

Funding projects for Spanish public universities in research, development, and innovation related areas: Implications for resource allocation and scientific investment

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This contribution examines the potential of integrating Science of Science, data analytics, and policy analysis to acquire insight into the scientific landscape of a country and guide the strategic allocation of government resources. We analyse 18,423 Spanish funding projects related to research, development, and innovation, specifically in public universities. The performance analysis was based on granted projects, budget, paper production and the relative specialisation index. The findings show that *Chemical Sciences and Technologies* and *Biomedicine* receive the highest number of projects, budget and have high production rates, while *Computer-based Technologies* also showed high production, although does not receive as much funding. In contrast, *Gender and Women studies* demonstrate low research output and investment. Our analysis contributes to the effective management of resources aiming to detect strengths and weaknesses points and further improving the quality and equality of science in Spain.

1. Introduction

The measure of scientific knowledge is often based on its papers production, and the analysis of different fields at a global or local level is a common approach to understand how knowledge is organized (Fortunato et al., 2018). This information, related to the topics covered by each field, is useful in understanding how knowledge is configured and structured at a global level. At the local level, it represents an understanding of the country's participation in the construction of knowledge. Likewise, with the development of science itself, its production increase in number and complexity and the Science of Science (SoS) becomes fundamental to understand, quantify and predict this complex system (Zeng et al., 2017).

In fact, the Nature publishing group annually publishes a study based on the scientific production of the previous year. The analysis focuses on the main institutions responsible for the production of papers and the areas of knowledge which are the highest production in each country ("Nature Index," s.f.). This knowledge allows understanding at a large-scale level and determines who and where handles scientific production in a country. Then, the SoS is used to study scientific production from different perspectives. Given this potential, it is important to consider this field to analyse investment in science due to its strategic potential for efficient resource allocation. However, the intersection of data science, SoS and policy analysis to improve governance is still underexplored (Zhang, Porter, Cunningham, Chiavetta, & Newman, 2021). The consequence of this gap is inefficient resource management, which can mean missed opportunities for scientific advancement and innovation, wasteful spending, lack of diversity and inclusivity, and finally decrease public trust in scientific institutions.

Thus, with this contribution, we propose merging data analytics and strategic thinking to analyse funding projects related to research and development (R&D) and research, development, and innovation (R&D&I), identifying fields of knowledge highlighted positively and negatively in Spanish public universities according to the number of research projects awarded, papers produced, budget received, investment per paper, and specialisation rate. The focus of the study is public universities, given the relevance of understanding what is at the core of their investment and production, identifying strengths and weakness.

2. Methodology

We propose a methodology based on four phases: *i)* Data acquisition, *ii)* Data filtering, *iii)* Performance analysis, and *iv)* Visualisation.

Data acquisition

In order to analyse funding projects for Spanish public universities in R&D&I related areas, we retrieved projects related to three calls issued by the Spanish State Research Agency: *i)* excellence/knowledge generation in R&D, *ii)* knowledge generation and research challenges in R&D&I, and *iii)* research challenges in R&D&I. These data were collected in the Spanish State Research Agency, a Spanish agency focused on promoting the development of high-impact scientific research. The query was performed in March 2023, to retrieve funding information for projects granted in the period between 2013-2021 and retrieved 26.066 unique projects that contained information about the projects call, the institution that received the funding, the funding identification, the field of knowledge covered by the project, the autonomous community where the institution that received the funding is based, and the amount received. To enrich the further analysis, the total of papers related to each funding project was retrieved using a query performed in the Scopus database.

Data filtering

To ensure that observations are as precise as possible, we focused our analysis on Spanish public universities that fulfil analogous scopes of work and activities. After data collection, the public universities in Spain were identified based on the list of recognised universities by the Spanish authorities (Ministerio de Educación, Cultura y Deporte, 2008). The dataset used is can be downloaded at DOI: [10.6084/m9.figshare.22643872.v1](https://doi.org/10.6084/m9.figshare.22643872.v1) (Choji, Moral-Munoz, & Cobo, 2023a).

Performance analysis

In order to analyse the performance of the public universities in Spain, our research is based on the number of national projects received by each university, the amount of funding represented by these projects, the number of papers produced in each field, the average cost of each paper, and the relative specialisation index (RSI). The RSI is an indicator used to measure the research profile of a country in a field of knowledge and compare its specialization rates in production with worldwide production (Aksnes, van Leeuwen, & Sivertsen, 2014). In the current research, we adapted the RSI using the metrics related to each university and the total production of all the public universities. This adjustment allows us to standardize the criteria for comparison in the degree of specialization of the different public universities at the national level and among universities.

All these metrics were calculated for each public university to provide a more specific view of each field of knowledge in the national scenario. With these metrics, we can evaluate and compare the scientific production in different fields and link this information with the granted

projects, estimating each paper's costs and detecting the specialisation rate for each university in different fields. The RSI calculation is based on the Thematic Specialization Index (TSI):

$$TSI = \frac{a/b}{c/d}$$

Where a = number of publications of university X in area Y ; b = number of publications of university X in all areas; c = number of publications from all universities in area Y and d = number of publications of all universities in all areas. Then,

$$RSI = \left(\frac{TSI - 1}{TSI + 1} \right)$$

The RSI range from -1 to 1, with 0 representing the mean output of universities in the field. The RSI lower than 0 means that the output rate is lower than the average, while RSI greater than 1 represents that the output rate is higher than the average.

Visualisation

To display the relationship between the areas of knowledge and the public universities that received funding in the computed metrics, a set of five heatmaps was generated. A heatmap is a type of graph that uses colour to represent numerical values in a matrix or table, representing multivariate data and aiding in the visualization of the relation between variables (Gehlenborg & Wong, 2012). By using colour to represent values, we can quickly identify areas of high and low activity and compare them across different dimensions. Each column in the heatmap represents the areas of knowledge for which the project was funded, while each row represents the public university that received funding for such projects. Using three colours gradient allows to highlight the low and high values and makes it more visible to the reader. Here, the colour green indicates high values, the yellow represents intermediate values and the grey the low ones.

3. Results

To create comprehensive analysis of Spanish scientific research in the public university scenario, this study analysed 18,423 funding projects. Projects that did not meet the criteria of being from a public university were excluded to prevent bias. Therefore, the funding projects were awarded to 48 different universities and focused on 39 different fields of knowledge. The Spanish government invested €1,932 billion between the years 2013 and 2021.

As previously indicated, this study was conducted to construct and comprehend the national landscape of investment in R&D&I. Accordingly, the number of projects, research papers, investments, investment per paper, and RSI were computed and are presented in Figures 1-5. To view them with high-resolution, please visit DOI: [10.6084/m9.figshare.22656988.v1](https://doi.org/10.6084/m9.figshare.22656988.v1) (Choji, Moral-Munoz, & Cobo, 2023b).

It is possible to observe that investments occur in different areas of knowledge, and the papers production varies across each university. The areas with the highest number of national projects in R&D&I are *Chemical Sciences and Technologies*, *Biomedicine*, *Law*, and *Environmental Sciences and Technologies*. *Chemical Sciences and Technologies* receive the second highest amount of funding for research and have the highest paper production in the country. *Biomedicine* is the area that receives the highest amount of funding, although the cost of investment per paper is one of the most expensive, close to papers produced in *Energy and*

Transport, and in *Bioscience and Biotechnology*. *Computer-based Technologies* is the area with the second highest papers production in the country and the number of projects received is at the mean compared to other areas. However, in this area, the amount of investment earned and the investment per paper are considerably lower compared to other universities.

The areas of knowledge with a lower number of projects and with lower investment are *Gender and Women Studies*, followed by *Sports science* and *Astronomy and Astrology*. The areas with lower paper production are *Gender and Women studies*, *Culture: Philology, Literature and Art* and *Law*.

At the university level, the *Universidad de Barcelona* received the higher number of projects, the highest budget, and had the highest paper production. Regarding the RSI, the highlighted areas are *Biomedicine*, and *Astronomy and Astrophysics*, although the conceived projects and papers production were mainly in *Biomedicine* and *Chemical Sciences and Technologies*. In the sequence, we observe the *Universidad Complutense de Madrid*, in which the highest production is in *Chemical Sciences and Technologies*, *Biomedicine*, *Computer-based Technologies* and *Materials*. In the same university, the areas with the highest RSI were *Gender and women studies*, *Physics science* and *Particle physics and accelerators*. On the other hand, the *Universidad Politecnica de Cartagena* is one of those that received the lowest number of R&D&I projects. Nevertheless, it demonstrated the highest investment per paper, highlighting the cost of paper in *Space Research* and *Materials Sciences and Technology*. In contrast, the *Universidad de Almeria* and the *Universidad de Alicante* had low paper production, although they showed the lowest investment per paper of all public universities.

Figure 5: Rate Specialization Index (RSI) for each area of knowledge in Spanish public universities.

	COMPUTER TECHNOLOGIES	ELECTRONIC AND COMMUNICATIONS TECHNOLOGIES	INFORMATION AND COMMUNICATION TECHNOLOGIES	AGRI-FOOD RESOURCES AND TECHNOLOGIES	PSYCHOLOGY	INDUSTRIAL PRODUCTION, CIVIL ENGINEERING AND ENGINEERING FOR	MIND, LANGUAGE AND THOUGHT	MEANS OF TRANSPORT	MATERIALS	MATHEMATICS	SPACE RESEARCH	HISTORY AND ART	PARTICLE PHYSICS AND ACCELERATORS	PHYSICS	PHILOLOGY AND PHILOSOPHY	GENDER AND WOMEN STUDIES	STUDIES OF THE PAST: HISTORY AND ARCHAEOLOGY	ENERGY AND TRANSPORT	ENERGY	ECONOMY	DESIGN AND INDUSTRIAL PRODUCTION	LAW	CULTURE: PHILOLOGY, LITERATURE AND ART	CONSTRUCTION	CHEMICAL SCIENCES AND TECHNOLOGIES	ENVIRONMENTAL SCIENCES AND TECHNOLOGIES	MATERIALS SCIENCE AND TECHNOLOGY	SOCIAL SCIENCES	MATHEMATICAL SCIENCES	PHYSICS SCIENCES	SPORTS SCIENCE	EDUCATIONAL SCIENCES	AGRICULTURAL AND AGRI-FOOD SCIENCES	BIOTECHNOLOGY	BIOMEDICINE	FUNDAMENTAL BIOLOGY	BIODIVERSITY, EARTH SCIENCES AND GLOBAL CHANGE	BIOSCIENCES AND BIOTECHNOLOGY	ASTRONOMY AND ASTROPHYSICS
UNIVERSIDAD AUTONOMA DE BARCELONA	-0.33	0.13	-0.10	-0.21	-0.09	-0.59	0.13	-0.78	0.35	-0.33	0.40	-0.23	0.01	0.42	0.31		-0.96	0.15	-0.40	0.06	-0.04	0.06	-0.04	-0.07	0.02	-0.47	0.53	0.11	-0.47	0.12	-0.44	0.64	0.28	0.14	0.23	-0.28	0.23		
UNIVERSIDAD AUTONOMA DE MADRID	-0.19	-0.43	-0.12	-0.46	0.17	-0.31	0.05		-0.18	0.34	-0.15	0.37	0.43	-0.34	-0.10	0.54	-0.85	-0.26	-0.81	-0.75	-1	-0.37	-1	0.06	-0.01	0.22	0.22	-0.40	0.22	0.05	-0.24	-0.03	0.41	-0.54	0.41	-0.11	-0.15		
MADRID	0.04	0.53	0.18		-0.69	0.37	-1	0.80	0.13	-0.40	0.07	0.48	0.10	-0.74	0.08		0.29	0.35	0.42	-0.25	-0.25	0.42	-0.25		0.18	0.17	0.26	0.18	0.24	0.18		-0.54	0.29	0.14	0.05	0.23			
UNIVERSIDAD COMPLUTENSE DE MADRID	-0.07	-0.82	-0.21	-0.29	-0.02	-0.34	0.12	-0.50	0.28	0.08	0.20	0.48	0.29	-0.38	0.08	0.88	-0.38	-0.42	-0.89	-0.60	0.22	-0.60	0.39	0.01	0.18	0.17	0.26	0.17	0.01	-0.93	-0.20	0.11	0.29	0.11	-0.20	0.09	0.23		
UNIVERSIDAD DE ALCALE	0.18	0.46	0.38	-0.35	-1	0.13	-1	0.42	-0.18	0.71	-0.83	-1	0.06	-0.11	0.39		0.48	-0.88	-0.44	-0.14	-0.01	0.48	-0.08	0.28	0.28	0.26	-1	-0.89	-0.94	-0.24	-0.35	0.09	0.09	0.09	0.09	0.09			
UNIVERSIDAD DE ALICANTE	0.15	0.29	0.14	-0.87	-1	0.70	-0.47		-0.12	-0.04	-0.55	0.32	0.01	-0.45	0.05	0.44		0.15	0.18	-0.43	0.37	0.15	-1	0.04	0.04	0.24	0.24	0.05	0.90	0.20	-0.38	-0.88	-0.38	-1.00	-0.02	0.38			
UNIVERSIDAD DE ALMERIA	0.30	0.15	0.34	0.51	0.34	-0.60	-0.03		0.06			0.67	-0.67	-0.45	0.15	-1	-0.27	-0.53	-0.40	-0.31	-0.37	0.37	0.87	0.01	0.04	0.04	0.04	0.04	-0.62	-1	0.52	0.17	0.52	0.17	0.52	0.17			
UNIVERSIDAD DE BARCELONA	-0.59	-0.80	-0.53	0.02	0.24	-0.92	0.31	0.31	0.37	-0.65	-0.23	0.39	0.13	0.38	0.13	-1	-0.40	0.09	-0.53	-0.40	-1	0.37	0.01	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04			
UNIVERSIDAD DE BURGOS	-0.59	-0.80	-0.53	0.02	0.24	-0.92	0.31	0.31	0.37	-0.65	-0.23	0.39	0.13	0.38	0.13	-1	-0.40	0.09	-0.53	-0.40	-1	0.37	0.01	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04			
UNIVERSIDAD DE CADIZ	-0.28	-0.17	-0.67	-0.87	-1	0.47	-1	0.21	0.01	0.21	-1	0.47	0.21	-0.66	0.37	0.46	0.37	0.05	0.05	0.05	-0.30	-1	0.26	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31			
UNIVERSIDAD DE CANTABRIA	0.19	0.41	0.40	0.43	-0.52	-0.16	0.37	-1	-0.19	-1	-0.16	0.37	-1	-0.66	0.37	0.46	0.37	0.05	0.05	0.05	-0.30	-1	0.26	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31			
UNIVERSIDAD DE CASTILLA-LA MANCHA	-0.21	0.03	0.03	-0.68	0.03	0.23	-0.68	0.03	0.36	0.15	0.37	-1	-0.85	-1	-0.45	-0.96	0.63	0.22	0.36	0.22	0.23	0.23	0.22	0.11	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40			
UNIVERSIDAD DE CORDOBA	0.13	-0.43	0.19	0.12	-0.09	-0.62	0.08	-0.68	-0.34	-0.37	0.08	-0.28	-0.96	-0.45	-0.33	0.31	0.31	0.02	-0.07	-0.84	-0.58	-0.84	0.22	0.11	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40			
UNIVERSIDAD DE EXTREMADURA	0.12	-0.60	-0.54	0.53	0.09	0.53	0.22	0.22	0.24		0.24	0.22	-0.13	-0.75	-0.59	-0.55	0.02	-0.07	-0.84	-0.58	-0.84	0.22	0.11	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40			
UNIVERSIDAD DE GIRONA	0.13	-0.32	0.13	0.56	0.27	-0.52	0.04	-1	-0.05	0.04	-1	-0.52	0.27	-0.55	-0.59	-0.55	0.02	-0.07	-0.84	-0.58	-0.84	0.22	0.11	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40			
UNIVERSIDAD DE GRANADA	-0.20	-0.89	-0.20	-0.87	0.41	-0.26	0.08	-0.71	-0.60	-0.02	0.39	-0.71	0.10	-0.40	-0.37	0.29	-0.88	-0.04	-0.30	-0.04	-0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30			
UNIVERSIDAD DE HUELVA	-0.96	-0.96	0.08	-0.79	0.41	-0.26	0.08	-0.71	-0.60	-0.02	0.39	-0.71	0.10	-0.40	-0.37	0.29	-0.88	-0.04	-0.30	-0.04	-0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30				
UNIVERSIDAD DE JAEN	0.39	-0.87	0.55	-0.65	0.55	-0.87	0.39	-0.42	0.32	-0.19	-0.42	0.04	-0.28	-0.18	-0.34	0.75	-0.17	-0.20	-0.47	-0.20	-0.47	-0.20	-0.47	-0.20	-0.47	-0.20	-0.47	-0.20	-0.47	-0.20	-0.47	-0.20	-0.47	-0.20	-0.47	-0.20			
UNIVERSIDAD DE LA CORUNA	0.47	-0.01	0.47	-0.71	0.47	-0.01	0.47	-0.71	0.47	-0.01	0.47	-0.71	0.47	-0.01	0.47	0.66	0.20	-0.62	-0.44	-0.71	-0.66	0.66	0.20	0.66	0.20	0.66	0.20	0.66	0.20	0.66	0.20	0.66	0.20	0.66	0.20	0.66			
UNIVERSIDAD DE LA LAGUNA	0.01	-0.25	-0.18	-0.56	0.53	-0.10	-0.18	-0.25	-0.69	0.57	0.61	0.71	0.05	0.19	0.14	-1	-0.57	0.11	-0.48	-0.83	0.05	-0.48	0.13	0.15	0.49	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29			
UNIVERSIDAD DE LA RIOJA	-0.29	0.00	-0.16	-0.40	-0.72	-0.40	0.78		-0.65	-0.63	-0.59	0.13	-0.18	0.25	-0.04	0.58	-0.04	-0.83	-0.69	0.09	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51			
UNIVERSIDAD DE LAS ISLAS BALEARES	-0.10	0.00	-0.16	-0.21	0.24	-0.69	-0.02	-0.69	-0.65	-0.63	-0.59	0.13	-0.18	0.25	-0.04	0.58	-0.04	-0.83	-0.69	0.09	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51			
UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA		0.53	0.25	-0.32	-0.32	0.25			-0.52	0.80		0.28	0.36	-0.31	0.18		0.18	0.53	-0.69	0.09	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51			
UNIVERSIDAD DE LEON	-0.01		-0.20	0.79	0.28	0.53	0.28	0.53	0.28	0.53	0.28	0.53	0.28	0.53	0.28	0.53	0.28	0.53	-0.69	0.09	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51			
UNIVERSIDAD DE LLEIDA	-0.01	-0.01	-0.45	-0.68	0.79	-0.20	-0.15	-1.00	0.13		0.04	-0.02	-0.02	0.14	-0.02	0.14	-0.02	0.14	-0.68	0.09	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51	-0.51			
UNIVERSIDAD DE MALAGA	0.11	0.38	0.27	0.22	0.22	0.00	0.27	0.11	0.05	-0.45	-0.45	-0.52	-0.09	-0.05	-1	-0.05	-1	0.08	-0.17	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27			
UNIVERSIDAD DE MURCIA	0.15	0.93	0.02	0.08	0.08	0.53	0.02	0.29	0.23	0.23	0.23	0.09	0.17	0.07	0.45	0.17	0.07	0.08	-0.48	-0.74	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45			
UNIVERSIDAD DE OVIEDO	0.23	-0.93	0.02	-0.28	-0.22	-0.04	-0.66	-0.58	-0.46	0.03	-0.17	0.32	-0.21	0.51	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11			
UNIVERSIDAD DE SALAMANCA	0.28	0.06	0.06	0.44	0.44	0.12	0.52	0.24	0.35	-0.40	-0.63	-0.31	-0.56	0.46	-0.62	-0.52	0.28	-0.17	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07			
UNIVERSIDAD DE SANTIAGO DE COMPOSTELA	-0.37	0.36	-0.27	0.33	0.41	-0.42	0.22	0.28	0.34	0.08	0.15	0.21	0.13	0.01	-0.82	0.10	0.04	-0.96	-0.64	-0.20	-0.79	0.15	0.55	0.32	0.53	0.52	0.59	0.40	0.19	0.11	0.11	0.11	0.11	0.11	0.11	0.11			
UNIVERSIDAD DE SEVILLA	0.19	-0.19	-0.29	-0.18	0.15	-0.38	0.37	0.01	0.44	-0.24	0.02	-0.26	-0.20	0.38	-0.15	0.22	0.35	-0.24	0.13	-0.03	0.10	0.10	-1	-0.48	0.12	0.10	0.03	-0.45	0.21	0.06	-0.33	-0.43	0.33	-0.33	-0.33	-0.33			
UNIVERSIDAD DE VALENCIA	0.48	0.00	-0.04	0.22	0.00	-0.67	0.17	0.07	-0.24	0.33	0.06	0.07	-0.24	0.33	0.06	0.07	-0.24	0.33	0.06	0.07	-0.24	0.33	0.06	0.07	-0.24	0.33	0.06	0.07	-0.24	0.33	0.06	0.07	-0.24	0.33	0.06	0.07			
UNIVERSIDAD DE VALLADOLID	-0.36	-0.53	-0.27	0.10	-0.51	-0.04	-0.32	0.23	0.15	-0.05	0.47	0.08	0.09	-0.62	0.14	-1	-0.11	0.33	0.01	-0.50	-0.20	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34				
UNIVERSIDAD DE VIGO	-0.02	0.28	0.28	-0.37	-0.77	-0.70	0.38	-1	-0.32	-0.68	-0.13	-0.05	-0.06	0.67	-0.27	-0.32	-0.19	-0.74	0.22	0.46	0.15	-0.70	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44				
UNIVERSIDAD DE ZARAGOZA		0.30	0.12	0.26	-0.20	-0.08	-0.08	-0.27	0.23	-0.09	-0.02	-0.09	-0.11	-0.23	-0.14	-0.72	0.17	-0.21	0.23	0.34	0.45	-0.19	0.56	0.31	-0.06	0.21	0.04	-0.21	0.18	-0.36	0.48	-0.78	-0.17	-0.38	-0.15	-0.04			
UNIVERSIDAD DEL PAIS VASCO	-0.17	0.02	-0.33	-0.53	0.13	0.12	-0.58	-0.22	-0.12	0.23	-0.51	-0.41	0.18	-0.21																									

4. Discussion

In this section, we discuss the results and present insights on funding projects research in Spanish public universities. This study reveals highlighted areas of knowledge based on their funding projects, budget, production, and RSI. Our study contributes to the bibliometric field and reinforces the strategic potential of using SoS and data science to identify strengths and weaknesses of scientific production in the country. The aim is to guide efficient government resources allocation, which could be useful for researchers and policymakers.

The areas *Chemical Sciences and Technologies*, *Biomedicine*, and *Biotechnology* have shown high income for funding projects. *Chemical Sciences and Technologies* achieved one of the highest papers productions in Spain. These results agree with the findings of 2022 year achieved by the Nature publishing group (“Nature Index|Country/territory outputs|Spain,” s.f.). According to Yan E. (2015), Chemical Engineering-related fields demonstrate the fastest growth in scientific impact, achieving scientific recognition and diffusion in a short period. Moreover, the study revealed that *Electronic and Communication Technologies* and *Computer-based Technologies* had the highest production and RSI. Both areas are considered as Science, Technology, Engineering and Mathematics (STEM) and have enormous potential for growth.

In contrast, *Gender and Women Studies* showed been underexplored by Spanish public universities. Only twelve Spanish universities conduct research in this area, which may explain the low number of projects, investment, and paper production in this field. As a result, policies regarding gender equality need to be imported from different universities and contexts. However, these policies may not reflect the local reality and could be ineffective. To achieve effective policies that promote gender equality, it is important to consider the potential of women in science and how their different perspectives can be disruptive. Including women in traditionally male-dominated fields can represent a paradigm shift in how scientific research is conducted (Paulitz, Kink, & Prietl, 2016). This shift can lead to important scientific discoveries, such as the use of gender as a variable in medicine, which offers greater possibilities for study and only begins after women’s presence (Mastroianni, Faden, & Federman, 1994).

Regarding the areas with low RSI, such as *Law* and *Mind, Language and Thought*, predominantly belong to humanities-related fields. Some studies reported that the pattern of production and citation of this field differ reasonably compared with other fields and the metric used to evaluate them needs to suit with the analysis performed (Ochsner, Hug, & Daniel, 2016). So, the use of RSI to directly compare Formal, Natural and Applied-sciences to Social-sciences could be imprecise and does not represent the reality. Additionally, when the analysis is focused on citations rates of the production, it is important to consider that the works achieve the highest citation level approximately 7 years after the publication (Yan, 2016). Likewise, the time could affect similarly in the project’s papers production, which means that the progress of funding projects awarded between 2020-2021 may not have been fully observed yet, as it may take some time for scientific articles to be published. However, this potential delay applies to all areas and projects analysed and does not significantly impact the findings of the analysis.

Although these findings are important, it is necessary to report and discuss some limitations. The metrics used to compare different areas can negatively affect the humanities-related fields. The evaluation criteria used is this contribution may not accurately represent the achievement in those areas. Additionally, we could not analyse the gender of the principal researchers due to a lack of information. In future research, we aim to cover the impact of the projects thought the citations received by papers and identify the gender balance in funding projects.

5. Conclusions

This contribution analyses the funding projects for Spanish public universities in areas related to R&D&I research, from 2013 to 2021. As demonstrated, the highest budget, granted projects and production were found in *Chemical Sciences and Technologies* and *Biomedicine*, while *Computer-based technologies* also has higher production, although low funding. In contrast, the area *Gender and Women studies* received few projects, investment, and just a few Spanish universities research in this area. Regarding the RSI, it is an imprecise metric to compare Formal, Natural and Applied-sciences to Social-sciences. These findings highlight the need to consider science investment strategically due to the implications for the government resources allocation, particularly to determine the optimal domains and objectives for investing in scientific research. These results offer valuable guidance for policymakers and funding agencies seeking to maximise the societal benefits of their scientific investments.

Open science practices

The data used and Figures presented are available in the supplementary material (dataset: <https://doi.org/10.6084/m9.figshare.22643872.v1>; Figures: <https://doi.org/10.6084/m9.figshare.22656988.v1>)

Author contributions

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Jose A. Moral-Munoz: Conceptualisation, Funding acquisition, Investigation, Methodology, Validation, Visualisation, Writing – review & editing.

Manuel J. Cobo: Conceptualisation, Funding acquisition, Investigation, Methodology, Validation, Visualisation, Writing – review & editing.

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