalism.

The results of the U-Ranking project are, therefore, fruit of the collaboration of many people and institutions that share our interest in analyzing the performance of Spanish universities and facilitating comparable and synthetic images of them. Nevertheless, the indicators presented and the resulting conclusions are the sole responsibility of the Ivie team.

1. Introduction

This report presents the results of the research undertaken by the Ivie to develop the third edition of Synthetic Indicators of the Spanish Public University System (ISSUE), based on an analysis of university teaching activities, research, and innovation and technological development.

The developed indicators provide the basis for compiling different rankings of Spanish universities: two general rankings —one on the volume of results (ISSUE-V) and the other on productivity (ISSUE-P)—, as well as more specific ones on teaching, research, innovation and technological development, and specific qualifications.

All of these rankings are approximations of university results, allowing them to be compared from different perspectives. Through such comparisons, synthetic indicators allow their performance to be assessed by answering relevant questions, such as the following:

- Which Spanish universities show the greatest volume of results? Which universities are more productive or efficient? Do the universities at the top of the rankings coincide with these two perspectives?
- Do the positions of Spanish universities in international rankings meet the criteria in terms of volume of activity or in terms of productivity? Are the positions of Spanish universities in the ISSUE Rankings correlated with the best-known international rankings such as that of Shanghai[2]?
- Do the universities with the best research results stand out for their teaching results? Are research results correlated with technological development and innovation?
- Are the positions of universities in the various general rankings sufficiently regular so as to classify them into homogeneous groups, or do their positions vary too much in some classifications to establish a typology? Do universities maintain their positions over time?
- Are the general rankings on university activities as a whole similar to those obtained when comparing specific qualifications? Is the internal heterogeneity of universities high?

Answering all these questions could be of great interest to form a vision of the Spanish public University system, identifying the strengths and weaknesses of each institution that is part of it, as well as to classify the position of universities within the university system. That is the purpose of this project and report, as noted in an earlier study by the Ivie, published by the BBVA Foundation (Pérez and Serrano dirs. 2012), the Spanish University system has greatly increased its size in recent decades but it is far from being homogenous. Not acknowledging its heterogeneity makes it difficult to assess. Thus, this assessment requires that the different specialization and changing characteristics of each university are taken into account, as well as their real possibility of competing in different areas.

Rankings as synthetic indicators of results

The performance of Spanish universities receives constant attention, and debates about the exploitation of the resources used and their results are increasingly frequent. The driving force behind this interest are the significant amount of resources currently dedicated to these activities and the recognition of the important role universities play in generating and transmitting knowledge, two key areas in the social and economic development of countries today.

[2] Academic Ranking of World Universities (ARWU).

In Spain, discussions about university results frequently focus on public universities. There are two reasons for this: the volume of their activity accounts for most of the Spanish university system and the origin of the majority of the resources used is public; the assessment of their results is therefore considered to be of general interest. There is also a more practical reason. In Spain, traditionally, it has been more feasible to assess the resources and results of public universities based on relatively homogeneous data, because until recently most of the numerous private universities (there are currently 33) did not provide the necessary data to carry out analyses. However, the participation of private universities in public statistics and information systems is increasing, and a project such as ISSUE, which aims to provide an overall view of the Spanish university system, should take on the challenge of including these institutions. The main new feature of the third edition is the inclusion in the ranking of those private universities with sufficient and adequate information so that the data can be homogeneous with that of the public universities in order to construct synthetic indicators. After reviewing the available information, the third edition of U-Ranking incorporates, as seen further on, eleven private universities which meet these characteristics.

Assessments to measure university results in many countries, as well as in Spain, are increasingly using rankings to classify institutions from different perspectives and with different criteria. Some of the international university rankings have found their place in debates about the quality of these institutions, becoming widely used references to assess the position of universities and national University systems. Thus, for example, the presence of only twelve Spanish universities (14.5% of the total of 83 public and private Spanish universities) among the first 500 institutions of the world according to the Shanghai Ranking, with only one in the top 200, is a fact often mentioned as proof of the limited quality and insufficient international projection of our university system.

Researchers, public and private institutions, university associations, along with companies in information and media are increasingly taking more initiatives to compile rankings. The objectives and interests of such initiatives and their scope are diverse, both in terms of university activities studied (many rankings focus on research), as well as in terms of coverage (national and international), the data used and its treatment. Some recent reports (Rauhvargers 2011, 2013) stressed the importance of carefully assessing the criteria with which the rankings are compiled when demonstrating their significance and interpreting results.

Indeed, the rankings are a particular way to approach the assessment of university results and their appeal lies in the fact that they offer simple and concise information. This facilitates comparisons while simplifying them, and can make them sensitive to the criteria and procedures followed when constructing indicators. It is for this reason that the value given to the rankings should not be separated from how they are compiled or from the metric used.

These precautions are not always present when using rankings. On the one hand, the reputation of a good position in a ranking turns them into an intangible asset to universities. Therefore, some develop strategies to convey information about themselves (signaling) by advertising their more favorable results, and to improve their positioning in the rankings. Certainly, the expected return of a good position in a ranking is significant, given that it can affect areas as diverse as recruiting students, attracting researchers, obtaining resources and the social projection of institutions.

On the other hand, the growing interest in these classifications is because they are perceived as useful tools (despite being imprecise) for various purposes and different stakeholder groups in universities because:

a) The information they provide to the users of university services is easy to interpret in terms of attractiveness or quality of institutions.

b) They provide comparative information to governments, with the possibility of being used to assign resources or for the accountability of universities to society.

c) They complement the work of university quality assurance agencies and provide information to analysts interested in having homogenized indicators available.

Approach of the project

In Spain different university rankings are being regularly presented, compiled with diverse perspectives and methodologies. What sets the rankings proposed by ISSUE apart is that they are developed according to criteria that respond to many recent international recommendations. One of them is that indicators should be created with the objective of studying university activities from a broad perspective, i.e. examining teaching, research, and innovation and technological development activities. Another important feature is that ISSUE offers rankings by degrees giving specific guidance to students when choosing what to study.

Among the criteria used in developing ISSUE that should be noted are the following:

- Developing multiple university rankings, in which university activities are examined from a general perspective, as well as in specific fields (teaching, research, innovation and technological development), and also in terms of the total volume of results (ISSUE-V) of each university and the productivity corresponding to the relationship between total results and university size (ISSUE-P).

- Taking into account the diverse perspectives and interests that potential users of the data have when using the rankings. In particular, special attention has been paid to the importance that many people give to specific areas such as degrees when comparing universities. To deal with this concern, a web tool has been developed which enables users to create personalized rankings in terms of Bachelor's degrees. It has been designed to guide students, their families and counsellors when choosing a university in which to study. The advantage of recognizing that users have different preferences is that the following problem can be avoided when constructing synthetic indicators: their excessive dependence on expert opinions (subjective and sometimes contentious) regarding the weights that should be attributed to teaching or research.

The project therefore offers two different products:

- A general collection of rankings on Spanish universities, based on the criteria of the project's team and the experts consulted, allowing each institution to be compared with others from different points of view.

- A web tool that provides personalized rankings for different Bachelor's degrees, grouped according to area of study and which allows universities to be compared taking into account the interests and criteria of each user (mainly students enrolling in universities) on their choice of studies, the regions considered and the importance given to teaching and research.

It is important to note that all the classifications are obtained from a common basis: the data correspond to the same set of variables and the same methodology has been followed when treating and aggregating variables, except obviously with regard to decisions taken by users when creating their *personalized* rankings.

Structure of the report

After this Introduction, the remainder of this report is structured in five chapters, with the following content. Chapter 2 details the methodology followed in preparing the different rankings. Chapter 3 describes the approach for the personalization of the rankings by the user and the web tool created to present the results to students. Chapter 4 provides an analysis of the main aggregated results, focusing on the comparison of the ISSUE Rankings with the main international ranking of reference. Also, to assess robustness, a sensitivity analysis of our results to variations in some of the assumptions used in preparing the rankings along with a comparison of the results obtained in the previous two editions of ISSUE Rankings are presented. Finally, Chapter 5 summarizes the main features and results of the project.

New developments in the third edition of ISSUE Rankings

This third edition of the ISSUE project corresponding to 2015 offers, as in previous editions, both the general ISSUE-V and ISSUE-P rankings, as well as personalized rankings for Bachelor's degrees. In addition, it presents an

important new feature with regard to the 2013 and 2014 editions: the inclusion of 11 private universities. The inclusion of private universities to any ranking is essential to give the most complete diagnosis possible of the university system and also to provide the users a guide in their decision making. If only the public offer is made available to families, then the private offer is being ignored, which is an important factor when considering the set of alternatives available to families.

The Spanish university system has, at the moment, 33 private universities[3], which represent 40% of the total. In terms of students, this accounts for a total of 173,000 students (12.3% of the total amount of students in the Spanish university system) and 13.1% accounts for teaching staff. During the 2013-14 year, Spanish private universities offered 560 undergraduate degrees compared to the 1975 degrees offered by public universities (28%). These figures are due to a strong growth in recent years. Since 1999, private universities have nearly doubled their amount of students and have increased from 18 to 33 universities.

Including private universities in the ISSUE project is a challenge that has put to test its methodological soundness, forcing it to respond to the question of whether or not a comprehensive system of indicators based on public sources, would work with institutions which management structures and obligations to provide information are different from public ones. Although the response has been positive, it required flexibility to apply the methodology, which will be explained later on. Also, the decision had to be made to incorporate for the moment only 11 of the 33 private universities, those with sufficient public information to construct the indicators needed for their ranking.

The result of incorporating those private universities that offer more information provides, as we will see in the main conclusions of this edition, a much richer view of the Spanish university system which reveals a specialization profile of private universities quite different from public universities. We will also verify that the diversity in productivity present among public universities equally exists in private institutions.

[3] The Fernando Pessoa-Canarias University, created in May 2014, has been included although it still does not offer official degrees.

2. Methodology

In the context raised by the reflections and criteria described in the previous sections, the starting point of the ISSUE project was an in-depth look at the most important national and international rankings, so as to identify possible ways of reducing their shortcomings. The most significant problems of rankings arise in the following areas: (1) university activities studied, (2) disaggregation by subject or type of studies, (3) data availability and use, (4) methodological rigor in the treatment of data and construction of indicators, (5) recognition of the user's perspective when creating and providing data, and (6) user-friendly tools to select their preferences in the rankings.

The project has studied the shortcomings in all these areas and the following section describes how they have been addressed.

2. 1. THE DESIGN OF RANKINGS

In the previous editions of the ISSUE project, and due to its novelty, an entire chapter was dedicated to the limitations of rankings and the improvements that a new tool like this one should include. The reader can view previous reports — found on the U-Ranking website (www.u-ranking.es)— for a detailed analysis of these aspects, which are summarized in this third edition.

The development and use of rankings entails a number of **risks** that should be forewarned. First of all, it is not wise to orient strategies focused on improvements of variables studied, instead of to the problems that underlie them: the improvement of the institutions should be based on principles of efficiency which will then be reflected in the indicators. The use of indicators that are not very robust, with values highly sensitive to the criteria of measuring the variables and aggregation procedures, and that focus on what should be measured and not only on what can be measured, must be avoided. Finally, a very common risk of rankings is to focus only on the elite forgetting the rest. This may inadequately compare institutions with very different specializations and resources.

Some of the published rankings show **limitations** that users should be aware of. In the case of universities outside the circle of the great universities, many rankings are exclusively based on indicators which focus on research activity and unreliable reputation factors. For example, the exclusive use of these indicators to rank Spanish universities is in many cases inappropriate and risky, leading to wrong conclusions.

After the two previous editions, the details on the revised issues to consider in the design that a good ranking must have and its inclusion in the ISSUE project are not necessary as they were introduced in those editions, however some aspects considered should be summarized:

- The study *Principles of Berlin on University Rankings* (Centrum für Hochschlentwicklung, CHE 2006) stresses, among other recommendations, to indicate clearly what the target audience of the ranking is, to be clear about what each indicator measures to be methodologically scrupulous, to focus on the outcomes rather than inputs and to maintain a high ethical standard, given the responsibility and impact that rankings have.

- The results of discussions held by the European University Association and the International group of Experts in Rankings (CHE 2006) insist on the importance of providing a global vision of all the institutions, addressing their multidimensional nature and diversity, respecting the user's perspective and maintaining the independence and temporal sustainability of the ranking.

The rankings system carried out by the ISSUE project, developed by the Ivie and the BBVA Foundation, expressly includes all the principles which were recently discussed internationally and

proposed by the EU. The following sections detail the many aspects that have been taken into account when working with these criteria.

2.2. ACTIVITIES STUDIED

One of the main failings of certain rankings, particularly international ones, in providing a general assessment of universities is that the activities are examined from a very partial perspective. The problem stems from data availability on the results of teaching activities, and innovation and development technology, which are far less abundant than research.

In fact, most of the important rankings focus on analyzing research, taking little account of another significant function of universities which is teaching and barely considering technological development activities, despite their increasing importance. The rankings which are biased towards research are frequently interpreted as representative of university activity as a whole.

There are three possible reasons for this: 1) the data available is used and, without a doubt, the abundance, quality and homogeneity of data on research is much greater than in the other two areas; 2) research activity is considered the most important distinctive element of universities in the last two centuries; and 3) the opinion holds that the research quality of professors is a proxy variable for other areas, and therefore it is enough to observe the results in this area to predict the others.

The first reason is practical, but can induce bias by omission in indicators and rankings. The second needs some clarification in that it is a powerful argument regarding postgraduate studies but less so in relation to the degree, especially in mass university systems, such as those of most developed countries today. In fact, in most of these systems there is a significant concentration of research activity in a small number of universities, while in a large number of institutions there is fundamentally teaching activity. The third reason is a hypothesis, which validity should be tested by developing indicators for all activities and testing whether the correlation between teaching and research results is high. If the validity of this hypothesis is not tested, and given that the intensity of university teaching specialization, research and innovation and technological development varies greatly[4], overlooking the direct indicators of teaching and innovation and technological development can bias the rankings.

Therefore, it is important to take advantage of the data available on university activity in the field of teaching, and innovation and technological development, so that the rankings reflect university activity as a whole more accurately. In addition, this also allows us to recognize the different specialization profiles of universities, as some focus more on basic research (as occurs in many of those most often included in the world rankings), others on higher education and professional development, and others on applied research, innovation and technological development.

Studying these three dimensions is a first step in the direction of addressing the different perspectives on university systems and the different interests that potential users of the rankings may have. Thus, a degree student probably shows greater interest in teaching, while a postgraduate student and teachers focus more on aspects related to the quality of research. On the other hand, a company interested in signing a contract for a line of specific research, may want to identify which university has a greater capacity to apply research or produce patents. If the data focuses solely on research results then these distinct approaches cannot be carried out accurately.

The ISSUE project specifically studies these three categories of university activities, analyzing the data available on each of them in Spain. The national dimension of the project ensures that reasonably homogeneous data is available with a set of variables representing the activity of Spanish public universities and a certain number of private universities. It would certainly be desirable that data on the rest of the private universities were available in the future with a guarantee of similar quality and homogeneity as those included in the ranking, which would improve the scope of the project.

[4] See Pérez and Serrano (dirs.) (2012, ch. 1 and 4).

The total amount of 59 universities is sufficiently high for the data available to allow a contrast of the hypothesis to which we referred earlier: if research results can predict correctly those of teaching or not. The project has examined this specific objective, with the results presented in Section 4.

2.3. DISAGGREGATION OF ACTIVITIES

A further shortcoming noticed when analyzing current rankings is that many deal with universities in a unitary manner, not recognizing the diversity of areas in which these institutions can offer professional development or conduct research. This problem needs little explanation: to be more useful, a ranking has to inform as far as possible the user on specific areas or scientific fields of their interest, since universities may not be homogeneous in the quality of each of their areas.

It is for this reason that a ranking system can be improved if it provides data disaggregated by areas of study, fields of knowledge or specific degrees. This last level of detail could be very significant for students, given that their fundamental interest is generally linked to the quality of the specific studies that they want to pursue.

For the disaggregation, the ISSUE project had to work in several directions. Firstly, it followed the criteria that it is important to start with the most disaggregated data available, maintaining its detail whenever possible, so as not to lose the wealth of its heterogeneity. Secondly, the disaggregated data had to be dealt with rigorously in order to homogenize it properly before adding it to the indicators. And third, the problems of combining (for the construction of some of the indicators studied) the data disaggregated according to scientific fields or degrees with other data aggregated at university or branch of knowledge level had to be solved. When there is no disaggregated data, or its disaggregation makes no sense, the aggregated data has been allocated to the various elements of the set, following the criteria considered more reasonable in each case.

Addressing the above problems is not trivial. For example, in the case of the rankings on specific Bachelor's degrees of Spanish universities, to deal with data on areas with different levels of disaggregation a series of matrices have been created that connect them. In order to do this, accurate connections had to be established between university, branch of knowledge, areas of the National Commission for the Evaluation of Research Activity (CNEAI), Web of Science category, areas of the National Evaluation and Foresight Agency (ANEP) and Bachelor's degrees.

In allocating research results to each degree, the starting point was data disaggregated by the Web of Science categories (more than 250 items). Given that one classification is not perfectly nested in another, both classifications have been connected, and the two types of errors that could be made have been taken into account:

1. *Inclusion error.* That is, attributing to a given degree the research carried out by teachers from other areas. For example, attributing to the Pharmacy degree of a given university, the research in "Hematology" that has actually been conducted by teachers from the Faculty of Medicine and who only teach in Medicine.

2. *Exclusion error.* That is, excluding research by teachers in areas that are not exactly the subject of the degree courses they teach in, as a result of being too restrictive when allocating areas to degrees. For example, if in Economy we only allocate the category "Economics", then important research may be missed in the area of "Business and Finance", theoretically closer to Business Administration degrees but also carried out by economists who teach in the degree of Economy.

These problems do not have a perfect solution and we had to choose one of the alternatives. We have opted for a more inclusive criterion: that is, when in doubt about whether to associate a category or scientific field to a degree we have chosen to include it, thus minimizing exclusion errors on the grounds that they are more serious errors.

2.4. INDICATORS, AREAS AND DIMENSIONS

The main pillar of a ranking system is, undoubtedly, the rigor of the procedure followed when dealing with existing problems so that the created classification is based on appropriate data and is treated with reasonable methodological criteria. Many of the rankings have clear shortcomings in this aspect, which the recent international literature has analyzed in detail.

The ISSUE project considers that a university ranking should consider all their activities and be structured according to the three following major dimensions:

- *Teaching*
- *Research*
- *Innovation and technological development*

The assessment of each of these dimensions can take into account multiple areas of activity and indicators. However, many experts agree that an excessive number of them obscure the meaning of a ranking and complicate the construction of synthetic indices, a complex matter as it is. Following a criterion of (relative) simplicity, four areas have been studied in each of the three large dimensions aforementioned:

- *Resources* available
- *Output* obtained
- *Quality* (particularly in the results and in some cases, resources and processes)
- *Internationalization* of the activities

The main reference to assess universities should be the results, but these can be studied both from the perspective of total volume as well as the efficiency achieved in obtaining them. In economic terms, while output considers the volume or quantity of results obtained, productivity measures the link between volume of results and resources used[5].

To assess the results, it is also important to take into account their quality. If there were a market that assessed the differences in quality, then results showing a higher quality would have a higher price. These prices hardly exist in the area of public universities. The differences in rates, currently very diverse between regions and degrees, respond in many cases to factors that have nothing to do with quality. However, some indicators can supplement, in part, this limited information. Thus, for example, there are indicators on the quality of teaching and research and also on a very relevant feature today regarding the specialization (and quality) of universities: their internationalization.

Each of the four areas mentioned has been analyzed using a series of indicators. For each area, between one and three indicators have been taken into account, depending on the availability and suitability of data, and according to the dimension that is being studied.

Table 1 shows the indicators studied, after analyzing the availability of data and discussing alternatives with the group of experts working on the project. Agreements were reached by analyzing the suitability of each indicator in capturing significant data on the area and dimension it forms part of it.[6] It is important to stress that the data used is obtained from sources allowing the project database and the rankings based on it not to require universities to provide data directly to ISSUE.

[5] It should be clarified that the variables classified under the heading *available resources* are not used as the denominator of the calculation of productivity, dividing them by the indicators of output, quality, or internationalization. In fact, some indicators of the resources group can be considered university achievements in fundraising, for example income gained in a competitive manner. Productivity is analyzed in all areas and in each dimension —teaching, research, innovation and technological development— relativizing each indicator by the appropriate variable. For example, in the area of competitive public resources for research, resources are relativized by the number of faculty members equivalent to full-time, on the grounds that this ratio measures the ability of university fundraising.

[6] In order to ensure the transparency of the process in developing indicators, the definition of each indicator, its source and its time frame are all included in Appendix 1 and in the following website of the project: www.u-ranking.es.

Table 1. List of indicators, areas and dimensions

Dimension	Area	Indicator
Teaching	Resources	Faculty member with PhD per 100 students
		Budget / Student
		Faculty member with PhD / Faculty members
	Production	Success rate
		Evaluation rate
		Drop-out rate
	Quality	Attractiveness index
		Percentage of postgraduate students
		Cut-off marks[1]
	Internationalization	Percentage of foreign students
		Percentage of students in exchanges programs
		Percentage of students registered in programs imparted in non-official languages
Research	Resources	Competitive public resources per faculty member with PhD
		Contracts with PhDs, research grants and technical support over total budget
	Production	Citable documents with ISI reference per faculty member with PhD
		Total *sexenios*[2] over possible *sexenios*
		Doctoral theses completed per 100 faculty members with PhD
	Quality	Mean impact factor
		Percentage of publications in the first quartile
		Citations per document
	Internationalization	European or international research funds per faculty member with PhD
		Percentage of publications with international co-authorship
Innovation and Technological Development	Resources	Income from licenses per 100 faculty members with PhD
		Income from consultancy contracts per 100 faculty members with PhD
		Income from CPD[3] courses per faculty member with PhD
	Production	Number of patents per 100 faculty members with PhD
		CPD hours per faculty member with PhD
		Number of contracts by faculty member with PhD
	Quality	Commercialized patents per faculty member with PhD
	Internationalization	Triadic patents per 100 faculty members with PhD
		Income from international contracts per faculty member with PhD

[1] Mark of the last student who gained admission to a degree with limited places. [2] Monetary compensation received for research activity based on the last six years.
[3] Continuing professional development.

Source: Own elaboration.

The logic underlying this selection of indicators, disclosed in summary form, is the following:

Teaching

- Teaching *resources* are characterized by budgetary allocations per student, and teaching and research staff per student, with special attention paid to faculty members with PhD
- Teaching *productivity* is measured by using results obtained by students, analyzing how many students undergo evaluation, how many succeed in those evaluations and how many drop out.
- The *quality* of teaching is very difficult to observe at present, but we studied as a proxy the ability to attract students from other provinces, the quality of students as measured by the cut-off mark of each area and the percentage of postgraduate students.
- The *internationalization* of teaching is shown by the percentage of foreign students, the percentage of students in exchange programs and by courses offered in non-official languages.

Research

- The *research* process is characterized by two types of resources: competitive public funds raised and the provision of research staff, scholarships and qualified technical support.
- *Output* is accounted for by citable papers published in each area, in the six years of research work that are achieved with publications, as well as in the number of doctoral theses, which are an indicator of the training activity of a researcher in a given area.
- The *quality* of the research is reflected in the impact the publications have and the citations that these papers generate.
- Finally, a greater proportion of international publications, international co-authoring and the percentage of research funds from external sources indicate a greater *international* vocation in research activity.

Innovation and technological development

- The *resources* studied cover the three main activities of innovation and technological development: income from patents, income from consulting contracts and income from the offer of continuing professional development.
- In terms of measurement of gross *output* in these activities, the total number of patents, the hours of professional development and the number of contracts for services.
- As an indicator of *quality*, due to the limited availability of data, only patents that are commercialized by faculty members with PhD are included.
- The *internationalization* of the transfer of knowledge is reflected through triadic patents (valid in Europe, US and Japan) and income for international contracts.

The list in table 1 defines the objective, which aims to be completed in the medium term, given that not all the ideal data is available today. In part, this is due to the ongoing process of adaptation of the Spanish university system to the European Higher Education Area (EHEA), which will end briefly, but there are also other causes for data deficiencies in certain areas[7]. The project is open in this sense, with the possibility of completing this information as it improves, especially in the different areas of innovation and technological development.

In this sense, the second edition of *ISSUE Rankings* contained some of these improvements thanks to the inclusion of new indicators and data sources. As shown in table 2, while the 2013 version contained 23 indicators, the last two editions incorporated 25 of the 31 indicators defined in table 1.

[7] Specifically, the following variables are not taken into account for reasons of availability or quality of data: Index on Attraction Capacity, percentage of students in non-official language programs, hours of continuing professional development, number of professor contracts and number of patents commercialized per PhD Professor. The relationship between indicators used will be adjusted as the availability of quality information increases and is consolidated.

Table 2. Indicators and level of disaggregation of the 2013 - 2015 ISSUE Rankings

	2013 Ranking	2014 and 2015 Rankings
Defined indicators	31	31
Used indicators	23	25
Degree level[1]	5	8
Area of study level	1	1
Branch of knowledge level	9	7
University level	8	9

[1] Bachelor's degree or Bachelor's degree group. The category 'bachelor's degree group' is the result of aggregating more than 2700 degrees offered by Spanish public universities for the 2014-1015 year into 132 groups.

Source: Own elaboration.

2.5. TIME COVERED BY THE DATA

University rankings, though they aspire to offer an image of the current position of each institution, cannot be conceived of as a snapshot of a given year. Many indicators have the character of a flow, and as such, can present high variability from year to year, both in the quality of the information and in the distance between the reality and what the information reflects. Other indicators reflect the accumulation of results over long periods of time.

The rankings referred to usually recognize this problem by taking comparison periods longer than a single year, either using moving averages (like the 5 or 10 years of the ISI Rankings of the Universidad de Granada) or even considering the complete history of the University (as in the case of the treatment of the Nobel Prize and Fields Medal winners in the Shanghai Ranking). This methodological approach provides greater interannual stability of the rankings and permits specific random disturbances to be smoothed out by considering a longer time range.

Our approach aims in this direction and, as information has become available, we have converged towards a 6-year moving average for nearly all the indicators. Most of the variables linked to research and to innovation and technological development, taken from Thomson-Reuters (2008-2013) and the RedOtri (2006-2011), are already being calculated as a mean of six years. In this edition, many of the teaching results have been reached with information from 3 academic years (2008-09, 2010-11 and 2012-13) which cover a 6 year period, thanks to the collaboration of the CRUE, which has supplied the data by university from the reports *La Universidad Española en Cifras 2010, 2012 and 2014.* Therefore, this third edition completes the first phase of the process by covering 6 years of university information. As further years become available, they will be incorporated into the moving average so as to finally have a chart that is completely coherent on the temporal plane.

Table 3 shows the updating in terms of years and time series registered by the indicators used in the ranking for 2015 compared to those for 2014, and permits us to observe the updates and improvements. One of the limitations found in the previous report had to do with the information lag corresponding to the *sexenios* (monetary compensation received for research activity based on the last six years) since the last updated year was 2009. This has been resolved in this year's edition which includes data corresponding to 2012 from CRUE. On the other hand, four indicators of the Innovation and Technological Development dimension obtained from the Spanish RedOtri survey on *Research and Knowledge Transfer* have not been updated since the new edition has not yet been published. These four indicators contain information for the 2006-2011 period. Another indicator that has not been updated is *European or international research funds per faculty member with PhD* within the Internationalization Area of the Research dimension, since it is not included in the 2014 CRUE Report.

The described orientation of the methodology on which the calculation of the ISSUE Rankings is based leads one to expect that the rankings of universities will not present, from one year to another, sudden changes. The existence of an inertia in the rankings seems to be a desirable property, since the quality of university institutions does not change radically in the short term, though some of their annual results may do so.

We have tried to respect the same structure — Resources, Output, Quality and Internationalization— within each dimension, as we consider that symmetry in the conceptual approach permits greater comparability and

coherence, as well as a possible identification of the strengths and weaknesses of each institution. Nevertheless, the availability of information conditions the effective achievement of this objective. Indeed, the "output and quality of Technological Development and Innovation" are without some of their indicators. Although information is available for certain of their variables, their quality is very dubious and, far from improving the results, compromises them by adding an excessive variability. In order to incorporate the best available information possible, the option of including them will be reconsidered in the future.

Table 3. Time series used in the 2014 and 2015 rankings

Dimension	Area	Indicator	2014 Ranking	2015 Ranking
Teaching	Resources	Faculty member with PhD per 100 students	2008-09 and 2010-11	2008-09, 2010-11 and 2012-13
		Budget / Student	2008 and 2010	2008, 2010 and 2012
		Faculty member with PhD / University teachers	2008-09 and 2010-11	2008-09, 2010-11 and 2012-13
	Production	Success rate	2008-09 and 2010-11	2008-09, 2010-11 and 2012-13
		Evaluation rate	2008-09 and 2010-11	2008-09, 2010-11 and 2012-13
		Drop-out rate	2008-09 and 2010-11	2008-09, 2010-11 and 2012-13
	Quality	Attractiveness index	-	-
		Percentage of postgraduate students	2009-10 to 2012-13	2008-10 to 2013-14
		Cut-off marks[1]	2013-14	2014-215
	Internacionalization	Percentage of foreign students	2010-11to 2012-13	2008-09 to 2013-14
		Percentage of students in exchanges programmes	2008-09 and 2010-11	2008-09, 2010-11 and 2012-13
		Percentage of students registered in programmes imparted in non-official languages	-	-
Research	Resources	Competitive public resources per faculty member with PhD	2007-2012	2008-2013
		Contracts with PhDs, research grants and technical support contracts over total budget	2007-2012	2008-2013
	Production	Citable documents with ISI reference per faculty member with PhD	2006-2011	2008-2013
		Total *sexenios* [2] over possible sexenios	2009	2012
		Doctoral theses completed per 100 faculty members with PhD	2008-2011	2008-2012
	Quality	Mean impact factor	2006-2011	2008-2013
		Percentage of publications in the first quartile	2006-2011	2008-2013
		Citations per document	2006-2011	2008-2013
	Internacionalization	European or international research funds per faculty member with PhD	2008 y 2010	2008 and 2010
		Percentage of publications with international co-authorship	2006-2011	2008-2013
Innovation and Technological Development	Resources	Income from licenses per 100 faculty members with PhD	2006-2011	2006-2011
		Income from consultancy contracts per 100 faculty members with PhD	2006-2011	2006-2011
		Income from CPD[3] courses per faculty member with PhD	2008 and 2010	2008, 2010 and 2012
	Production	Number of patents per 100 faculty members with PhD	2006-2011	2008-2013
		Hours of CPD per faculty member with PhD	-	-
		Number of contracts by faculty member with PhD	-	-
	Quality	Commercialized patents per faculty member with PhD	-	-
	Internacionalization	Triadic patents per 100 faculty members with PhD	2006-2011	2006-2011
		Income from international contracts per faculty member with PhD	-	-

[1] Mark of the last student who gained admission to a degree with limited places. [2] Monetary compensation for research activity based on the last six years.
[3] Continuing professional development.
Source: Own elaboration.

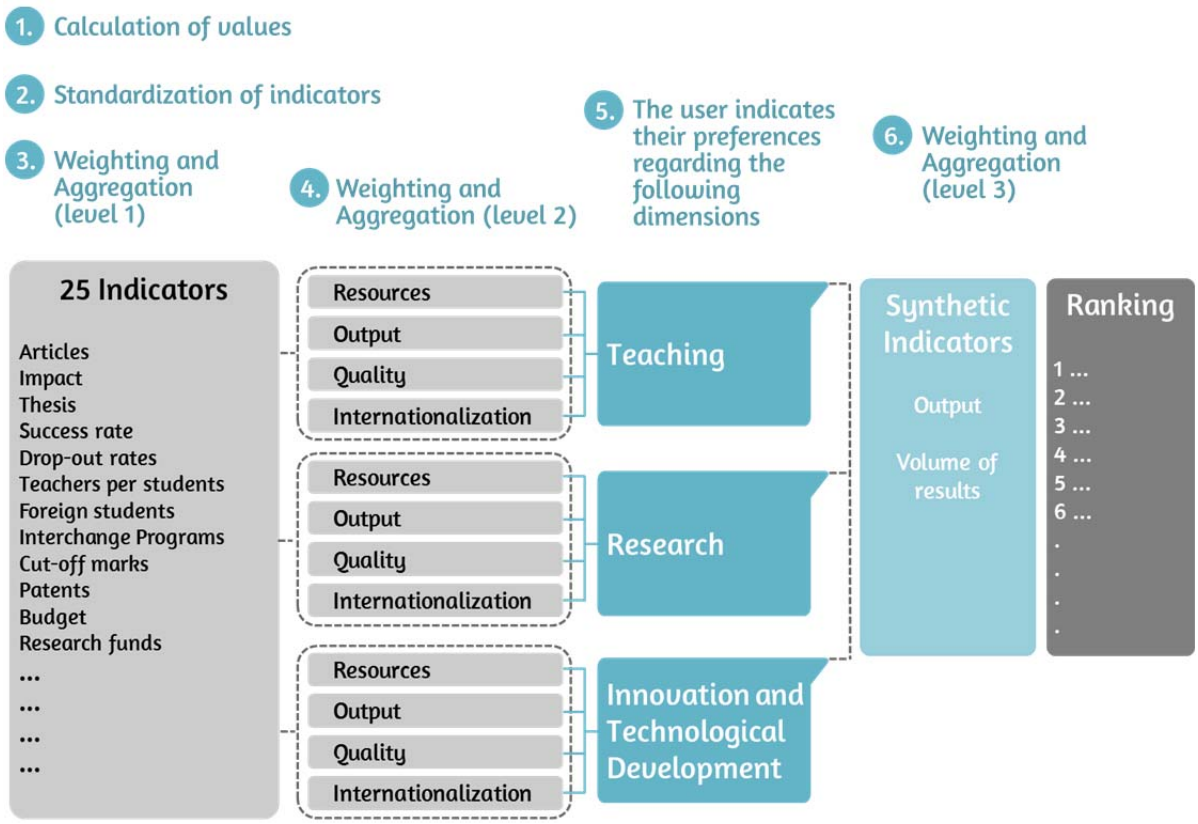
2.6. CRITERIA FOR THE CONSTRUCTION OF INDICATORS

Key to being able to trust the meaning of the rankings is that the processes on which they are based should be transparent and respect the foundations established by statistical publications for the construction of indicators. In this regard, the project team contacted specialists in the subject and analyzed the methodological principles established in the specialized literature, especially in the *Handbook on constructing composite indicators: methodology and user guide* (OECD 2008).

The underlying process of drawing up any of the rankings of universities constructed is structured according to the following steps —the fifth step being unnecessary in the case of the partial rankings of teaching, research and innovation and technological development:

1. Preparation of the data bank and estimation and allocation of missing values
2. Standardization of indicators
3. Weighting and aggregation of indicators within the areas of each dimension
4. Weighting and aggregation of area indicators, within the dimensions
5. Weighting and aggregation of the dimensions
6. Obtaining of rankings

The following scheme graphically illustrates the time sequence of the steps. To complete each of them it is necessary to solve the corresponding technical problems, as described below and dealt with according to the approaches indicated.



2.6.1. Allocation of missing data

The starting point for any ranking is to have available the necessary information on the variables to be considered in order to construct each indicator. A first technical problem to be solved is the treatment of the data missing from certain universities in some of the variables to be used. For example, the number of theses read in the last year in a particular university may not be available. Such gaps may be due to several factors, whether technical (an error in loading the data), or of availability (the university may not have generated certain information or not done so in time) and even strategic (a university may opt not to give certain information because it is not in its interests to do so).

Not facing this problem rigorously would condition the comparability of the universities, the quality of the aggregate indices, and the final results. Specifically, to calculate the ranking ignoring such missing information would be equivalent to allocating a value for that variable equivalent to the mean of the rest of the variables forming the dimension. This criteria is especially problematic if it is the university itself that does not reveal the information for strategic reasons, as that mean value might favor it. On the other hand, to calculate the ranking on the assumption that the real value of the missing variable is zero would be to penalize the university unfairly if there has been a technical problem of data availability or of deadlines.

To estimate and allocate the missing values of each variable we have proceeded as follows:

1. From a matrix of correlations[8] we identify, for each variable, the two variables with the highest correlation (in absolute terms) and associate them with the variable to be estimated.

2. We estimate a linear model (by minimum squares) between the variable to be allocated and the two most correlated variables —that is, those which the variable to be estimated had the highest absolute correlation. For the estimation of this model we use only the information from the same area of study, thus acknowledging the different operational situation of each subject area in the areas studied.

3. From the parameters estimated in the above model we calculate the estimated value of the missing variable, using the said parameters and the existing information for that university in the related variables.

For example, let us suppose a university for which there are no data on doctoral theses directed by a faculty member with PhD (T) in an engineering degree. After analyzing all the variables of the Spanish universities we observe that, within the engineering degrees, the theses directed are highly correlated with the research *sexenios* obtained as a proportion of the total of possible *sexenios* of its teaching staff (S) and also with the percentage of postgraduate students of that university (P). On the basis of this ratio, $T = f(S,P)$, we estimate linear model $T = a_0 + a_1S + a_2P$. Once the values of a_0, a_1 and a_2 have been estimated, the theses directed in that engineering degree of that university are estimated from the data available on *sexenios* and postgraduate students.

2.6.2. Standardization of indicators

One of the pillars upon which the construction of synthetic indicators rests is the proper standardization of the information, that is, its transformation in order to homogenize it and make possible its comparison and aggregation. There are numerous systems of standardization, such as the Gaussian (subtracting from each variable its arithmetic mean and dividing by its standard deviation), relative order (ordering the values according to their relative value), distances from the mean or the median, and the ratio between the variable and its mean or its median.

The standardization chosen must be in consonance with the method of aggregation to be used subsequently. Because as a general rule the geometric aggregation method has been chosen, requiring the value of the standardized variables to be positive, we must exclude the Gaussian and absolute distances from the mean

[8] The correlations matrix is constructed by calculating, for each possible pair of indicators, their linear correlation coefficient.

and from the median, which necessarily generate negative values, as alternatives of standardization.

For this reason, the standardization method chosen is the calculation of the ratio between the variable and its median. Taking into account that the median is the value separating each distribution into two halves, the standardized results will be centered on the value 1: values below the median are bounded between 0 and 1, while those above will be greater than 1.

2.6.3. Weighting and aggregation of indicators within an area

Once the missing values have been allocated and the basic indicators standardized, we aggregated these to obtain a first synthetic indicator for each area. Thus, for example, to obtain the value of the indicator for the *quality* area in the *Research* dimension we aggregate the standardized values of the *Mean impact factor of publications* and the *Percentage of publications in the first quartile*.

As in the case of standardization, there exist numerous aggregation procedures, such as the arithmetic, the geometric or those based on factor analysis. The choice of one method or the other has implications in aspects like the substitutability of the indicators or the importance of extreme values (both large and small). The aggregation criterion chosen implies a weighting of the indicators, which is important to bear in mind.

It must be taken into account that some universities might have zeros in some indicator of a specific area (for example, they may not possess *Triadic patents*). For this reason we have opted in this phase for an arithmetic aggregation, ruling out the geometric aggregation because the presence of a zero in the product would cause the whole area analyzed to take a nil value.

As the weighting of the indicators shows the importance assigned to each variable when aggregating it into a synthetic indicator, we also reflect on this question. This is a classic problem in the construction of such indices and generally requires a judgment on the relative importance of each element. In the case of economic aggregates the weights are offered by prices — which reflect the market valuation of the goods, services or factors exchanged— but in many other cases there are no prices and the indicators have to be constructed following other criteria, frequently based on subjective opinions.

There are three possible approaches to weighting: 1) assignation of identical weights (which also implies a judgment, since the weight of one indicator is conditioned by the number of indicators included); 2) consultation among experts to identify the most widely held opinions (by means of surveys or methods such as the Delphi); 3) weighting according to the user's preferences. These three alternatives have been used in each case according to the level of aggregation to be achieved.

At this first level of aggregation (of simple indicators into synthetic indicators for each area) we have opted for the first system, that is, equal weighting. This is because in most cases the indicators capture different aspects of the area analyzed, but there are no clear arguments for granting one of them greater or lesser importance. Also, the nature of the information captured in each indicator is fairly homogeneous and in that case there is less interest in giving greater weight to one indicator or another, because in many cases they are correlated. This occurs, for example, in the case of the mean impact of publications index and the percentage of these in the first quartile. Consequently, the different simple indicators will enter into the calculation of the arithmetic mean with the same weight.

2.6.4. Weighting and aggregation of the area indicators within each dimension

At the second level of aggregation the indicators of the different areas are grouped into an indicator for each of the three dimensions considered: teaching, research, and innovation and technological development. At this stage there are reasons for following a different aggregation criterion, as after the arithmetic aggregation of the previous stage no area indicator presents zeros.

Table 4. Weights by area

	Resources	Production	Quality	Internationalization
Teaching	25.4	30.4	23.9	20.3
Research	20	30	30	20
Innovation and Technological Development	34.2	26.3	21.1	18.4

Source: Own elaboration.

This stage proceeds by means of a *geometric* aggregation method. Among the most interesting properties of geometric aggregation is that it limits the substitutability among the components that it aggregates. In other words, geometric aggregation penalizes those universities that have neglected any of the four transversal areas (*Resources, Output, Quality, Internationalization*) as against those that attend to them in a balanced manner.

As to the weight to be given to each area within each dimension at this second level of aggregation, we decided to carry out a survey of university experts, applying the Delphi method, instead of granting them the same weight, as in the previous stage.

One reason for changing the criterion is that if all the areas were aggregated with the same weight, this being a geometric mean the number of areas considered would influence the result. For example, if we had decided to group the indicators of quality and internationalization in a single area, their influence on the dimension would have been less than if considered separately. Another reason is that, unlike what occurred with the basic indicators, in this case there may be reasons to grant different values to each of the areas. Thus the decisions on the number of areas to be considered and their weights are relevant, and we have preferred to ask experts about the importance that should be given to each area. To make this valuation easier we followed the criterion that the number of areas should be small, and similar within each dimension.

Table 4 shows the weights given to the different areas by the experts consulted[9].

2.6.5. Weighting and aggregation of the dimensions to obtain the rankings

The last phase of the methodology establishes how the different rankings of the ISSUE project are drawn up. This offers university rankings of each of the three dimensions separately, but for this it is no longer necessary to take any further step beyond those described in the above sections. On the other hand, to draw up the rankings combining the three dimensions it is necessary to perform a new aggregation and, once again, decide the most reasonable criteria for doing so.

In the transition from the dimensions to the final ranking we consider that the importance attributed to each dimension can be very different depending on the interests of the people contemplating the ranking, that is, of its potential users: students, researchers, managers, society. For this reason, we have come to the conclusion that the user's perspective can be key to giving more or less importance to each of the dimensions. It could be unconvincing to impose weights from a specific standpoint —for example, that of a group of experts, who consider that research is the most important— especially for individuals with another standpoint, for example, for students or careers guidance staff who consider that it is more important to attend to the teaching aspects.

[9] Two rounds of consultation were carried out, after which a reduction of 2.1 percentage points was obtained in the mean interquantile range.

After due reflection, therefore, we have opted to consider two alternatives.

1. First, rankings of Bachelor's degrees offer the option of the system earlier described as personalized ranking, based on the user's own preferences. We understand that in this case users are more likely to seek to compare the universities with fairly closely defined interests and diverse criteria, probably different from those of the experts. For this reason, with the help of a web tool, users can state the importance for them of each of the three dimensions when placing the degrees in order, and the tool automatically offers them the ranking corresponding to the preferences revealed by the user.

   To apply this first approach we have considered various alternatives for the choice of weights by the user. We opted for the procedure known as Budget Allocation Process, that is, for the distribution by the user of 100 points among the dimensions to be valued. This method, widely used in marketing to find out a consumer's valuation of the characteristics of a product, has the principal advantage of forcing the user to adopt a more active and reflexive position by having to distribute the points, being therefore more aware of the opinion that he/she displays.

2. Second, for the general rankings, corresponding to the universities' activities as a whole, the three dimensions are weighted on the basis of the experts' opinions, according to a survey such as that mentioned above when aggregating areas into dimensions, and a Delphi process to achieve convergence among the experts' opinions.

The weights finally granted to teaching, research, and to technological development and innovation, are those corresponding to the Delphi among the experts, respectively 56%, 34% and 10%.

2.7. RANKINGS OF VOLUME OF RESULTS VS. RANKINGS OF PRODUCTIVITY

When comparing universities, it is relevant whether or not their size is taken into account. Making one choice or the other is not in itself a methodological advantage or failure, but implies adopting a particular perspective which affects the rankings and must be borne in mind when interpreting the results.

In the same way as when analyzing the activity of a firm or a country we can consider its volume of output or its productivity, and both positions are reasonable, so it occurs in the case of analysis of the results of universities. Neither of the two approaches is, *a priori*, more valid than the other, and the choice depends on the intended use of the results. Likewise the per capita GDP is more useful than total GDP when comparing the quality of life between countries or regions, but the volume or the growth of GDP are also important for explaining, for example, the employment generated. So, although in some cases productivity may be more important than output, the size may also be relevant. A very productive and large university is more beneficial for society than a very productive but small one; likewise, a very large but unproductive university is a much bigger problem than an unproductive but small one.

2.7.1. Interest of the two approaches

The existing rankings adopt on occasions an approach based on productivity and in other cases on the volume of results. For example, some of the most cited international rankings — especially, the Academic Ranking of World Universities (ARWU), known as the Shanghai Ranking— are volume rankings.

The Shanghai Ranking can be said to be one rather of volume, because most of the variables from which it is built —number of Nobel prize-winners or Fields medalists among their ex-students or staff, widely cited researchers, publications in Nature or Science, articles

published in indexed journals— are not relativized by the size of the university. Such variables form the greater part of the weight in the ranking, while only one —an indicator of academic performance— is expressed in *per capita* terms. So, the universities' positions are conditioned both by their quality and by their size, both qualities being necessary for reaching good positions in this ranking.

Other rankings, on the other hand, make their comparisons from the point of view of productivity. Such is the case of the QS World Universities Ranking, whose indicators are taken from surveys of academic reputation or are variables standardized by size. There are also examples of rankings that expressly contemplate both approaches, and make differentiated comparisons based on productivity or on the total volume of results, as does the I-UGR Ranking of research results (www.rankinguniversidades.es).

The reason for acknowledging the interest of both approaches is that the size of institutions can be relevant for valuing the contributions of the universities, but correcting the results for size permits us to compare the universities from a perspective that makes them, in a certain sense, more homogeneous. However, since it has already been pointed out that it is not the same for the university system that a university of high (low) quality is large or small, we should ask whether the universities' positions would be the same in terms of productivity as in terms of volume of results and underline the specific meaning of both rankings. To sum up:

- The rankings of volume of production are based on indicators not relativized by size, and depend on both the university's productivity and its size. Thus, a university may generate a greater volume of research results than another of smaller size, even though the second is more productive.

- The productivity rankings are based on indicators of results corrected by size, and seek to measure the output per unit of inputs or resources used. For example, scientific output is measured as a function of the number of faculty members with PhD and the teaching results are relativized by the number of students. This enables some smaller universities to obtain a better final result in the ranking than other much larger ones.

An interesting question is whether size influences productivity positively or negatively, that is, whether productivity increases or decreases with the size of the university. In the first case, the universities' positions in the rankings of volume would be favored by two factors (size and productivity). The testing of the two hypotheses is an empirical matter, which can be analyzed by drawing up both types of rankings using the same approach, as the ISSUE project does. This test will be presented later.

2.7.2. Treatment of the size of universities

The selection of simple indicators with which we started implies that all are relativized depending on the variable considered most appropriate (students, faculty members, budget, etc.), so that size does not have a direct influence on the results. Consequently, the general scheme of the methodology described leads to measuring each university's results independently of its size, so these are rankings of productivity. Therefore, to construct rankings of volume of results, the size has to be included with the indicators hitherto described. This task has been undertaken following the criteria detailed below.

The first criterion for introducing the role of size into the system of rankings defined in the rest of the project is to preserve, as far as possible, the methodological homogeneity of both rankings, calculating them on the basis of the same set of indicators and with the same aggregation criteria. This criterion makes it advisable not to draw up the ranking of volume simply by not relativizing those indicators that can be expressed in total terms —for example, reflecting the income from patents or the doctoral theses read without dividing them by the number of faculty members with PhD— as the Shanghai Ranking does.

The reason for not proceeding thus is that some variables like those cited can be presented in absolute terms but others cannot, being rates or indices —such as the percentage of publications in the first quartile or the mean impact of

publications factor—. If some variables are expressed in absolute terms and others are not, the relative importance of the size within the results would fall only on the variables that can be expressed in absolute terms. In that case, the importance accorded to size would depend implicitly on the proportion of those variables that can be expressed in absolute terms. For example, in the variables considered in our study only 13 of the 25 indicators finally used could be expressed in absolute terms, which would be equivalent to the acknowledged importance of size being 52%. This percentage would be arbitrary because it would only reflect the proportion of indicators that form part of the database and can be expressed in absolute terms.

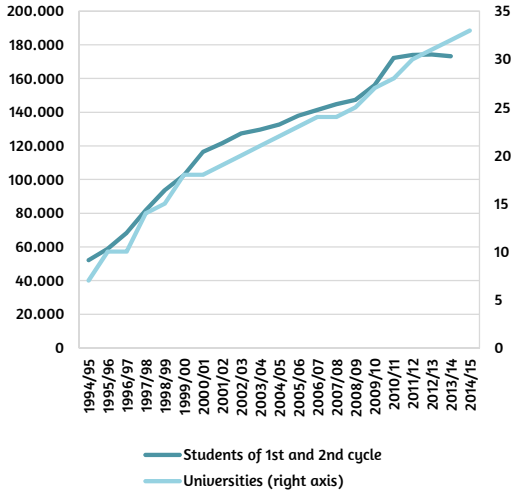
So this solution is unsatisfactory, and we have explored other alternatives for introducing size. The option chosen consists of calculating the total volume of results of each university by multiplying the productivity index by a measure of size. We have considered three indicators of the size of a university: the number of faculty members, the number of students, and the budget. Each one has its specificities and can be a better proxy of different aspects of the university's activity that do not have the same importance in each of them. To avoid skewing the size proxy in one or other direction in the most general indices —which could favor some institutions by giving greater weight to one of the aspects— we have taken as indicator of size the standardized arithmetic mean of the three variables.

2.8. PRIVATE UNIVERSITIES

Private universities are an important part of the Spanish university system. They have experienced a large growth in the last twenty years, multiplying by four their number to 33 institutions out of 83 that make up the entire Spanish university system today. Likewise, the amount of students has increased; tripling in number. Currently, 13% of the total university students in Spain attend private universities.

Up until now, U-Ranking only analyzed Spanish public universities, due mainly to the limited information available needed to build an accurate ranking. Fortunately, the participation of private universities in information systems is increasing. This fact, along with the desire to offer a full vision of the Spanish university system, has allowed this third edition of U-Ranking to commit itself to include those private universities with enough information to construct synthetic indicators that are homogenous with those of public universities.

Figure 1. Evolution of the number of private universities and students. 1994/95 to 2014/15 academic years



Source: Registro de Universidades Centros y Titulaciones (2015) and Spanish Ministry of Education, Culture and Sport

The first step to reach this goal has been the revision of the available data for each of the 33 private universities. Synthetic indices have been calculated from 25 indicators. Although it should be advised that, due to the idiosyncrasies of private universities, two of the indicators defined in the methodology, "Total *sexenios* over possible *sexenios*" (Research) and "Cut-off marks"[10] (Teaching), are not applicable to these institutions. In the first case, the *sexenios* are a monetary compensation that the Spanish Ministry of Education, Culture and Sport gives to teachers in recognition of their research activity based on six years. In the second case, students must pass a university admissions test (PAU) and upper secondary education tests in order to study a degree regardless of whether it is offered by a public

[10] The cut-off mark is the mark of the last student who gained admission to a degree with limited places. This mark is only a guideline and varies from one year to the next, depending on the number of free places and the marks of the students registered.

or private university. In the case of private universities, although it is a requirement, the mark obtained does not always constitute a criterion of admission, since the majority of these universities have their own procedures, based on specific tests, personal interviews and academic record. Therefore, with rare exceptions[11], private universities do not publish cut-off marks for their degrees.

Furthermore, it should be emphasized that, in general, information on innovation and technological development is more limited in private universities. It was already difficult, in the case of public universities, to obtain public and homogeneous information, since there are few sources. The Spanish RedOtri survey on *Research and Knowledge Transfer* is the main source of data and requires active participation of the universities that must complete the survey and authorize the diffusion of data. So far, there was less participation on behalf of private universities than public ones, due either to their management model or because their specialization makes them focus less on these activities.

With these two exceptions, the criterion to include private universities in U-Ranking, has been for them to have at least 18 of the 25 indicators considered for the public system[12]. Specifically, the following have been incorporated:

- Mondragon Unibertsitatea
- Universidad Cardenal Herrera - CEU
- Universidad Católica de Valencia San Vicente Mártir
- Universidad de Deusto
- Universidad de Navarra
- Universidad Europea de Madrid
- Universidad Pontificia Comillas
- Universitat de Vic
- Universitat Internacional de Catalunya
- Universitat Oberta de Catalunya
- Universitat Ramon Llull

[11] The cut-off marks for Vic University are published by the Consell Interuniversitari de Catalunya along with those of all the public universities in Catalonia. Mondragón University publishes on its website the cut-off marks for each of the degrees offered. For the rest of the private universities, the cut-off mark for each degree is 5 since the prerequisite is to pass university admissions tests.

[12] Since the indicators are based on moving averages, the requirement has been for each of the chosen indicators, with data offered by CRUE, to have information that would enable to calculate at least one of the 3 academic years that make up the moving average.

3. Rankings personalized by the user

The appropriate response to one of the issues related to the aggregation of the information analyzed in the previous point —the importance assigned to each of the aspects of a complex problem when evaluating it synthetically— may depend on the user. Certainly, in the case of the universities, there are different dimensions in their performance, but also different profiles of users interested in them: undergraduate or postgraduate student, teacher, manager, member of the governing team or of the Board of Directors, head of university policy in the Public Administration, journalist, interested citizen, etc. The importance granted by each to the different activities of the universities may be different and their interest may focus on one or more of their activities. For example, students are likely to focus their interest on those aspects of the university related with the degree that they wish to study and teachers may focus more on research.

Given the high number of users that might value the universities' activity from this particular viewpoint, it makes sense to consider the possibility of drawing up personalized rankings, established taking into account the interest from which the user contemplates the universities. The ISSUE project considers this question for the case of Bachelor's degrees, in order to offer a tool to facilitate for students, their families and careers advisers, information on the ranking of degrees, taking into account their specific interests.

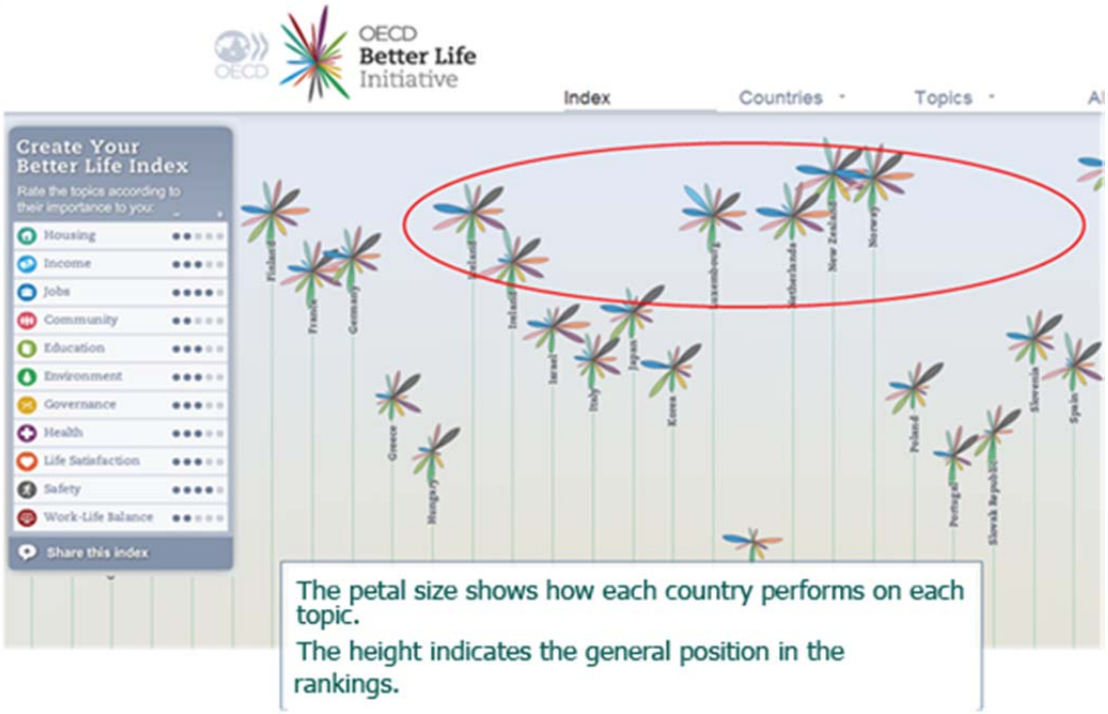
3.1. EXAMPLES OF PERSONALIZED RANKINGS

The possibility of constructing synthetic indicators acknowledging the preferences of users has been possible for a relatively short time, thanks to the interactivity permitted by web tools. Through them, the user can value for him/herself each one of the dimensions considered, indicating which areas he/she wants to consider and which are the most important for him/her. Web technology allows these preferences revealed by the users to be incorporated and combined with other elements contributed by the experts, such as the selection of variables and aggregating them in intermediate indicators according to criteria as described in section 2.

Two interesting examples of this approach, referring to very distinct areas, are those corresponding to the quality of life index Better Life Index, drawn up by the OECD, and the CHE Ranking, a ranking of university degrees drawn up by the German Center for Higher Education.

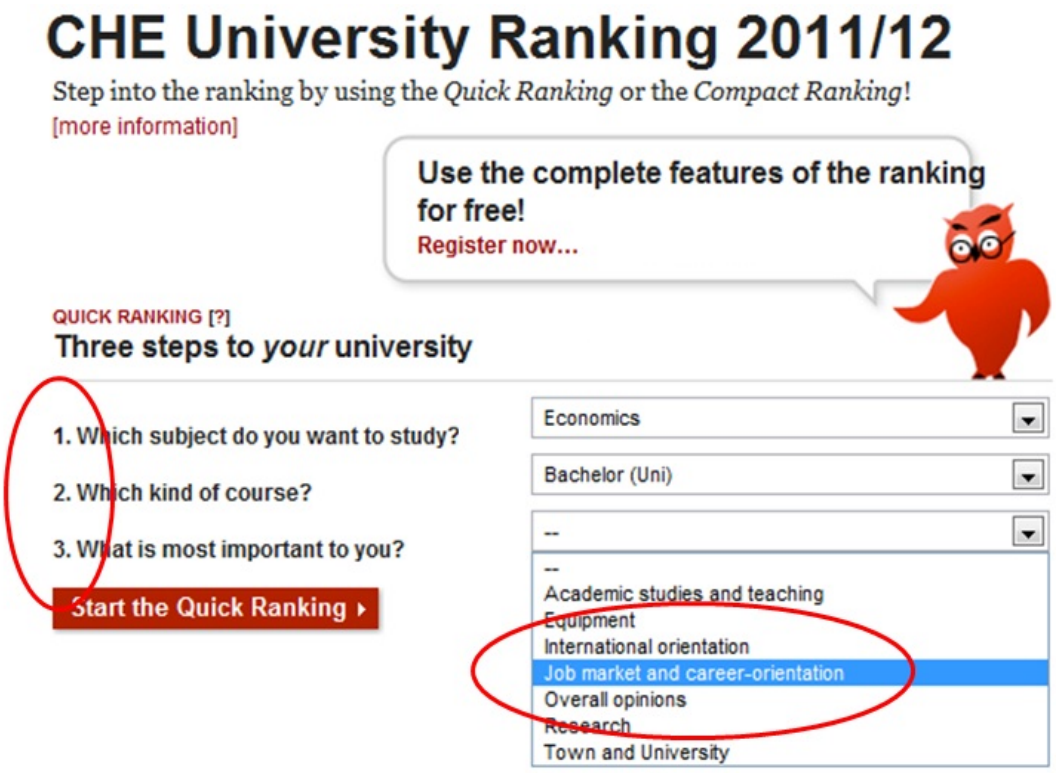
The OECD draws up a synthetic index that allows countries to be ranked according to their characteristics in various areas relevant to the quality of life (access to housing, income, education, security and safety, etc.), according to the aspects most valued by the user. These valuations are introduced through the website, on which a score must be assigned to each one of the dimensions of quality of life considered.


OECD
Better Life
Initiative
Index
Countries
Topics
Create Your Better Life Index
How do you define a better life? Use our interactive tool to see how your country performs on the topics you feel make for a better life.
Start with all topics rated equally
or set your own preferences here.
Create Your Better Life Index
Rate the topics according to their importance to you:
Housing
Income
Jobs
Community
Education
Environment
Governance
Health
Life Satisfaction
Safety
Work-Life Balance
Share this index
Belgium
Canada
Chile
Czech Republic
Denmark
Greece
Hungary
Iceland
Ireland
Mexico
Netherlands
New Zealand
Norway
Poland
Sweden
Switzerland
Turkey


OECD
Better Life
Initiative
Index
Countries
Topics
Create Your Better Life Index
Rate the topics according to their importance to you:
Housing
Income
Jobs
Community
Education
Environment
Governance
Health
Life Satisfaction
Safety
Work-Life Balance
Share this index
The petal size shows how each country performs on each topic.
The height indicates the general position in the rankings.

The experts prepare the set of relevant dimensions and variables and, after the user has introduced his/her valuation of each area, the web tool shows a synthetic index of quality of life that takes into account the weights awarded by the user.

A similar approach is used by one of the university rankings analyzed, the CHE Ranking, drawn up by Germany's Center for Higher Education for the journal *Zeit*. In this case, the student who wishes to choose a degree should select the subject he/she wishes to study, the type of course that interests him/her and the aspects that he/she considers most important (the teaching, the subsequent employment opportunities, research, etc.). Based on these preferences, a personalized university ranking is created.



3.2. DESCRIPTION OF THE WEB TOOL FOR GENERATING PERSONALIZED RANKINGS OF DEGREES

This personalized rankings approach has been used in the ISSUE project to arrange degrees in order, constructing rankings of universities for the different Bachelor's degrees. In the future it is intended to extend this approach to other aspects of university activities, in particular to Master's degrees, when the necessary databases are available.

The value of a tool like this depends greatly on the effort made to facilitate its use. The objective of ISSUE is to present a simple intuitive tool to minimize the number of clicks needed to obtain the relevant information, which is above all the corresponding ranking. This ease of use must be present both when limiting the degrees to be compared and when permitting the user to declare his/her preferences in order to draw up the personalized rankings.

The opinion as to when a user-friendly procedure has been achieved must also take into account the user's point of view. Therefore, to harmonize the tool with the most frequent potential users we performed trials among students of 17-18 years, who are less familiar with the concepts of the university world than the experts participating in the project. On the basis of these trials the necessary corrections were made to the tool in order to adapt it better to students and make understanding of the results easier.

The tool is presented on the screen of the project's website via the *Select University* tab. When this part of the screen is clicked, it shows the three questions that must be answered in order to obtain a ranking of a university adapted to the interests of the student in three aspects:

- *What to study*
- *Where to study*
- *Study and research*

When each of the three questions are clicked, a selection box opens in which the user has to choose, respectively:

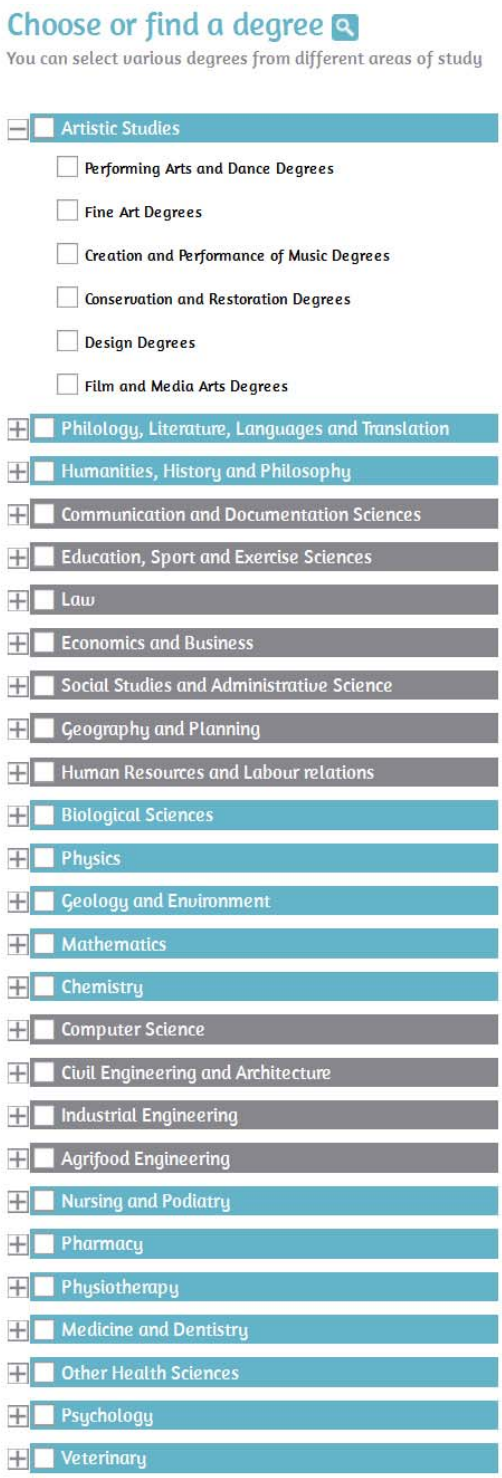
- The Bachelor's degree or degrees that he/she wishes to study
- The autonomous community or regions whose universities he/she wants to compare
- The importance for the user of the teaching, research and innovation and technological development activities.

The user can choose either one or several options in the first two questions (one or several degrees; one, several or all of the autonomous communities).

To avoid having to make the choice among the over 2,700 different Bachelor's degrees offered by Spanish universities, the first selection window shows them grouped into 26 *areas of study*.

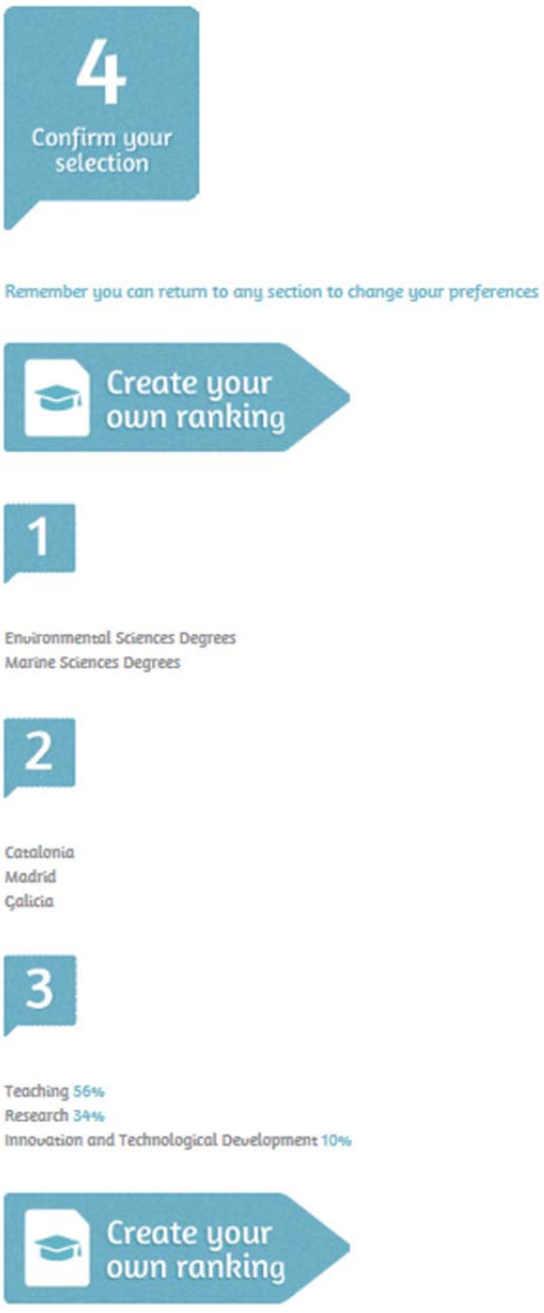
When one of these areas is clicked, a drop-down list is displayed showing the Bachelor's degrees that it contains. Thus, for example, when the "Artistic Studies" area of study is selected the Bachelor's degrees contained in this area of study are displayed.

The names of the degrees that appear in the drop-down list are not exhaustive or literal either, as those Bachelor's degrees with very similar names have been grouped, as for example "Humanities" and "Humanities and social studies" have been grouped under the name "Humanities Degrees". In this way the initial more than 2,700 Bachelor's degrees have been reduced to 132, to make the user's decision easier. However, irrespective of this initial reduction, the final results do show the complete title of the degree, as well as the center where it is taught in case there are various options.



The second step is to choose the autonomous community or regions that are being considered as places in which to study. For this, the user must mark those chosen on the following table, one of the options being "Any region". The option of restricting the search to specific autonomous communities is a response to the fact that many students do not contemplate geographical mobility as an alternative, or contemplate it restrictively. In this case, their interest will be to know which of the studies offered are valued best in the territories that he/she is considering. Anyway, complementary information is offered so that they can position their options relative to the remaining offers of the Spanish University System.

Thirdly, the user must declare his/her preferences with regard to the importance given to study and research when valuing the universities' profiles, assigning the 100 points available to him/her according to the weight he/she wishes to grant to teaching, research, and innovation and technological development.



As the user chooses the degrees and the autonomous communities of his/her interest and distributes the 100 points among the three dimensions in such a way as to reflect his/her preferences, the decisions are registered in the boxes below. Once the information is introduced in the three fields, the "Create your own ranking" button appears on screen.

When this button is clicked the personalized ranking corresponding to the selection criteria introduced is displayed, showing in order the corresponding Bachelor's degrees of the universities that offer those studies in the territories considered. The user is also informed that there are other options in addition to those selected in the same area of study, in case he/she is interested. This more complete set of alternatives is offered in a pdf file.

The first column shows the position of the Bachelor's degree in the personalized ranking. The second shows the value of the index reached for the particular degree. As we observe in the example, various Bachelor's degrees can occupy the same position in the ranking, since the indices are rounded to one decimal because greater precision is not considered to reflect, more accurately, differences among the degrees.

Together with the names of the Bachelor's degrees appears a link to the web address of each university. Next the cut-off mark of the last year is indicated and the price per credit on first registration, information that is completed when various centers of a university impart the same Bachelor's degree, if it is offered in one center or there is any commentary relating to the cost of the degree. The last columns at the right show the information on the environment which will be described in the next section.

To sum up, the web tool for constructing personalized rankings is easy to use, very flexible, and is underpinned by a rigorous methodology identical to the one described in previous sections on how general rankings are constructed. Therefore, it is a complement to the latter with a high potential for students, families and careers counsellors, as well as for the universities themselves. For this potential to be effective, it is essential to keep all the supporting information up-to-date and to constantly incorporate improvements, taking the users' experience into account, work which is currently underway.

Ranking	Index	University	Degree		2014/2015 (*) Cut-off mark	2014/2015 (*) Cost	Environment
1	1.7	Universidad Carlos III	Grado en Filosofía, Política y Economía	WWW	12.30	27.00	
2	1.6	Universidad Carlos III	PCEO Grado en Derecho / Grado en Economía	WWW	11.78	27.00	
3	1.5	Universidad Carlos III	Grado en Economía	WWW	9.83	27.00	
3	1.5	Universitat Pompeu Fabra	Grado en Filosofía, Política y Economía	WWW	11.97	25.00	
4	1.4	Universitat Pompeu Fabra	Grado en Economía	WWW	10.13	25.00	
5	1.3	Universidad de Navarra	Grado en Economía	WWW	+		
5	1.3	Universidad de Navarra	PCEO Degree in Economics / Leadership and Governance Program	WWW	+		
5	1.3	Universidad de Navarra	PCEO Grado en Economía / Grado en Derecho	WWW	+		

3.3. COMPLEMENTARY INFORMATION ON THE UNIVERSITIES' ENVIRONMENTS

The geographical and social environment in which a university is situated influences the users' valuations of its services. In particular, the costs of accessing the services can condition decisions affecting their demand. This seems to be indicated by, for example, the distribution of foreign students of the Erasmus Program. For this reason, it has been considered appropriate to include information on environmental variables as a complement to that offered by the rankings.

After reflecting on how to include such information, we came to the conclusion that the data of the environment should be treated differently from the rest of the variables considered, since they represent circumstances external to the universities and not features that are under their control. For this reason, we decided to provide the information without integrating it with the indicators computed in the ranking as a complement to them.

We have included four categories of environmental variables: a) climate —temperatures and rainfall— b) cost of living —housing prices—, c) accessibility —airports, railways and their connections— and d) socio-cultural environment —total activity in the sectors of art and entertainment. This information is presented by means of a system of icons (similar to that of hotel guides) to make easier the identification of the advantages of the universities in these four aspects. The web tool offers up to four icons against each university, one for each environmental category considered, when the environment reinforces the university's attraction. The size of the icon indicates, intuitively, what university environments offer him/her a better quality of life (see, for example, the following diagram).

To decide the size of the corresponding icons, a synthetic indicator[13] has been calculated for each of them, based on the data available, which in general is by province. After arranging the universities in order of these indices, a large icon is assigned to those situated in the tertile with highest value in the distribution (best climate, highest cost, greatest connectivity, most socio-cultural opportunities) and an identical but smaller icon to those in the second tertile (between 33% and 66%); finally, those in the third tertile are indicated with even smaller icons.

It should be taken into account that three of the four environmental characteristics are more favorable the larger the icon (climate, transport and socio-cultural opportunities), while a higher cost of living must be understood as less attractive.

The same as in the previous edition, the 2015 edition also includes the price per credit for over 2,700 Bachelor's degrees analyzed by U-Ranking, based on information provided by the Spanish Ministry of Education, Culture and Sport. In recent years university fees have increased considerably and unequally. These prices, despite the maximum limit set by the Spanish Ministry, can vary depending on the autonomous community, the university, the cycle —Bachelor, Master, Doctorate— the level of experimentality of the degree and the ownership of the center[14] offering that degree. As can be appreciated in table 5, the current range of fees by regions is considerable, even more if differences of experimentality and cycle are considered.

For this reason, it can be considered relevant that, as a guide, the user of U-Ranking will be able to know the price per credit at first registration for each Bachelor's degree. The prices included in U-Ranking correspond to those established for the academic year 2014-2015. Also, the cost was included by degree course offered by private universities when this information was available on their web pages.

Table 5. Public price per credit at the time of first enrolment by region. 2014-2015 academic year (euros/credit)

Region	Average price	Minimum price	Maximum price
Andalusia	12.62	12.62	12.62
Aragon	20.15	13.77	25.83
Asturias	17.13	12.11	22.03
The Balearic Islands	17.92	12.88	23.13
The Canary Islands	15.21	12.3	18.95
Cantabria	13.5	10.65	16.65
Castile and Leon	23.34	17.07	30.25
Castile-La-Mancha	15.81	12.13	18.87
Catalonia	33.52	25.27	39.53
UOC (Oberta de Catalunya)	20.74	19.6	21.88
The Valencian Community	20.39	16.31	24.89
Extremadura	14.74	10.31	18.51
Galicia	11.89	9.85	13.93
Madrid*	30.33	27.00	33.00
Murcia	15.58	14.38	16.78
Navarre	19.22	15.9	22.53
Basque Country	16.88	14.08	19.84
La Rioja	18.37	14.14	23.51
UNED	16.43	12.7	22.16

* Madrid has established a maximum public price for the public universities in this region.

Source: Spanish Ministry of Education, Culture and Sport.

[13] The synthetic indicators were constructed, for those environmental variables with more than one indicator, by first standardising each indicator with respect to its distance (ratio) from the median and then applying a geometric mean to those indicators. Next, each sample was divided into three sets bounded by the tertiles of each distribution in order to subsequently assign them to each group.

[14] U-ranking also includes Bachelor's degrees imparted by private centres attached to public universities. In general, the price of these degrees includes an extra cost above public prices.

4. Main results

This chapter offers the principal results obtained in this third edition of the ISSUE Project, corresponding to 2015, in which both the general rankings and the personalized rankings of Bachelor's degrees have been updated. Both rankings are available in full on the project website www.U-ranking.es.

The 2015 rankings will be analyzed from three different perspectives in order to emphasize the contribution made by the project and its methodology: a) comparing them with other rankings already known in order to evaluate their similarities and differences; b) evaluating the sensitivity of the results to changes in some of the hypotheses put forward; and c) analyzing the results obtained in the 2014 edition as against those of 2015. The second question has been considered from two perspectives: the importance of considering, or not, the size of the university, and the implications of granting more or less weight to research or teaching.

4.1. ISSUE RANKING OF PRODUCTIVITY (ISSUE-P)

Table 6 offers the ranking of 59 Spanish universities analyzed after homogenizing them taking into account their size, that is, what we call *productivity ranking* (ISSUE-P Ranking). The order is based on the value of the synthetic indicator obtained by each university, offered in the second column. This indicator has been rounded to one decimal as a greater detail of the index would not reflect more accurately the differences among universities, given the set of decisions adopted in the process of construction of indicators already described.

As the table shows, various universities obtain the same index and therefore present the same position in the ranking. As a result of this criterion, the fifty-nine universities are grouped into ten levels of productivity. Those universities with the same index have been ordered alphabetically within their group. Only those

Table 6. ISSUE-P Ranking of the Spanish public universities

Ranking	Index	University	Ranking	Index	University	Ranking	Index	University
1	1.5	Universitat Pompeu Fabra	5	1.1	Universitat de València	7	0.9	Universidad de Murcia
2	1.4	Universidad Carlos III	5	1.1	Universitat Jaume I	7	0.9	Universidad de Oviedo
2	1.4	Universitat Autònoma de Barcelona	5	1.1	Universitat Ramon Llull	7	0.9	Universidad de Valladolid
2	1.4	U. Politècnica de Catalunya	6	1	Mondragon Unibertsitatea	7	0.9	Universidad del País Vasco
2	1.4	Universitat Politècnica de València	6	1	Universidad Complutense	7	0.9	Universidad Pontificia Comillas
3	1.3	Universidad Autónoma de Madrid	6	1	Universidad de Almería	7	0.9	Universidad Rey Juan Carlos
3	1.3	Universidad de Navarra	6	1	Universidad de Deusto	8	0.8	Universidad Cardenal Herrera - CEU
4	1.2	Universidad de Cantabria	6	1	Universidad de Granada	8	0.8	Universidad de Burgos
4	1.2	U. Miguel Hernández de Elche	6	1	Universidad de Huelva	8	0.8	Universidad de Extremadura
4	1.2	Universidad Politécnica de Madrid	6	1	Universidad de Salamanca	8	0.8	Universidad de Jaén
4	1.2	Universitat de Barcelona	6	1	Universidad de Sevilla	8	0.8	Universidad de La Laguna
4	1.2	U. Internacional de Catalunya	6	1	Universidad de Zaragoza	8	0.8	U. de Las Palmas de Gran Canaria
4	1.2	Universitat Rovira i Virgili	6	1	Universidad Pablo de Olavide	8	0.8	Universidad Europea de Madrid
5	1.1	Universidad de Alcalá de Henares	6	1	U. Politécnica de Cartagena	8	0.8	Universidade da Coruña
5	1.1	Universidad de Alicante	6	1	Universidade de Vigo	9	0.7	U. Católica de Valencia S. Vte. Mártir
5	1.1	Universidad de Córdoba	6	1	Universitat de Girona	9	0.7	Universidad de La Rioja
5	1.1	Universidad Pública de Navarra	7	0.9	Universidad de Cádiz	9	0.7	Universitat de Vic
5	1.1	U. de Santiago de Compostela	7	0.9	Universidad de Castilla-La Mancha	10	0.6	UNED*
5	1.1	Universitat de les Illes Balears	7	0.9	Universidad de León	10	0.6	Universitat Oberta de Catalunya
5	1.1	Universitat de Lleida	7	0.9	Universidad de Málaga			

* The National Distance Education University.
Note: Universities are ordered from the highest to the lowest index value. Universities with the same index value are ordered alphabetically.
Source: BBVA Foundation-Ivie.

cardinal and ordinal aspects of the universities that make notable differences will be commented upon.

Each column of table 6 brings together one-third of the universities according to the order provided by this ranking, but, since there are universities with the same level of productivity, in this case the classification system arranged in tertiles is not precise[15].

An aspect worth mentioning is that the range of the index from which this ranking is derived continues to show, as in previous editions, significant differences of productivity among the Spanish universities, the most productive ones doubling the results of those in the last positions.

In the productivity ranking the leading group is formed by twenty-three universities occupying the first to the fifth positions. These universities are: Pompeu Fabra in first place, followed in second place by the group formed by: Carlos III, Autònoma de Barcelona, Politècnica de Barcelona and Politècnica de Valencia. The third place corresponds to the Autónoma de Madrid and to the first private university that appears in the ranking, Universidad de Navarra. The forth place is occupied by the following universities: Cantabria, Miguel Hernández (Elche), Politècnica de Madrid, Barcelona, Internacional de Catalunya, which is the second private university appearing in the productivity ranking, and Rovira i Virgili. The first twenty-three universities ranked by their productivity are completed by the group of universities which come in fifth place: Alcalá de Henares, Alicante, Cordoba, Pública de Navarra, Santiago de Compostela, Illes Balears, Lleida, Universitat de València, Jaime I (Castellón) and Ramon Llull.

Other groups of universities with similar levels of productivity are found in the following positions: thirteen universities share the sixth position, ten others the seventh position, eight share the eighth, three share the ninth and two the tenth position.

The first conclusion that can arise from the inclusion of private universities in U-Ranking, is that in terms of productivity, diversity among them is equivalent to that of public universities. Thus, table 6 shows that there are private universities at all levels of the ranking between the 3rd and 10th position. The second conclusion is that there are less private universities present in the first tertile compared with public, being the average productivity of public universities superior.

4.2. ISSUE RANKING OF VOLUME OF RESULTS (ISSUE-V)

Table 7 shows the index and the ranking of Spain's 59 public universities according to their volume of results (ISSUE-V Ranking), which differs from that of productivity because it is obtained without correcting for the size of each university.

As in table 6, each column contains one-third of the Spanish universities according to their order in the ranking. The first column contains the 20 universities forming the first tertile. Standing out in first place is the Universidad Complutense, with an index (4.4) almost one point higher than the university in second place, that of Barcelona (3.8). In third position is the Universidad de Granada and in forth the Polytechnics of Madrid and València and the Universidad de Sevilla. The Universitat de València and the Universidad del País Vasco stand in fifth and sixth place. The seventh to the tenth positions are occupied in this order by the following universities: Autónoma de Barcelona, Politécnica de Catalunya, Autónoma de Madrid, UNED (National Distance Education University), Zaragoza, Santiago de Compostela, Málaga and Salamanca. The tertile finishes off with the universities which occupy the fifteenth place, Carlos III, Alicante and Murcia and the sixteenth place is occupied by Universidad de Oviedo.

Following are the rest of the universities grouped in most cases by the same level of results. The number of different positions in this order is

[15] The tables have been structured in 3 columns to maintain asymmetry with previous editions despite the fact that some universities have been artificially separated even though they occupy the same place in the ranking.

twenty-nine, much more than in the case of productivity.

The inclusion of private universities in U-Ranking highlights the fact that private universities have a lower size than public universities. Thus, we see in table 8 that, except for the Ramon Llull University and Universidad de Navarra that occupy intermediate places in the second tercile, the rest of the private universities are found in the last positions of the third tertile.

4.3. VOLUME RANKING VS. PRODUCTIVITY RANKING

The comparison of the above two tables indicates that the differences between the ISSUE-V Ranking and the ISSUE-P Ranking are substantial. But both approaches can be useful, one or the other being suitable depending on the question to be answered.

The differences in the values of the indicators are much greater in the volume ranking due to the importance of size. The indicator of total results ranges from 4.4 to 0.1, very much wider than for the indicator of productivity, which goes from 1.5 to 0.6.

Figure 2 combines the two types of rankings and facilitates the comparison of the position of each university in both. On the vertical axis it shows the results of the ISSUE-V Ranking —which depends on the size— while on the horizontal axis it shows the ISSUE-P Ranking —which corrects the effects of size. The universities are ordered from top to bottom on the first and from right to left on the second. In each case the scale is different, to reflect that each ranking establishes a different number of groups of universities with the same index. As can be observed, the dispersion of points in the figure is significant and reflects that there is no definite correlation between the two rankings. Therefore, size does not seem, in general, to have any positive or negative influence on productivity.

Table 7. ISSUE-V Ranking of the Spanish public universities

Ranking	Index	University	Ranking	Index	University	Ranking	Index	University
1	4.4	Universidad Complutense	17	1.3	Universidad de Castilla-La Mancha	23	0.7	Universidad de Jaén
2	3.8	Universitat de Barcelona	17	1.3	Universidad de Valladolid	23	0.7	Universitat de Girona
3	3.2	Universidad de Granada	18	1.2	Universidad de Alcalá de Henares	23	0.7	Universitat Oberta de Catalunya
4	3.1	Universidad de Sevilla	19	1.1	Universidad de Córdoba	24	0.6	Universidad de Huelva
4	3.1	Universidad Politécnica de Madrid	19	1.1	Universidad de La Laguna	24	0.6	Universidad de León
4	3.1	Universitat Politècnica de València	19	1.1	Universidade de Vigo	24	0.6	Universidad Pablo de Olavide
5	3	Universitat de València	20	1	Universidad de Cádiz	24	0.6	Universidad Pública de Navarra
6	2.9	Universidad del País Vasco	20	1	Universidad Rey Juan Carlos	24	0.6	Universitat de Lleida
7	2.8	Universitat Autònoma de Barcelona	20	1	Universitat Pompeu Fabra	25	0.5	Universidad de Deusto
8	2.7	Universitat Politècnica de Catalunya	21	0.9	Universidad de Cantabria	26	0.4	Universidad Europea de Madrid
9	2.5	Universidad Autónoma de Madrid	21	0.9	Universidad de Extremadura	26	0.4	U. Politécnica de Cartagena
10	2.3	UNED*	21	0.9	U. de Las Palmas de Gran Canaria	26	0.4	Universidad Pontificia Comillas
11	2.2	Universidad de Zaragoza	21	0.9	Universitat Jaume I	27	0.3	U.Católica de Valencia S. Vct. Mártir
12	2	U. de Santiago de Compostela	21	0.9	Universitat Ramon Llull	27	0.3	Universidad de Burgos
13	1.8	Universidad de Málaga	21	0.9	Universitat Rovira i Virgili	28	0.2	Mondragon Unibertsitatea
14	1.6	Universidad de Salamanca	22	0.8	Universidad de Navarra	28	0.2	Universidad Cardenal Herrera - CEU
15	1.5	Universidad Carlos III	22	0.8	U. Miguel Hernández de Elche	28	0.2	Universidad de La Rioja
15	1.5	Universidad de Alicante	22	0.8	Universidade da Coruña	28	0.2	U. Internacional de Catalunya
15	1.5	Universidad de Murcia	22	0.8	Universitat de les Illes Balears	29	0.1	Universitat de Vic
16	1.4	Universidad de Oviedo	23	0.7	Universidad de Almería			

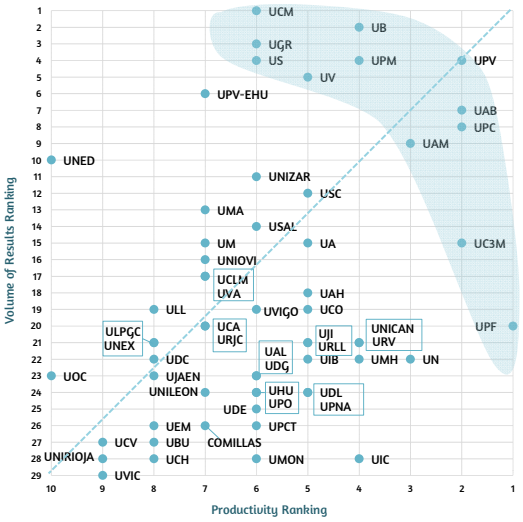
* The National Distance Education University.

Note: Universities are ordered from the highest to the lowest index value. Universities with the same index value are ordered alphabetically.

Source: BBVA Foundation-Ivie.

Figure 2. ISSUE-V vs. ISSUE-P of the Spanish public universities

Position in each ranking



See appendix 2 for a list of the University abbreviations used.
Source: BBVA Foundation-Ivie.

In the top part of the figure are the universities with the highest output: Universidad Complutense, Universitat de Barcelona, Universidad de Granada, Universidad de Sevilla, Universidad Politécnica de Madrid, Universitat Politècnica de València, Universitat de València, Universidad del País Vasco, Universitat Autònoma de Barcelona, Universitat Politècnica de Catalunya, Universidad Autónoma de Madrid y UNED.

However, not all of these large universities are among the most efficient. In fact, other smaller ones stand out in this regard (see them more to the right in the figure). This is the case of the Universitat Pompeu Fabra, which obtains the highest productivity in the ISSUE-P Ranking, and of other medium- or small-sized and very productive universities, such as Universidad Carlos III or Universidad de Navarra.

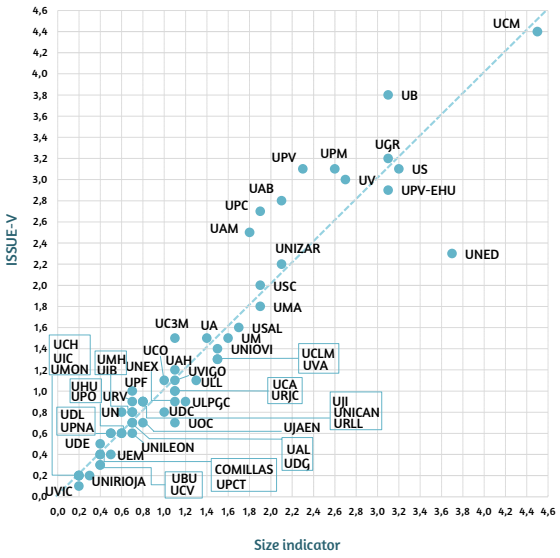
With the aim of highlighting the universities that present simultaneously the best results in both rankings we have shaded an area containing twelve universities that stand out because for each of them there is almost no university with simultaneously greater productivity and greater volume of results. In consequence, it can be said that their position is hardly *dominated* by any other university. For the rest, on the other hand, there are universities that present at the same time better results in both rankings.

The universities situated in the shaded zone form the *frontier of best practice in volume of results-productivity of Spanish universities.* It is formed by the Universidad Complutense, Universitat de Barcelona, Universitat de València, Universidad Politécnica de Madrid, Universitat Politècnica de València, Universitat Autònoma de Barcelona, Universitat Politècnica de Catalunya, Universidad Autónoma de Madrid, Universidad de Granada, Universidad de Sevilla, Universidad Carlos III and Universitat Pompeu Fabra. If we were to draw a line along this outer frontier, it would have a negative gradient. It could therefore be said that, even among the best, the larger universities gain volume of results at the expense of a certain loss of productivity. Nevertheless, the extent of this size effect is limited, as most of those situated at the frontier are large universities and can be considered examples of good practice or university *benchmarking* in Spain.

In fact, examples of higher or lower productivity can be found among universities of very different sizes.[16] Figure 3 shows this by representing the size indicator on the horizontal axis and the volume index ISSUE-V of each university on the vertical axis. Those situated above the diagonal achieve results higher than the average productivity, the gradient of the vector radius joining each position to the origin being the measure of its productivity. It is visually evident that size is not a determinant of the universities' productivity. There are institutions of large size like the Universities of Barcelona, the Polytechnics of Madrid, Valencia and Catalunya or the Autonomous Universities of Barcelona or Madrid, which productivity is high. However, some universities of smaller size such as Universitat Pompeu Fabra, Carlos III de Madrid, Rovira i Virgili or Universidad de Navarra also present high productivity indices.

[16] The indicator of size is the result of calculating the standardized arithmetic mean of the number of students, faculty members and budget of each university.

Figure 3. ISSUE-V indicator vs. Size indicator*



(*) The Size indicator is a standard arithmetic mean of the teachers, students and budget of each university.

See appendix 2 for a list of the University abbreviations used.

Source: BBVA Foundation-Ivie.

4.4. ISSUE RANKING VS. SHANGHAI RANKING

Given the popularity attained by some international rankings, many universities are interested in being compared with the best in the world. For this reason, it is obligatory to ask to what extent the ISSUE Rankings constructed offer results different or similar to the former. As external reference for comparison we will consider especially the Shanghai Ranking, which without a doubt has become the most widely known to date.

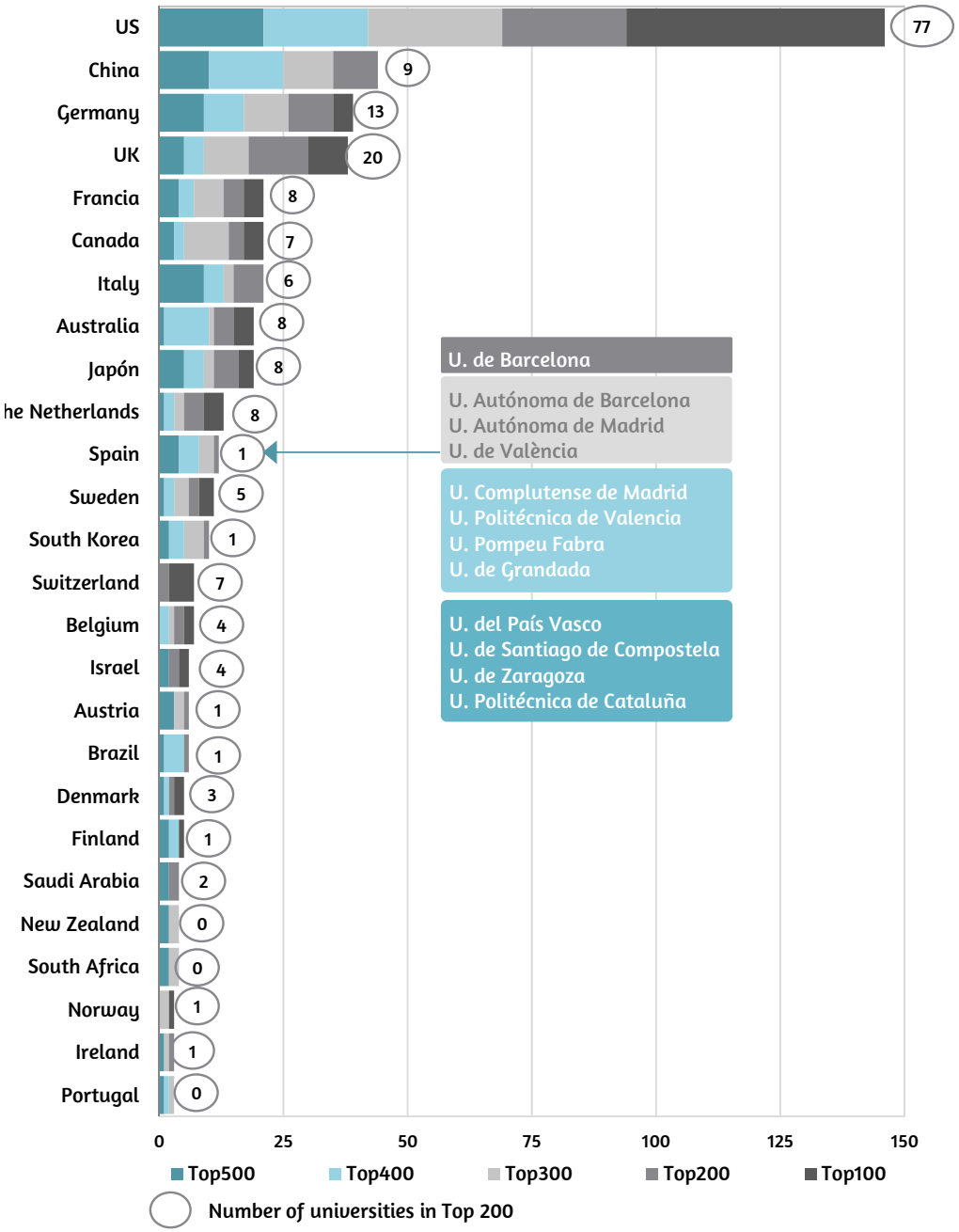
Regarding the Shanghai Ranking, as we see in figure 4, only twelve Spanish universities appear in the latest list of the top 500. With the exception of the Universitat de Barcelona, all of them are below the 200th place. Therefore, a comparison between U-Ranking and Shanghai Ranking would be very limited. However, a recent study (Docampo 2014) offers a version of the Shanghai Ranking adapted to the Spanish universities that includes all the private and public universities, allowing a better comparison.

The results of the ISSUE-V Ranking and the Shanghai Ranking are much more alike than those of our two ISSUE Rankings with each other, as shown by the following figures. The first of them (figure 5) represents on the horizontal axis the position of the Spanish universities in the ISSUE-V Ranking, while the vertical axis represents the Shanghai Ranking. Regardless of the different number of levels that each ranking sets, both offer a fairly similar order, and therefore the universities are mostly grouped around area I and III of the figure.

The universities located in area II of the figure are comparatively better situated in our ranking. The case of the UNED stands out, occupying a clearly better position in the ISSUE-V Ranking than in that of Shanghai. The universities in area IV, on the contrary, are comparatively better placed in the adaptation for Spain of the Shanghai Ranking. The common denominator in many cases is that these are small but more productive universities, such as Pompeu Fabra or Rovira i Virgili, whose greater efficiency was already manifest in the ranking of productivity.

In the figure 4 we have highlighted with dark squares the universities that are expressly mentioned among the top 500 of the Shanghai Ranking —not only in the adaptation for Spain. As can be observed, they are all at the top in the adaptation by Docampo (2014), and the majority form part of the first tertile of our ISSUE-V Ranking: Universitat de Barcelona, Universidad Autónoma de Madrid, Universitat Autònoma de Barcelona, Universidad Complutense, Universitat de València, Universitat Politècnica de València, Universidad de Granada, Universidad del País Vasco, Universidad de Santiago de Compostela, Universidad de Zaragoza and Universitat Politècnica de Catalunya. The remaining one is the Universitat Pompeu Fabra, situated in the second tertile of the ISSUE-V Ranking.

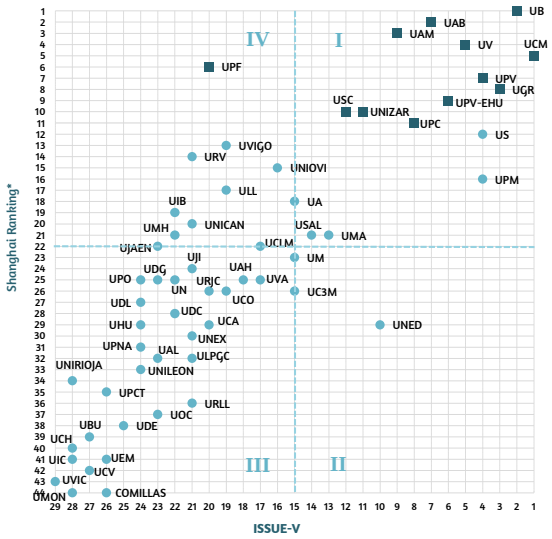
Figure 4. Spanish universities in the 2014 Shanghai Ranking



Note: Ordered from the countries' highest to lowest number of universities in the Top 500.

Source: Academic Ranking of Word Universities (ARWU, CWCU 2013).

Figure 5. ISSUE-P vs. Shanghai Ranking*
Position in each ranking



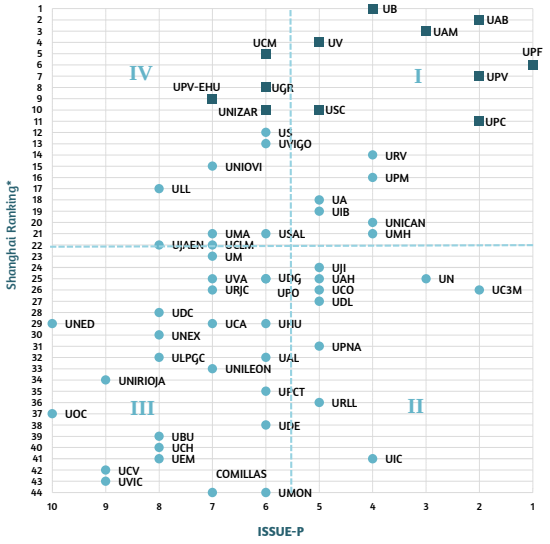
(*) Results correspond to our adaptation of the Shanghai Ranking by Docampo (2014) for Spanish universities ('Shanghai Ranking expanded'). Of the universities that appear in Docampo's ranking, 14 private universities have been excluded and are not analyzed in the ISSUE Ranking. The numbers assigned in Docampo's ranking have been changed to facilitate the comparison.

■ Universities in the Shanghai Ranking Top 500.

See appendix 2 for a list of the University abbreviations used.

Source: BBVA Foundation-Ivie and Docampo (2014).

Figure 6. ISSUE-P vs. Shanghai Ranking*
Position in each ranking



(*) Results correspond to our adaptation of the Shanghai Ranking by Docampo (2014) for Spanish universities ('Shanghai Ranking expanded'). Of the universities that appear in Docampo's ranking, 14 private universities have been excluded and are not analyzed in the ISSUE Ranking. The numbers assigned in Docampo's ranking have been changed to facilitate the comparison.

■ Universities in the Shanghai Ranking Top 500.

See appendix 2 for a list of the University abbreviations used.

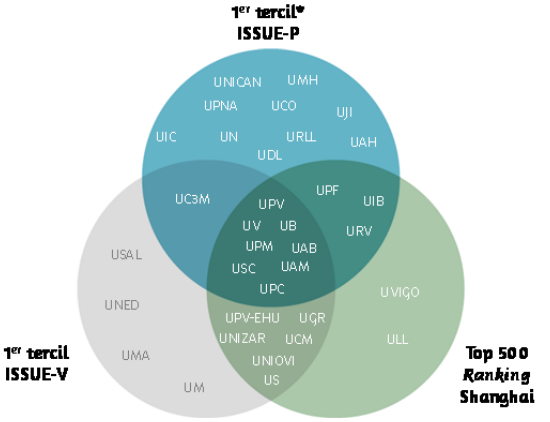
Source: BBVA Foundation-Ivie and Docampo (2014).

The inclusion of private universities does not alter the high consistency of our ranking in terms of volume with the Shanghai Ranking. As seen in Figure 5, all the private universities analyzed are found in area III. Hence, the less prominent places in ISSUE-V also correspond with those in the lowest positions in Docampo's adaptation (2014).

Up to what point the comparison between the Shanghai Ranking adapted to Spain and the ISSUE-P Ranking offers conclusions different to the above is shown in figure 6. In it, almost half of the universities change tertile between one ranking and the other. In short, the differences with Shanghai are much more substantial in the case of the ISSUE-P Ranking than in that of ISSUE-V, which agrees with the characteristic of the Shanghai Ranking already pointed out: it scarcely corrects the indicators used to take into account the size and, therefore, it is more a ranking of volume of results than of productivity.

To illustrate at the same time the extent to which the three rankings compared generate different groupings of the universities a Venn diagram can be used, representing the universities that form part of the first tertile in each of the classifications and the intersections among the three.

Figure 7. ISSUE Rankings vs. Shanghai Ranking



(*) The ISSUE-P Ranking includes 23 universities in the 1st tertile instead of 20 in order to include all the universities that belong to group 5.

See appendix 2 for a list of the University abbreviations used.

Source: BBVA Foundation-Ivie and Docampo (2014).

In the center of the diagram (figure 7) appear the eight universities situated in the first tertile in the three rankings. They are Universitat de Barcelona, Universitat de València, Universitat Autònoma de Barcelona, Universitat Autónoma de Madrid, Polytechnics of València, Catalunya, and Madrid and Universidad de Santiago de Compostela. Ten other universities are in the first tertile of two of the rankings: Universitat Pompeu Fabra, Illes Balears and Rovira I Virgili in Shanghai and ISSUE-P; Universidad Carlos III ISSUE-V and ISSUE-P; and Universidad del País Vasco-EHU, Universidad de Granada, Universidad de Zaragoza, Complutense de Madrid, Oviedo and Sevilla, in Shanghai and ISSUE-V. Finally, sixteen other universities stand out by only one of the three criteria considered.

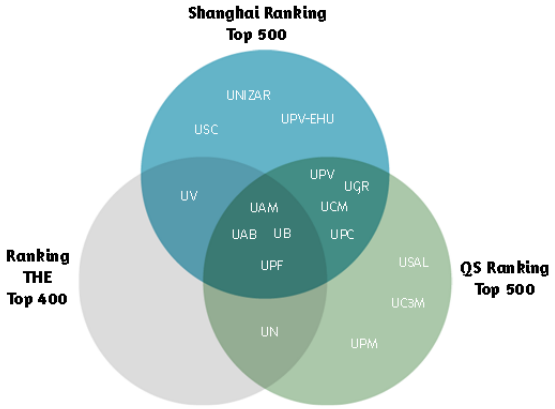
In sum, these results show important coincidences between the rankings when identifying the universities that stand out, but also significant differences that reflect the different approach of each ranking. It is especially interesting to observe that of the twelve universities that the Shanghai Ranking places in its Top 500, seven also appear in the first tertile of our two rankings, in the intersection of the three circles of the diagram; another, Universitat Pompeu Fabra, heads our ranking of productivity, and four more belong to the first tertile of the ISSUE-V Ranking, Universidad de País Vasco-EHU, Universidad de Zaragoza, Complutense de Madrid and Universidad de Granada.

In brief, it can be said that, of the twelve Spanish universities included in the Top 500 of the Shanghai Ranking, eleven are to be found in our tertile with greatest volume of results according to the ISSUE-V Ranking and eight among our most productive universities according to the ISSUE-P Ranking. Consequently, our classifications present a substantial harmony with those of the Shanghai Ranking, which strengthens their interest as instruments for identifying best practice. They also allow us to see that there may be differences in the rankings according to the perspective with which they were drawn up, and at the same time indicate that some universities are well positioned from any perspective.

4.5. COMPARISON OF RESULTS OF OTHER INTERNATIONAL RANKINGS

Although the Shanghai ranking is consolidating its influence as the most cited international indicator, there exist other initiatives of high international repute, such as the Times Higher Education (THE) or the QS-Ranking. The principal differences between these two initiatives and the Shanghai ranking are that they (i) try to measure the role of teaching and (ii) incorporate subjective valuations based on surveys of international employers and experts. The results for the Spanish universities in the three initiatives present similarities but also some differences, as shown in figure 8.

Figure 8. Comparison of the results of three international rankings. 2013-2014



See appendix 2 for a list of the University abbreviations used.

Source: ARWU (CWCU 2014), THE (2013) and QS (2014).

In the intersection of the three rankings we find a set of four universities (UAB, UB, UPF and UPV) which appear systematically in the top positions of our rankings and also belong to the group of universities at the *frontier* of figure 2 —that is, those universities that are not dominated by hardly any other university—. Finally, among the universities at this frontier, the UCM, UGR, UPC and UPV do not figure in the Top 400 of the THE, and the UV does not belong to the Top 500 of the QS Ranking.

These results again confirm the presence of a group of Spanish universities in the top positions within our university system, regardless of the prism with which it is analyzed and that the discrepancies between our ranking

and any of the well-known international rankings are not any greater than the differences among these.

4.6. RESEARCH *VS.* TEACHING: SENSITIVITY ANALYSIS

One of the biggest problems inherent to any composite indicator is the effect of the relative weight of the elements composing it. The ISSUE project expressly considers that teaching and research can have different importance for each user of the universities' services. This is acknowledged to the point of allowing a web tool to draw up personalized rankings that take into account the user's preferences in this sense.

The question posed in this section is how much the general rankings of the universities would change if the weights allocated to teaching and to research were to change. In the results presented above the weights used to calculate the rankings were those obtained by applying the Delphi method capturing the opinions of the experts who collaborated in the project as well as other available information.[17] But other experts or other users could give different valuations. Consequently, we should analyze whether the results are highly sensitive or insensitive —in the latter case we will say that they are *robust*— to changes in the weights of these dimensions.

The previous question is important for valuing to what extent we can rely on the results of the rankings, given the possible arbitrariness of the attribution of one weight or another to research or any other university activity. Specifically, would the results change much if a greater weight was granted to research, as in other well-known rankings? Another interesting question is if a university can occupy a high place in a ranking if the weights of teaching and research change to suit its interests? As we will see, the answer to this question is negative.

Studying the sensitivity of rankings to changes of the weights of teaching and research permits us to analyze also whether the universities' results in these two activities are correlated. Most rankings place great emphasis on research because the information on the results of this activity is abundant and seems more precise and reliable. But, although it is often argued that teaching and research are highly correlated, this hypothesis has barely been tested for lack of indicators of teaching results. We will revisit this question in a later section.

That the research dimension is easier to measure should not be an argument for not measuring the quality of teaching. Likewise, the existence of a positive correlation between the quality of teaching and that of research should not hide the fact that disparity is also possible: if for the same level of research quality there are different teaching results between universities, ignoring this information biases the results in favor of one and against the other.

To value the effect of the selection of the weights given to teaching and to research we performed an analysis of sensitivity to their variations on the ranking of productivity. For this, we calculated three rankings that are differentiated by the very different relative weights of research and of teaching, as indicated below:

- Option 1: Teaching 20 / Research 70 / Innovation 10
- Option 2: Teaching 45 / Research 45 / Innovation 10
- Option 3: Teaching 70 / Research 20 / Innovation 10

We opted to leave the weight of innovation and technological development with a fixed value of 10 points so as not to hinder comparisons of the effect of a greater or lesser relative weight of the other two variables. If together with a reduction of the weight of research we applied a reduction of the weight of innovation (or vice versa), we

[17] The weights used are 56% for teaching, 34% for research and 10% for innovation and technological development. The weights were established on the basis of the opinion of the experts consulted, and agree practically with the distribution of resources among the teaching, research and transfer activities in the universities' budgets. It also reflects an intensity of research activity in accordance with the results of the Spanish universities: if we consider that in the top universities of the world by their research results these activities had a weight of 85-90%, the corresponding figure for the Spanish universities would be 35%.

could not know to which of the two variations the changes in the ranking were due [18].

Figure 9 shows the effect on the position in the ranking of each of Spain's 59 universities analyzed when the weight of research is increased, according to the three weightings chosen.

The evolution of the universities, when the weight of research increases, frequently presents movements from right to left (regressions) characterized by:

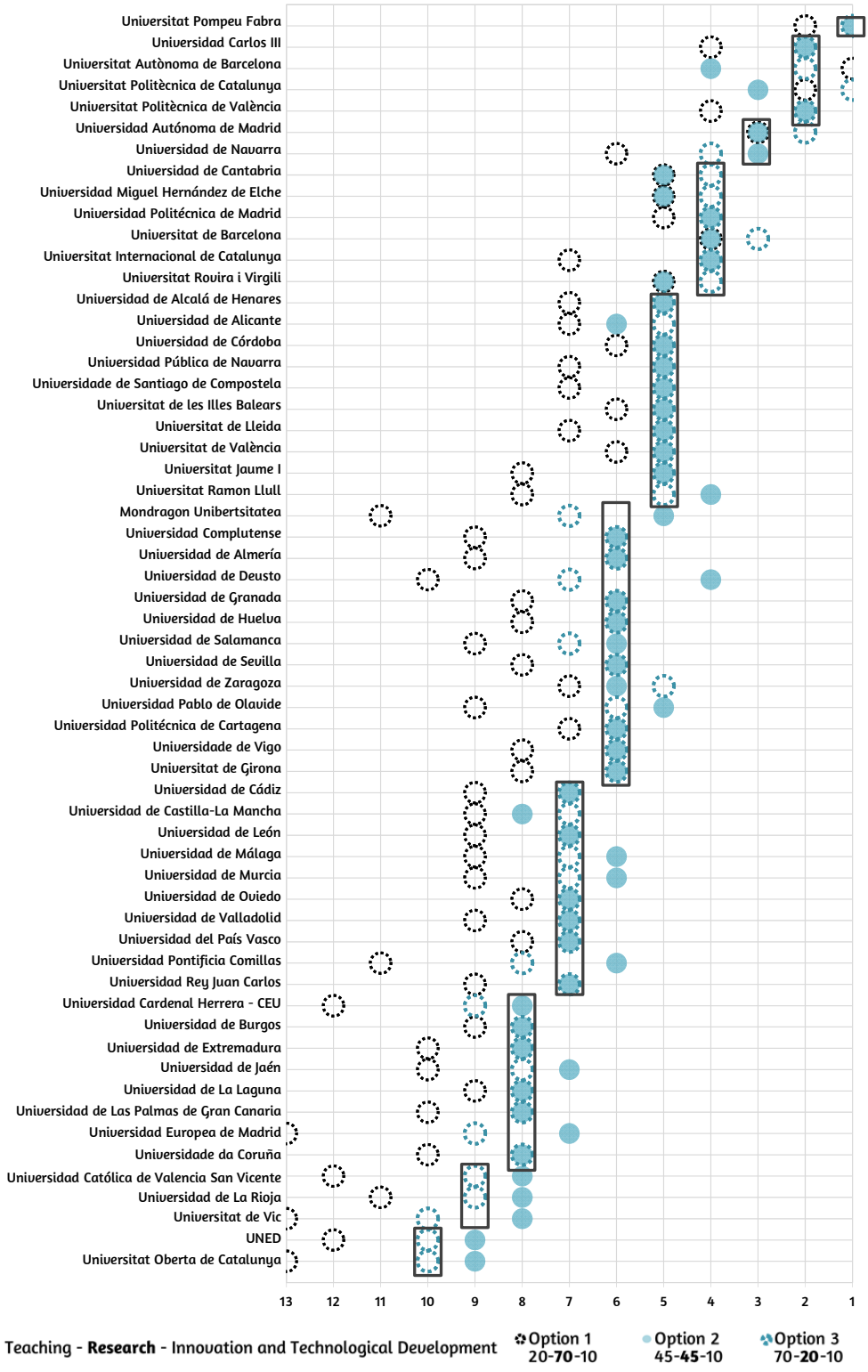
- The drops and moderate rises in the weight of research (option 2 and 3) barely involve changes in the rankings with respect to the ISSUE-P.
- If the weight of research drops to 20% (option 3), variations are minor with no University being affected in more than one position, one way or the other.
- When the weight of research rises moderately up to 45% (option 2), the ranking still remains stable. There are only two cases in which a university moves more than one level; the Universidad de Deusto, which goes from the 6th to the 4th position and the Universitat Autònoma de Barcelona with two position regressions.
- When significant changes occur in the ranking, the weight of research doubles from its starting position (from 34% to 70% of option 1). The fundamental pattern of these changes is that the universities worsen their position in the ranking more intensely when applied to universities at the bottom part in the original ranking. Of the 23 universities in the first tertile, 7 fall back two positions (Carlos III, Universidad Politécnica de Valencia, Alcalá de Henares, Alicante, Pública de Navarra, Santiago de Compostela and Lleida) and 4 universities go down 3 places: Universidad de Navarra, Internacional de Cataluña, Jaume I and Ramon Llull.
- This last result reveals another pattern of sensitivity of the ranking to changes in weights: private universities are much more sensitive than public universities due to their high teaching specialization, to increases in the weight of research. We have seen that only one university of those that lost 3 positions in the first tertile is public, Jaume I.
- Although, as you go down in positions regarding the original weightings, the falls are emphasized for all universities, again, the private are more sensitive. Taking a look at the last tertile, all the universities that recede three positions or more are private (Pontificia de Comillas, Cardenal Herrera-CEU, Europea de Madrid, Católica de Valencia-San Vicente Mártir, Vic y Oberta de Catalunya).

Thus, the rankings are sensitive to changes in the weights given to teaching and to research, especially if we compare weightings as different as those corresponding to our options 1 and 3. When these weights change less, variations are minor and, definitely, alterations never occur for this reason in the classifications. A university does not pass from the top places to the bottom ones no matter how substantial the changes in the weights may be, but it is true that some can improve by some places in the ranking if greater importance is accorded to teaching or research.

We must consider that, as with any type of measuring instrument, the sensitivity to changes is desirable. If the instrument is insensitive to the weights that reflect different attribution of importance to different factors, it would not be reliable. The ISSUE Ranking, as seen, proves to be tolerant to moderate changes in the weights, but sensitive to very significant changes.

[18] Furthermore, significantly increasing the weight of the activities relating to technological development and innovation would not be justified, given their limited importance in the budgets of the Spanish universities. Certainly, in the Polytechnic universities the weight of these activities is greater, but disaggregated information is not available to value more precisely the results of each in this aspect of their specialization.

Figure 9. Evolution of the ISSUE-P Ranking according to variations in the weight of research



Position in the global productivity ranking

* The National Distance Education University.

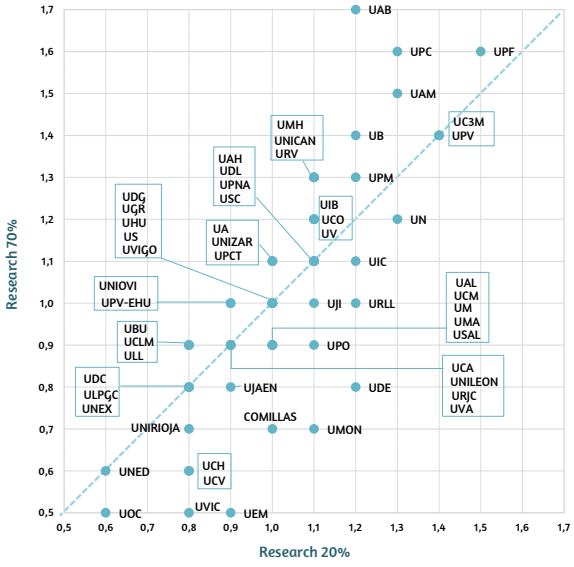
Note: Universities are ordered by their position in the global productivity ranking with the following weights: 56/34/10.

Source: BBVA Foundation-Ivie.

If instead of focusing on the analysis of sensitivity of the ranking, in other words, in the positions of the universities, we consider the values of the index by which the ISSUE-P ranking is obtained, we observe that their stability when changing the weights of teaching and research is very notable. Figure 10 presents the synthetic indicator from which the ISSUE-P Ranking is derived for research weights of 20% and 70%. It shows that a drastic change in the weights would cause an increase of only three decimals or more for the Autònoma de Barcelona and Politècnica de Catalunya, improving their index. On the contrary, only some private universities such as Vic, Europea de Madrid, Comillas, Mondragón y Deusto would experience a fall in the index of three decimal points or more.

Figure 10. ISSUE-P for two different weights in Research

Weights of Teaching/Research/Innovation: 70/20/10 vs. 20/70/10. Index



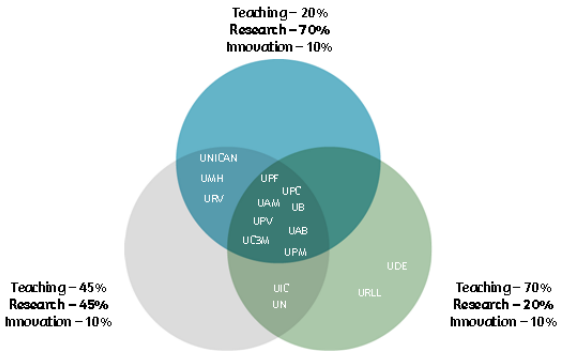
See appendix 2 for a list of the University abbreviations used.

Source: BBVA Foundation-Ivie.

To offer another sample of the stability of the groups of universities, the Venn diagram in figure 11 presents the results of the productivity ranking for the three weights described above. Concentrating on the top 4 universities[19], the stability mentioned is evident, as there is a group of 8 universities —of the 15 that appear in the first positions in some scenarios— that are located at the intersection, that is, that belong to the first tertile independently of the weight given to teaching or to research.

Figure 11. The role of research in ISSUE-P

Top 20 universities according to different weights given to Research



**Option 20-70-10: Top 11 universities*
Option 70-20-10: Top 12 universities
Option 45-45-10: Top 13 universities
See appendix 2 for a list of the University abbreviations used.

Source: BBVA Foundation-Ivie.

They are: Universitat Pompeu Fabra, Universitat Politècnica de Catalunya, Universidad Autónoma de Madrid, Universitat Politècnica de València, Universitat Autònoma de Barcelona, Universitat de Barcelona, Universidad Carlos III and Universidad Politécnica de Madrid. When the weight in research is low, the universities in this privileged position are: Deusto, Ramon Llull, Internacional de Catalunya and Navarra (all are private). However, the increase in this weight would benefit the Universidad de Cantabria, Miguel Hernández and Rovira i Virgili.

4.7. RANKINGS OF TEACHING, RESEARCH, AND INNOVATION AND TECHNOLOGICAL DEVELOPMENT

The methodology used constructs indicators of results of the three activities of the universities, which are then aggregated to draw up the two overall rankings presented. These results for each university in each of the three dimensions can be analyzed and arranged in order to obtain a *teaching ranking*, a *research ranking* and an *innovation and technological development ranking*. Each of them can be calculated in the two variants, volume of results and productivity.

[19] To include a 5th place, ten more universities would have to be added which exceeds the total number of universities in the first tertile. For this reason, the analysis has been limited to the top four positions.

As a result of the novelty of introducing private universities in this edition and in order to have a first approach to the differences that exist in their specialization with respect to the public system, each of the panels (productivity and volume) is broken down for the total number of universities, public universities and private universities.

Figure 12 shows by means of *box plots* the distribution corresponding to the indices of the different dimensions and the overall index of a university in the case of productivity (panel a) and volume of results (panel b). The extremes of the black lines represent the maximum and minimum values reached by the indices in each dimension and define the range of variation of the index; the top of the central box indicates the 75% percentile, while the 25% percentile is marked by the bottom of the box, so that between them is situated 50% of the distribution (interquartile range). The border between the two parts of the box defines the median value. From the comparative analysis of the two panels two fundamental aspects stand out:

- First, the comparison of panels *a* and *b* permits us to observe that the differences between the public universities are much greater if their volume of results is analyzed and not their productivity. This feature is observed in any of the dimensions considered, but in the activities of innovation and technological development it is greater than in teaching and research. Given the total weight of public universities in the university system, this pattern applies to the average of the system.

- In the case of private universities, since they all have a smaller size, the situation is the opposite, the volume index has much greater homogeneity than the productivity.

- Second, the differences in terms of productivity present an increasing scale when going from teaching to research and from the latter to innovation and technological development for both public and private universities. Thus for example, the range of the teaching index is 0.8 points, that of research 1.5 and that of innovation and technological development 2.8. The relative differences of the interquartile ranges are even greater in the case of this last dimension.

- In construction, the median for the total number of universities in the distribution of the indices is 1 (see figures 12.a1 and 12.b1). However, when we analyze the private universities (figures 12.a3 and 12.b3), we clearly observe the difference that exists in specialization to which we have been making reference. Fixing our attention on the indices of productivity, we observe how the median is higher than the average of the system in the teaching dimension, somewhat below in the innovation and technological development dimension, but, above all, it is half in research.

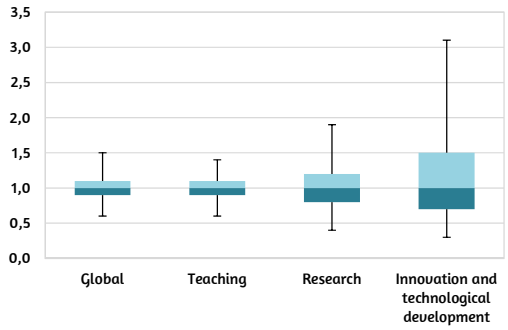
Table 8 shows the coefficients of correlation between the different rankings and productivity indices for each pair of activities. Once again, we can observe that the behavior is different depending on whether a university is private or public. While the correlation is high and fairly homogeneous among the three dimensions in the public universities, perhaps with greater intensity between teaching and research, the strongest correlation in private universities occurs between teaching and technological innovation, being the lowest between teaching and research and practically non-existent between research and innovation and technological development. These results suggest that complementarity exists among the different activities, but is limited, especially with reference to research and innovation. But above all, they warn that if the aim is to analyze the university system as a whole, the existence of groups with different characteristics that result from the coexistence of private and public institutions cannot be ignored. If we did, it could lead to biases in the analysis of the reality of the university system.

A validation of these differences can be obtained by checking if the hypothesis that research results can predict correctly those of teaching is true or not. Therefore, the rates of productivity in research are represented against the rates of productivity in teaching (figure 13.a). We can see that this relationship is practically undetectable, since the coefficient of determination of the regression line barely exceeds 6%. If we examine the heterogeneity of the universities and focus the analysis only on the public system (Figure 13.b), the adjustment between the synthetic

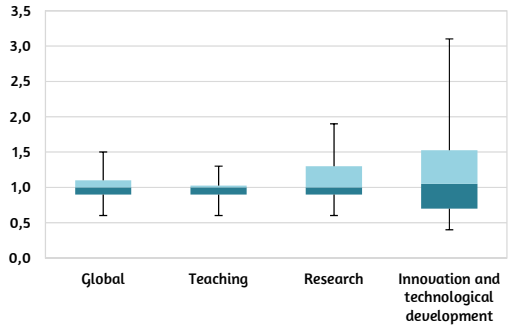
Figure 12. ISSUE Rankings. Distribution of the indices obtained in each dimension

a) ISSUE-P

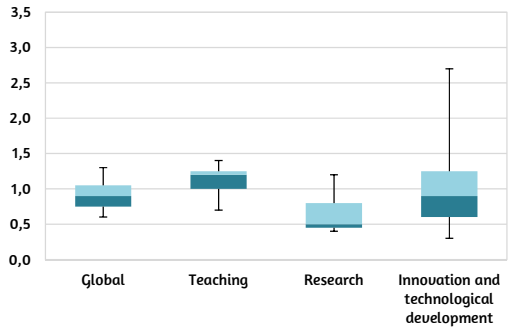
a1. Total universities



a2. Public universities

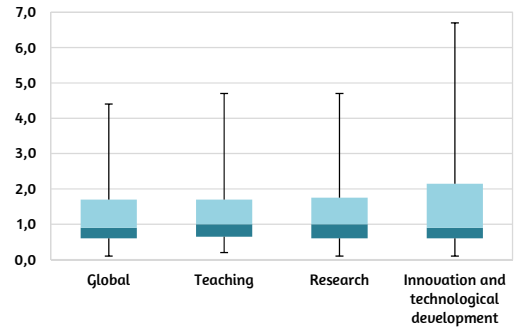


a3. Private universities

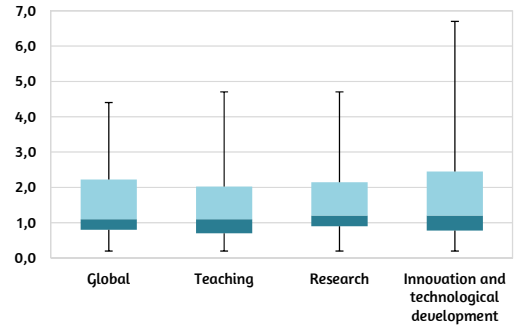


b) ISSUE-V

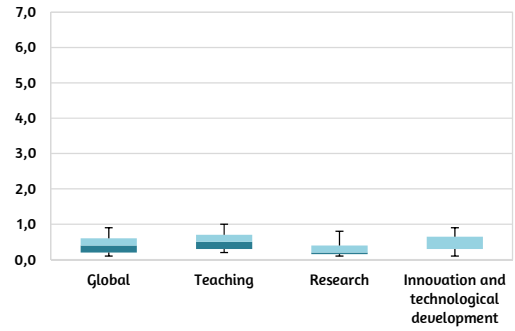
b1. Total universities



b2. Public universities



b3. Private universities



Source: BBVA Foundation-Ivie.

indexes of teaching and research improves and reaches a coefficient of determination of 0.51, giving evidence of a somewhat stronger relationship than in the private system but, in any case, limited. In the subset of private universities, the relationship is irrelevant (figure 13.c).

Table 8. Correlation coefficients of the ISSUE-P rankings by dimension

a) Index

	Total	Public U.	Private U.
Teaching - Research	0.27	0.69	0.43
Teaching - Innovation and Technological Development	0.53	0.62	0.59
Research - Innovation and Technological Development	0.48	0.64	0.08

b) Ranking

	Total	Public U.	Private U.
Teaching - Research	0.35	0.70	0.37
Teaching - Innovation and Technological Development	0.50	0.56	0.66
Research - Innovation and Technological Development	0.47	0.56	0.15

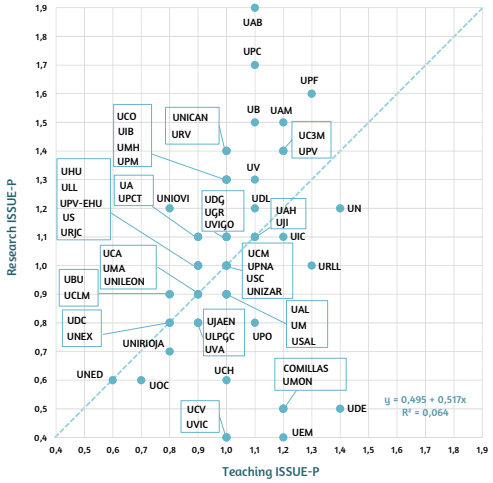
Note: The ranking values are calculated by means of a Spearman correlation coefficient and the index values by means of a Pearson correlation coefficient..

Source: BBVA Foundation-Ivie.

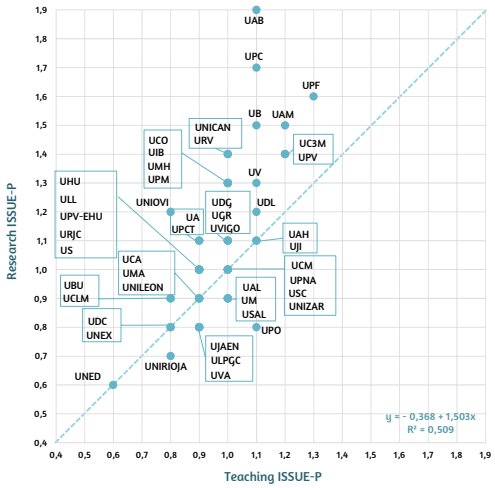
Finally, after describing the results of the rankings of teaching, research and innovation and technological development, tables 9 and 10 present in detail the results of the eight rankings drawn up for all the Spanish public universities. In the productivity ranking you can see a well-defined pattern of teaching specialization of private universities: all improve when comparing their position in teaching ranking with the overall ranking and worsen when considering the research ranking. That pattern is also shown in panel c of figure 13: all the private universities are located below the diagonal because their research rate is lower than their teaching rate. In the case of the public universities, on the other hand, the opposite happens in the majority of cases.

Figure 13. ISSUE-P Ranking. Teaching vs. Research Index

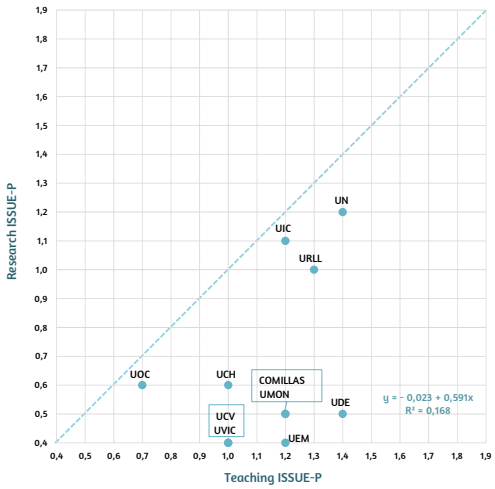
a) Public and private universities



b) Public universities



c) Private universities



See appendix 2 for a list of the University abbreviations used.

Source: BBVA Foundation-Ivie

Table 9. ISSUE-P Ranking for Teaching, Research, and Innovation and Technological Development

University	Global		Teaching		Research		Innovation and Technological University	
	Rank.	Index	Rank.	Index	Rank.	Index	Rank.	Index
Universitat Pompeu Fabra	1	1.5	2	1.3	3	1.6	4	2.6
Universidad Carlos III	2	1.4	3	1.2	5	1.4	6	2.3
Universitat Autònoma de Barcelona	2	1.4	4	1.1	1	1.9	9	1.7
U. Politècnica de Catalunya	2	1.4	4	1.1	2	1.7	1	3.1
Universitat Politècnica de València	2	1.4	3	1.2	5	1.4	2	3
Universidad Autónoma de Madrid	3	1.3	3	1.2	4	1.5	6	2.3
Universidad de Navarra	3	1.3	1	1.4	7	1.2	14	1.1
Universidad de Cantabria	4	1.2	5	1	5	1.4	11	1.5
U. Miguel Hernández de Elche	4	1.2	5	1	6	1.3	8	1.9
Universidad Politécnica de Madrid	4	1.2	5	1	6	1.3	5	2.5
Universitat de Barcelona	4	1.2	4	1.1	4	1.5	13	1.2
U. Internacional de Catalunya	4	1.2	3	1.2	8	1.1	12	1.4
Universitat Rovira i Virgili	4	1.2	5	1	5	1.4	12	1.4
Universidad de Alcalá de Henares	5	1.1	4	1.1	8	1.1	12	1.4
Universidad de Alicante	5	1.1	6	0.9	8	1.1	8	1.9
Universidad de Córdoba	5	1.1	5	1	6	1.3	16	0.9
Universidad Pública de Navarra	5	1.1	5	1	9	1	9	1.7
U. de Santiago de Compostela	5	1.1	5	1	9	1	11	1.5
Universitat de les Illes Balears	5	1.1	5	1	6	1.3	14	1.1
Universitat de Lleida	5	1.1	4	1.1	7	1.2	18	0.7
Universitat de València	5	1.1	4	1.1	6	1.3	18	0.7
Universitat Jaume I	5	1.1	4	1.1	8	1.1	18	0.7
Universitat Ramon Llull	5	1.1	2	1.3	9	1	16	0.9
Mondragon Unibertsitatea	6	1	3	1.2	14	0.5	3	2.7
Universidad Complutense	6	1	5	1	9	1	18	0.7
Universidad de Almería	6	1	5	1	10	0.9	13	1.2
Universidad de Deusto	6	1	1	1.4	14	0.5	7	2.1
Universidad de Granada	6	1	5	1	8	1.1	18	0.7
Universidad de Huelva	6	1	6	0.9	9	1	13	1.2
Universidad de Salamanca	6	1	5	1	10	0.9	16	0.9
Universidad de Sevilla	6	1	6	0.9	9	1	10	1.6
Universidad de Zaragoza	6	1	5	1	9	1	10	1.6
Universidad Pablo de Olavide	6	1	4	1.1	11	0.8	12	1.4
U. Politécnica de Cartagena	6	1	6	0.9	8	1.1	11	1.5
Universidade de Vigo	6	1	5	1	8	1.1	18	0.7
Universitat de Girona	6	1	5	1	8	1.1	20	0.5
Universidad de Cádiz	7	0.9	6	0.9	10	0.9	14	1.1
Universidad de Castilla-La Mancha	7	0.9	7	0.8	10	0.9	16	0.9
Universidad de León	7	0.9	6	0.9	10	0.9	18	0.7
Universidad de Málaga	7	0.9	6	0.9	10	0.9	13	1.2
Universidad de Murcia	7	0.9	5	1	10	0.9	15	1
Universidad de Oviedo	7	0.9	7	0.8	7	1.2	19	0.6
Universidad de Valladolid	7	0.9	6	0.9	11	0.8	16	0.9
Universidad del País Vasco	7	0.9	6	0.9	9	1	17	0.8
Universidad Pontificia Comillas	7	0.9	3	1.2	14	0.5	14	1.1
Universidad Rey Juan Carlos	7	0.9	6	0.9	9	1	18	0.7
Universidad Cardenal Herrera - CEU	8	0.8	5	1	13	0.6	22	0.3
Universidad de Burgos	8	0.8	7	0.8	10	0.9	20	0.5
Universidad de Extremadura	8	0.8	7	0.8	11	0.8	20	0.5
Universidad de Jaén	8	0.8	6	0.9	11	0.8	16	0.9
Universidad de La Laguna	8	0.8	6	0.9	9	1	21	0.4
U.d de Las Palmas de Gran Canaria	8	0.8	6	0.9	11	0.8	21	0.4
Universidad Europea de Madrid	8	0.8	3	1.2	15	0.4	20	0.5
Universidade da Coruña	8	0.8	7	0.8	11	0.8	19	0.6
U. Católica de Valencia S.Vte. Mártir	9	0.7	5	1	15	0.4	16	0.9
Universidad de La Rioja	9	0.7	7	0.8	12	0.7	19	0.6
Universitat de Vic	9	0.7	5	1	15	0.4	18	0.7
UNED*	10	0.6	9	0.6	13	0.6	19	0.6
Universitat Oberta de Catalunya	10	0.6	8	0.7	13	0.6	22	0.3

' The National Distance Education University.*
'Note: Universities are ordered from the highest to the lowest global index value. Universities with the same index value are ordered alphabetically.
'Source: BBVA Foundation-Ivie.

Table 10. ISSUE-V Ranking for Teaching, Research, and Innovation and Technological Development

University	Global		Teaching		Research		Innovation and Technological University Development	
	Rank.	Index	Rank.	Index	Rank.	Index	Rank.	Index
Universidad Complutense	1	4.4	1	4.7	2	4.3	8	3.1
Universitat de Barcelona	2	3.8	2	3.5	1	4.7	6	3.6
Universidad de Granada	3	3.2	3	3.2	4	3.5	15	2.1
Universidad de Sevilla	4	3.1	5	2.8	7	3.1	4	5
Universidad Politécnica de Madrid	4	3.1	7	2.6	5	3.3	2	6.3
Universitat Politècnica de València	4	3.1	6	2.7	7	3.1	1	6.7
Universitat de València	5	3	4	3	4	3.5	16	1.8
Universidad del País Vasco	6	2.9	4	3	7	3.1	12	2.4
Universitat Autònoma de Barcelona	7	2.8	9	2.2	3	4	6	3.6
U. Politècnica de Catalunya	8	2.7	10	2.1	6	3.2	3	6
Universidad Autónoma de Madrid	9	2.5	10	2.1	8	2.7	5	4.2
UNED*	10	2.3	8	2.3	9	2.3	14	2.2
Universidad de Zaragoza	11	2.2	11	2	10	2.1	7	3.4
U. de Santiago de Compostela	12	2	12	1.9	11	2	9	2.9
Universidad de Málaga	13	1.8	13	1.8	13	1.7	13	2.3
Universidad de Salamanca	14	1.6	14	1.6	15	1.5	18	1.5
Universidad Carlos III	15	1.5	16	1.4	14	1.6	11	2.6
Universidad de Alicante	15	1.5	16	1.4	14	1.6	10	2.7
Universidad de Murcia	15	1.5	15	1.5	15	1.5	17	1.6
Universidad de Oviedo	16	1.4	17	1.3	12	1.8	23	0.9
Universidad de Castilla-La Mancha	17	1.3	18	1.2	16	1.4	19	1.4
Universidad de Valladolid	17	1.3	16	1.4	18	1.2	20	1.3
Universidad de Alcalá de Henares	18	1.2	18	1.2	18	1.2	18	1.5
Universidad de Córdoba	19	1.1	20	1	17	1.3	23	0.9
Universidad de La Laguna	19	1.1	19	1.1	18	1.2	27	0.5
Universidade de Vigo	19	1.1	19	1.1	18	1.2	24	0.8
Universidad de Cádiz	20	1	20	1	21	0.9	21	1.1
Universidad Rey Juan Carlos	20	1	19	1.1	19	1.1	24	0.8
Universitat Pompeu Fabra	20	1	21	0.9	19	1.1	16	1.8
Universidad de Cantabria	21	0.9	22	0.8	19	1.1	21	1.1
Universidad de Extremadura	21	0.9	20	1	20	1	26	0.6
U. de Las Palmas de Gran Canaria	21	0.9	20	1	21	0.9	27	0.5
Universitat Jaume I	21	0.9	21	0.9	21	0.9	26	0.6
Universitat Ramon Llull	21	0.9	20	1	23	0.7	25	0.7
Universitat Rovira i Virgili	21	0.9	22	0.8	20	1	22	1
Universidad de Navarra	22	0.8	21	0.9	22	0.8	25	0.7
U. Miguel Hernández de Elche	22	0.8	23	0.7	21	0.9	20	1.3
Universidade da Coruña	22	0.8	21	0.9	21	0.9	25	0.7
Universitat de les Illes Balears	22	0.8	23	0.7	20	1	24	0.8
Universidad de Almería	23	0.7	23	0.7	24	0.6	24	0.8
Universidad de Jaén	23	0.7	23	0.7	24	0.6	24	0.8
Universitat de Girona	23	0.7	23	0.7	22	0.8	28	0.4
Universitat Oberta de Catalunya	23	0.7	22	0.8	24	0.6	29	0.3
Universidad de Huelva	24	0.6	24	0.6	24	0.6	25	0.7
Universidad de León	24	0.6	24	0.6	24	0.6	27	0.5
Universidad Pablo de Olavide	24	0.6	23	0.7	25	0.5	24	0.8
Universidad Pública de Navarra	24	0.6	25	0.5	25	0.5	23	0.9
Universitat de Lleida	24	0.6	24	0.6	24	0.6	28	0.4
Universidad de Deusto	25	0.5	24	0.6	27	0.2	23	0.9
Universidad Europea de Madrid	26	0.4	24	0.6	27	0.2	29	0.3
U. Politécnica de Cartagena	26	0.4	27	0.3	26	0.4	26	0.6
Universidad Pontificia Comillas	26	0.4	25	0.5	27	0.2	27	0.5
U.Católica de Valencia S. Vte. Mártir	27	0.3	26	0.4	27	0.2	29	0.3
Universidad de Burgos	27	0.3	27	0.3	26	0.4	30	0.2
Mondragon Unibertsitatea	28	0.2	27	0.3	28	0.1	26	0.6
Universidad Cardenal Herrera - CEU	28	0.2	27	0.3	28	0.1	31	0.1
Universidad de La Rioja	28	0.2	28	0.2	27	0.2	30	0.2
U. Internacional de Catalunya	28	0.2	28	0.2	27	0.2	29	0.3
Universitat de Vic	29	0.1	28	0.2	28	0.1	31	0.1

** The National Distance Education University.*
'Note: Universities are ordered from the highest to the lowest global index value. Universities with the same index value are ordered alphabetically.
'Source: BBVA Foundation-Ivie.

4.8. 2014 AND 2015 ISSUE RANKINGS

The direct comparison of the 2014 and 2015 ISSUE Rankings has an inherent difficulty to its main novelty, the inclusion of private universities. Since they were not present in the 2014 edition, the level of correlation between both editions should be confined to public universities. To make this comparison, the indices of productivity and volume have been recalculated, eliminating the private universities in order to precisely analyze the level of temporal consistency of the results of the ranking.

The results obtained by the U-Ranking Project in 2015 are highly correlated with those presented in the 2014 edition, as will be shown below. Nevertheless, there are some interesting differences that deserve to be mentioned in this section.

As table 11 shows, the coefficients of correlation between the indices and the rankings corresponding to the two editions are high. All the correlations, both those referring to the positions in the ranking (Spearman) and to the values of the synthetic indicator (Pearson), are significant to 1% and present coefficients higher than 0.8. These correlations approach 1 in the case of the synthetic indicators of the ISSUE-P rankings, indicating that hardly any changes can be appreciated in the levels of productivity. This result is not surprising but it is important because it means that data updates have not significantly altered the results and give reliability to the methodology used.

Table 11. Correlation coefficients of the 2013 and 2014 ISSUE Rankings

	ISSUE-P		ISSUE-V	
	Ranking	Index	Ranking	Index
Global	0.96	0.97	0.99	1.00
Teaching	0.83	0.92	0.99	1.00
Research	0.89	0.93	0.99	0.99
Innovation and Technological Development	0.95	0.95	0.98	0.97

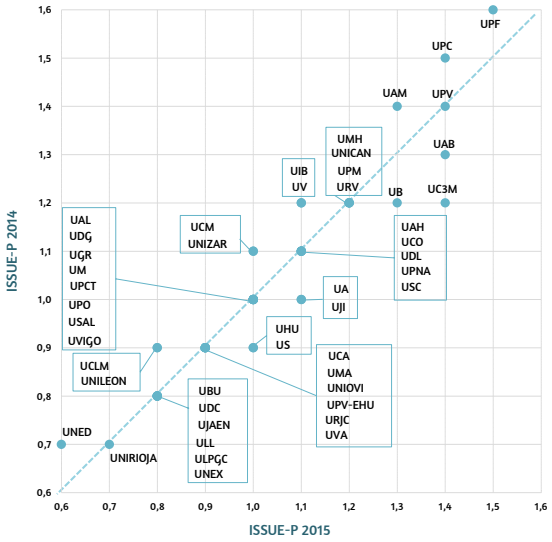
Note: The ranking values are calculated by means of a Spearman correlation coefficient and the index values by means of a Pearson correlation coefficient..

Source: BBVA Foundation-Ivie.

The close fit between the indicators of both editions of the ISSUE Project can also be appreciated in the following figures, which show on the horizontal axis the synthetic indicator of each public university in 2015 and on the vertical axis the results for 2014, both for ISSUE-P (figure 14) and for ISSUE-V (figure 15). In both cases we observe that a greater number of observations are situated above the diagonal, indicating that in 2015 more universities have worsened the value of the indicator over that calculated for the preceding year.

Figure 14. ISSUE-P of the Spanish public universities. 2014 and 2015

Index



See appendix 2 for a list of the University abbreviations used.

Source: BBVA Foundation-Ivie.

Finally, to facilitate the comparison between the 2014 and 2015 rankings, table 12 reflects the position obtained in both years by all the universities after adapting the 2015 rankings by eliminating private universities. Table 13 contains a column with the 2015 index that includes all the universities and the adapted index which excludes the private ones in order to compare with the column that contains the 2014 index.

Figure 15. ISSUE-V of the Spanish public universities. 2014 and 2015

Index

See appendix 2 for a list of the University abbreviations used.

Source: BBVA Foundation-Ivie.

The results obtained confirm a notable stability of the ISSUE-V ranking: with very few exceptions, the positions barely differ by one or two places. The group of universities that occupied the top places in 2014 continue to be located at the top in the 2015 edition. The same occurs with the other two tertiles.

From the point of view of productivity the differences are also small in the group of 19 universities located in 2015 in the 1st to the 5th places. In 2015 more universities are located on steps 5 and 6 compared with 2014, making it more difficult to compare and giving the impression of greater changes than have actually taken place when the values of the indices and the correlations presented are considered.

Table 12. ISSUE-P and ISSUE-V Rankings. 2014 and 2015 results

University	ISSUE-P Ranking			ISSUE-P Index		
	2015	2015 adapted	2014	2015	2015 adapted	2014
Universitat Pompeu Fabra	1	1	1	1.5	1.5	1.6
Universidad Carlos III	2	2	5	1.4	1.4	1.2
U. Autònoma de Barcelona	2	2	4	1.4	1.4	1.3
U. Politècnica de Catalunya	2	2	2	1.4	1.4	1.5
Universitat Politècnica de València	2	2	3	1.4	1.4	1.4
Universidad Autónoma de Madrid	3	3	3	1.3	1.3	1.4
Universidad de Cantabria	4	4	5	1.2	1.2	1.2
U. Miguel Hernández de Elche	4	4	5	1.2	1.2	1.2
Universidad Politécnica de Madrid	4	4	5	1.2	1.2	1.2
Universitat de Barcelona	4	3	5	1.2	1.3	1.2
Universitat Rovira i Virgili	4	4	5	1.2	1.2	1.2
Universidad de Alcalá de Henares	5	5	6	1.1	1.1	1.1
Universidad de Alicante	5	5	7	1.1	1.1	1,0
Universidad de Córdoba	5	5	6	1.1	1.1	1.1
Universidad Pública de Navarra	5	5	6	1.1	1.1	1.1
U. de Santiago de Compostela	5	5	6	1.1	1.1	1.1
Universitat de les Illes Balears	5	5	5	1.1	1.1	1.2
Universitat de Lleida	5	5	6	1.1	1.1	1.1
Universitat de València	5	5	5	1.1	1.1	1.2
Universitat Jaume I	5	5	7	1.1	1.1	1,0
Universidad Complutense	6	6	6	1,0	1,0	1.1
Universidad de Almería	6	6	7	1,0	1,0	1,0
Universidad de Granada	6	6	7	1,0	1,0	1,0
Universidad de Huelva	6	6	8	1,0	1,0	0.9
Universidad de Salamanca	6	6	7	1,0	1,0	1,0
Universidad de Sevilla	6	6	8	1,0	1,0	0.9
Universidad de Zaragoza	6	6	6	1,0	1,0	1.1
Universidad Pablo de Olavide	6	6	7	1,0	1,0	1,0
U. Politécnica de Cartagena	6	6	7	1,0	1,0	1,0
Universidade de Vigo	6	6	7	1,0	1,0	1,0
Universitat de Girona	6	6	7	1,0	1,0	1,0
Universidad de Cádiz	7	7	8	0.9	0.9	0.9
U. de Castilla-La Mancha	7	8	8	0.9	0.8	0.9
Universidad de León	7	8	8	0.9	0.8	0.9
Universidad de Málaga	7	7	8	0.9	0.9	0.9
Universidad de Murcia	7	6	7	0.9	1,0	1,0
Universidad de Oviedo	7	7	8	0.9	0.9	0.9
Universidad de Valladolid	7	7	8	0.9	0.9	0.9
Universidad del País Vasco	7	7	8	0.9	0.9	0.9
Universidad Rey Juan Carlos	7	7	8	0.9	0.9	0.9
Universidad de Burgos	8	8	9	0.8	0.8	0.8
Universidad de Extremadura	8	8	9	0.8	0.8	0.8
Universidad de Jaén	8	8	9	0.8	0.8	0.8
Universidad de La Laguna	8	8	9	0.8	0.8	0.8
U. de Las Palmas de Gran Canaria	8	8	9	0.8	0.8	0.8
Universidade da Coruña	8	8	9	0.8	0.8	0.8
Universidad de La Rioja	9	9	10	0.7	0.7	0.7
UNED	10	10	10	0.6	0.6	0.7

University	ISSUE-V Ranking			ISSUE-V Index		
	2015	2015 adapted	2014	2015	2015 adapted	2014
Universidad Complutense	1	1	1	4.4	3.8	4.3
Universitat de Barcelona	2	2	2	3.8	3.4	3.3
Universidad de Granada	3	3	4	3.2	2.7	2.7
Universidad de Sevilla	4	3	6	3.1	2.7	2.5
Universidad Politécnica de Madrid	4	3	3	3.1	2.7	2.8
Universitat Politècnica de València	4	3	3	3.1	2.7	2.8
Universitat de València	5	4	3	3,0	2.6	2.8
Universidad del País Vasco	6	4	5	2.9	2.6	2.6
U. Autònoma de Barcelona	7	5	6	2.8	2.4	2.5
U. Politècnica de Catalunya	8	6	6	2.7	2.3	2.5
Universidad Autónoma de Madrid	9	7	7	2.5	2.1	2.2
UNED	10	8	7	2.3	2,0	2.2
Universidad de Zaragoza	11	9	8	2.2	1.9	1.9
U. de Santiago de Compostela	12	10	8	2,0	1.8	1.9
Universidad de Málaga	13	11	9	1.8	1.6	1.5
Universidad de Salamanca	14	12	9	1.6	1.4	1.5
Universidad Carlos III	15	13	11	1.5	1.3	1.2
Universidad de Alicante	15	13	10	1.5	1.3	1.3
Universidad de Murcia	15	13	10	1.5	1.3	1.3
Universidad de Oviedo	16	14	11	1.4	1.2	1.2
U. de Castilla-La Mancha	17	15	11	1.3	1.1	1.2
Universidad de Valladolid	17	15	11	1.3	1.1	1.2
Universidad de Alcalá de Henares	18	15	12	1.2	1.1	1.1
Universidad de Córdoba	19	16	14	1.1	0.9	0.9
Universidad de La Laguna	19	16	14	1.1	0.9	0.9
Universidade de Vigo	19	16	13	1.1	0.9	1,0
Universidad de Cádiz	20	17	15	1,0	0.8	0.8
Universidad Rey Juan Carlos	20	16	15	1,0	0.9	0.8
Universitat Pompeu Fabra	20	16	12	1,0	0.9	1.1
Universidad de Cantabria	21	17	15	0.9	0.8	0.8
Universidad de Extremadura	21	17	15	0.9	0.8	0.8
U. de Las Palmas de Gran Canaria	21	17	15	0.9	0.8	0.8
Universitat Jaume I	21	18	16	0.9	0.7	0.7
Universitat Rovira i Virgili	21	17	15	0.9	0.8	0.8
U. Miguel Hernández de Elche	22	18	16	0.8	0.7	0.7
Universidade da Coruña	22	18	16	0.8	0.7	0.7
Universitat de les Illes Balears	22	18	15	0.8	0.7	0.8
Universidad de Almería	23	19	17	0.7	0.6	0.6
Universidad de Jaén	23	19	17	0.7	0.6	0.6
Universitat de Girona	23	19	17	0.7	0.6	0.6
Universidad de Huelva	24	20	18	0.6	0.5	0.5
Universidad de León	24	20	18	0.6	0.5	0.5
Universidad Pablo de Olavide	24	20	18	0.6	0.5	0.5
Universidad Pública de Navarra	24	20	18	0.6	0.5	0.5
Universitat de Lleida	24	20	18	0.6	0.5	0.5
U. Politécnica de Cartagena	26	21	19	0.4	0.3	0.4
Universidad de Burgos	27	21	20	0.3	0.3	0.3
Universidad de La Rioja	28	22	21	0.2	0.2	0.2

* The National Distance Education University.

Note: The table does not include private universities since they were not analyzed in the 2014 Edition. We have also obtained a new synthetic index (2015 adapted) that excludes the 11 private universities to allow a homogeneous comparison with the results obtained in the 2014 Edition. Universities are ordered from the highest to the lowest index value. Universities with the same index value are ordered alphabetically.

Source: BBVA Foundation-Ivie.

5. Conclusions

The aim of the ISSUE Rankings (Synthetic Indicators of the Spanish University System) is to generate classifications of the Spanish universities on the basis of broad data sets that consider the principal dimensions of their activities: teaching, research and innovation and technological development. The ISSUE methodology is rigorous and is aligned with the recommendations of the recent international studies on this subject.

Aggregating the information on the results of the universities in different areas presents difficulties. Not considering them and contemplating the different indicators separately is not a practical solution, since most people interested in comparing the universities do not want to face large and complex volumes of information. Students, faculty members, researchers, university managers or politicians, and communications media appreciate having synthetic indicators available. The rankings —provided they are constructed with suitable criteria and metrics— are useful in this sense, because they condense the results of universities in several areas, reducing the effort that the users must make to obtain and analyze the information.

The ISSUE Rankings permit us to overcome both limitations in good measure by analyzing the teaching, research and transfer results of all the public universities of Spain (48) and since the 2015 third edition, it also analyzes 11 private universities that offer the information needed to make the comparison. In the near future we will incorporate into the ISSUE Rankings the rest of the private universities for which similar information is available to that used to analyze the 59 universities that are now included.

The rankings were constructed from a set of variables that take into account three relevant aspects: (i) the universities' different missions (teaching, research, innovation and technological development); (ii) the existence of differences in the results of a university in the different areas of study; and (iii) the importance of considering the preferences of the users of university services when constructing some rankings.

ISSUE has generated two general rankings of the universities —that of volume of results (ISSUE-V) and that of productivity (ISSUE-P)— as well as six partial rankings: teaching, research and transfer, in terms both of volume and of productivity. The set of rankings offers eight profiles of each of the universities, which can be of interest for assessing them from different perspectives. In some cases the images of a university projected by each ranking are the same, and in others they are different. It corresponds to the users of the information —university or political leaders, researchers, students, analysts, etc.— to consider which of these images are the most relevant for their needs or interests.

The main novelty of the 2015 Edition is the inclusion in the ISSUE Rankings of those private universities that offer information comparable to that used to rank public universities. The institutions included in the ranking have 60% of the degree students of the total private universities within the university system and 80% of its research output. Once included, the 59 universities analyzed in the ISSUE Rankings (48 public and 11 private) cover 95% of the degree students enrolled in the Spanish university system and practically all of the research activity.

The main results derived from the analysis of the 2015 Edition of the ISSUE Ranking, are:

1. The synthetic indicators from which the rankings are obtained show that the differences in productivity among universities are relevant: the level of the indicator in the most productive universities doubles the level of the least.

2. The differences among universities in terms of volume of results are much higher, since they are influenced by productivity and the different sizes of the universities.

3. There is a group of universities formed institutions with varied profiles, but among which predominate those of larger dimension- that occupy the most prominent places regarding volume of results and also productivity. Most of them appear at the top 400 or top 500 universities in the well-known international rankings, such as Shanghai, THE and QS. Thus, the ISSUE Ranking confirms that Spanish universities that frequently appear in the international rankings are those with greater volume of results which are more productive. The repeated quality signals given by these institutions identify, rather robustly to the use of different criteria, which Spanish universities stand out for their excellence.

4. The incorporation of private universities allows to verify their high specialization in and remarkable performance in teaching: their average productivity in teaching exceeds by 10% the Spanish average. Seven out of eleven universities with a high level of productivity in teaching are private. To evaluate this result in perspective, it is important to note that the private universities that have been included have higher indicators than the majority of those not included due to lack of information, according to the available variables.

5. The specialization in teaching of the private universities has its counterpart in a worse position with respect to the public system regarding research productivity: 40% less on average than the university system. Only 2 of the 25 most productive universities in this field are private. The superiority of the public universities in research orientation and productivity is, therefore, very clear, holding the first fourteen positions in the ranking. The public universities also present higher levels of productivity in innovation and technological development activities than private ones, placing these in the lower 20% positions.

6. Some international initiatives in this area are already very well known —such as the Shanghai Ranking or THE— and have increased the visibility of the classifications of universities and the social demand for such rankings. But these rankings place the emphasis on the indicators of research and training of high international prestige, leaving out most of the activity of our university system, focused on the teaching of the Bachelor's degree and not really competing in these leagues. This orientation towards indicators of research is also characteristic of most of the existing national rankings, drawn up with guarantees of quality by specialists but considering indicators of the activities of our universities that are too partial. Our results highlight the key importance of combining research productivity with teaching productivity measures. Using the first as proxy of the second causes a very biased view of reality because the correlation between both measures is very low. The incorporation of private universities mitigates even more the relationship between both dimensions and confirms the need to recognize the heterogeneity of the Spanish university system.

7. Differences in the level of productivity of the universities are also seen at regional level. Cataluña, Navarra, Cantabria, Comunitat Valenciana, Madrid and Illes Balears are the most productive regions in the university system, with average levels higher than in the whole of Spain.

8. The evolution of the results of the university system with respect to the 2014 edition can only be analyzed for public universities, since they were the only ones included in the previous edition. The productivity rates of the public university system have remained constant, and the same happens for most of the universities in terms of output. However, one-third of public universities slightly worsen their output indicator. If we take into account that it is the size variable which determines the volume figures, it is most likely that the contraction of the rate of these universities may be due to the reduction of human and

financial resources, particularly in R&D&I activities.

The case in which the attention of the user of the rankings focuses most clearly on teaching is when students want to consult them in order to choose a university to study for their degrees. In this situation it is probable that the student will be interested above all in the quality of the university in certain studies, more than in the quality of research or in the quality of the teaching in general. In response to the demands for information from this perspective, ISSUE has developed a web tool that generates *personalized rankings* of Bachelor's degrees. These rankings are obtained taking into account students' preferences as to what they want to study, where they are willing to study it, and the importance they attribute to teaching aspects. The project intends to extend this analysis in the future to postgraduate degrees, but the information currently available does not allow this.

The role of the web tool developed is to offer students information of quality and rankings very easy to obtain. In this way we facilitate their task of assessing the options that best fit their criteria, when choosing the university in which to study for a degree. If the rankings are constructed rigorously they can help to orientate with reasonable criteria decisions that are complex for non-experts, and even for professionals such as careers advisers. Actually, no ranking is without problems but the alternative is to dedicate much effort to gathering and sorting a lot of information. The difficulties and the cost of doing so often lead to making the decision in almost total absence of information. We therefore consider that a well-founded system of rankings like the one offered —and the complementary information on cut-off marks, cost of registration and characteristics of the surrounding environment— may be of utility, since by enormously easing the task it will permit many people to make better informed decisions. The wide use of this web tool in its two years of life confirms this fact.

One general conclusion from the results of the project is that it confirms a notable diversity among the Spanish public universities with regard to their capacity to generate results and to their productivity. This diversity is also very notable with regard to their teaching and research specialization and their capacity to stand out in specific subject areas or degrees. In fact, some general characteristics of each university constitute an important element in explaining their results in each of their activities, but a notable internal diversity is also appreciated in many cases, examples of excellence existing in specific degrees in institutions that are not, in general terms, outstanding and vice versa, the results in specific degrees are below the average level of quality of the university.

The broad dataset on the universities offered by U-Rankings permits us to outline very relevant features of the diversity of the Spanish university system and inside each of the universities. Acknowledgement of this diversity is very relevant to various objectives: to evaluate the universities' results; to selectively guide their strategies for improvement and university policies; to orientate the potential users of teaching services; and to supply information to firms and institutions interested in knowing the universities' capacity to generate R&D&I results.

Appendix 1: Glossary of Indicators

Appendix 1. Glossary of indicators and statistical sources of 2015 ISSUE Rankings

Dimension	Area	Indicator and definition	Source	Period	Disaggregation
Teaching	Resources	**Faculty member with PhD per 100 students:** Faculty member with PhD equivalent to full-time per each 100 students registered in studies of 1st and 2nd cycle (former Spanish degree structure) and in Bachelor's degrees in centers belonging to the University, Master's degrees and Doctoral degrees (Bologna's degree structure)	CRUE	2008-09, 2010-11 and 2012-13	Branch of knowledge
		Budget / Student: Effective income of the University by number of students registered in studies of 1st and 2nd cycle and Bachelor's degree (in centers belonging to the University), Master's degrees and Doctoral degrees	CRUE	2008-09, 2010-11 and 2012-13	University
		Faculty member with PhD / Faculty members: Faculty member with PhD equivalent to full-time over total teaching and research staff equivalent to full-time	CRUE	2008-09, 2010-11 and 2012-13	University
	Output	**Success rate:** Number of credits passed (excluding transfer, validated and recognized credits) over total credits evaluated	CRUE	2008-09, 2010-11 and 2012-13	Bachelor's degree group
		Evaluation rate: Number of credits evaluated over total credits registered CRUE	CRUE	2008-09, 2010-11 and 2012-13	Bachelor's degree group
		Drop-out rate: Students registered in academic year t who, two years after registering in the first year of a degree, abandon it without graduating, over the total number of students registered in year t	CRUE	2008-09, 2010-11 and 2012-13	Bachelor's degree group
	Quality	**Attractiveness index**	-	-	-
		Percentage of postgraduate students: Students registered in Master's degrees over the total number of students of 1st and 2nd cycle, Bachelor's degrees and Master's degrees	MECD	2008-09 to 2013-14	University
		Cut-off mark: Mark of the last *general group*[1] student that gained admission to a degree with limited places	Universities	2014-215	Bachelor's degree
	Internationalization	**Percentage of foreign students:** Non-Spanish students of 1st and 2nd cycle, Bachelor's degrees and Master's degrees over the total number of students of 1st and 2nd cycle, Bachelor's degrees and Master's degrees	MECD	2008-09 to 2013-14	University
		Percentage of students in exchange programs: Spanish Students of 1st and 2nd cycle and Bachelor's degrees who participate in the ERASMUS programme, over the total number of students of 1st and 2nd cycle and Bachelor's degrees	CRUE	2008-09, 2010-11 and 2012-13	University
		Percentage of students registered in programs imparted in non-official languages	-	-	-

Appendix 1. Glossary of indicators and statistical sources of 2015 ISSUE Rankings (continued)

Dimension	Area	Indicator and definition	Source	Period	Disaggregation
Research	Resources	**Competitive public resources per faculty member with PhD:** Competitive public resources for undirected research projects, including both projects and complementary actions and ERDF funds, over the total number of faculty members with PhD equivalent to full-time	DGICT CRUE	2008-2013	Branch of knowledge
		Contracts with PhDs, research grants and technical support over total budget: Competitive resources obtained for research staff training, Juan de la Cierva, Ramón y Cajal and support technicians over total effective income	DGICT CRUE	2008-2013	Branch of knowledge
	Output	**Citable documents with ISI reference per faculty member with PhD:** Documents with ISI reference published per 100 faculty members with PhD equivalent to full-time	IUNE (Thomson Reuters) CRUE	2008-2013	Branch of knowledge
		Total *sexenios*[2] over possible sexenios: Sexenios obtained over the total possible sexenios for the universities' tenured research staff	CRUE	2012	Branch of knowledge
		Doctoral theses read per 100 faculty members with PhD: Doctoral theses read per 100 faculty members with PhD equivalent to full-time	MECD CRUE	2008-2012	Branch of knowledge
	Quality	**Mean impact factor:** Mean impact factor of the publications with at least one author affiliated to the University	IUNE (Thomson Reuters)	2008-2013	Bachelor's degree group
		Percentage of publications in the first quartile: Publications corresponding to journals in the first quartile of relevance within the Thomson Reuters classification by areas, over the total number of publications belonging to that area	IUNE (Thomson Reuters)	2008-2013	Bachelor's degree group
		Citations per document: Citations received by each document from the date of publication to the date of data gathering	IUNE (Thomson Reuters)	2008-2013	Bachelor's degree group
	Internationalization	**European or international research funds per faculty member with PhD:** Effective income from abroad due to applied research per faculty member with PhD equivalent to full-time	CRUE	2008 and 2010	University
		Percentage of publications with international co-authorship: Publications with at least one co-author affiliated to a foreign institution over the total number of publications	IUNE (Thomson Reuters)	2008-2013	Bachelor's degree group

Appendix 1. Glossary of indicators and statistical sources of 2015 ISSUE Rankings (continued)

Dimension	Area	Indicator and definition	Source	Period	Disaggregation
Innovation and Technological Development	Resources	**Income from licenses per 100 faculty members with PhD[3]:** Income generated by the use and exploitation of licenses of the university for each 100 faculty members with PhD	IUNE (OTRIs)	2006-2011	University
		Income from consultancy contracts per 100 faculty members with PhD[3]: Income from R&D and consultancy contracts and from provision of services per 100 faculty members with PhD	IUNE (OTRIs)	2006-2011	University
		Income from continuing professional development (CPD) courses per faculty member with PhD[3]: Fees received from registration both for CPD and for the university's own postgraduate programs (master, specialist and expert) per faculty member with PhD	CRUE IUNE (INE)	2008, 2010 and 2012	University
	Output	**Number of patents per 100 faculty members with PhD[3]:** Number of national patents granted to each Spanish university by the Spanish Patents and Trade Marks Office per 100 faculty members with PhD	IUNE (OTRIs)	2008-2013	University
		CPD hours per faculty member with PhD	-	-	-
		Number of contracts per faculty member with PhD	-	-	-
	Quality	**Patents commercialized per faculty member with PhD**		-	-
	Internationalization	**Triadic patents per 100 faculty members with PhD:** Number of simultaneous protections of inventions in different countries obtained through an international patent application, per 100 faculty members with PhD	IUNE (OTRIs)	2006-2011	University
		Income from international contracts per faculty member with PhD	-	-	-

[1]General group: students finishing high school or students graduated in Advanced Vocational Training or foreign students.
[2] Monetary compensation received for research activity based on the last six years.
[3] The faculty members with PhD used for calculating the indicators of Innovation and Technological Development are those in the following categories: Professor, University School Professor, Associate Professor, University School Associate Professor, and Assistant
Professor, registered each year in the centers belonging to the public universities

Appendix 2: List of University Abbreviations

University	Abbreviation	Type
Mondragon Unibertsitatea	UMON	Private
Universidad Autónoma de Madrid	UAM	Public
Universidad Cardenal Herrera - CEU	UCH	Private
Universidad Carlos III	UC3M	Public
Universidad Católica de Valencia San Vicente Mártir	UCV	Private
Universidad Complutense	UCM	Public
Universidad de Alcalá de Henares	UAH	Public
Universidad de Alicante	UA	Public
Universidad de Almería	UAL	Public
Universidad de Burgos	UBU	Public
Universidad de Cádiz	UCA	Public
Universidad de Cantabria	UNICAN	Public
Universidad de Castilla-La Mancha	UCLM	Public
Universidad de Córdoba	UCO	Public
Universidad de Deusto	UDE	Private
Universidad de Extremadura	UNEX	Public
Universidad de Granada	UGR	Public
Universidad de Huelva	UHU	Public
Universidad de Jaén	UJAEN	Public
Universidad de La Laguna	ULL	Public
Universidad de La Rioja	UNIRIOJA	Public
Universidad de Las Palmas de Gran Canaria	ULPGC	Public
Universidad de León	UNILEON	Public
Universidad de Málaga	UMA	Public
Universidad de Murcia	UM	Public
Universidad de Navarra	UN	Private
Universidad de Oviedo	UNIOVI	Public
Universidad de Salamanca	USAL	Public
Universidad de Sevilla	US	Public
Universidad de Valladolid	UVA	Public
Universidad de Zaragoza	UNIZAR	Public
Universidad del País Vasco	UPV-EHU	Public
Universidad Europea de Madrid	UEM	Private
Universidad Miguel Hernández de Elche	UMH	Public
Universidad Nacional a Distancia	UNED	Public
Universidad Pablo de Olavide	UPO	Public
Universidad Politécnica de Cartagena	UPCT	Public
Universidad Politécnica de Madrid	UPM	Public
Universidad Pontificia Comillas	COMILLAS	Private
Universidad Pública de Navarra	UPNA	Public
Universidad Rey Juan Carlos	URJC	Public
Universidade da Coruña	UDC	Public
Universidade de Santiago de Compostela	USC	Public
Universidade de Vigo	UVIGO	Public
Universitat Autònoma de Barcelona	UAB	Public
Universitat de Barcelona	UB	Public
Universitat de Girona	UDG	Public
Universitat de les Illes Balears	UIB	Public
Universitat de Lleida	UDL	Public
Universitat de València	UV	Public
Universitat de Vic	UVIC	Private
Universitat Internacional de Catalunya	UIC	Private
Universitat Jaume I	UJI	Public
Universitat Oberta de Catalunya	UOC	Private
Universitat Politècnica de Catalunya	UPC	Public
Universitat Politècnica de València	UPV	Public
Universitat Pompeu Fabra	UPF	Public
Universitat Ramon Llull	URLL	Private
Universitat Rovira i Virgili	URV	Public

References

4ICU-4 (4 International Colleges & Universities) (2015). *2015 World University Web Rankings: Top 200 Universities and Colleges in the World.* Available at http://www.4icu.org [last accessed: January 2015].

Aguillo, I.F. (2012). "Ranking Web of World Universities". Madrid: Cybermetrics Lab, Consejo Superior de Investigaciones Científicas (CSIC). Available at http://www.webometrics.info/methodology.html.

Aguillo, I.F., Bar-Ilan, J., Levene, M. and Priego, J.L. (2010). "Comparing University Rankings". *Scientometrics* 85, 1, 243-256.

Altbach, P.G. (2006). "The Dilemmas of Ranking". *International Higher Education* 42.

Bengoetxea, E. and Buela-Casal, G. (2013). "The new multidimensional and user-driven higher education ranking concept of the European Union". *International Journal of Clinical and Health Psychology* 13, 67-73.

Butler, D. (2007). "Academics strike back at spurious rankings". *Nature* 447, 514-515.

CWCU (Center for World-Class Universities of Shanghai Jiao Tong University) (2014). *Academic Ranking of World Universities 2014.* Available at http://www.shanghairanking.com/index.html [last accessed January 2015].

CWTS (Centre for Science and Technology Studies) (2008). Leiden ranking. CWTS, Leiden University. Available at http://www.cwts.nl/ranking/LeidenRankingWebSite.html.

CWTS (Centre for Science and Technology Studies) (2014). *CWTS Leiden Ranking* 2014. Available at http://www.leidenranking.com [last accessed: January 2015].

CHE (Centrum für Hochschulentwicklung) (2006). *Berlin Principles on Ranking of Higher Education Institutions*. Available at http://www.che.de/downloads/Berlin_Principles_IREG_534.pdf.

CHE (Centrum für Hochschulentwicklung) (2012). *Methodology*. Available at http://ranking.Zeit.de/che2012/en/.

CHERPA-Network (2011). U-Multirank "Design and Testing the Feasibility of a Multidimensional Global University Ranking. Final Report". Available at http://ec.europa.eu/education/library/study/2011/multirank_en.pdf.

Docampo, D. (2013). "Reproducibility of the Shanghai academic ranking of world universities results". *Scientometrics* 94, February.

Docampo, D. (2014). *Shanghai Ranking Expanded. Universidades españolas según el Ranking de Shanghai-2014 Ed.* Available at http://sci2s.last accessed: ugr.es/rankinguniversidades/shanghai.php.

Docampo, D., Herrera, F., Luque-Martínez, T. and Torres-Salinas, D. (2012). "Efecto de la agregación de universidades españolas en el Ranking de Shanghai (ARWU): caso de las comunidades autónomas y los campus de excelencia". *El profesional de la información* 21, 4, 428-442, July-August.

EC3 (2012). *Metodología - Metaranking de las Universidades Españolas*. Available at http://ec3.ugr.es/metaranking/metodologia.html.

Eccles, C. (2002). "The Use of University Rankings in the United Kingdom". *Higher Education in Europe* 27, 4.

García, J.A. (2012). "Ranking of research output of universities on the basis of the multidimensional prestige of influential fields: Spanish universities as a case of study". *Scientometrics*, April 25.

González-Pereira, B., Guerrero-Bote, V.P. and Moya-Anegón, F. (2010). "A new approach to the metric of journals' scientific prestige: The SJR indicator". *Journal of Informetrics* 4.

Marginson, S. (2007a). "Global University Rankings: Implications in general and for Australia". *Journal of Higher Education Policy and Management* 29, 2.

Marginson, S. (2007b). "Global university rankings: where to from here?". Presented at *Ranking Systems: Universities of Choice*, National University of Singapore, March 7-9.

Ministerio de Educación, Cultura y Deporte (2014). "Datos y cifras del Sistema Universitario Español 2013-2014". Available at http://www.mecd.gob.es/.

Ministerio de Educación, Cultura y Deporte (2014). "Estadística de Precios Públicos Universitarios. Curso 2013-2014". Available at http://www.mecd.gob.es/.

Nardo, M., Saisana, M., Saltelli, A., Tarantola, S., Hoffman, A. and Giovanni, E. (2005). "Handbook On Constructing Composite Indicators: Methodology And User Guide". OECD Statistics Working Paper, Paris.

NTU Ranking (National Taiwan University) (2013). *Performance Ranking of Scientifics Paper for World Universities 2013*. Available at http://nturanking.lis.ntu.edu.tw [last accessed: March 2014].

OECD (Organisation for Economic Co-operation and Development) (2008). *Handbook on constructing composite indicators: methodology and user guide*, Paris.

Pérez, F. y Serrano, L. (dirs), Pastor J.M., Hernández, L., Soler A. and Zaera I. (2012). *Universidad, universi-*

tarios y productividad en España. Madrid: BBVA Foundation.

QS (2014). QS World University Rankings 2014-2015. Available at http://www.topuniversities.com [last accessed: January 2015].

Rauhvargers, A. (2011). "Global University Rankings and their impact". Brussels: European University Association.

Rauhvargers, A. (2013). "Global University Rankings and their impact. Report II". Brussels: European University Association.

Rehn, C., Kronman, U. and Wadskog, D. (2007). "Bibliometric indicators - definitions and usage at Karolinska Institutet". Stockholm: Karolinska Institutet.

Salmi, J. (2009). "The Challenge of Establishing World-Class Universities". Washington DC: The World Bank.

Salmi, J. and Saroyan, A. (2007). "League tables as policy instruments: Uses and misuses". *Higher Education Management and Policy* 19, 2.

SCImago Research Group (2014). *SCImago Global Rank 2014.* Available at http://www.scimagoir.com.

THE (Times Higher Education) (2014). *Times Higher Education World University Rankings 2013-2015.* Available at http://www.timeshighereducation.co.uk [last accessed: January 2015].

THE-QS (2009). "Methodology: purpose and approach". Available at http://www.topuniversities.com.

Torres-Salinas, D., Moreno-Torres, J.G., Robinson, N., Delgado López-Cózar, E. and Herrera, F. (2013). "Rankings I-UGR de Universidades Españolas según Campos y Disciplinas Científicas". Available at http://www.rankinguniversidades.es [last accessed: June 2013].

URAP Center (University Ranking by Academic Performance) (2014). *2014-2015 World University Ranking.* Available at http://www.urapcenter.org [last accessed: February 2015].

Web of Science [online]. Philadelphia: Institute for Scientific Information: Thomson, cop. 2009.

Webometrics (2014). *Top 500 Ranking Web de Universidades del Mundo Julio 2014.* Available at http://www.webometrics.com [last accessed: January 2015].