

Systematic review on R&D&I aid in Spain

Maria J. Vilaplana-Aparicio , Marta Martín Llaguno 

Universidad de Alicante (Spain)

maria.vilaplana@ua.es, marta.martin@ua.es

Received June, 2018

Accepted November, 2020

Abstract

Purpose: To analyse the scientific production around public R&D&I funds in Spain, in a context in which policies to promote innovation and development are considered essential for the progress of developed countries and receive significant amounts of the public budget.

Design/methodology: Systematic review of all the scientific contributions collected in the Web of Science Core Collection, Scopus and Proquest until March 2021, in which mention is made of R&D&I grants in Spain.

Findings: Scientific production indicates the positive impact of R&D&I aid on employment, private investment and cooperation. The list of topics which academic research deals with in this sense is, however, limited. Thus, aspects are identified in which there is still not enough scientific evidence, such as the effect of aid on the production of patents and utility models or the dissemination of the supported projects.

Research limitations/implications: The analysed data is limited to the Web of Science Core Collection, Scopus and Proquest. Gray literature is not analysed.

Originality/value: It is a study that can be useful to define future support policies for R&D&I aimed at companies.

Keywords: Innovation, R&D&I, Subsidies, Public funds, Tax incentives

Jel Codes: H2

To cite this article:

Vilaplana-Aparicio, M.J., & Martín Llaguno, M. (2022). Systematic review on R&D&I aid in Spain. *Intangible Capital*, 18(3), 331-349. <https://doi.org/10.3926/ic.1339>

1. Introduction

Research, Development and Technological Innovation (R&D&I) is a multifactorial concept widely defined and delimited by organisations such as the Organisation for Economic Co-operation and Development (OECD), which have developed the Frascati Manual (OCDE, 2002) and the Oslo Manual (OCDE, 2005), international benchmarks.

This definition of concepts is essential when establishing public policies to promote R&D&I and to determine the type of projects to be supported. In Spain there is a complex system of direct and indirect aid, promoted by the central administration and the different regional agencies (CEIM, 2010), which seeks to ensure that the

resources available to Spanish science contribute transversally to economic and social recovery, transformation and resilience over the coming years (MINHAFP, 2021).

Analysing the dimensions and impact of this public aid and strengthening lines of research that broaden knowledge in this field is particularly relevant in the context in which we find ourselves, and in which there is an urgent need to stimulate business R&D&I.

1.1. The situation of R&D&I in Europe and Spain

Innovation appears to be the differentiating competitive element of the most advanced societies. Not only is it a fundamental driver of growth, but it has also been shown to be essential for finding solutions to the challenges facing society today. Such is its importance at global level that it has been included among the Sustainable Development Goals (SDGs) set out in the United Nations Development Agenda (Naciones Unidas, 2021).

The European Union carries out various studies to ascertain the situation of R&D&I in its member countries in relation to the world's leading powers. Thus, the "European Innovation Scoreboard" makes a comparative analysis of innovation performance in Europe, and its strengths and weaknesses, so that member states know where to concentrate their efforts (European Union, 2020).

The latest 2020 report reveals that the EU's innovation performance is improving steadily. Globally, the EU performs better than the United States, Brazil, Russia, South Africa and India, but worse than South Korea, Canada, Australia and Japan. With respect to China, the EU still maintains a favourable position, although the gap is narrowing rapidly as the Asian country has a growth rate five times that of the EU (European Union, 2020).

From a regional perspective, however, progress is uneven across the 27 member states, and, in this respect, the EU categorises countries into four groups (European Union, 2019):

- "Innovation leaders" with performance more than 20% above the EU average.
- "Strong innovators": with performance between 90% and 120% of the EU average.
- "Moderate innovators": with performance between 50% and 90% of the EU average, and
- "Emerging innovators": performing below 50% of the EU average.

Denmark, Finland, Luxembourg, the Netherlands and Sweden are consistently the innovation leaders. Spain, in global terms, is considered a "Moderate Innovator", ahead of Slovenia, but behind Cyprus and Portugal and below the average. Moreover, the Autonomous Communities of the Canary Islands, Extremadura and Castilla la Mancha are considered "Emerging Innovators" (European Union, 2019).

It is particularly worrisome that of the different indicators measured, Spain continues to lag behind all the countries in terms of companies investing in R&D (Top R&D spending enterprises per 10 million population), employment share in manufacturing (Employment share manufacturing) and share of value added in foreign-controlled enterprises (Foreign-controlled enterprises - share of value added (%)).

According to the latest available data, domestic R&D expenditure in Spain amounted to 15,572 million euros in 2019, an increase of 4.2% over the previous year (Figure 1). By sector of execution, companies accounted for 56.1% of total domestic R&D expenditure, which translates into 0.7% of GDP. Likewise, R&D expenditure increased by 3.5% over the previous year in the Companies sector, by 4.9% in Higher Education and by 5.3% in Public Administration.



Figure 1. Total domestic R&D expenditure by sector of execution (thousands of euros). Orange business, red public administration, grey higher education, green IPDFLs (Instituto Nacional de Estadística)

However, over the last decade the number of companies in Spain that carry out R&D activities has been progressively decreasing, from 13,603 entities in 2009 to 11,096 in 2019. This reduction has been sharper in the case of small and medium-sized companies, from 12,553 companies in 2009 to 10,006 in 2019.

From the above data it can be inferred that R&D expenditure in Spain shows a modest increase compared to the previous two years. Nevertheless, although investment in the private sector is growing, it is concentrated in a smaller number of companies, especially SMEs.

1.2. R&D investment in the EU: Europe's revitalised NextGeneration EU plan

The EU-28 R&D expenditure as a percentage of GDP is lower than in countries such as South Korea (4.52%, 2018), Japan (3.28%, 2018) or the United States (2.82%). The most serious issue is that the case of Spain is striking, as it spends only 1.25% of GDP (2019), far behind countries such as Germany and Austria, which top the list of European countries with spending above 3%. The evolution of our country in recent years has not been good (it has been surpassed for the first time by Poland or Greece) and it does not look like it will improve substantially, as it even aspires to achieve an investment level of 2%, a very modest target (Eurostat, 2021).

In contrast, over the last decade, the European Union has intensified its levels of investment in R&D and innovation. Thus, by 2020 it had set a target of 3% of GDP (1% public funding and 2% private sector investment), but the health crisis caused by COVID has frustrated this aspiration and the latest data published for 2019 show only a slight increase in investment compared to the previous year, reaching 2.14%.

However, the forecasts for investment in R&D&I have been significantly modified in the last year. In response to the economic and social damage caused by the coronavirus pandemic, the European Union has created a temporary recovery instrument called Next GenerationEU, endowed with 750 billion euros. The aim of this instrument is to counteract the impact of the pandemic on the economy with investments and reforms and to "make the economy and employment more sustainable and resilient and solidly prepared for future scenarios". This budget complements the budget already foreseen in the European framework, which means that the total EU budget will almost double what was initially foreseen, reaching more than 1.8 trillion euros (European Commission, 2021).

The European Recovery and Resilience Mechanism is the central element within Next GenerationEU, with 672.5 billion euros in loans and grants available to support reforms and investments undertaken by EU countries. From this budget, Spain is expected to be able to obtain around 69 billion euros for the period 2021-2026 (European Commission, 2021).

The different member states have until 30 April to present their National Recovery and Resilience Plans with a programme of investments and reforms for the years 2021-2026, which must be articulated around six objectives strongly related to Innovation and Development, namely (European Commission, 2021):

1. Green and digital transformation: for the development of infrastructures, technologies and processes to make Europe a highly competitive continent on a global level and to increase its resilience and capacity for innovation.
2. Encouraging digitisation in services and SMEs: always with a focus on interoperability, energy efficiency and personal data protection.
3. Promotion of biodiversity, energy efficiency, building renovation and circular economy to foster sustainable growth.
4. Supporting social and territorial cohesion: to ensure public health and economic, social and institutional resilience, with a view to increasing responsiveness and preparedness to crises.
5. Development of sound education policies for the next generations to protect children and youth.
6. Responding to the specific recommendations of the European Semester, the system of European economic and social policy coordination.

The temporary recovery instrument Next Generation EU represents a change for investment in innovation and a unique opportunity for the public and private sector.

1.3. Public R&D policies in Spain

The different EU Member States have developed policies to stimulate R&D and, as mentioned above, allocate significant economic resources to this end.

In Spain, the 2021 budget allocation has been significantly increased, in a health context in which science and knowledge have been placed in a pre-eminent position. For this period, 11,483 million euros were earmarked for research, development, innovation and digitalisation, which is 5,106 million more than in 2020. Specifically noteworthy is the public support for initiatives within the framework of the Digital Agenda Spain 2025. This budget makes possible the development and implementation of the Shock plan for Science and Innovation (9 July 2020), the Spanish Science, Technology and Innovation Strategy and the Strategic Plan of the CDTI (MINHAFP, 2021). In addition, to this amount of state funding must be added the R&D&I investments of the different autonomous communities, which have also been boosted as a result of COVID.

But one of the distinguishing features of public investment in R&D policies in Spain is that, during 2021 and through the general budgets, more than 27 billion euros must be channelled from the Recovery, Transformation and Resilience Plan agreed at the European Council on 21 July 2020 (MINHAFP, 2021). A sum of money that has already been committed, at least on paper.

1.4. The regulatory framework for R&D&I policies in Spain

In Spain, the regulation of science, technology and innovation has its origins in the Law for the Promotion and General Coordination of Scientific and Technical Research (Law 13/1986 of 14 April 1986), now repealed, which sought to provide a solution to the scarcity of resources, lack of coordination and disconnection between research and technological development (Muñoz, 1985). The development of this legal text, together with Spain's entry into the European Union, constituted a crucial moment for the development of public R&D policies, and in February 1988 the first National R&D Plan was approved, whose objectives were (Pesquero & Muñoz-Alonso, 1997): the programming and coordination of activities, the intensification of the research effort, the mobilisation of private resources, and the incorporation of new human resources into the science and technology system. Since then, Spain has had eight national R&D plans: 1988-1991, 1992-1995, 1996-1999, 2000-2003, 2004-2007, 2008-2011, 2013-2016 and 2017-2020.

The State Plan for Scientific and Technical Research and Innovation 2017-2020, known as State Plan for R&D&I (MINECO, 2018) is "the fundamental instrument of the General State Administration, for the development and achievement of the objectives of the Spanish Strategy, and the Europe 2020 Strategy" (p. 11), and includes the different state aids that are aimed at promoting R&D&I. This plan is aligned with the Spanish Science and Technology and Innovation Strategy 2013-2020 (MINECO, 2013) and contains the vision and general objectives of science, technology and innovation policies.

In addition to the aforementioned texts, there is a rich regulatory framework that regulates R&D&I aid and which is made up of different legal texts of national and European origin. The General Subsidies Act (Spain, 2003) and its Regulation (Spain, 2006) are the main reference texts. In addition, there is the Framework for State Aid for Research and Development and Innovation (European Commission, 2014), which establishes the context in which EU Member States may grant public aid for R&D and the Commission Regulation declaring categories of aid compatible with the internal market (European Commission, 2014b).

1.5. R&D&I aid in Spain

In Spain, companies can access different types of R&D&I aid. This aid can be classified into direct aid (non-refundable subsidies or soft loans) and indirect aid (tax incentives applied to corporate income tax or social security rebates). The Autonomous Communities have the power to grant direct aid and the General State Administration manages both (CEIM, 2010).

On a practical level, there are several differences between direct and indirect aid. In the former, companies have to make an application and undergo an evaluation process in which their projects compete with others (competitive concurrence). Furthermore, direct aid lines have a minimum and maximum budget and can be aimed at specific sectors or companies of a certain size, especially SMEs. Another distinguishing feature is that a large part of direct aid is mutually incompatible and, moreover, is taxed.

Indirect aid, on the other hand, is non-competitive and any company that meets the requirements, regardless of its size, location or sector, can apply for it. Moreover, such aid is compatible with both direct and indirect aid, and is not taxed, resulting in a net saving.

It can be inferred from the above that, in Europe and in Spain, public policies to support Research, Development and Technological Innovation mobilise significant amounts of the public budget for their development and it is expected that this amount will be increased. In this context, in order to design efficient policies, it is essential to analyse, from a systematic point of view, the impact and dimensions of these public aids based on evidence.

The general objective of this article is to compile, examine and synthesise the scientific production carried out in Spain on R&D&I subsidies, with the aim of finding out what is known about their characteristics and impact at the present time.

Specifically, the aim is to:

- Describe the characteristics of the existing scientific texts: type of document, year of publication, language and number of authors.
- Identify the authors who publish on the issue, the works they have accumulated, the organisations to which they belong and the country in which they are based.
- Describe the characteristics of the journals that deal with the subject: articles published, publisher, country, language of publication, indexation, impact and citations received.
- Analyse the quality of these publications, taking as a reference the number of citations and the impact factor.
- Describe the elements of the research: object of study, geographical scope and methodologies.
- Analyse the results of the systematic review to determine what is known about the topic.

2. Materials and methods

In order to achieve the indicated objectives, a bibliometric study of the literature compiled in the databases Web of Science Core Collection, Scopus and Proquest has been carried out, taking into account articles, contributions to conferences and book chapters, which deal with the subject. The search was carried out in March 2021.

The search equation, which was the same in the three databases consulted (Table 1), was entered in Spanish and English and was as follows: (innovation OR R&D OR "research and development") AND (Aid OR subsidies OR "public funds" OR "tax incentives" OR "tax deductions" OR funding OR subsidies OR "public support").

Two complementary strategies have been used to narrow down the works referring to Spain. First, "Spain" was selected in the "country" filter offered by the three platforms; second, the search equation was repeated by including "Spain" or "español*" in the "subject, title or abstract" field, according to the different possibilities offered by each database in order to select only the additional papers referring to Spain that had not appeared in the first step. All languages have been searched and no time limitation has been used.

DATABASE	SEARCH EQUATION
Web of Science Core Collection	Year: all Font type: all Field: title / subject Equation: TI=((innovation OR R&D OR "research and development") AND (grant OR subsidy OR "public fund*" OR "tax incentives" OR "tax deductions" OR "public support")) AND TS=(Spain OR Spanish)
Scopus	Year: all Font type: all Field: title / title, abstract and keywords Equation: Title((innovation OR R&D OR "research and development") AND (grant OR subsidy OR "public fund*" OR "tax incentives" OR "tax deductions" OR "public support")) AND Title, abstract, keywords: (Spain or Spanish)
Proquest	Year of publication: all Font type: all Field: title / abstract Equation: Title: ((innovation OR R&D OR "research and development") AND (grant OR subsidy OR "public fund*" OR "tax incentives" OR "tax deductions" OR "public support")) AND Abstract: (Spain or Spanish)

Table 1. Search equation used

A total of 212 papers were compiled. After eliminating duplicates and reviewing the title, abstract and language of the paper, 74 papers were selected for further in-depth analysis (Figure 2).

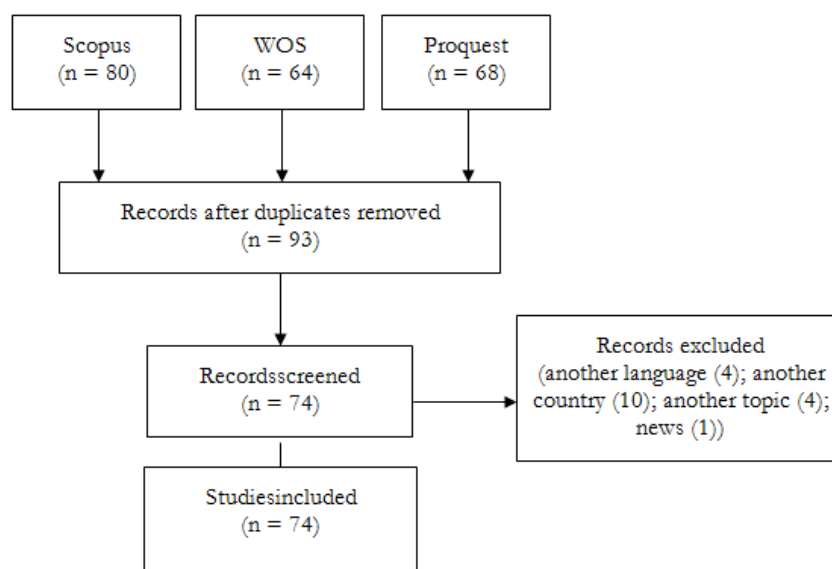


Figure 2. Study selection process

The documents eventually selected have been coded using a protocol that consists of twenty-five variables (Table 2), which have been grouped into the five categories shown below:

CHARACTERISTICS OF THE DOCUMENT	AUTHORS AND ORGANISATION	CHARACTERISTICS OF THE JOURNAL	QUALITY OF THE WORK	CONTENT OF THE PAPER
Type of document	Author's name	Number of articles published in the journal	Number of references used in the text	Object of the study
Year of publication	Number of author's publications	Publisher	Number of citations in the text	Geographical scope
Language	Institution	Country		Methodology
No. Authors	Country of origin of the institution	Seniority		Results
		Quartile of the journal		
		Language of publication		
		Periodicity		
		Category (subject)		
		Indexing		
		Impact		
		Total citations journal		

Table 2. Variables analysed for the coding of the papers

To obtain the data relating to the journals, the Journal Citation Reports database, Scimago Journal & Country Rank, the CIRC classification, MIAR and the websites of each journal were consulted.

3. Results

3.1. Characteristics of the documents

The documents compiled are 89.2% research articles, 8.1% contributions to conferences and 2.7% book chapters. With regard to their distribution over time, it can be seen that the number of papers has been increasing progressively over the last two decades, with the years of greatest production being 2016, 2012 and 2018 (Figure3).

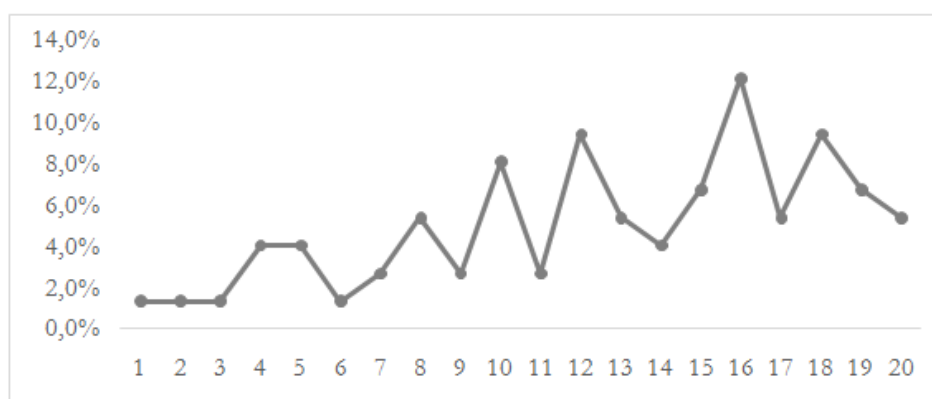


Figure 3. Time distribution of the documents compiled

With regard to the language of publication, English-language papers are more common (81.1%) than Spanish-language papers (18.9%). Likewise, there is a predominance of co-authored papers (82.4%), with studies with two authors (40.5%) and three authors (35.1%) prevailing.

A total of 126 authors have written on this issue, however, only 18.7% have more than one publication. The authors with the most papers (Table 3) are Guisado-González (2010; 2010; 2012; 2012; 2012; 2016; 2016; 2016; 2017; 2019), Guisado-Tato (2010; 2012; 2013; 2016; 2016; 2016), Afcha (2009; 2012; 2016; 2016; 2018; 2020), García-Quevedo (2004; 2005; 2009; 2012; 2016), Busom (1999; 2004; 2014; 2017), Martínez-Ros (2008; 2012; 2014; 2014; 2017) and Vila-Alonso (2010; 2010; 2012; 2019).

Author	Number of publications
Guisado-González, Manuel	8
Guisado-Tato, Manuel	6
Afcha, Sergio	5
García-Quevedo, José	5
Busom, Isabel	4
Martínez-Ros, Ester	4
Vila-Alonso, Mercedes	4

Table 3. Authors with the most publications

The researchers involved in R&D grants come from 63 different institutions, 52.4% of which are Spanish. The institutions with the highest number of researchers are the University of Vigo with eleven researchers, followed by the Complutense University of Madrid with eight, the University of Alicante with seven, and the Carlos III University of Madrid, the University of Barcelona and the Polytechnic University of Valencia with six authors each (see Table 4).

Author's institution of origin	No. of authors from the institution
University of Vigo	11
ComplutenseUniversidad ofMadrid	8
University of Alicante	7
Carlos III UniversityofMadrid	6
University of Barcelona	6
Polytechnic University of Valencia	6

Table 4. Organisations with the largest number of authors who have published on the issue

3.3. Characteristics of the journals

The selected papers have been published in a total of 47 journals, of which 36.2% are based in the UK, 21.3% in Spain, 19.1% in the Netherlands, 8% in the USA and the remaining 14.9% in Venezuela, Colombia, Switzerland, Canada and Chile.

The journals with the most publications on public R&D&I subsidies in Spain are (Table 5) Research Policy (7) from the Netherlands, Economics of Innovation and New Technology (4) from the UK, the Spanish journal Hacienda Pública Española (4) and the Dutch journal Small Business Economics (3).

Journal	Publisher	Country	Start year	No. Year	Subject	Language	No articles
Research Policy	Elsevier	The Netherlands	1972	10	Natural sciences, experimental sciences and technology in general; economics; industrial engineering; mathematics; political and administrative sciences	English	7
Economics of Innovation and New Technology	Taylor & Francis	United Kingdom	1990	8	Economics and business in general	English	4
Hacienda Publica Espanola	Instituto de Estudios Fiscales	Spain	1964	4	Economics	Spanish and English	4
Small Business Economics	Springer	The Netherlands	1989	8	Economics	English	3
BRQ Business Research Quarterly	Elsevier	The Netherlands	2014	4	Economics	English	2

Journal	Publisher	Country	Start year	No. Year	Subject	Language	No articles
Dyna	Federación de Asoc. de Ingenieros Industriales de España	Spain	1926	6	Industrial engineering	Spanish and English	2
Economic Modelling	Elsevier	The Netherlands	1984	8	Economics	English	2
Investigaciones Regionales	Facultad de Ciencias Económicas. Uni. de Alcalá	Spain	2002	3	Economics, geography	Spanish and English	2
Technological Forecasting & Social Change	Elsevier	United States of America	1969	9	Natural sciences, experimental sciences and technology in general; economics; political science and administration; psychology	English	2
The journal of industrial economics	Wiley	United Kingdom	1952	4	Economics	English	2

Table 5. Journals with the most publications on the subject, publisher, subject of the journal and number of publications on the object of study

In global terms, the journals that publish on the subject have a wealth of experience. In this sense, with the exception of BRQ Business Research Quarterly, the rest have a track record of more than ten years and 80.9% have more than 20 years' experience. In terms of frequency of publication, quarterly journals predominate (34%) and those that publish six and eight issues per year (12.8% each).

By analysing the profile of the journals in which the papers are published, it can be seen that these are in the field of economics (66%), business management (27.7%) and/or business (17%). It should also be noted that 55.3% of the journals are classified in more than one subject.

In 70.2% of the journals it is possible to publish in English, in English and Spanish (12.8%), in Spanish (8.5%) or in English and another language (8.5%).

Taking into consideration the data included in the Journal Citation Reports database, it is observed that 17% of the journals are in the first quartile, 19.1% in the second, 14.9% in the third, 8.5% in the fourth and 40.4% do not currently appear in this database.

The journal Research Policy, in addition to being the journal that accumulates the most papers on the object of study, is the journal with the second highest impact factor, behind Technological Forecasting & Social Change (Table 6), and the one with the second highest total citations.

Journal	Quartile	Impact factor	Impact factor without self cites	Total cites	Rank	Ranking
Technological Forecasting & Social Change	Q1	5.846	4.961	13,606	17/152	Business
Research Policy	Q1	5.351	4.716	24,817	24/226	Management
Energy Policy	Q1	5.042	4.394	49,950	28/112	Energy & fuels
Small Business Economics	Q1	4.803	4.227	8,306	31/152	Business
Food Policy	Q1	4.189	3.793	6,848	01/21	Agricultural economics & policy
Journal of Technology Transfer	Q1	4.147	3.420	3,311	50/226	Management
Industry and Innovation	Q1	3.351	3.221	1,602	48/373	Economics
Journal of Economic Surveys	Q1	3.126	3.036	3,450	57/373	Economics

Table 6. Q1 quartile journals that have published on R&D aid (Journal Citation Reports)

The journals analysed are indexed in different international databases such as Scopus (91.5%), Social Science Citation Index (59.6%), ABI/Inform (61.7%), Econlit (55.3%), Business Source Elite (51.1%) or Business Source Premier (51.1%) and International Bibliography of Social Sciences (44.7%).

3.4. Quality of the work

The number of references used in the academic papers was mainly between 21 and 40 (34.7%), followed by between 41 and 60 (22.7%), 61 and 80 (17.3%) and 1 and 20 (12%).

On the other hand, Table 7 shows the ten papers that have received the most citations. The contributions by González and Pazó (2008), González, Jaumandreu and Pazó (2005), Zúñiga-Vicente, Alonso-Borrego, Forcadell and Galán (2014), Blanes and Busom (2004) and García-Quevedo (2004), receive more than one hundred citations well above the rest of the papers.

Title Primary	Authors	Year	Scopus Citations	WOS Citations
Do public subsidies stimulate private R&D spending?	González, X.; Pazó, C.	2008	246	218
Barriers to innovation and subsidy effectiveness	González, X.; Jaumandreu, J.; Pazó, C.	2005	203	181
Assessing the effect of public subsidies on firm R&D investment: A survey	Zúñiga-Vicente, J. A.; Alonso-Borrego, C.; Forcadell, F. J.; Galán, J. I.	2014	186	163
Who participates in R&D subsidy programs?: The case of Spanish manufacturing firms	Blanes, J.; Busom, I.	2004	150	130
Do public subsidies complement business R&D? A meta-analysis of the econometric evidence	García-Quevedo, J.	2004	107	101
Tax incentives... or subsidies for business r&d?	Busom, I.; Corchuelo, B.; Martínez-Ros, E.	2014	53	44
Public selection and financing of R&D cooperative projects: Credit versus subsidy funding	Santamaría, L.; Barge-Gil, A.; Modrego, A.	2010	47	39
Public funding for product, process and organisational innovation in service industries	Un, C. A.; Montoro-Sanchez, A.	2010	34	35
Linking public support, R&D, innovation and productivity: New evidence from the Spanish food industry	Acosta, M.; Coronado, D.; Romero, C.	2015	31	34
Does the effect of public support for R&D depend on the degree of appropriability?	Gelabert, L.; Fosfuri, A.; Tribó, J. A.	2009	34	34

Table 7. Citations received in the selected documents (Scopus and Web of Science)

3.5. Content of the document

The papers analysed address different topics, with the impact of subsidies receiving the most attention (Table 8).

THEMATIC	% OF DOCUMENTS
1. Impact of subsidies	58.1%
2. Business participation in R&D programmes and propensity to innovate	24.3%
3. Financing tools, Effect of different subsidies	31.1%
4. Differences and complementarity of regional, state and European aid	10.8%
5. Other topics	9.5%

Table 8. Main topics under study

Within the impact of R&D&I subsidies, the following sub-themes have been addressed:

- Impact of subsidies on the R&D effort made by companies (51.2%),

- Impact of R&D aid on cooperation between entities (19.5%),
- Impact according to company size (14.6%),
- Impact on employment and human resources of the company (9.8%),
- Impact on R&D strategy (4.9%),
- Technology production (2.4%),
- Impact on knowledge acquisition (2.4%).

It should be noted that in some cases the same work has explored different topics in depth.

The publications have a national (73%), global (13.5%) and European (6.8%) geographical scope. As far as methodology is concerned, the use of a quantitative methodology predominates (79.7%), as opposed to qualitative (13.5%) or mixed (6.8%).

Empirical studies stand out, accounting for 56.4% of the total. A more in-depth analysis of the type of empirical study shows that 85.1% are based on the analysis of secondary data, with the most commonly used data source being the Survey on Business Strategies (ESEE) (33.3%); the Panel on Technological Innovation (PITEC) (23.8%), which is based on the Community Innovation Survey, but provides much richer information; the Community Innovation Survey (CIS) (14.3%); or other sources such as CDTI, Acció, Profit, Torres Quevedo or SABI, among others (28.6%).

The studies that have been identified with a qualitative methodology correspond to literature reviews.

3.6. Main ideas on R&D&I funding drawn from the documents

The main conclusions from the reading of the compiled documents are shown below:

3.6.1. Impact of subsidies

3.6.1.1. Innovative effort

Numerous papers analyse how R&D subsidies influence the innovative effort made by the firm. The results suggest that subsidies have a positive effect and stimulate R&D in Spanish entities (Busom, 1999; Callejón & García-Quevedo, 2005; González & Pazó, 2008; González et al., 2005; Huergo & Moreno, 2017; Marra, 2006; Segarra, 2018), and that the increase in publicly supported investment can be quantified at more than 50% (Acosa, Coronado & Romero, 2015). This argument is supported by a recent study conducted in 14 European countries, including Spain, which concludes that there is no total crowding out of investment and that, therefore, beneficiary firms invest more in R&D than non-beneficiary firms (Bianchini, Llerena & Martino, 2019), although public funding needs to be complemented by private funding (Callejón & García-Quevedo, 2005; Un & Montoro-Sánchez, 2010). Moreover, some entities, mainly smaller and operating in low-tech sectors, might stop investing in R&D activities in the absence of public support (Albors-Garrigós & Rodríguez, 2011; González & Pazó, 2008).

However, González et al. (2005) suggest that most subsidies are granted to firms that would otherwise have undertaken R&D activities. In this direction, financially constrained firms that receive R&D aid invest less in projects than those that also receive aid but do not have financing difficulties, i.e., aid alone does not seem to increase R&D investment (Acebo, Miguel-Dávila & Nieto, 2020).

Regarding tax incentives, Marra (2004; 2008) and Romero and Sanz (2007) conclude that they are an appropriate instrument with positive effects on private R&D investment, although their effect varies according to the size of the firm. However, a study conducted in France, Italy, UK and Spain (Sterlacchini & Venturini, 2019) underlines that in all countries, with the exception of Spain, there is a significant increase in the intensity of R&D expenditure.

In general, there is a broad consensus that subsidies complement private R&D and that there is no total crowding out between public and private spending. However, the existence of disagreements on some issues such as the impact of tax incentives keeps the debate open.

3.6.1.2. Cooperation

While authors such as Santamaría, Barge-Gil and Modrego (2010) or Guisado-González, Ferro-Soto and Guisado-Tato (2016) claim that R&D subsidies are useful to increase the external cooperation of companies with other agents, authors such as Chapman, Lucena and Alcha (2018) find heterogeneity in the impact, while noting that only half of the companies analysed experience a boost in their collaboration agreements. In addition, Guisado-González, González-Blanco, Coca-Pérez and Guisado-Tato (2017) argue that R&D grants and R&D cooperation agreements are not complementary and question their use to promote innovation in EU countries. In another study focusing on the hotel sector, Guisado-González, Guisado-Tato and Vila-Alonso (2012) also claim that R&D cooperation does not seem to actively contribute to innovation. Despite the divergent results, it seems that cooperating firms are more likely to get public support for their innovative projects (Guisado-Tato, Vila-Alonso and Guisado-González, 2010).

3.6.1.3. Firm size

There is a growing interest in the influence of firm size on the likelihood of receiving public support. However, the conclusions reached by experts are varied. Segarra-Blasco and Teruel (2016) conclude that firm size is not an influential variable in accessing subsidies and their results are in line with those of Alarcón and Arias (2018), who argue that firm size is not significant in regional support. On the contrary, several authors (Busom, 1999; Vila, Ferro & Guisado, 2010; Marra, 2006; García & Afcha, 2009; Labeaga & Martínez-Ros, 2012; Huergo & Moreno, 2017) claim that there are substantial differences associated with the size of the entity. In turn, while Vila et al. (2010) point out that larger firms are the ones that benefit most from public aid for innovation, Segarra-Blasco and Teruel (2016) note that younger firms tend to show a greater propensity to receive aid, as the probability of receiving public funds decreases with the size of the firm (Cuenca & Boza, 2015). In addition, agencies seem to be able to attract relatively smaller firms (Blanes & Busom, 2004).

On the other hand, the size of the company is also related to the access to support at different levels (regional, national or European). Large firms are more likely to have access to central government funding and SMEs are more likely to have access to regional funding. Likewise, having patents and belonging to a medium-high technology sector increases the probability of receiving public support from the central government, while this does not influence regional support (García & Afcha, 2009).

In the case of tax incentives, the size of the firm is also a determining factor. Taking into account the weight of SMEs in the Spanish economy, Labeaga and Martínez-Ros (2012) propose revising the system to increase its use by SMEs.

3.6.1.4. Employment and HR

The literature also suggests that there is a positive relationship between R&D subsidies and employment. Afcha and García-Quevedo (2016) conclude that subsidies increase the number of employees engaged in R&D and Wolff and Reinthaler (2008) suggest that subsidies have a direct relationship with a wage increase of R&D personnel. However, Martínez, Cruz-Castro and Sanz-Menéndez (2015) clarifies that, although there is an increase in jobs resulting from the support received, only about half of the subsidised contracts are consolidated at the end of their second year.

Similarly, Busom, Corchuelo and Martínez-Ros (2017) conclude that the lack of human capital can be a constraint for receiving subsidies and tax incentives and d'Andria and Savin (2018) discuss the need to use a tax incentive to attract and motivate innovation-driven workers.

3.6.1.5. R&D strategy

Afcha (2012) finds that the impact of public subsidies on R&D expenditures is related to the innovation strategy developed by the firm and its effect is more positive in entities that carry out internal and external R&D activities. Guisado-González et al. (2012) analyse the role of the technological strategy followed by firms to improve their innovative capacity and conclude that strategy has a more positive impact on innovation in processes.

3.6.1.6. Technological production

Torres-Barreto, Mendez-Duron and Hernandez-Perlines (2016) state that there is a positive relationship between participation in public subsidies and the technological production of the firm, understood as the registration of patents, utility models, etc. This is corroborated by Afcha and Lucena (2020) when they validate that national subsidy programmes favour stronger innovation, measured in patent applications and new product launches.

3.6.2. Participation of firms in R&D programmes and propensity to innovate

The results show that subsidies are a feasible and efficient tool to expand and enhance firms' participation in R&D&I (Huelgo & Moreno, 2017; Labeaga & Martínez-Ros, 2012; Arqué-Castells & Mohnen, 2015) and that they are also essential to foster sustained investment (Arqué-Castells, 2013). Their participation in programmes is often determined by the sector in which they operate (Acosta, Coronado, Romero, 2015; Alarcón & Arias, 2018; García-Álvarez-Coque, Mas-Verdu & Sanchez, 2015; Guisado-Tato et al., 2010) or by other factors such as the age of the firm (Busom, Corchuelo & Martínez-Ros, 2014) since, although it does not exert a significant direct impact, it seems that young firms are more likely to receive R&D grants (Segarra-Blasco & Teruel, 2016).

Previous experience in R&D projects is also positively associated with obtaining aid, as public R&D support policies seem to have been more effective in attracting firms that already have experience in R&D projects, especially in high-tech industries (Blanes & Busom, 2004).

3.6.3. Financing tools

Types of subsidies. Spanish companies have access to different types of aid that can be classified as direct and indirect (Szarowská, 2015). Furthermore, this aid can come from regional, state and European agencies (Altuzarra, 2010; González-Blanco, Vila-Alonso & Guisado-González, 2019). Although some authors clarify that the different levels of aid complement each other (Douglas & Radicic, 2020) or that there is insufficient evidence of overlap between the interventions of the different agencies (Alarcón & Arias, 2018; García & Afcha, 2009), there are other authors who note that there is evidence of substitution between regional and national aid (González-Blanco, et al., 2019).

In terms of indirect aid, firms can take advantage of R&D&I tax deductions and/or the Patent Box. Tax deductions for R&D&I in the Spanish system are among the most generous in the European context (Szarowská, 2017), as they allow companies to recover a significant part of their R&D&I efforts via corporate income tax. However, their limited application with respect to the total tax liability means that the Patent box scheme, which consists of the reduction of tax bases derived from the assignment and/or transfer of intangible assets, may be more attractive for financing R&D&I (Palomares & Ripoll, 2020).

Several experts address the suitability of each tool. Álvarez-Ayudo, Kao and Romero-Jordán (2018) suggest that tax deductions are more useful for boosting long-term investment, while R&D grants seem more effective when R&D investment is persistent and the projects are of quality. This contrasts with the findings of Szarowská (2015), who states that direct subsidies are aimed at supporting research with long-term objectives and tax incentives encourage short-term applied research and incremental innovation. Furthermore, Santamaría et al. (2010) conclude that near-market projects are more supported through soft loans, while basic research projects receive more support in the form of non-repayable grants. Busom et al. (2017) go a step further and add that highly productive industrial firms are more likely to obtain subsidies, while, on the contrary, the use of tax credits is not directly related to the firm's productivity level. Finally, it appears that subsidies are better suited than tax credits to encourage younger firms to engage in R&D activities (Busom et al., 2014).

In any case, there is a tendency to combine direct and indirect public funding to boost investment in research and technological development (Szarowská, 2015).

3.6.4. Selection of subsidised projects

Santamaría et al. (2010) develop a model that analyses the selection of R&D&I projects and examines which factors are key to their selection. They conclude that there are relevant regional differences in terms of project funding and that there is also diversity in terms of the technological areas to which the projects belong. Thus,

there is a preference for the selection of projects that are close to the market and involve the application of knowledge.

3.6.5. Other themes

The communication and dissemination of the results of innovation has also attracted the attention of academics. Despite the amounts allocated to R&D&I, information on subsidies and their impact is inaccessible (Poblet, Aryani, Caldecott, Sellis & Casanovas 2014) and it is necessary to increase communication actions in R&D&I grants, in order to comply with the transparency and communication purposes established by European and Spanish regulations (Vilaplana-Aparicio, Martín-Llaguno & Iglesias-García, 2018). However, a strict regulation of information disclosure on R&D subsidies can have very negative effects for the firm (Rebolledo & Sardonís, 2012), so striking a balance on this issue seems to be a matter of interest.

4. Conclusions

In the light of the results, it can be affirmed that research on R&D&I aid in Spain is an emerging topic, which has been of systematic interest since 2004. Most of the studies have focused on the impact of R&D&I aid, although the agenda of topics analysed has progressively broadened.

In terms of the journals in which the studies have been published, despite being contributions on R&D&I aid in Spain, most of them have been published in foreign journals. This fact shows how difficult it is to publish on this subject.

The literature related to the object of study is fundamentally of an empirical nature and has focused on the effects of subsidies and their impact on private investment, cooperation and employment. However, it is worth noting that there is still little depth and diversity in works that analyse the differences and effects between direct and indirect aid or even between the different types of subsidies. It seems urgent to analyse this last aspect in view of the shift of budgets in recent years in favour of direct aid in the form of credits.

On the other hand, aspects on which there is still insufficient scientific evidence have been identified such as the differences between regional and national programmes, the effect of aid on the production of patents and utility models and on the communication of innovation, the appropriateness of the moment at which aid arrives and the influence of R&D aid on the process of diffusion and adoption of innovations. Likewise, different points of view have been found when assessing the impact of subsidies on large companies and SMEs and the differences they entail. For this reason, it is necessary to go deeper in order to reach valid conclusions.

Broadening the academic analysis of the causes and effects of innovation is key to the progress of society and the evaluation of public policies to support R&D&I is currently crucial. Spain still has a pressing need to bring its R&D performance into line with the European average and to seek formulas that contribute to this. For all these reasons, and even more so in the scenario opened up by the arrival of the recovery funds, the study of aid for R&D&I is a subject of scientific interest.

A consensus emerges from the papers reviewed on the value of R&D subsidies and their impact on private investment. The value of the complementarity of regional, state and European aid, which supports different company profiles, is also noted. Nevertheless, it seems necessary to clarify the impact on cooperation between companies and organisations or to establish clear communication policies that allow citizens to know the impact of subsidies, without harming companies.

In conclusion, it is worth making progress in this field of research because it is essential to reach contrasted conclusions in order to be able to design public policies to promote R&D that are based on scientific evidence.

Finally, it should be noted that the study is not without limitations. The main limitation is based on having analysed only the scientific literature collected in the Web of Science Core Collection, Scopus and Proquest databases. Therefore, the results obtained should only be considered as a trend. In future lines of research, it would be appropriate to extend the study to the international sphere.

Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

References

- Acebo, E., Miguel-Dávila, J.Á., & Nieto, M. (2020). Do financial constraints moderate the relationship between innovation subsidies and firms' R&D investment?. *European Journal of Innovation Management*, 25(2), 347-364. <https://doi.org/10.1108/EJIM-07-2020-0286>
- Acosta, M., Coronado, D., & Romero, C. (2015). Linking public support, R&D, innovation and productivity: New evidence from the Spanish food industry. *Food Policy*, 57, 50-61. <https://doi.org/10.1016/j.foodpol.2015.09.005>
- Afcha, S. (2012). Analyzing the interaction between R&D subsidies and firm's innovation strategy. *Journal of technology management & innovation*, 7(3), 57-70. <https://doi.org/10.4067/S0718-27242012000300006>
- Afcha, S., & García-Quevedo, J. (2016). The impact of R&D subsidies on R&D employment composition. *Industrial and Corporate Change*, 25(6), 955-975. <https://doi.org/10.1093/icc/dtw008>
- Afcha, S., & Lucena, A. (2020). The effectiveness of R&D subsidies in fostering firm innovation: The role of knowledge-sourcing activities. *BRQ Business Research Quarterly*, 2340944420933629. <https://doi.org/10.1177/2340944420933629>
- Alarcón, S., & Arias, P. (2018). The public funding of innovation in agri-food businesses. *Spanish J. Agric. Res*, 16(13), 2018164-12657. <https://doi.org/10.5424/sjar/2018164-12657>
- Albors-Garrigos, J., & Rodríguez Barrera, R. (2011). Impact of public funding on a firm's innovation performance: Analysis of internal and external moderating factors. *International Journal of innovation management*, 15(06), 1297-1322. <https://doi.org/10.1142/S136391961100374X>
- Altuzarra, A. (2010). Public funding for innovation at different levels of government: an analysis of Spanish manufacturing. *European Journal of Economics, Finance and Administrative Sciences*, 20, 94-105.
- Álvarez-Ayuso, I.C., Kao, C., & Romero-Jordán, D. (2018). Long run effect of public grants and tax credits on R&D investment: A non-stationary panel data approach. *Economic Modelling*, 75, 93-104. <https://doi.org/10.1016/j.econmod.2018.06.011>
- Arqué-Castells, P. (2013). Persistence in R&D Performance and its Implications for the Granting of Subsidies. *Review of Industrial Organization*, 43(3), 193-220. <https://doi.org/10.1007/s11151-013-9381-0>
- Arqué-Castells, P., & Mohnen, P. (2015). Sunk costs, extensive R&D subsidies and permanent inducement effects. *The Journal of Industrial Economics*, 63(3), 458-494. <https://doi.org/10.1111/joie.12078>
- Blanes, J.V., & Busom, I. (2004). Who participates in R&D subsidy programs?: The case of Spanish manufacturing firms. *Research policy*, 33(10), 1459-1476. <https://doi.org/10.1016/j.respol.2004.07.006>
- Bianchini, S., Llerena, P., & Martino, R. (2019). The impact of R&D subsidies under different institutional frameworks. *Structural Change and Economic Dynamics*, 50, 65-78. <https://doi.org/10.1016/j.strueco.2019.04.002>
- Busom, I. (1999). An empirical evaluation of the effects of R&D subsidies. *Economics of innovation and new technology*, 9(2), 111-148. <https://doi.org/10.1080/10438590000000006>
- Busom, I., Corchuelo, B., & Martínez-Ros, E. (2014). Tax incentives... or subsidies for business R&D?. *Small Business Economics*, 43(3), 571-596. <https://doi.org/10.1007/s11187-014-9569-1>
- Busom, I., Corchuelo, B., & Martínez-Ros, E. (2017). Participation inertia in R&D tax incentive and subsidy programs. *Small Business Economics*, 48(1), 153-177. <https://doi.org/10.1007/s11187-016-9770-5>

- Callejón, M., & García-Quevedo, J. (2005). Public subsidies to business R&D: Do they stimulate private expenditures?. *Environment and Planning C: Government and Policy*, 23(2), 279-293. <https://doi.org/10.1068/c0428>
- CEIM Confederación Empresarial de Madrid (2010). *Impacto de las deducciones fiscales a la I+D en los resultados de las empresas. Análisis comparativo por países y tipos de empresas*. Available in: http://www.ayming.es/typo3conf/ext/almacg/user_upload/Ayming_Spain/Publicaciones/almacg-impacto-deducciones-I_D_i-resultados-de-las-empresas_01.pdf
- Chapman, G., Lucena, A., & Afcha, S. (2018). R&D subsidies & external collaborative breadth: Differential gains and the role of collaboration experience. *Research Policy*, 47(3), 623-636. <https://doi.org/10.1016/j.respol.2018.01.009>
- Cuenca, L., & Boza, A. (2015). Public funding in R&D projects: Opportunities for companies. *INTED2015 Proceedings*, 2194-2199.
- d'Andria, D., & Savin, I. (2018). A Win-Win-Win? Motivating innovation in a knowledge economy with tax incentives. *Technological Forecasting and Social Change*, 127, 38-56. <https://doi.org/10.1016/j.techfore.2017.05.030>
- Douglas, D., & Radicic, D. (2020). Network additionality and policy mix of regional and national public support for innovation. *Economics of Innovation and New Technology*, 31(3), 148-172. <https://doi.org/10.1080/10438599.2020.1789277>
- European Commission (2014). Framework for State aid for research and development and innovation. *Official Journal of the European Union*, 27 June 2014. Available in: [https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52014XC0627\(01\)&from=ES](https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52014XC0627(01)&from=ES)
- European Commission (2014b). Commission Regulation (UE) No 651/2014 of 17 June 2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty. *Official Journal of the European Union*, 26 June 2014. Available in: <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32014R0651&from=ES>
- European Commission (2021). *Recovery plan for Europe*. Available in: https://ec.europa.eu/info/strategy/recovery-plan-europe_es#nextgenerationeu
- European Union (2019). *Regional Innovation Scoreboard 2019*. Available in: https://ec.europa.eu/growth/industry/policy/innovation/regional_nn
- European Union (2020). *European Innovation Scoreboard 2020*. Available in: https://ec.europa.eu/growth/industry/policy/innovation/scoreboards_en
- Eurostat (2021). *Gross Domestic Expenditure on R&D* (consulted on March 16, 2021). Available in: https://ec.europa.eu/eurostat/web/products-datasets/-/t2020_20
- García-Quevedo, J. (2004). Do public subsidies complement business R&D? A meta-analysis of the econometric evidence. *Kyklos*, 57(1), 87-102. <https://doi.org/10.1111/j.0023-5962.2004.00244.x>
- García Quevedo, J., & Afcha Chávez, S. (2009). Assessing the impact of public funds on private R&D: A comparative analysis between state and regional subsidies. *Investigaciones Regionales-Journal of Regional Research*, 15, 277-294.
- García-Álvarez-Coque, J.M., Mas-Verdu, F., & Sanchez Garcia, M. (2015). Determinants of agri-food firms' participation in public funded research and development. *Agribusiness*, 31(3), 314-329. <https://doi.org/10.1002/agr.21407>
- González, X., Jaumandreu, J., & Pazó, C. (2005). Barriers to innovation and subsidy effectiveness. *RAND Journal of Economics*, 930-950.
- González, X., & Pazó, C. (2008). Do public subsidies stimulate private R&D spending?. *Research Policy*, 37(3), 371-389. <https://doi.org/10.1016/j.respol.2007.10.009>

- González-Blanco, J., Vila-Alonso, M., & Guisado-González, M. (2019). Public Support Agencies for Innovation in Multilevel Governance Systems: Exploring the Existence of Signs of Complementarity and Substitution. *Sustainability*, 11(20), 5778. <https://doi.org/10.3390/su11205778>
- Guisado-González, M., Ferro-Soto, C., & Guisado-Tato, M. (2016). Assessing the influence of differentiation strategy and R&D subsidies on R&D cooperation. *Technology Analysis & Strategic Management*, 28(7), 857-868. <https://doi.org/10.1080/09537325.2016.1180352>
- Guisado-González, M., González-Blanco, J., Coca-Pérez, J. L., & Guisado-Tato, M. (2017). Assessing the relationship between R&D subsidy, R&D cooperation and absorptive capacity: An investigation on the manufacturing Spanish case. *The Journal of Technology Transfer*, 43, 1-20. <https://doi.org/10.1007/s10961-017-9579-7>
- Guisado-González, M., Guisado-Tato, M., & Vila-Alonso, M. (2012). How public funding and firms' innovation strategies affect the innovation of the Spanish hotel industry. *The Innovation Journal*, 17(2), 1.
- Guisado-Tato, M., Vila-Alonso, M., & Guisado-González, M. (2010). Public funding of innovation. R+D cooperation and membership in printing industry. *Dyna*, 85(9), 760-767. <https://doi.org/10.6036/3627>
- Huergo, E., & Moreno, L. (2017). Subsidies or loans? Evaluating the impact of R&D support programmes. *Research Policy*, 46(7), 1198-1214. <https://doi.org/10.1016/j.respol.2017.05.006>
- Labeaga Azcona, J.M., & Martínez-Ros, E. (2012). Evaluation of the Impact of R&D Tax Incentives on the Propensity to Innovate. *Proceedings of the 9th International Conference on Innovation & Management*, 966-974.
- Marra Domínguez, M.A. (2004). Incentivos fiscales, inversión en actividades de I+ D y estructura de costes. Un análisis por tamaño para una muestra de empresas manufactureras españolas, 1991-1999. *Hacienda Pública Española*, (3), 9-35.
- Marra Domínguez, M.A. (2006). Efectos de las subvenciones públicas sobre la inversión en I+ D de las empresas manufactureras españolas. *Revista Galega de Economía*, 15(2), 227-246.
- Marra Domínguez, M.A. (2008). The effects of fiscal incentives and public subsidies on private R&D investment. *Hacienda Pública Española*, 184(1), 35-66.
- Martínez, C., Cruz-Castro, L., & Sanz-Menéndez, L. (2015). Innovation capabilities in the private sector: Evaluating subsidies for hiring S&T workers in Spain. *Research Evaluation*, 25(2), 196-208. <https://doi.org/10.1093/reseval/rvv035>
- MINECO, Ministerio de Economía y Competitividad (2018). *Plan Estatal de Investigación Científica, Técnica y de Innovación*. Madrid: Ministerio de Economía y Competitividad. Available in: <https://www.ciencia.gob.es/stfls/MICINN/Prensa/FICHEROS/2018/PlanEstatalIDI.pdf>
- MINECO, Ministerio de Economía y Competitividad (2013). *La Estrategia Española de Ciencia y Tecnología y de Innovación*. Madrid: Ministerio de Economía y Competitividad. Available in: http://www.idi.mineco.gob.es/stfls/MICINN/Investigacion/FICHEROS/Estrategia_espanola_ciencia_tecnologia_Innovacion.pdf
- MINHAFP, Ministerio de Hacienda y Función Pública (2021). *Presentación del proyecto de Presupuestos Generales del Estado 2021*. Available in: <https://www.sepg.pap.hacienda.gob.es/sitios/sepg/es-ES/Presupuestos/PGE/ProyectoPGE2021/Documents/LIBROAMARILLO2021.pdf>
- Muñoz, E. (1985). *Ley de Fomento y Coordinación General de la Investigación Científica y Técnica: Las razones de una propuesta de organización para la Investigación y el Desarrollo*. Available in: https://digital.csic.es/bitstream/10261/25273/1/SAD_DIG_IFS_Muñoz_Arbor475-476.pdf
- Naciones Unidas (2021). *Objetivos de Desarrollo Sostenible*. <https://www.undp.org/content/undp/es/home/sustainable-development-goals/goal-9-industry-innovation-and-infrastructure.html>
- OCDE (2002). *Frascati Manual, Propuesta de norma práctica para encuestas de investigación y desarrollo experimental*. París: OCDE.

- OCDE/Eurostat (2005). *Manual de Oslo: Guía para la recogida e interpretación de datos sobre innovación* (3ª ed.). Paris: OCDE
- Palomares Miralles, P., & Ripoll Alcón, J. (2020). El papel de los incentivos fiscales a la inversión en I+D+i en España. *Boletín Económico de ICE*, 3129, 61-72. <https://doi.org/10.32796/bice.2020.3129.7115>
- Pesquero Franco, E., & Muñoz-Alonso López, G. (1997). Consideraciones teóricas y evolución del Plan Nacional de la Investigación Científica y el Desarrollo Tecnológico. *Revista General de Información y Documentación*, 7(1), 169.
- Poblet, M., Aryani, A., Caldecott, K., Sellis, T. K., & Casanovas, P. (2014). Open-Access Grant Data: Towards Meta-Research Innovation. In *JURIX*, 125-130.
- Rebolledo, M., & Sandoñis, J. (2012). The effectiveness of R&D subsidies. *Economics of Innovation and New Technology*, 21(8), 815-825. <https://doi.org/10.1080/10438599.2012.671997>
- Romero Jordán, D., & Sanz Sanz, J.F. (2007). Eficacia de los incentivos fiscales a la inversión en I+D en España en los años noventa. *Hacienda Pública Española*, 183(4/2007), 9-32.
- Santamaría, L., Barge-Gil, A., & Modrego, A. (2010). Public selection and financing of R&D cooperative projects: Credit versus subsidy funding. *Research Policy*, 39(4), 549-563. <https://doi.org/10.1016/j.respol.2010.01.011>
- Segarra Blasco, A. (2018). Subsidies, Loans and Tax Incentives for Business R&D in Catalonia. *Investigaciones Regionales*, (40), 109-140.
- Segarra-Blasco, A., & Teruel, M. (2016). Application and success of R&D subsidies: What is the role of firm age?. *Industry and Innovation*, 23(8), 713-733. <https://doi.org/10.1080/13662716.2016.1201649>
- Spain (2003). Ley 38/2003, de 17 de noviembre, General de Subvenciones. *Boletín Oficial del Estado*, España, 18 de noviembre de 2003. Available in: <https://www.boe.es/buscar/act.php?id=BOE-A-2003-20977>
- Spain (2006). Real Decreto 887/2006, de 21 de julio, por el que se aprueba el Reglamento de la Ley 38/2003, de 17 de noviembre, General de Subvenciones. *Boletín Oficial del Estado*, España, 25 de julio de 2006. Available at: https://www.boe.es/diario_boe/txt.php?id=BOE-A-2006-13371
- Sterlacchini, A., & Venturini, F. (2019). R&D tax incentives in EU countries: Does the impact vary with firm size?. *Small Business Economics*, 53(3), 687-708. <https://doi.org/10.1007/s11187-018-0074-9>
- Szarowská, I. (2015). Direct and indirect funding of R&D and generosity of tax subsidy for R&D in selected EU countries. *Proceedings ICABR 2015*, 990.
- Szarowská, I. (2017). *Fiscal R&D incentives and tax subsidy in selected EU countries*. Available at: https://aak.slu.cz/en/artkey/aak-201702-0005_Fiskalni-pobidky-pro-vyzkum-a-vyvoj-a-danove-subvence-ve-vybranych-zemich-EU.php?l=en
- Torres-Barreto, M. L., Mendez-Duron, R., & Hernandez-Perlines, F. (2016). Technological impact of R&D grants on utility models. *R&D Management*, 46(S2), 537-551. <https://doi.org/10.1111/radm.12198>
- Un, C.A., & Montoro-Sanchez, A. (2010). Public funding for product, process and organisational innovation in service industries. *The Service Industries Journal*, 30(1), 133-147. <https://doi.org/10.1080/02642060802252035>
- Vila Alonso, M., Ferro Soto, C., & Guisado González, M. (2010). Innovación, financiación pública y tamaño empresarial. *Cuadernos de gestión*, 10(1), 75-87. <https://doi.org/10.5295/cdg.090176mv>
- Vilaplana Aparicio, M.J., Martín Llaguno, M., & Iglesias García, M. (2018). Communications obligations for Spanish enterprises receiving state R&D+i grants. *Dyna*, 93(3), 268-271. <https://doi.org/10.6036/8505>
- Wolff, G. B., & Reinthaler, V. (2008). The effectiveness of subsidies revisited: Accounting for wage and employment effects in business R&D. *Research Policy*, 37(8), 1403-1412. <https://doi.org/10.1016/j.respol.2008.04.023>

Zúñiga-Vicente, J.Á., Alonso-Borrego, C., Forcadell, F.J., & Galán, J.I. (2014). Assessing the effect of public subsidies on firm R&D investment: a survey. *Journal of Economic Surveys*, 28(1), 36-67.
<https://doi.org/10.1111/j.1467-6419.2012.00738.x>

Intangible Capital, 2022 (www.intangiblecapital.org)



Article's contents are provided on an Attribution-Non Commercial 4.0 Creative commons International License. Readers are allowed to copy, distribute and communicate article's contents, provided the author's and Intangible Capital's names are included. It must not be used for commercial purposes. To see the complete license contents, please visit <https://creativecommons.org/licenses/by-nc/4.0/>.