Funding projects for Spanish public universities in research, development, and innovation related areas

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This contribution examines the integration of Science of Science and data visualization to acquire insight into the scientific landscape of funding projects for Spanish public universities, as well as to detect the research, development and innovation related areas and analyse its development by universities. We analyse 18,423 Spanish funding, 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 investment and research output. Our analysis contributes to broaden knowledge about the national scientific production, and it could be used to detect strengths and weaknesses in the development of science in Spain.

1. Introduction

The measure of scientific knowledge is often based on its papers production and its impact, 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 knowledge from different perspectives. Given this potential, it is essential to consider this field as valuable for understanding the science landscape and supporting the policymakers in strategic decisions, such as developing resource allocation policies and understanding the impact of specific policies for example. However, due to the complexity of the science system, accurate measurement and assessment of scientific knowledge transfer is challenging. To address this complexity, various indicators have been developed to increase the accuracy of measurements (Donovan & Butler, 2007). However, any method of measurement has inherent potential limitations. For instance, metrics based solely on paper production and impact are not suitable for comparing academics from different fields, this is due to potential variations in the behavior of these variables within each research field, and which could imply an unfair comparison between them (Zeng et al., 2017). Therefore, it is recommended to consider multiple variables, in addition to those mentioned above, as well as a thorough understanding of what needs to be measured, in order to select or develop an approach that provides a more accurate assessment of scientific research.

The complexity of the evaluation process has been addressed by several authors from different perspectives. On the one hand, evaluation can be analysed by accessing different research fields, analyzing and/or developing indicators specifically tailored to examine the landscape of each field (Butler, 2008). On the other hand, evaluation can be performed by analyzing the funding projects awarded in different research fields and their impact on each area that received a grant (Cattaneo, Meoli, & Signori, 2016; Thomas, Nedeva, Tirado, & Jacob, 2020).

To the best of our knowledge, there is no previous analysis of the funding projects in Spain. Therefore, in order to address one of these perspectives of research evaluation, with this contribution, we propose merging SoS and data visualization to analyse funding projects related to research and development (R&D) and research, development, and innovation (R&D&I), identifying fields of knowledge and its behaviour according to the number of research projects awarded, papers produced, budget received, investment per paper, and specialisation rate in Spanish public universities. The focus of the study was 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 through a query performed in the Scopus database using the grant number supporting the work.

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 (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):

$$TSI = {}^{a/b}\!\big/_{c/d}$$

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 (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 Astrophysics*. 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 highest number of projects, budget, and 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 Burgos*, the *Universidad de la Rioja*, the *Universidad de Huelva* and the *Universidad Politecnica de Cartagena* received the lowest number of projects. The first three presented the lowest budget and the lowest paper production, with less than 600 articles.

Figure 1: Funding projects granted by each area of knowledge in Spanish public universities.

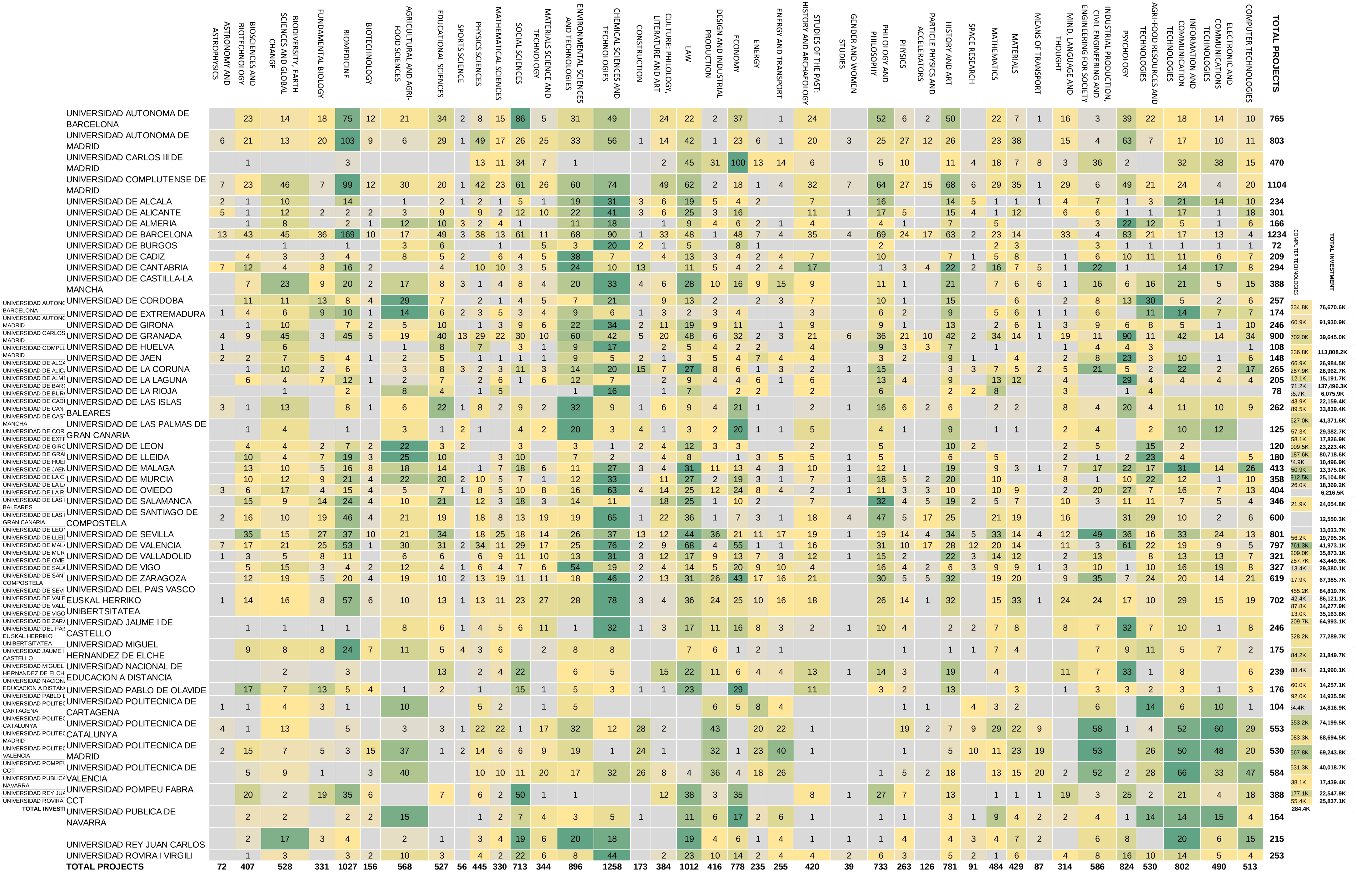

Figure 3: Number of papers produced in each area of knowledge in Spanish public universities.

	ASTRONOMY AND ASTROPHYSICS	BIOSCIENCES AND BIOTECHNOLOGY	BIODIVERSITY, EARTH SCIENCES AND GLOBAL CHANGE	FUNDAMENTAL BIOLOGY	BIOMEDICINE	BIOTECHNOLOGY	AGRICULTURAL AND AGRI-FOOD SCIENCES	EDUCATIONAL SCIENCES	SPORTS SCIENCE	PHYSICS SCIENCES	MATHEMATICAL SCIENCES	SOCIAL SCIENCES	MATERIALS SCIENCE AND TECHNOLOGY	ENVIRONMENTAL SCIENCES AND TECHNOLOGIES	CHEMICAL SCIENCES AND TECHNOLOGIES	CONSTRUCTION	CULTURE: PHILOLOGY, LITERATURE AND ART	LAW	DESIGN AND INDUSTRIAL PRODUCTION	ECONOMY
UNIVERSIDAD AUTONOMA DE BARCELONA		65	101	113	353	221	21	69	4	38	137	208	33	180	531		6	14	82	327
UNIVERSIDAD AUTONOMA DE MADRID	91	42	141	73	502	49	35	79	25	336	70	29	149	179	719	0	1	6	22	150
UNIVERSIDAD CARLOS III DE MADRID		0			40					94	120	61	51	7			0	5	320	340
UNIVERSIDAD COMPLUTENSE DE MADRID	71	58	372	37	465	79	46	19	1	309	145	115	198	314	1114		13	4	14	128
UNIVERSIDAD DE ALCALA	27	1	97		74		8	0	0	2	1	12	0	87	339	13	2	11	51	5
UNIVERSIDAD DE ALICANTE	46	0	87	15	6	11	0	35		32	49	59	73	105	752	15	0	4	38	172
UNIVERSIDAD DE ALMERIA		2	47		10	16	39	18	10	20	6	0		44	141		0	42	98	76
UNIVERSIDAD DE BARCELONA	248	70	383	190	852	96	41	113	46	287	54	62	37	255	1359	13	9	9	2	406
UNIVERSIDAD DE BURGOS			1		9		3	9			3		11	29	219	10	0	2		51
UNIVERSIDAD DE CADIZ		20	29	15	31		21	12	11		41	5	32	173	58		1	0	22	18
UNIVERSIDAD DE CANTABRIA	50	19	32	31	54	3		8		21	52	8	32	121	145	91		0	17	47
UNIVERSIDAD DE CASTILLA-LA MANCHA		28	180	55	81	20	41	10	43	1	30	16	10	254	469	66	2	12	194	234
UNIVERSIDAD DE CORDOBA		40	102	152	35	33	64	17		3	3	1	32	32	338		5	1	5	
UNIVERSIDAD DE EXTREMADURA	34	6	88	99	47	2	33	30	9	25	25	6	38	21	69	4	0	3	3	32
UNIVERSIDAD DE GIRONA		2	139		9	5	20	43		1	48	12	47	97	571	37	2	8	124	77
UNIVERSIDAD DE GRANADA	54	27	478	32	175	38	59	81	193	144	198	62	66	183	383	30	5	17	81	280
UNIVERSIDAD DE HUELVA	3		71				1	26		63		32	0	57	123		0	0	25	18
UNIVERSIDAD DE JAEN	19	10	62	24	48	10	2	9		1	2	2	2	19	16	6	0	0	60	19
UNIVERSIDAD DE LA CORUNA		0	48	4	10		3	33	8	14	20	20	5	60	153	85	2	7	94	22
UNIVERSIDAD DE LA LAGUNA		10	8	34	89	2	22	15		3	30	3	40	20	66		1	0	22	35
UNIVERSIDAD DE LA RIOJA			13		24		3	29		2	59			8	212		1	2		8
UNIVERSIDAD DE LAS ISLAS BALEARES	42	0	117		17	4	28	61	2	32	6	26	13	225	629	3	2	2	91	96
UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA		0	27		1		1	0	22	2		19	0	104	14	50	0	0	7	86
UNIVERSIDAD DE LEON		4	47	12	28	11	55	11	1			17		14	15	11	1	2	38	29
UNIVERSIDAD DE LLEIDA		70	40	15	43	44	82	36			20	15		30	10		8	6		37
UNIVERSIDAD DE MALAGA		23	84	23	56	52	23	35		3	61	47	50	15	396	32	4	2	112	159
UNIVERSIDAD DE MURCIA		30	107	53	133	38	77	56	18	39	32	10	0	29	275		7	0	20	128
UNIVERSIDAD DE OVIEDO	36	13	103	10	61	17	4	19	11	12	16	13	53	68	643	20	11	7	132	126
UNIVERSIDAD DE SALAMANCA		25	69	78	172	21	44	58		59	18	50	7	31	59		6	1	21	146
UNIVERSIDAD DE SANTIAGO DE COMPOSTELA	14	66	79	129	355	15	26	73		39	97	64	105	101	469	4	6	10	3	40
UNIVERSIDAD DE SEVILLA		62	128	161	142	68	25	121		112	292	40	97	106	417	127	5	20	410	153
UNIVERSIDAD DE VALENCIA	143	50	206	164	241	12	92	77	16	207	152	89	141	117	1198	33	6	46	47	517
UNIVERSIDAD DE VALLADOLID	9	6	49	49	30		23	13		31	70	27	117	96	344	6	4	0	73	228
UNIVERSIDAD DE VIGO		18	145	18	12	4	54	0	5	9	38	26	37	406	158	13	2	1	13	174
UNIVERSIDAD DE ZARAGOZA		66	202	126	115	36	40	27	30	77	92	46	64	95	399	8	8	7	267	434
UNIVERSIDAD DEL PAIS VASCO EUSKAL HERRIKO UNIBERTSITATEA	34	50	108	31	305	73	17	41	20	199	42	31	154	133	895	44	12	6	298	296
UNIVERSIDAD JAUME I DE CASTELLO		4	2	5	7		18	18	17	38	38	20	44	21	359	0	4	1	110	183
UNIVERSIDAD MIGUEL HERNANDEZ DE ELCHE		28	47	38	84	60	31	12	20	24	81		4	40	101			5	50	6
UNIVERSIDAD NACIONAL DE EDUCACION A DISTANCIA			32		8			10		19	33	44		59	60		5	1	140	39
UNIVERSIDAD PABLO DE OLAVIDE		26	67	80	36	15	1	0		2		38	19	25	57	37	4	4		189
UNIVERSIDAD POLITECNICA DE CARTAGENA	6	2	7	12	0		27			3	95		2	6					34	30
UNIVERSIDAD POLITECNICA DE CATALUNYA	81	0	87		32		1	36	6	188	220	0	205	168	113	314	5		767	
UNIVERSIDAD POLITECNICA DE MADRID	14	49	27	45	10	91	57	0	25	43	59	8	39	88	1	137	0		201	4
UNIVERSIDAD POLITECNICA DE VALENCIA		3	65	25		3	115			33	119	22	154	92	289	185	0	11	431	4
UNIVERSIDAD POMPEU FABRA CCT		30	34	188	160	47		5		21	30	109	2	5			11	23	13	191
UNIVERSIDAD PUBLICA DE NAVARRA		4	28		3	23	23			0	6	9	12	14	18	5		0	108	192
UNIVERSIDAD REY JUAN CARLOS		5	143	22	15		17	0		57	52	35	77	44	146			1	24	63
UNIVERSIDAD ROVIRA I VIRGILI		4	40		20	14	10	7		28	1	80	40	22	470		3	9	193	126
PRODUCED PAPERS	**1022**	**1038**	**4569**	**2158**	**5000**	**1233**	**1353**	**1371**	**543**	**2673**	**2763**	**1598**	**2292**	**4399**	**15312**	**1399**	**164**	**312**	**4877**	**6121**

	ENERGY	ENERGY AND TRANSPORT	STUDIES OF THE PAST: HISTORY AND ARCHAEOLOGY	GENDER AND WOMEN STUDIES	PHILOLOGY AND PHILOSOPHY	PHYSICS	PARTICLE PHYSICS AND ACCELERATORS	HISTORY AND ART	SPACE RESEARCH	MATHEMATICS	MATERIALS	MEANS OF TRANSPORT	MIND, LANGUAGE AND THOUGHT	INDUSTRIAL PRODUCTION, CIVIL ENGINEERING AND ENGINEERING FOR SOCIETY	PSYCHOLOGY	AGRI-FOOD RESOURCES AND TECHNOLOGIES	INFORMATION AND COMMUNICATION TECHNOLOGIES	ELECTRONIC AND COMMUNICATIONS TECHNOLOGIES	COMPUTER TECHNOLOGIES	**PRODUCED PAPERS**
UNIVERSIDAD AUTONOMA DE BARCELONA		1	24		169	175	46	106		722	124	4	22	26	126	114	213	385	203	**4963**
UNIVERSIDAD AUTONOMA DE MADRID	45	4	11	11	36	454	170	36		254	528		20	56	225	68	219	127	292	**5254**
UNIVERSIDAD CARLOS III DE MADRID	113	56	4		7	143		11	24	302	71	202	0	150	19		256	665	297	**3358**
UNIVERSIDAD COMPLUTENSE DE MADRID	2	26	19	21	40	404	270	88	70	380	448	14	28	64	189	125	220	37	453	**6400**
UNIVERSIDAD DE ALCALA	12		9		17			10	56	10	0	25	0	41	0	26	181	253	180	**1550**
UNIVERSIDAD DE ALICANTE			7	4	7	87		18	14	50	235		3	9	0	6	172	82	274	**2467**
UNIVERSIDAD DE ALMERIA	0	6	4		6	8		10		72				6	108	83	99	12	173	**1156**
UNIVERSIDAD DE BARCELONA	43	27	41	0	213	313	253	140	9	301	153		45	6	350	252	114	109	63	**6964**
UNIVERSIDAD DE BURGOS	5				6					34	36			27	1	0	5	4	10	**475**
UNIVERSIDAD DE CADIZ	32	35	8		4			9	0	72	156		0	21	14	125	175	85	209	**1434**
UNIVERSIDAD DE CANTABRIA	13	9	5		0	48	2	47	12	256	63	25	0	56	10		96	247	94	**1714**
UNIVERSIDAD DE CASTILLA-LA MANCHA	133	123	4		16	2		16		106	71	24	2	53	22	137	237	75	330	**3097**
UNIVERSIDAD DE CORDOBA	32	12	1		3	10		6			122		8	24	55	173	24	23	157	**1513**
UNIVERSIDAD DE EXTREMADURA			0		5	74		3		78	67	0	0	8		156	104	38	132	**1239**
UNIVERSIDAD DE GIRONA		1	2		10	7		17		30	88	26	1	43	9	113	21	7	93	**1710**
UNIVERSIDAD DE GRANADA	12	5	10	7	101	375	76	34	30	603	145	13	46	26	445	125	374	250	801	**6064**
UNIVERSIDAD DE HUELVA	4		0		52	27	27	3		0			0	4	2	10			1	**549**
UNIVERSIDAD DE JAEN	98	9	0		9	16		17	4		19		3	11	88	7	173	4	177	**946**
UNIVERSIDAD DE LA CORUNA	15	3	1	6	40			4	18	245	72	11	3	38	10	19	307	113	437	**1930**
UNIVERSIDAD DE LA LAGUNA	69	3	4		24	46		21		116	219		1		118	34	44	43	53	**1195**
UNIVERSIDAD DE LA RIOJA	15		0		48			1	37	104			16		3	9				**594**
UNIVERSIDAD DE LAS ISLAS BALEARES	4		5	5	49	51	41	5		31	24		7	8	106	49	82	127	143	**2133**
UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA	2	6	2		4	9		9		12	3		0	5		10	48	106		**549**
UNIVERSIDAD DE LEON			1		15			15	8				6	20		166	19			**546**
UNIVERSIDAD DE LLEIDA	131	110	1	1	16			12		108			3	0	7	233	24		96	**1198**
UNIVERSIDAD DE MALAGA	39	11	1	0	34	1		17		174	52	7	3	47	133	96	251	205	502	**2750**
UNIVERSIDAD DE MURCIA	16	3	15	2	27	75	40	29		252			14	3	81	260	124	5	248	**2246**
UNIVERSIDAD DE OVIEDO	73	2	1	2	11	22	7	10		162	223		0	60	174	41	153	130	294	**2740**
UNIVERSIDAD DE SALAMANCA	24		5		26	145	47	54	38	36	52		3	29	100	89	31	30	119	**1693**
UNIVERSIDAD DE SANTIAGO DE COMPOSTELA	50	4	13	8	100	40	177	9		605	273		16		162	203	141	27	217	**3740**
UNIVERSIDAD DE SEVILLA	135	44	16	0	25	224	62	50	12	550	287	17	7	209	118	162	189	326	210	**5129**
UNIVERSIDAD DE VALENCIA	2	1	18		49	239	463	72	56	398	332		5	26	315	251	87	139	86	**6093**
UNIVERSIDAD DE VALLADOLID	48	7	4	3	23	16		26	20	222	201		8	56		92	66	196	168	**2331**
UNIVERSIDAD DE VIGO	123	28	1		80	48	1	3	7	161	51	3	4	61	3	95	63	281	118	**2264**
UNIVERSIDAD DE ZARAGOZA	233	27	39		114	132	99	43		198	311		7	254	16	108	103	193	323	**4339**
UNIVERSIDAD DEL PAIS VASCO EUSKAL HERRIKO UNIBERTSITATEA	115	118	17		148	400	47	91		341	534	12	80	136	90	79	320	140	404	**5861**
UNIVERSIDAD JAUME I DE CASTELLO	65	2	0	3	36	61		0	27	132	117		15	13	145	54	36	20	150	**1765**
UNIVERSIDAD MIGUEL HERNANDEZ DE ELCHE	22	0				17		3	7	114	41			37	62	107	33	83	37	**1194**
UNIVERSIDAD NACIONAL DE EDUCACION A DISTANCIA	56	18	6	0	71	36		15		44			18	56	151	2	53		86	**1062**
UNIVERSIDAD PABLO DE OLAVIDE			12		6	16		11			31		0	12	38	9	12	0	35	**782**
UNIVERSIDAD POLITECNICA DE CARTAGENA	52	12				14	3		8	66	28			22		118	40	137	6	**730**
UNIVERSIDAD POLITECNICA DE CATALUNYA	233	181	0			359	12	4	186	725	300	80		337	2	25	310	1089	838	**6904**
UNIVERSIDAD POLITECNICA DE MADRID	183	130	0			0		5	107	151	177	134		193		143	254	656	258	**3289**
UNIVERSIDAD POLITECNICA DE VALENCIA	203	64			7	48	11	28		368	279	225	1	233	2	231	489	473	670	**4883**
UNIVERSIDAD POMPEU FABRA CCT			6	3	67	43		9		23	5	0	28	1	176	25	115	56	277	**1703**
UNIVERSIDAD PUBLICA DE NAVARRA	7	24	2		1	0		28	1	54	14	3	0	37	1	49	182	241	177	**1266**
UNIVERSIDAD REY JUAN CARLOS	18	8	0	1	0	139		9	7	55	87	8		20	38		178	166	152	**1587**
UNIVERSIDAD ROVIRA I VIRGILI	49	20	1	2	8	12		0	16	14	180		5	23	127	126	165	147	153	**2115**
PRODUCED PAPERS	**2526**	**1140**	**320**	**79**	**1730**	**4336**	**1854**	**1154**	**774**	**8731**	**6219**	**833**	**428**	**2567**	**3841**	**4405**	**6602**	**7532**	**10196**	

Figure 4: Average of investment per paper in euros in each area of knowledge in Spanish public universities.

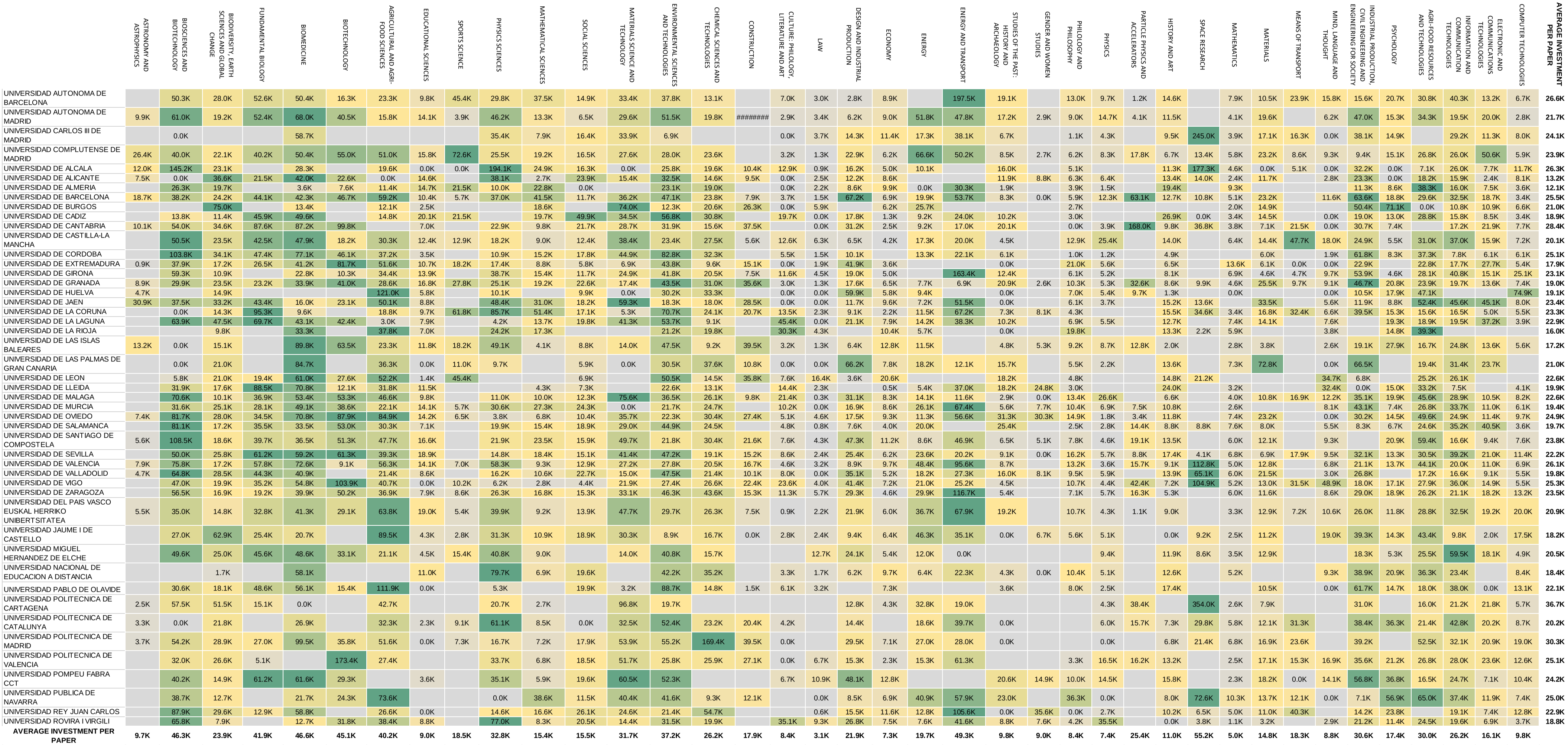

Figure 5: Rate Specialization Index (RSI) for each area of knowledge in Spanish public universities.

	ASTRONOMY AND ASTROPHYSICS	BIOSCIENCES AND BIOTECHNOLOGY	BIODIVERSITY, EARTH SCIENCES AND GLOBAL CHANGE	FUNDAMENTAL BIOLOGY	BIOMEDICINE	BIOTECHNOLOGY	AGRICULTURAL AND AGRI-FOOD SCIENCES	EDUCATIONAL SCIENCES	SPORTS SCIENCE	PHYSICS SCIENCES	MATHEMATICAL SCIENCES	SOCIAL SCIENCES	MATERIALS SCIENCE AND TECHNOLOGY	ENVIRONMENTAL SCIENCES AND TECHNOLOGIES	CHEMICAL SCIENCES AND TECHNOLOGIES	CONSTRUCTION	CULTURE: PHILOLOGY, LITERATURE AND ART	LAW	DESIGN AND INDUSTRIAL PRODUCTION	ECONOMY	ENERGY	ENERGY AND TRANSPORT	STUDIES OF THE PAST: HISTORY AND ARCHAEOLOGY	GENDER AND WOMEN STUDIES	PHILOLOGY AND PHILOSOPHY	PHYSICS	PARTICLE PHYSICS AND ACCELERATORS	HISTORY AND ART	SPACE RESEARCH	MATHEMATICS	MATERIALS	MEANS OF TRANSPORT	MIND, LANGUAGE AND THOUGHT	INDUSTRIAL PRODUCTION, CIVIL ENGINEERING AND ENGINEERING FOR	PSYCHOLOGY	AGRI-FOOD RESOURCES AND TECHNOLOGIES	INFORMATION AND COMMUNICATION TECHNOLOGIES	ELECTRONIC AND COMMUNICATIONS TECHNOLOGIES	COMPUTER TECHNOLOGIES
UNIVERSIDAD AUTONOMA DE BARCELONA		0.23	-0.28	0.14	0.28	0.64	-0.44	0.12	-0.69	-0.47	0.11	0.53	-0.47	0.02	-0.07		-0.04	0.06	-0.40	0.15		-0.96	0.31		0.42	0.01	-0.23	0.40		0.35	-0.33	-0.78	0.13	-0.59	-0.09	-0.21	-0.10	0.13	-0.33
UNIVERSIDAD AUTONOMA DE MADRID	0.36	-0.02	-0.15	-0.11	0.41	-0.03	-0.24	0.16	0.05	0.50	-0.25	-0.40	0.22	-0.01	0.06	-1	-0.75	-0.37	-0.81	-0.26	-0.40	-0.85	-0.10	0.54	-0.34	0.43	0.37	-0.15		-0.18	0.34		0.05	-0.31	0.17	-0.46	-0.12	-0.43	-0.19
MADRID		-1.00			-0.54					0.14	0.24	0.18	-0.09	-0.89			-1	-0.25	0.42	0.35	0.25	0.29	-0.36		-0.74	0.10		-0.47	0.07	0.13	-0.40	0.80	-1	0.37	-0.69		0.18	0.53	0.04
UNIVERSIDAD COMPLUTENSE DE MADRID	0.15	0.05	0.23	-0.50	0.29	0.11	-0.20	-0.57	-0.93	0.39	0.01	0.17	0.26	0.17	0.18		0.22	-0.60	-0.89	-0.42	-1	-0.38	0.08	0.68	-0.38	0.29	0.48	0.20	0.28	-0.08	0.17	-0.50	0.12	-0.34	-0.02	-0.29	-0.21	-0.82	-0.07
UNIVERSIDAD DE ALCALA	0.36	-0.86	0.26		0.09		-0.35	-1	-1	-0.89	-0.94	-0.24	-1	0.23	0.28	-0.14	-0.01	0.48	-0.08	-0.88	-0.44		0.39		-0.11			-0.18	0.71	-0.83	-1	0.42	-1	0.13	-1	-0.35	0.38	0.46	0.18
UNIVERSIDAD DE ALICANTE	0.39	-1.00	-0.02	-0.48	-0.88	-0.38	-1.00	0.13		-0.24	-0.05	0.30	0.24	0.10	0.43	-0.29	-1	-0.21	-0.43	0.18			0.05	0.44	-0.66	0.01		-0.12	-0.04	-0.55	0.32		-0.47	-0.70	-1	-0.87	0.14	-0.29	0.15
UNIVERSIDAD DE ALMERIA		-0.65	0.06		-0.64	0.17	0.52	0.18	0.33	-0.10	-0.62	-1		0.04	0.00		-1	0.87	0.37	0.15	-1	-0.27	0.15		-0.45	-0.67		-0.03		-0.06				-0.60	0.51	0.34	0.24	-0.71	0.30
UNIVERSIDAD DE BARCELONA	0.63	0.10	0.20	0.23	0.51	0.17	-0.29	0.20	0.21	0.32	-0.48	-0.18	-0.55	0.02	0.23	-0.71	-0.01	-0.32	-1	0.09	-0.53	-0.40	0.40	-1	0.38	0.13	0.42	0.37	-0.65	-0.23	-0.39		0.31	-0.92	0.24	0.02	-0.53	-0.59	-0.80
UNIVERSIDAD DE BURGOS			-0.89		-0.36		-0.26	0.27			-0.55		0.12	0.27	0.58	0.31	-1	0.26		0.38	-0.31				-0.04					0.01	0.21			0.47	-0.87	-1	-0.67	-0.75	-0.59
UNIVERSIDAD DE CADIZ		0.26	-0.29	-0.24	-0.30		0.15	-0.13	0.28		0.13	-0.57	0.10	0.55	-0.50		-0.30	-1	-0.43	-0.59	0.05	0.46	0.37		-0.66			-0.19	-1	-0.16	0.37		-1	-0.17	-0.52	0.43	0.40	-0.01	0.28
UNIVERSIDAD DE CANTABRIA	0.56	0.15	-0.32	0.03	-0.12	-0.70		-0.40		-0.27	0.16	-0.46	0.01	0.34	-0.18	0.65		-1	-0.59	-0.28	-0.45	-0.27	0.07		-1	-0.10	-0.85	0.50	0.06	0.36	-0.15	0.37	-1	0.23	-0.68		0.03	0.41	-0.19
UNIVERSIDAD DE CASTILLA-LA MANCHA		0.04	0.23	0.02	-0.21	-0.21	0.10	-0.54	0.52	-0.97	-0.39	-0.42	-0.70	0.40	0.11	0.31	-0.34	0.22	0.23	0.22	0.36	0.63	-0.33		-0.45	-0.96		-0.28		-0.34	-0.37	0.08	-0.68	-0.09	-0.62	0.12	0.19	-0.43	0.13
UNIVERSIDAD DE CORDOBA		0.52	0.30	0.71	-0.27	0.38	0.59	0.01		-0.83	-0.83	-0.90	0.07	-0.25	0.29		0.43	-0.58	-0.84		0.02	-0.07	-0.59		-0.75	-0.68		-0.40			0.24		0.22	-0.13	0.09	0.53	-0.54	-0.60	0.12
UNIVERSIDAD DE EXTREMADURA	0.54	-0.26	0.32	0.65	-0.02	-0.72	0.42	0.38	0.25	-0.03	-0.04	-0.45	0.25	-0.35	-0.37	-0.55	-1	-0.01	-0.88	-0.31			-1		-0.55	0.27		-0.58		-0.05	0.04	-1	-1	-0.52		0.56	0.23	-0.32	0.13
UNIVERSIDAD DE GIRONA		-0.75	0.38		-0.77	-0.54	0.04	0.39		-0.95	0.12	-0.29	0.20	0.24	0.46	0.32	-0.06	0.31	0.30	-0.04		-0.88	-0.37		-0.40	-0.79		0.04		-0.60	0.02	0.39	-0.71	0.10	-0.71	0.31	-0.62	-0.87	-0.20
UNIVERSIDAD DE GRANADA	0.04	-0.30	0.37	-0.53	-0.16	-0.22	-0.05	0.10	0.76	0.05	0.19	-0.11	-0.25	-0.07	-0.32	-0.39	-0.23	0.06	-0.49	-0.03	-0.82	-0.83	-0.21	0.29	0.09	0.28	-0.08	-0.24	-0.11	0.18	-0.35	-0.51	0.38	-0.65	0.41	-0.26	0.08	-0.19	0.24
UNIVERSIDAD DE HUELVA	-0.20		0.56				-0.71	0.63		0.69		0.64	-1.00	0.50	0.29		-1	-1	0.08	-0.20	-0.47		-1		0.75	0.17	0.54	-0.25		-1.00			-1.00	-0.47	-0.79	-0.32			-0.96
UNIVERSIDAD DE JAEN	0.42	0.12	0.29	0.19	0.12	0.04	-0.67	-0.07		-0.91	-0.82	-0.72	-0.79	-0.27	-0.76	-0.27	-1	-1	0.24	-0.42	0.67	0.02	-1		-0.18	-0.34		0.32	-0.19		-0.42		-0.04	-0.28	0.50	-0.65	0.55	-0.87	0.39
UNIVERSIDAD DE LA CORUNA		-1	-0.19	-0.78	-0.77		-0.75	0.22	-0.02	-0.49	-0.36	-0.10	-0.75	-0.06	-0.21	0.60	-0.12	0.19	0.11	-0.62	-0.44	-0.71	-0.66	0.66	0.20			-0.63	0.20	0.29	-0.14	-0.08	-0.37	-0.02	-0.71	-0.56	0.50	-0.01	0.47
UNIVERSIDAD DE LA LAGUNA		0.01	-0.69	0.25	0.30	-0.71	0.26	0.07		-0.79	0.07	-0.67	0.29	-0.35	-0.38		-0.22	-1	-0.36	-0.25	0.48	-0.57	0.14		0.19	0.05		0.31		0.16	0.57		-0.61		0.53	-0.10	-0.18	-0.25	-0.29
UNIVERSIDAD DE LA RIOJA			-0.25		0.01		-0.36	0.63		-0.73	0.64			-0.44	0.49		0.13	0.15		-0.57	0.11		-1		0.71			-0.69	0.82	0.43			0.78		-0.72	-0.40			
UNIVERSIDAD DE LAS ISLAS BALEARES	0.41	-1	0.20		-0.67	-0.68	0.10	0.45	-0.64	-0.17	-0.77	-0.02	-0.50	0.50	0.41	-0.78	-0.16	-0.45	0.05	-0.04	-0.83		-0.04	0.58	0.25	-0.18	0.13	-0.59		-0.65	-0.63		-0.02	-0.69	0.24	-0.21	-0.16	0.00	-0.10
UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA		-1	0.15		-0.91		-0.71	-1	0.81	-0.71		0.46	-1	0.69	-0.65	0.78	-1	-1	-0.51	0.53	-0.69	0.09	0.18		-0.31	-0.36		0.28		-0.52	-0.80		-1	-0.38		-0.32	0.25	0.53	
UNIVERSIDAD DE LEON		-0.06	0.41	0.12	0.13	0.34	0.81	0.30	-0.41			0.42		-0.16	-0.63	0.29	0.17	0.19	0.28	0.04			-0.16		0.33			0.50	0.41				0.53	0.28		0.79	-0.20		
UNIVERSIDAD DE LLEIDA		0.75	-0.04	-0.16	-0.05	0.58	0.73	0.47			-0.14	-0.01		-0.17	-0.87		0.67	0.34		-0.22	0.69	0.82	-0.51	0.14	-0.02			0.04		0.13			-0.15	-1.00	-0.68	0.69	-0.45		-0.01
UNIVERSIDAD DE MALAGA		0.01	-0.09	-0.35	-0.32	0.32	-0.13	0.08		-0.90	0.004	0.15	-0.002	-0.73	0.08	0.02	0.05	-0.55	0.02	0.08	-0.17	-0.39	-0.75	-1	-0.05	-1		-0.20		-0.05	-0.45	-0.45	-0.52	-0.09	0.22	0.00	0.27	0.11	0.38
UNIVERSIDAD DE MURCIA		0.24	0.13	0.16	0.20	0.27	0.52	0.39	0.30	-0.10	-0.21	-0.48	-1	-0.46	0.002		0.41	-1	-0.63	0.08	-0.48	-0.74	0.45	0.17	-0.07	-0.02	0.09	0.17		0.23			0.29	-0.88	0.08	0.53	0.02	-0.93	0.15
UNIVERSIDAD DE OVIEDO	0.23	-0.27	0.02	-0.65	-0.28	-0.23	-0.76	-0.22	-0.04	-0.66	-0.58	-0.46	0.03	-0.17	0.32	-0.21	0.51	0.01	0.11	-0.03	0.14	-0.85	-0.75	0.07	-0.55	-0.62	-0.71	-0.43		-0.08	0.24		-1	0.03	0.35	-0.40	0.03	-0.12	0.14
UNIVERSIDAD DE SALAMANCA		0.28	0.06	0.46	0.44	0.12	0.41	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		0.05	0.42	0.31	0.55	0.57	-0.53	-0.23		-0.32	-0.09	0.32	0.20	-0.48	-0.54	-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		0.17	0.21	-0.17	-0.79	-0.17
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	-1	-0.48	0.12	-0.10	0.03	-0.45	0.21	0.06	-0.33	-0.43	0.33	-0.14	-0.05	-0.18	0.03	-0.33
UNIVERSIDAD DE VALENCIA	0.48	0.00	-0.04	0.22	0.00	-0.67	0.17	0.07	-0.24	0.23	0.06	0.07	0.12	-0.29	0.23	-0.35	-0.14	0.50	-0.67	0.27	-1	-0.96	0.07		-0.26	0.06	0.67	0.12	0.20	-0.03	0.05		-0.61	-0.65	0.26	0.08	-0.57	-0.45	-0.70
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	-0.17	-0.67		0.10	0.16	0.16	0.27		0.00	0.08		0.06	-0.30	0.17	-0.06
UNIVERSIDAD DE VIGO		-0.02	0.28	-0.37	-0.77	-0.70	0.38	-1	-0.32	-0.69	-0.13	-0.05	-0.06	0.67	-0.27	-0.32	-0.19	-0.70	-0.74	0.22	0.46	0.15	-0.70		0.44	-0.24	-0.94	-0.75	-0.33	0.01	-0.38	-0.67	-0.32	0.14	-0.92	0.09	-0.31	0.35	-0.22
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 EUSKAL HERRIKO UNIBERTSITATEA	-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	0.11	-0.20	0.22	-0.42	0.13	0.02	-0.01	0.38	0.06		0.29	0.33	-0.30	0.26		-0.09	0.30	-0.53	0.60	0.06	-0.33	-0.45	0.02	-0.43	-0.08
UNIVERSIDAD JAUME I DE CASTELLO		-0.57	-0.94	-0.72	-0.82		-0.03	-0.03	0.38	0.01	-0.01	-0.06	0.15	-0.49	0.25	-1	0.27	-0.63	0.23	0.36	0.29	-0.78	-1	0.46	0.19	0.17		-1	0.43	0.04	0.14		0.43	-0.47	0.46	-0.07	-0.44	-0.68	0.02
UNIVERSIDAD MIGUEL HERNANDEZ DE ELCHE		0.48	0.04	0.30	0.28	0.67	0.41	-0.04	0.59	-0.03	0.51		-0.69	-0.02	-0.18			0.25	0.04	-0.81	-0.04	-1.00				-0.42		-0.57	-0.03	0.16	-0.18			0.20	0.26	0.44	-0.31	0.07	-0.45
UNIVERSIDAD NACIONAL DE EDUCACION A DISTANCIA			-0.09		-0.68			-0.07		-0.09	0.17	0.53		0.23	-0.37		0.57	-0.45	0.54	-0.14	0.45	0.30	0.38	-1	0.66	-0.01		0.21		-0.25			0.66	0.44	0.65	-0.90	-0.03		0.00
UNIVERSIDAD PABLO DE OLAVIDE, DE SEVILLA		0.60	0.40	0.71	0.07	0.32	-0.79	-1		-0.79		0.58	0.14	-0.05	-0.25	0.62	0.59	0.35		0.66			0.71		-0.28	-0.26		0.21			-0.11		-1	-0.14	0.23	-0.51	-0.55	-1.00	-0.29
UNIVERSIDAD POLITECNICA DE CARTAGENA	0.004	-0.50	-0.58	-0.02	-1		0.55			-0.68	0.71		-0.74	-0.62					0.09	-0.09	0.56	0.29				-0.29	-0.56		0.28	0.13	-0.13			0.19		0.64	0.02	0.52	-0.82
UNIVERSIDAD POLITECNICA DE CATALUNYA	0.18	-1	-0.49		-0.79		-0.97	-0.35	-0.67	0.12	0.18	-1	0.24	-0.18	-0.76	0.61	-0.29		0.48		0.25	0.49	-1			0.20	-0.79	-0.88	0.63	0.20	-0.07	0.27		0.41	-0.98	-0.81	-0.08	0.45	0.20
UNIVERSIDAD POLITECNICA DE MADRID	-0.31	0.29	-0.63	-0.11	-0.86	0.48	0.23	-1	0.27	-0.24	-0.10	-0.68	-0.21	-0.13	-1	0.58	-1		0.22	-0.95	0.47	0.63	-1			-1		-0.72	0.68	-0.21	0.04	0.72		0.48		0.11	0.19	0.54	-0.02
UNIVERSIDAD POLITECNICA DE VALENCIA		-0.86	-0.46	-0.54		-0.88	0.37			-0.52	0.05	-0.48	0.27	-0.30	-0.35	0.55	-1	-0.05	0.39	-0.97	0.35	0.18			-0.81	-0.56	-0.74	-0.23		0.04	0.07	0.75	-0.89	0.40	-0.97	0.15	0.31	0.23	0.26
UNIVERSIDAD POMPEU FABRA CCT		0.36	-0.29	0.73	0.40	0.47		-0.58		-0.27	-0.11	0.67	-0.88	-0.85			0.66	0.69	-0.67	0.39			0.16	0.47	0.48	-0.16		-0.27		-0.67	-0.89	-1	0.66	-0.94	0.54	-0.41	0.12	-0.29	0.33
NAVARRA		-0.45	-0.24		-0.89	0.30	0.26			-1	-0.65	-0.28	-0.32	-0.52	-0.79	-0.48		-1	0.37	0.51	-0.57	0.35	-0.24		-0.89	-1		0.41	-0.77	-0.24	-0.64	-0.47	-1	0.18	-0.95	0.05	0.46	0.52	0.26
UNIVERSIDAD REY JUAN CARLOS		-0.45	0.42	-0.11	-0.62		-0.003	-1		0.26	0.20	0.27	0.45	-0.12	-0.14			-0.60	-0.44	-0.10	-0.28	-0.29	-1	0.0004	-1	0.43		-0.24	-0.17	-0.34	0.05	-0.14		-0.24	-0.12		0.36	0.27	0.08
UNIVERSIDAD ROVIRA I VIRGILI		-0.63	-0.32		-0.62	-0.20	-0.39	-0.54		-0.23	-0.96	0.50	0.02	-0.54	0.29		0.04	0.26	0.40	0.10	0.07	0.02	-0.69	0.20	-0.57	-0.72		-1	0.10	-0.83	0.26		-0.18	-0.31	0.32	0.26	0.19	0.07	-0.06

4. Discussion

In this section, we discuss the results and present insights on research funding projects in Spanish public universities. Our aim was to combine SoS with data visualization to identify the research fields and public universities that received grant projects in R&D and R&D&I from a national perspective. This study reveals highlighted areas of knowledge based on the number of funding projects received, budget, production, and RSI. Our heat maps enable comparisons between the same research fields across different universities, providing a comprehensive view of national R&D&I projects and enhancing our understanding of funding distribution.

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 align 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 recognition and diffusion in a short period. Moreover, our study revealed that *Electronic and Communication Technologies* and *Computer-based Technologies* had the highest production and RSI. Both areas are considered to be Science, Technology, Engineering and Mathematics (STEM) and have significant potential for application and growth. At university level, it is interesting to note that even in cases of relatively low investment, such as the *Universidad de Burgos*, *Universidad de la Rioja* and *Universidad de Huelva*, *Chemical Sciences and Technologies* was the field that received the highest number of funded projects and budget allocation. In all three cases, the budget allocated to this specific field was the highest compared to other fields, and the paper production in this area was higher than in other fields explored within each respective university.

In contrast, *Gender and Women Studies* showed been underexplored by Spanish public universities. Only twelve Spanish universities received funding in this research field, which could explain the low investment, RSI, and paper production in projects related to R&D&I in this area.

Regarding areas with low RSI, such as *Law* and *Mind*, *Language and Thought*, they predominantly belong to humanities-related fields. Some studies have reported significant differences in the pattern of production and citation within this field compared to others, and the metrics used for evaluation need to fit to the analysis performed (Ochsner, Hug, & Daniel, 2016). These differences may be due to the fact that knowledge production in different fields contributes to different publication categories, including books, book chapters, journal articles, and conference papers (Butler, 2008). Therefore, to improve the assessment of different research fields one of the perspectives is to study the knowledge transfer between them. This suggests that using of the RSI to directly compare Formal, Natural and Applied-sciences to Social-sciences could be imprecise and may not represent the reality. Additionally, when the analysis is focused on citations rates, it is essential 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.

Therefore, it is as important to study the complexity of both the scientific structure and the potential impact of funding projects as it is to develop methodologies to evaluate them (Kenkmann, Schumacher, Freiburg, Eisenmann, & Muckenfuss, 2020). This is because different circumstances can lead to different results. For example, when evaluating the effects of specific policies across different universities, Cattaneo et al. (2014) demonstrated that universities with high legitimacy perceived greater benefits in terms of output production and performance in response to funding mechanisms compared to other universities (Cattaneo et al., 2016). Regarding the management of funding projects, Butler et al. (2001) analysed their application in terms of the reward system and observed an increase in scientific output despite a decrease in quality in the Australian context (Butler, 2003). These observations may have implications for the performance of both the funded project and the universities themselves. It is therefore essential to develop an evaluation infrastructure that considers the complexity of the fields and the behavior of universities, with the aim of the most accurate evaluation results possible.

Our approach and findings have the potential to benefit both researchers directly involved in the projects and individuals not directly involved in the research. On the one hand, the use of heat maps improves the efficiency of the benchmarking process, thereby facilitating the identification of potential collaborations. On the other hand, our findings can be used to support policymakers in their resource allocation decisions, to serve as a data source for critical studies assessing the impact of specific policies, and to provide insights into the expertise of different fields and universities in a country-level perspective (Thomas et al., 2020), among others.

Although these findings are relevant, it is necessary to report and discuss some limitations. Our study included some measurements based on research output, but science is marked by inequality, random chance, and other factors that make it difficult to measure the impact of research (Bornmann, 2017). In addition, research output can be influenced by factors, such as gender, age, academic qualification, academic rank, and other characteristics (Armijos Valdivieso, Avolio Alecchi, & Arévalo-Avecillas, 2022). In this respect, the metrics used to compare different areas may have a negative impact on the humanities-related fields, and the evaluation criteria used in this contribution may not accurately represent achievement in those areas. Additionally, we were unable to conduct a gender analysis of the principal researcher due to a lack of information. In future research, we aim to cover the impact of the projects by looking at the citations received by the papers in order to better understand the performance achieved in each field and to identify the gender balance in funding projects in Spain.

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 conducting research in R&D&I in this area. Regarding the metrics presented in this contribution, it is relevant to acknowledge that these indicators are imprecise for analysing the performance of humanities-related fields and, that comparing disciplines within Formal, Natural and Applied Sciences to those within Social Sciences can be challenging due to differences in production patterns. The findings highlight the potential of integrating SoS and data visualization as a powerful tool to improve understanding to the Spanish funding landscape. The implications of these results are diverse, such as providing a valuable resource for identifying potential collaborations based on research fields within the country, initiating discussions on the impact of funding projects, and potentially assisting policymakers and government agencies in formulating science policies.

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)

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

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