

PUBLIC EXPENDITURE EVALUATION 2018

PROJECT 5 (R&D+i)

STUDY

PROGRAM FOR THE PROMOTION OF TALENT AND ITS EMPLOYABILITY IN R&D+i



Independent Authority
for Fiscal Responsibility





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The Independent Authority for Fiscal Responsibility (AIReF by its Spanish acronym) was created with the mission of ensuring strict compliance with the principles of budgetary stability and financial sustainability set out in article 135 of the Spanish Constitution.

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CONCLUSION OF THE EVALUATION

Within the framework of the Spending Review carried out in Spain in 2018 by AIReF, the State Programme for the Promotion of Talent and its Employability in Research, Development and Innovation (R&D+i) of the *Ministerio de Ciencia, Innovación y Universidades* (Ministry of Science, Innovation and Universities - MCIU) has been analysed, the objective of which is to favour the training, specialisation and integration into the labour market of human resources in R&D+i, and their mobility. This programme is a key element of the R&D+i policy that generates talent and transfers it to the institutions that make up the Spanish System of Science, Technology and Innovation, as well as to the rest of the country's productive structure, with the aim of enhancing its social, economic and business development.

In 2017, the State allocated a budget of around 305 million euros to this Programme, which represented approximately 5% of the total State R&D+i budget. The analysis of this item of expenditure has been made considering three aspects: strategy, procedure and effectiveness, with the aim of offering proposals that improve the efficiency of the Programme from this threefold perspective and thereby promote the best use of public money.

The effectiveness analysis has focused on two Programme grants, both representing around 50%¹ of the Programme's budget: 1) the most important grant at the beginning of the research stage for the training of doctors, *Formación de Personal Investigador* (Research Staff Training - FPI), with an annual budget of around 98 million euros, 100,000 euros per grant; and 2) the most important grant in the consolidation stage of the researcher, which are the *Ramón y Cajal* (RyC) contracts, with an annual budget of around 54 million euros, 300,000 euros per grant. Specifically, the study evaluates the effectiveness of these two grants in improving academic and scientific production, as well as aspects linked to the professional career of researchers (among others, employment status and salary).

The following table summarises the objectives set out in the evaluation, the sources of information used and some of the main findings detected.

¹ The programme contains 11 predoctoral and post-doctoral grants. In addition to the FPI and RyC grants, there are other highly relevant aids in the field of research support, such as: *Formación del Profesorado Universitario* grants (University Professor Training - FPU), the Juan de la Cierva contracts for post-doctoral training (Training and Incorporation), the Torres Quevedo grants for the recruitment of doctorate holders in companies, and the Beatriz Galindo grants for the recruitment of doctorate holders.

TABLE 1. OBJECTIVES, SOURCES OF INFORMATION USED AND MAIN FINDINGS

1 STRATEGY	2 IMPLEMENTATION	3 EFFECTIVENESS
<p>To analyse the Programme for the Promotion of Talent and Employability in R&D+i in key aspects such as coverage, generosity and relevance.</p>	<p>To analyse the processing procedure of the Programme's grants; and their control and monitoring.</p>	<p>To analyse the extent to which FPI and RyC grants have contributed to aspects of working life and academic excellence.</p>
<p>Sources of information:</p> <ul style="list-style-type: none"> • Surveys of doctoral students, young researchers, and principal researchers in R&D Centres and Universities. • Documentary review. • Interviews to: <ul style="list-style-type: none"> – MCIU (including the <i>Agencia Estatal de Investigación</i> - State Research Agency, AEI) and some <i>Consejería de Educación</i> (Regional Ministries of Education). – R&D centres (including the <i>Consejo Superior de Investigaciones Científicas</i> - Spanish National Research Council-CSIC and the <i>Agencia Vasca de Innovación</i> - Basque Innovation Agency). – Foundations: <i>Rafael del Pino</i> and <i>La Caixa</i>. • Comparison and search for examples of good practices. 	<p>Sources of information:</p> <ul style="list-style-type: none"> • Information of applicants for pre-doctoral grants (FPI) and post-doctoral grants (<i>Ramón y Cajal</i>) from the 2008-2012 calls, including: application management information, scientific production information (Web of Science), information on working life (SS and <i>Agencia Estatal de Administración Tributaria</i> - Spanish Tax Agency - AEAT), thesis dissertation (TESEO). 	<p>Sources of information:</p> <ul style="list-style-type: none"> • Information of applicants for pre-doctoral grants (FPI) and post-doctoral grants (<i>Ramón y Cajal</i>) from the 2008-2012 calls, including: application management information, scientific production information (Web of Science), information on working life (SS and <i>Agencia Estatal de Administración Tributaria</i> - Spanish Tax Agency - AEAT), thesis dissertation (TESEO).
<p>Findings:</p> <ul style="list-style-type: none"> – State Plan grants are managed through different actors. Insufficient coordination with private innovation actors. – Lack of integration of the public R&D+i system with the private sector, only ~2% of pre-doctoral grants go to the private sector. – Lack of coverage during the post-doctoral stage, total grant coverage drops from 21% to 5% after completion of the doctorate. – The amounts of the grants have remained stable while there are large differences between Regions in terms of cost of living. 	<p>Findings:</p> <ul style="list-style-type: none"> – Lack of unity and transparency in the provision of information on research grants (at State, regional and European level). – Uncertainty of grant applicants in relation to the schedule of calls, and excessively long resolution deadlines. – Lack of transparency in the evaluation criteria of potential candidates for FPI grants, depending on the criteria of the principal researchers. – Excess of documentation to be presented and procedures to be carried out by researchers. 	<p>Findings:</p> <ul style="list-style-type: none"> – FPI grants have a positive but modest impact on the research career and a significant negative impact, at least in the short term, on the working lives of those who receive them. – RyC grants have a slightly more than modest impact on the research career and a positive impact on the employment rate and remuneration.

Source: AIR²F.

It is important to highlight, among others, the following three distinctive elements in this study: 1) this is the first time that the registers of grant applicants of the AEI of the MCIU have been cross-referenced with information from the AEAT and Social Security, and with various academic and scientific production websites to analyse the effectiveness of the grants in aspects of working life and academic and scientific excellence; 2) a survey has been carried out aimed at all doctoral students, young researchers and principal researchers from all universities and main R&D centres with the aim of enriching and complementing the study; and 3) it has identified the best national and international practices and the key aspects that need to be analysed in greater depth in order to improve the functioning of the R&D+i system in Spain.

From the analysis carried out by AIR^eF, systematised in 38 findings, there are five key aspects faced by the R&D+i ecosystem in Spain in order to strengthen its development: 1) the lack of alignment between the strategic challenges and the specific objectives of the Programme's actions; 2) the level of coverage of grants throughout the research career is not homogeneous and the amounts have not been updated; 3) the lack of integration of the public R&D+i system with the private sector; 4) the room for improvement in the reputation of the institutions and the quality of research in Spain; and 5) the high bureaucratisation of the procedure, its lack of transparency in some of these grants, and the scattered information on the different research grants (at State, regional and European level).

In relation to the two grants analysed, receiving an FPI pre-doctoral grant, which has a candidate selection design in which there may be discretionary elements, seems to lead, at least in the short term, to worse results in some aspects of working life. Specifically, a lower probability of obtaining employment and a lower salary are observed. On the other hand, the grant has a positive impact on the completion of the doctorate and a limited impact on scientific production, in quantity and quality.

In contrast, and in a positive way, receiving a *Ramón y Cajal* post-doctoral contract, which has a rigorous design where academic excellence prevails in the selection of candidates, improves scientific production, in quantity and quality, and increases the likelihood of obtaining employment and receiving a higher salary. It should be noted that there are indications that the *Ramón y Cajal* programme helps the Spanish R&D+i system to attract and fix talent by offering high-level professional opportunities in Spain to researchers who are also highly valued abroad.

Taking into account the above, and considering the best practices in other countries of our economic environment, AIR^eF makes 19 proposals, which can be grouped into:

1. Strategic reorientation: to align all the actors of the R&D+i system in the definition of the strategy and to redefine the specific objectives and indicators for the evaluation of results.

2. Focus on excellence: design a financing system based on excellence and performance, orienting the offer of grants towards centres of excellence, and encouraging completion of the doctorate in three years.
3. Overall review of coverage and generosity: increase in the number of grants in the post-doctoral stage and adjust the amount of grants to the cost of living, taking into account regional differences.
4. Public-private collaboration: create a new form of grant in innovation clusters and increase grants for human resources in collaboration with the private sector.
5. Optimisation of the processes of the Programme's grants: unify the information of grant programmes (at state, regional and European level) in a single web platform, redesign the schedule of calls for grants, revise the current criteria for awarding FPI grants, automate and simplify the process of monitoring grants, and implement rigorous parameters for scientific-technical monitoring, the compliance of which should condition the continuity of the grant.

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SUMMARY OF THE EVALUATION

1.1. Background

Article 149.1.15 of the Spanish Constitution establishes that the State has the exclusive competence for the promotion and general coordination of scientific research, while the promotion and financing of R&D+i is a shared responsibility between the *Administración General del Estado* (Central State Administration – AGE) and the Regions.

Human resources, their training and qualifications, are a key element of science, technology and innovation policy and constitute the basis of a country's progress and well-being. The quantity and quality of these human resources is directly related to a country's capacity to generate knowledge and, therefore, to improve its competitiveness and productivity and to be able to successfully face international challenges.

The objective of this study, within the framework of the Spending Review carried out in Spain in 2018 by AIReF, is to analyse the State Programme for the Promotion of Talent and its Employability of the State Research Agency (MCIU), whose aim is to favour the training, specialisation and integration into the labour market of human resources in R&D+i. Specifically, its strategy and definition are studied, as well as the procedure for the management and processing of its grants and contracts, as well as the impact of its two most important grants (FPI, and *Ramón y Cajal*, RyC) with respect to aspects of academic excellence and working life.

The study carried out by AIReF has the following differential elements:

- Use of information from the registers of FPI and RyC grants of the calls for the 2008-2012 period, administered by the State Research Agency. It is the first time that the information of the applicants of these grants is used with information of their working life in the registers of the Social Security and the Tax Agency, and the public information of academic and scientific production. All this

information has been used to analyse the effectiveness of the FPI and RyC grants in aspects of academic and scientific excellence and working life.

- Survey aimed at doctoral students and researchers from all over Spain. The analysis has been enriched with the elaboration of surveys, aimed at doctoral students and researchers in universities and research centres. The aim of the surveys is to ascertain their opinion on different aspects: needs and motivation, procedure for processing grants, and experience and impact of research grants. AIReF has benefited from the collaboration of 28 universities, 33 research centres and around 1,000 researchers (doctoral students and young researchers) and 400 principal researchers.
- International comparison. The best national and international practices have been identified, as well as the key aspects that should be analysed in greater depth in order to improve the functioning of the R&D+i system in Spain.

Additional information has also been obtained through interviews with: 1) officials from the AEI, the *Dirección General de Investigación, Desarrollo e Innovación* (Directorate General for Research, Development and Innovation), and the *Subdirección General de Formación del Profesorado Universitario* (Sub-Directorate General for University Teacher Training), all belonging to the MCIU, 3) staff from research centres and foundations.

AIReF has counted with the collaboration of McKinsey & Company for the implementation of this project and with the academic advice of the Fundación de Estudios de Economía Aplicada (Foundation for Applied Economic Studies – FEDEA), specifically José Emilio Boscá, Javier Ferri and Mauro Mediavilla. In any case, the final content of the study is the exclusive responsibility of AIReF.

1.2. Overview

The reference framework is the Spanish Strategy for Science, Technology and Innovation. Its objectives are aimed at promoting the country's scientific, technological and business leadership and increasing the innovation capacities of Spanish society and economy, including the recognition and promotion of talent and its employability.

The fundamental instrument of the AGE to promote the training and incorporation of human resources in R&D+i is the Programme for the Promotion of Talent and its Employability in R&D+i of the State Research Agency. The budget of the State Programme for the Promotion of Talent and its Employability in 2016 was 310 million euros (a decrease of 32% since 2008). The programme allocates 62% to grants for the promotion of talent, 33% to grants for the incorporation of researchers into the labour market and the rest to mobility grants.

The analysis carried out in relation to the needs of doctoral students and researchers has identified that these are similar throughout all stages of the research career, and job stabilisation is the priority in all of them. Financial needs should cover the opportunity cost versus other job opportunities and ensure job stability. The coverage of academic needs (e.g. mobility) increases the reputation of the Spanish R&D+i system, thus attracting international talent. Finally, with regard to information and administrative management needs, those related to the transparency of information and the simplification of administrative processes stand out.

With regard to the relevance of the strategic plans, these have been aimed at overcoming the current strategic challenges while at the same time they have been simplified in order to structure actions according to objectives. The current indicators reflect current research challenges (e.g., percentage of innovative SMEs, occupancy rate of doctoral graduates, among others) and have been grouped together to align them with the different programmes. However, from the analysis of the implementation it can be seen that most of the objectives have not been achieved. The total budget allocated to the different programmes of the state plans has decreased by 55 % from 2011 to 2016 (5,604 million euros to 2,504 million euros) which limits the ability to achieve the objectives of both the State Plan and those of the European Union's H2020 (e.g. to reach 3% of GDP in R&D+i investment).

As for the coverage and generosity of the system of grants, the coverage is variable throughout the research career, there is a significant decrease in the number of grants between the doctoral and post-doctoral stages. With respect to generosity, the amount offered by the grants is similar to the average opportunity cost of insertion in the private sector. In the post-doctoral period, the research career with grants exceeds in retribution its alternative in the public sector (teaching and research staff) but not so in the private sector. If the difference in remuneration observed between the private and public sectors in Spain is weighted over the entire professional career, it is estimated at 10.1%. In general terms, the state grants system is slightly less competitive than the regional and European systems in terms of the amount of the grants. Moreover, these amounts do not take into account temporary and regional variations in the cost of living.

In all, these grants do not sufficiently cover economic needs, nor some of the non-economic needs (stabilisation expectations, transversal skills, excessive administrative burden, and transparency in the information of the grants, among others), which can suppose a limitation for the attraction of talent to the Spanish R&D+i system.

With regard to the analysis of the procedure for processing grants, significant limitations have been identified in terms of information, deadlines and bureaucratisation that may negatively affect the attraction of talent to the Spanish R&D+i system. The procedures for selecting candidates differ in the two grants studied, which may be influencing their results.

In the FPI grant there is a certain discretion on the part of the principal researcher in charge of evaluating the candidates (40% CV, 60% suitability to the project). RyC grants have a rigorous design of selection of candidates based on curricular merit and the demonstrated ability to lead a line of research.

The impact analysis of the two main grants, FPI and RyC, makes it possible to study the effect of these grants on certain target variables on aspects such as academic and scientific excellence² and working life³ using traditional impact assessment techniques. These techniques try to create a control group that is similar to the treatment group (the researchers who receive the grant) except that this group does not receive the grant. The results of both groups are compared to determine the differential effect of the grant on the target variables. The results show that:

- The FPI predoctoral grant has a positive impact on completing the doctorate, and on continuing with academic activity⁴. On the contrary, in the short term, this grant appears to lead to poorer outcomes in aspects of working life⁵ such as employment rate, wage and job stability, and to have a limited impact on scientific production⁶. It is important to reassess these aspects of working life in the longer term⁷ and thus better estimate their effect on the life cycle.
- On the other hand, the *Ramón y Cajal* post-doctoral programme has a positive and significant impact on scientific production and continuity with academic activity. In addition, the grant has a significant impact on employment aspects such as the employment rate and annual remuneration. The period of study of the RyC grants, 2008-2012, overlaps with the economic recession that began in 2009 and which may explain the negative impact that RyC grants have on job stabilisation. It is important to reassess the impact of the grant on job stabilisation from the 2012 call onwards, which provides an incentive for bodies to create permanent jobs.

² Quantity and quality of scientific production

³ Rate of employment and remuneration, among others

⁴ The researcher is considered to be continuing in the academic career if he or she has published in the last three years available publications of sufficient quality to appear in the Journal Citation Report.

⁵ These seemingly paradoxical results may have different explanations, including that a later entry into the labour market may result in less experience and therefore have a cost in the form of worse labour outcomes in the short term.

⁶ Both in quantity and quality.

⁷ The FPI grant has a duration of four years and aspects of working life have been assessed in 2017

The study has taken into account the best practices identified in the EU-5 countries (Germany, Spain, France, Italy and the United Kingdom) as they have an economic and political situation that is comparable with Spain. Moreover, both Germany and the UK have very different systems to ours, and are at the forefront of some aspects of R&D.

1.3. Conclusions on findings and lessons learned

Context

- I. The level of total R&D+i investment is far from the EU average and the H2020⁸ targets. R&D+i investment in Spain was approximately 13,256 million euros in 2016, representing approximately 1.2% of GDP, less than the 2% European average (e.g. Germany invests 2.9% of GDP).
- II. From 2010 to 2016, the number of researchers and R&D staff fell by around 8%. In addition, the insertion rate of doctorate holders is low in the private sector compared to other countries (17% of active doctorate holders in the private sector compared to 65% in Germany).
- III. Spain stands in a good position in terms of the quantity of scientific production. However, in terms of research quality, Spain is below all EU-5 countries and below the EU average. For example, below all EU-5 countries in the h⁹ index and in publications in the top 10% most cited.
- IV. Low public-private collaboration reflected in a limited number of innovation clusters and R&D+i collaboration networks. One of the main characteristics of the financing of the Spanish system is the lesser involvement of the private sector in research and innovation. In addition, both the public and private sectors have a high self-financing ratio.
- V. As for the impact of business-related R&D, Spain stands out negatively in the percentage of innovative companies, 34%, compared to 49% in the EU, and in the low number of patents, 18 per million inhabitants, compared to 72 in the EU.
- VI. Lack of an institutional funding system based on academic excellence, a practice that is becoming more and more widespread in Europe in order to

guarantee the efficiency of R&D+i resources. There is no Spanish university in the top 100 of the rankings of prestigious universities.

⁸ Horizon 2020 is the framework programme on which a large part of the European Union's research and innovation activities are concentrated. In the 2014-2020 period, the main social challenges are addressed, promoting industrial leadership in Europe and reinforcing the excellence of its scientific base

⁹ The h index is a measure of scientific quality. A researcher has index h = n if he has n articles with at least n citations

Strategy

- I. The total R&D+i budget and its execution have fallen progressively year after year, severely limiting the ability to develop and implement new programmes. From 2009 to 2016, the State budget for R&D+i decreased by approximately 33% (from 9,673 million euros to 6,430 million euros).
- II. In 2016, one out of every two euros budgeted for R&D+i was not spent. This low budget execution is due to the high weight of instruments in the form of loans, which may not be attractive under current economic conditions. On the other hand, for the programme under study, managed mostly by the AEI, 86% was implemented in 2016, and 93% in 2017.
- III. The current R&D+i strategy has emerged from a simplification of programmes, but maintains the main challenges. The simplification is consistent with the structuring of actions according to the main objectives. In spite of this, there is little communication between the different actors involved in its management.
- IV. Relevant definition of the different programmes, as the aid instruments and the objectives of the state plan are aimed at overcoming the main challenges of the R&D+i ecosystem.
- V. It has not been possible to systematically achieve the strategic objectives for most of the indicators, especially in: a) collaboration with the private sector, b) turning Spain into an international benchmark of excellence in R&D+i.
- VI. Since 2008, the budget allocated to human resources in R&D+i has been gradually decreasing. The Programme for the Promotion of Talent and Employability in R&D+i, which is the subject of this study, reduced its budget by 32% from 2008 to 2016 (from 450 million euros to 304 million euros).
- VII. The grants assessed under the State Plan are managed through different actors (e.g. AEI, Subdirección General de Formación del Profesorado Universitario). Not all human resource grants are focused on the priority areas of the State Plan (e.g., Society Challenges). There is little coordination with private innovation actors and the coordination of universities is done in each Region, with few strategic alignment mechanisms.
- VIII. In the Basque Country, *Innobasque* is the innovation agency that coordinates research centres, universities, political actors and innovative private companies, in such a way that all these points of view are integrated into the definition of the strategic plans. In Catalonia there are mechanisms dedicated to fostering the collaboration of the entire innovation ecosystem (e.g. Barcelona Global).

- IX. Currently, there is no clear relationship between the grants and the strategic objectives pursued with each of them. Likewise, there is no direct connection between the indicators of the State Plan and the achievement of objectives.
- X. Lack of integration of the public R&D+i system with the private sector. The grants are mainly aimed at attracting talent in the public sector, and only approximately 2% of pre-doctoral grants go to the private sector.

Researchers' needs

- I. The needs of the researchers are similar throughout the research career, and the expectation of job stabilisation is the priority at all stages. The wage of researchers takes on greater importance as an economic need when moving forward in the research working life.

Coverage and generosity of the grant system

- I. The suppression of some grants from the Programme (*Junta para la Ampliación de Estudios - Council for the Extension of Studies - of the CSIC*) and the reduction of the Torres Quevedo grants budget have significantly reduced the total coverage from 2008 to 2017.
- II. Lack of coverage during the post-doctoral stage, which could jeopardise the future replacement of stable teaching and research staff in universities and public centres. The total coverage of the grants falls from 21% to 5% after completion of the doctorate. This discontinuity leads to high job instability, especially due to the lack of alternative opportunities.
- III. During the doctorate stage, the amount offered by the grants is similar to the average opportunity cost of insertion in the private sector. In the post-doctoral stage, the research career with grants exceeds its alternative in the public sector (teaching and research staff) in retribution but not so in the private sector. If the difference in remuneration observed between the private and public sectors in Spain is weighted over the entire professional career, it is estimated at 10.1%. Comparing Spain's data at the international level, the wage difference between the private sector and the academic world is consistent with the data recorded in the EU25, which has an average differential between sectors of 10%.
- IV. The RyC and Beatriz Galindo grants have a competitive amount which makes them an attraction factor for talent in Spain. During the consolidation of employment, the grants, on average, offer a higher remuneration, both to their alternative in the public sector and in the private sector.
- V. The amount of the grants has remained constant in recent years, however, the cost of living varies significantly and is different between the Regions.

- VI. The generosity of the grants represents a differential factor in the financial attractiveness of the research career. So much so that the investment of doing a doctorate is only financially attractive if it has a grant for its completion. Doing a doctorate with a grant generates an internal rate of return (IRR) of 26%, while doing it without a grant generates an IRR of -5% and it would take 22 years to compensate for the initial investment made.
- VII. In general terms, the state system is slightly less competitive than the regional and European systems. State grants cannot compete in remuneration with EU grants, which provide an amount 75% higher.

Implementation of the system of grants

- I. Low predictability of publication and resolution dates of the grants. Thus, there is great variability in the dates of the annual calls for grants, lack of temporal coordination between the stages of the research career and the dates of the calls for grants, there is little time to prepare the documentation required in the call, long periods for the resolution of the grants, which can extend beyond six months, etc.
- II. Lack of a single information platform, which can affect the access and continuity of students and researchers in the Spanish R&D system, and generates an additional administrative burden for applicants.
- III. The main problem in the application phase throughout all stages of the research career is the excessive bureaucratisation of the application process. Among the causes are the excessive time invested in completing forms (not homogeneous between all the grants, e.g. different standard CV models), the lack of contact points for resolving doubts about completing them, and the excessive documentation to be presented.
- IV. The candidate's academic record and the impact and relevance of the project are the two criteria most valued by researchers in the resolution of the grants. The weighting of the evaluation criteria is different for the main pre-doctoral grants, and significant differences are also found in the post-doctoral stage.
- V. After the awarding of the grants, the main problem is the uncertainty about the periods of receipt of the funding.
- VI. The economic justification is not sufficiently digitised and simplified. This process differs from one grant to another and requires an important burden of documentation for the different coordination units, which affects both the recipients of the grants and the coordination units of centres and universities in terms of workload. In some cases, additional documentation is requested for follow-up after the grant period.

- VII. The bureaucracy of the monitoring and control process is chosen as the biggest problem during the entire research career. Uncertainty about periods of receipt of the grant and excessive documentation in their approval are the two most relevant problems for researchers receiving grants.

Effectiveness of FPI and RyC grants

- I. We should be cautious about interpreting the results due to database limitations. Among other aspects, it is worth highlighting the following:
 - 1) information is only available on applicants for grants between 2008-2012, therefore the conclusions are limited to a period with unique characteristics (the significant impact of the financial crisis began to be felt between 2007/2008);
 - 2) lack of integration of information from applicants for other research grants; and
 - 3) lack of relevant information in order to be able to track applicants' career paths outside Spain.
- II. We do not have a single bibliographic code per researcher. Since names and surnames are filled in by the applicant when applying for a grant, there may be a variety of problems when searching for their scientific production (only one name from a composite name, name in the surname box, applicants with the same name and surname, etc.).
- III. FPI grants have a positive but modest impact on the research career, and a significant negative impact, at least in the short term, on the working lives of those who receive them.
- IV. The descriptive analysis shows us indications that FPI grants do not guarantee a higher employment rate, but they do encourage a higher rate of insertion in the academic world (university or R&D centres). Beneficiaries of FPI grants have a greater insertion in the university (40%) than non-beneficiaries (22%).
- V. RyC grants have a limited impact on the research career and a positive impact on the working life of researchers, except for stabilisation (affected by the period of study).
- VI. The descriptive analysis shows signs that the RyC programme helps the Spanish R&D system to attract and fix talent, reducing the departure of promising researchers abroad. 24% of the non-beneficiaries of the grant might have left the country¹⁰, compared to 3% of the beneficiaries.

8 It is assumed that individuals without a current contract and with more than three years of Social Security inactivity are carrying out their activities abroad.

TABLE 2. CAUSAL EFFECT OF FPI GRANT ON ASPECTS OF ACADEMIC EXCELLENCE AND WORKING LIFE

Objectives analysed	Treatment	Impact	Methods used
Finish the doctorate	Receive the FPI grant (duration 4 years)	The probability of completing the doctorate is 0.47 higher with a grant than without a grant.	Logit model
Increase in the number of publications after 5 years of applying for the grant	Receive the FPI grant (duration 4 years)	Increase between 0.30 and 0.50 publications.	Matching techniques (Mahalanobis, Genetics, Propensity Score), Impact estimators (A-I, regression, stratification, IPTW)
Increase in the h-index after 5 years of applying for the grant	Receive the FPI grant (duration 4 years)	Increases between 0.23 and 0.28. It is equivalent to an increase of between 19% and 24% of the beneficiaries' average	Matching techniques (Mahalanobis, Genetics, Propensity Score), Impact estimators (A-I, regression, stratification, IPTW)
Not to continue in the academic world	Receive the FPI grant (duration 4 years)	It decreases the probability of observing no publications in the last three years between 3 and 7 percentage points	Matching techniques (Mahalanobis, Genetics, Propensity Score), Impact estimators (A-I, regression, stratification, IPTW)
To be employed (year 2017)	Receive the FPI grant (duration 4 years)	The grant decreases the chances of being employed by approximately 3 percentage points (in the short term).	Matching techniques (Mahalanobis, Genetics, Propensity Score), Impact estimators (A-I, regression, stratification, IPTW)
To belong to the contribution group 1, (Engineers and Graduates. Senior management personnel not included in article 1.3.c) of the Workers' Statute) (year 2017)	Receive the FPI grant (duration 4 years)	Increases the probability of belonging to the contribution group 1 by about 12 percentage points.	Matching techniques (Mahalanobis, Genetics, Propensity Score), Impact estimators (A-I, regression, stratification, IPTW)
Gross annual remuneration (year 2017)	Receive the FPI grant (duration 4 years)	Causes a negative effect on the annual remuneration (in the short term), this effect ranges from 2,857 euros to 3,577 euros per year in favour of not receiving the grant. It is equivalent to reducing the average annual remuneration of beneficiaries by 36%.	Matching techniques (Mahalanobis, Propensity Score), Impact Estimators (A-I, Regression, Stratification, IPTW)

Source: AIReF.

TABLE 3. CAUSAL EFFECT OF THE RYC CONTRACT ON ASPECTS OF ACADEMIC EXCELLENCE AND WORKING LIFE

Objectives analysed	Treatment	Methods used
Increase in the number of publications after 5 years of applying for the grant	Receive the RyC contract (duration 5 years)	Increase between 1 and 2 publications.
Increase in the h-index after 5 years of applying for the grant	Receive the RyC contract (duration 5 years)	Increases between 0.36 and 0.57. It is equivalent to an increase of between 7% and 11% of the beneficiaries'
Not to continue in the academic world	Receive the RyC contract (duration 5 years)	It increases the probability of continuing the academic career between 5 and 6 percentage points.
To be employed (year 2017)	Receive the RyC contract (duration 5 years)	The grant increases the chances of being employed by about 25 percentage points.
To belong to the contribution group 1 (Engineers and Graduates, Senior management personnel not included in article 1.3.c) of the Workers' Statute) (year 2017)	Receive the RyC contract (duration 5 years)	Increases the probability of belonging to the contribution group 1 by 5 to 7 percentage points.
Gross annual remuneration (year 2017)	Receive the RyC contract (duration 5 years)	It causes a positive impact on the annual remuneration, ranging from 7,197.82 euros to 7,618.25 euros. This is equivalent to increasing the average annual remuneration of the beneficiaries by almost 25%.

Source: AIReF.

1.4. Measures proposed by AIReF

Based on the findings described in the previous section that affect the R&D+i System in Spain and that may limit its contribution to the social and economic progress of the country, AIReF makes the following proposals:

STRATEGIC REORIENTATION

These proposals seek to achieve more effective policies to strengthen research and innovation in the economy, aligning strategic and specific objectives and grants.

- **Alignment of all R&D+i actors.** To align all the points of view of the actors involved in the R&D+i system in order to define the strategy.

- **Focus the system of grants to research projects.** To associate grants with specific high-impact projects and to guarantee the continuity of these grants in long-term priority lines of research.
- **Redefinition of specific objectives and indicators for the evaluation of results.** To associate the objectives of the programme and the State Plan with specific objectives for each of the different grants and to establish traceable indicators to evaluate the effectiveness of each instrument.

OVERALL REVIEW OF COVERAGE

These proposals seek to increase coverage, especially in the post-doctoral stage, to make it more consistent with the cost of living. The aim is to guarantee a consistent flow of researchers to the university system and to achieve greater stability.

- **Reorientation of the unexecuted budget of the Plan towards the Programme for the Promotion of Talent and its Employability in R&D+i.** To balance the budget of the Programme for the Promotion of Talent and its Employability in R&D+i in order to increase its coverage and generosity in accordance with the needs of the innovative sector.
- **Review post-doctoral coverage** to ensure the sustainability and growth of R&D+i.
- **Adjust the amounts of the grants to take into account the evolution of the cost of living.** To modulate the generosity of research grants and adjust them to the evolution of the cost of living and its geographical variations.

PUBLIC-PRIVATE COLLABORATION

These proposals seek to achieve greater stability in the research career and generate greater attraction of national and international talent through collaboration with the private sector.

- **Promotion of clusters of excellence.** Grants for the training of doctors in innovation clusters, in order to strengthen the development of public-private R&D+i networks around institutions of excellence.
- **Promote opportunities in the private sector.** To promote collaboration opportunities with private companies, especially in the doctoral and post-doctoral stages and in the SMEs and start-up sectors.

- **Promotion of transversal business skills.** Training in transversal skills aimed at improving the employability of doctorate holders in the private sector, as well as carrying out activities aimed at promoting the connection with the private sector.

FOCUS ON EXCELLENCE

These proposals seek to guarantee a finalist research system, aimed at generating impact, which prioritises lines of research.

- **Funding based on excellence and performance.** To design an integral financing system in which such financing is defined annually by means of excellence and performance indicators of the research centres.
- **Orientation of the offer towards centres of excellence.** Priority access to grants for centres of excellence, especially in those areas of specific knowledge where coverage is critically low.
- **Evaluation of the excellence of thesis advisors.** To evaluate *ex post* the degree of quality of supervision of doctoral theses that have received grants. An evaluation of the thesis advisors that indicates a lack of compliance with the requirements will condition access to subsequent funding by the director and will harm the centre's position in the research ranking.
- **Encourage completion of the doctorate in three years.** To define appropriate incentives to encourage completion of the doctorate within three years (and before the end of the grant, four years).

OPTIMISATION OF PROCESSES FOR GRANTS

These proposals seek to make processes more efficient and information more accessible. They also include redesigning the evaluation criteria to make them consistent with the objectives of the different programmes.

- **Improve accessibility to information on doctoral and post-doctoral grants and contracts.** Unify information on grants and applications at the regional, national and European levels in a single online platform.
- **Redesign the schedule of calls for grants and contracts.** Redesign the schedule of calls: call date, application deadline and date of resolution of the grants so that the process is developed systematically and recurrently in time and to be known by potential applicants in advance.

- **Review of the mobility criteria of FPU grants.** Simplify the awarding of mobility grants for FPU, financing mobility stays for all beneficiaries of FPU grants.
- **Review of the FPI criteria established in the call.** Review and redefine the evaluation and award criteria of FPI grants established in the call for these grants.
- **Automation and simplification of the monitoring of grants.** To automate and simplify the process of monitoring applicants' grants.
- **Review of the scientific-technical monitoring of grants.** Implement rigorous parameters for scientific-technical monitoring, compliance with which conditions the continuity of the grant.



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