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Scientific production of the Portuguese and Spanish universities: a comparative analysis

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Abstract: Increasingly higher education institutions play a key role in research and scientific production. In every country and region the production's thematic orientation of universities presents particular characteristics. The need of identify outstanding institutions had as consequence a variety of papers that compare the main thematic orientation of universities in an international level (Bordons et al., 2010; Souza et al. 2015).
This study analyses the scientific production of universities in Portugal and Spain in the period between 2005 and 2014. We used the Web of Science (WoS) from which we identified their subject area specialization.
The objective is to know and compare the contribution of universities in each of these countries and identify their thematic specialization profiles through the usage of bibliometric and statistical indicators. The analysis will present tendencies of the scientific production comparing and relating the situation of Portugal and Spain.
The results show that 66% of the Spanish scientific output corresponds to the production of higher education institutions, while the Portuguese values of this type of institutions reach 84% of the total.
We identified the main research areas and conclude that the subject areas with more production indexed in WoS are Engineering, Chemistry, Physics and Computer Science in both countries. Besides we identified the collaboration in research output between both countries and with other countries.
These results give valuable information to recommend strategies for the cooperation between universities of both Iberian countries in order to increase their visibility and impact worldwide.

Keywords: Scientific Production; Higher Education Institutions; Web of Science; Portugal; Spain

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1. Introduction

Currently the higher education sector is in most countries the primarily responsible for the scientific production. In many countries, the thematic focus of the production of the universities has its own characteristics and its expertise levels diverge according to the scientific tradition or the profile of the production of each country. The need to identify the institutions that stand out, according to criteria of scientific excellence and teaching, has led in recent years to the emergence of several studies comparing the subject specialization of universities internationally (Bordons et al., 2010).

The bibliometric analysis is one of the most requested and used method to identify the scientific activities of universities and identify their strengths and weaknesses in the several scientific knowledge subject areas.

This study analyses the scientific production of universities in Portugal and Spain in the period between 2005 and 2014. We used the Web of Science (WoS) from which we identified their subject area specialization.

2. Objectives and Methods

With this study we aim to answer three main questions:

- What is the contribution of each university system in the total of each country?
- What evolution can be observed in the period studied?
- What are the main subject areas of the university sector?
- How similar are the activity profiles in both countries at the level of the higher education sector?
- What priorities can be observed in collaboration in both countries?

In this study we used Web of Science (WoS) database from Thomson Reuters which includes the Science Citation Index, the Social Science Citation Index and the Art & Humanities Citation Index. Due to its characteristics, WoS and its components are traditionally used worldwide for the development of indicators in most scientific evaluation studies.

The methodology applied consists in the identification of the publications of both countries through the use of the advanced search in the field "country" (CU = SPAIN or CU = PORTUGAL) between the years 2005- 2014 (PY = 2003-2012).

3. Results

In this study we analyzed the following indicators:

i. Total number of documents - measure of the amount of work produced by both countries and annual production trends
ii. Subject areas (WoS categories) - measure of diversity and specificity of the work produced

iii. International collaboration (countries and institutions) - measure of the internationalization of scientific activity of each country

Total number of documents

Figure 1 shows the year-by-year data of Portuguese scientific production from 2003 to 2014. It is clear that the number of documents with Spanish and Portuguese affiliation has gradually increased in recent years.

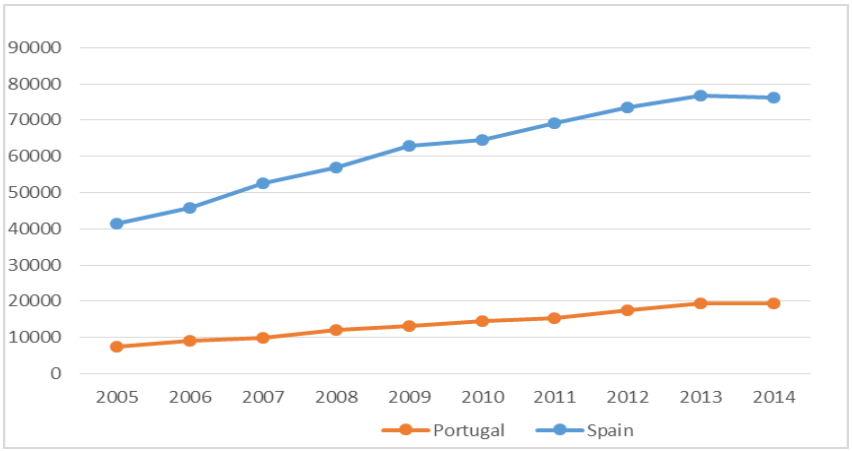

Figure 1 – Total number of documents with Portuguese and Spanish affiliation

Between 2003 and 2014 the Portuguese scientific production indexed on WoS was 138.204 documents increasing 8.73%, rising from 7.476 to 19.530 publications; while for Spain the increase was 5.61% going from 41.427 publication to 76.207 (table 1).

Table 1 – Total number of documents indexed in WoS: 2005-2014

Years	Portugal	Spain
2005	7 476	41 427
2006	9 164	45 641
2007	10 011	52 444
2008	11 948	56 837
2009	13 158	62 851
2010	14 401	64 601
2011	15 443	69 046
2012	17 574	73 387

2013	19 499	76 674
2014	19 530	76 207
Total	138 204	619 115

The majority of documents located in both countries have affiliation in higher education institutions: 66% of the Spanish scientific output corresponds to the production of higher education institutions, while the Portuguese values of this type of institutions reach 84% of the total (Table 2).

Table 2 - % of universities scientific output in the total production

	Portugal	**Spain**
Universities	84%	66%
Others	16%	44%

The universities with more scientific article indexed in WoS are identified in table 3 and 4.

Table 3 and 4 - Universities with more production

Universities	**Records**	**Universities**	**Records**
Univ Porto	23898	Univ Barcelona	36557
Univ Coimbra	14811	Univ Autonoma Barcelona	25084
Univ Lisbon	14668	Univ Valencia	23403
Univ Aveiro	12682	Univ Granada	20484
Univ Minho	10969	Univ Autonoma Madrid	19905

These universities have distinctive sizes, the University of Porto and the University of Lisbon are the largest Portuguese universities, the university of Coimbra and Minho have medium size and Aveiro is the smallest of the five institutions.

Regarding the Spanish universities the five universities identified as more productive are between the largest universities in the country (Michavila, 2012, España. Ministerio de Educación Cultura y Deporte, 2014).

We also analyse the international collaboration of both Iberian countries and conclude that Spain and Portugal work mainly with the same countries, i.e., 9 in 10. The exception is Belgium for Spain and Brazil for Portugal.

However, it can be observed differences in priorities as for Portugal Spain is the first option whereas Spanish researchers prefer the collaboration with other countries.

Both countries are inclined to collaborate with USA and England. In the case of Spain there is not noteworthy connection with any of Iberoamerican countries, and in Portugal the collaboration with Brazil is not as frequent as can be expected.

Table 5 and 6 – International collaboration countries

Countries	Items	Countries	Items
SPAIN	619 115	PORTUGAL	138 258
USA	64 190	SPAIN	14 320
ENGLAND	40 571	USA	12 580
GERMANY	40 368	ENGLAND	10 280
FRANCE	40 001	FRANCE	9 051
ITALY	37 976	GERMANY	8 658
NETHERLANDS	19 489	ITALY	7 134
SWITZERLAND	14 417	BRAZIL	6 221
PORTUGAL	14 320	NETHERLANDS	4 872
BELGIUM	13 526	SWITZERLAND	3 551

From the total of the 757,319 documents found in WoS with affiliation in Portuguese and Spanish universities we identified the five subject areas with the largest number of items. We have disaggregated the scientific production of both countries in WoS Categories and concluded that the specialization of both Iberian countries is similar regarding the scientific areas.

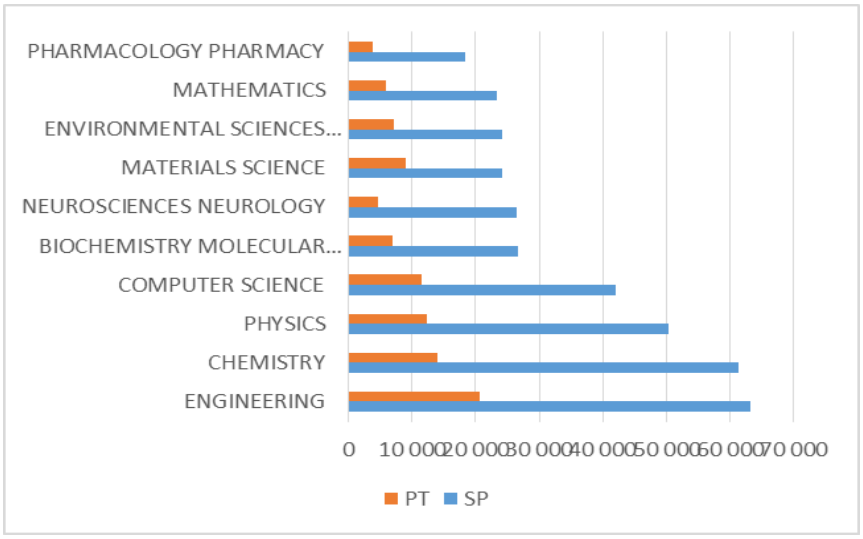

Figure 2 – Main research WoS Categories

The main research areas -with more production indexed in WoS- are Engineering, Chemistry, Physics and Computer Science in both countries.

4. Conclusions

To begin with it should be noted that the output of research include in WoS from both countries is far from including the complete production as this database is restrictive and with noteworthy bias: journals, STM sector and English language.

The number of full time researchers in Spain in 2013 was 123,224, that is 8.5% less than in 2010 (134,653), year with the highest number since 2007. In Portugal the number was 36.215 in 2010 decreasing to 33.528 in 2013.

The big difference between the numbers of researchers is responsible of the considerable distance in total numbers of documents indexed. Spanish production being 4, 47 times bigger than Portuguese production. The difference of researchers is quite parallel but the ratio documents/researchers are larger in Spain.

However, in the period studied the increase of the output is bigger in Portugal In Spain, the ratio WoS total of documents/100 researcher is of 47 documents in 2010 and 62 in 2013. In the case of Portugal the increase is from: 40 documents for each 100 researchers in 2010 to 58 in 2013.

Nonetheless, in both countries we observed the two last year stability in production figures that are firmly connected with the decrease in the numbers of research staff.

The results of a previous work -that study a set of universities in both countries- show that Portuguese universities analysed were more active than the set of Spanish universities considered, in terms both of information consumption and of academic output (Rodríguez-Bravo, B., Melo, L. B. & Costa, T., 2014). In the present study we found out similar data from both countries taking into account size differences.

In Portugal, research is carried out mainly by universities, mainly the public ones. There are 117 higher education institutions in Portugal, of which 34 are public. These are fully supported by public funding and are responsible for majority of the Portuguese scientific production. Is also worth mentioning that most of the scientific production and research has the support of the Portuguese funding agency, FCT (Foundation for Science and Technology).

With respect to Spain the research the universities research is unexpectedly less dominant if we consider that there are an important number of them, 82. From those, 50 are supported totally by the public administration and 32 are private ones. The rest of the research belongs to the CSIC (Consejo Superior de Investigaciones Científicas) and hospitals principally. The universities more productive are some of the largest in the country but not strictly the largest ones.

Cooperation between Portuguese and Spanish researchers might increase as the areas of interest in both countries are similar. The high cooperation with researchers of countries with English as a mother tongue in both Iberian countries can be explained because of the predominance of documents in English indexed in WoS.

As for the thematic specialization the results show what we expect as many previous studies noted that researchers of STM disciplines are between the heaviest users of electronic resources and the most productive.

We found in previous studies that for Spain, in both consumption and academic production it was the field of chemistry that has a preponderant position, followed at some distance by publications related to food science and technology, in respect of preferred title use, and physics with regard to communication of research results (Rodríguez et al. , 2012; Rodríguez-Bravo, Alvite-Díez, 2013). Bordons et al. (2010) noted that Spanish researchers in the area of chemistry demonstrated a clear preference for publication in international journals and this would seem to translate into the greater visibility of research in this field in the international databases.

In future works we will compare the situation of the research in both countries from data in Scopus and try to analyse separately the various fields, subfields and specialities of the most productive areas.

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