Analysis of the Research & Development Funding in Greece under EU Programmes

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Abstract

This paper presents the findings of the study of the funding of Research and Development (R&D) projects in Greece. Initially, a descriptive approach by sector and geographical area is performed on the absorption of Research and Development funds upon the completion of 1,949 research projects implemented by 3,259 research institutions in the framework of funding actions of the operational programmes of the Partnership Agreement for the Development Framework, for the 2007-2013 programming period. The absorption indicators identified by type of beneficiary, by scientific field and region resulting from the processing of the above data can be used in the future to allocate the funds for research projects. Subsequently, the paper studies the existence or not of a correlation between the initial project evaluation and the fund absorption at completion, as well as the correlation between the initial project evaluation and the effectiveness indices of projects at completion. For the specific deterministic analysis, statistical models are used with data from 293 research projects implemented in two programmes. In both cases, it appeared that there was no statistically significant relation between the initial evaluation and the degree of fund absorption or the eventual effectiveness of projects, a result which indicates that the initial evaluation approach may need improvement.

Keywords: R&D policy, R&D funding, Greece, descriptive analysis, deterministic analysis, ex-ante evaluation

1. Introduction

In 2010 the European Commission outlined a strategy for smart, sustainable and inclusive growth for the European Union and set, inter alia, the Research Objective for the 2020 Europe, which that was "3% of the European Union's Gross Domestic Product must be invested in Research and Development". EU Member States have adopted this objective as a national objective and, by implementing actions at national, EU and international level, have sought to create a new and more sustainable development path in the EU in the field of research. In parallel, they aimed to create an 'Innovation Union' to ensure the conversion of innovative ideas into products and services that would facilitate the creation of new jobs.

Greece, as a Member State of the EU, also embraced the above objective, presented as "R&D intensity" indicator, which is calculated as a percentage (%) of R&D expenditure on Gross Domestic Product and is one of the nine headline indicators used for monitoring the progress of EU2020 strategy in the research field. The main objectives of the funding of these research projects are related to enhancing all types of research and exploiting their results, promoting innovation, creating new research jobs, and improving the competitiveness of businesses with the production of high value-added products and services.

Furthermore, the development of cooperation between research teams from EU Member States, as well as from countries associated with the EU, is another objective. Additionally, we must not overlook the objectives of the exchange of know-how among researchers, generating innovation, high economic, environmental, social added value. Another important group of objectives is those of linking academic research with market needs and the economy, linking research and innovation with entrepreneurship, and the development of specialized scientific staff in R&D. Finally, we should note the objectives of the enhancement of business involvement in launching R&D activities and more effective interconnection of the research system of the country with the productive sectors of the economy.

The remarkable increase in the funding of research projects from resources under the Partnership Agreement for the Development Framework in recent years, in combination with the resulting benefits for the research institutions, the researchers, the economy and consequently the society was the motivation for the present study. More specifically, we would like to study the absorption of resources and examine whether the initial evaluation of research projects has a predictive effect on their fund absorption and effectiveness measured by established indicators. For the implementation of the present study, we used the data derived from 1,949 research projects executed in the framework of funding actions of the operational programmes of the Partnership Agreement for the Development Framework, for the 2007-2013 programming period, as there is data for both the absorption of the grant received for their implementation as well as data regarding their evaluation and effectiveness. The characteristics of these projects are presented for the first time with this paper.

In this study, we focus on two main objectives. The first objective is to present the most

important results concerning the absorption of funds from the implementation of funding programmes for research and development projects in Greece with a sectoral and geographical analysis. Specifically, the objective is to identify the key indicators of descriptive statistics for the absorption of funds for research projects by type of beneficiary, by Research Technological Development and Innovation (R.T.D.I.) sector, and by region of implementation with the aim of drawing conclusions on the absorption of research funds so far, but on the formulation of allocation policies of research and development funds in the future through respective funding programs as well.

Going one step further, following the overall descriptive analysis for the public expenditure absorption, the second objective is to attempt a deterministic analysis on two research projects funding actions "Collaboration 2009" and "Collaboration 2011" for which we have data to evaluate, as well and the values of their performance indicators. Specifically, we investigate the relationship between the initial evaluation of research projects, prior to their implementation, with the absorbency of the funds used, and their effectiveness, as it is valued with the help of some of the indicators listed below. The main purpose is to study whether the evaluation of research proposals carried out so far for the selection of research projects for funding is appropriate and successfully linked to their absorption and effectiveness or whether new methods of evaluation and selection of research projects should be proposed. However, according to the results of the deterministic analysis presented below, there are no significant correlations between the three factors: absorption, evaluation and effectiveness, a fact that research project management and funding entities should take seriously into consideration in the review of the framework for selecting and funding research projects in the future.

The remainder of the paper is organized as follows: In section 2, a literature review where some basic and recent papers are presented. In section 3 we provide the data on which the present paper relies. In section 4 we present the methodology for the descriptive and the deterministic analysis where the fund absorption is the key element. In section 5 we present the results and finally, the concluding remarks are included in the last section 6.

2. Literature Review

In the respective literature, many researchers studied the causes and effects in the field of funding R&D projects by using various research practices, methods and models. Among such studies the focus was mainly on the selection of the R&D projects to be funded as well as the effects of the R&D subsidies and the effectiveness of public intervention. Both ex-ante and ex-post evaluation processes and debates on which approach is more efficient were the subject of several researchers. Special mention was made to ex-ante evaluation by stressing its importance as part of the funding process and particularly to its role during the rating and selection of R&D projects. Some of the researchers distinguished between private and public research, while others between private and public funding; others explored the interplay between national and EU R&D programmes. Business growth, competitiveness and productivity were among the perspectives approached. Regional and geographical factors as well as collaborations between research entities were the main interest of other researchers.

Moreover, methodological problems in the respective R&D research field were identified and proposals were provided to address them.

The establishment of a policy-oriented research agenda map based on field observations was attempted using as survey markings the questions and challenges posed to evaluators by policy-makers (Feller, 2007). The paper underscored the trend towards ex-ante evaluation, which was then preferable because of its nature to provide analytical frameworks, metrics or methodologies relevant to future decisions.

With the use of a structural equation model (SEM) and Malcolm Baldrige National Quality Award (MBNQA) criteria an attempt was with the aim to evaluate the performance of R&D funding programmes for SMEs in terms of three aspects: output, outcome and impact under given funding inputs, R&D environment of the recipient company, and external evaluation programmes of the funding organization. The importance of internal R&D process of the recipient company and the external fund evaluation programme of the funding organization was stressed (Sohn et al., 2007).

An alternative three-stage approach was proposed employing data envelopment analysis to evaluate efficiency and Tobit regression to control external variables applied to 110 projects over 9 years, in order to assess the relative efficiency of government-sponsored research and development projects (GSP). It was concluded that firm size, industry, and ratio of public subsidy on research and development (R&D) budget of recipient firm significantly influences the technical efficiency of GSP in Taiwan (Hsu & Hsueh, 2008).

A research agenda for the measurement of economic impacts of Canadian government R&D support programmes was introduced (Cozzarin, 2008). Eighteen areas for both qualitative and quantitative data collection were categorized as general information, while R&D input or R&D output have been put forth. Using such information on five existing Canadian major business-related R&D federal programmes, the researcher assessed which indicators and methodologies can be implemented, reiterated the reasons for government R&D support programmes, and proposed a method for analyzing the socio-economic impact of these programmes.

The causes and effects of persistence in the discretionary allocation of public subsidies to R&D activities performed by private Italian manufacturing firms with more than 11 employees investing in R&D activities were studied by means of a descriptive analysis based on Transition Probability Matrixes and the Probit model (Antonelli & Crespi, 2013). They elaborated a crucial distinction between vicious Matthew-effects and virtuous Matthew-effects.

Afcha and López (2014) by applying the Multinomial Logit Model and descriptive Statistics on a dataset of 2007 manufacturing companies with more than 10 employees and R&D positive expenditure in the period 1991-2008 for at least one year deriving from the Survey on Business Strategies and confirmed that the public funding of R&D expenditure through subsidies have a positive impact on internal R&D and especially in the decision to conduct R&D internally and externally simultaneously.

The ex-ante evaluation process of an energy programme and specifically how exploration is codified in a peer review ex-ante evaluation process was also investigated (Bulathsinhala, 2015). By applying a qualitative approach, combining in-depth interviews with an observation study of 34 project evaluations, the study showed that there is a divergence and confusion between what the informants think constitutes the main purpose of the program and the level of exploration.

Through a Meta-Regression Analysis (MRA) a representative subsidy effect was identified (Dimos & Pugh, 2016). After controlling for publication selection bias and for a wide range of sample and study heterogeneities, their MRA findings rejected crowding out of private investment by public subsidy but revealed no evidence of substantial additionality. Furthermore, among the research practices explaining the heterogeneous effects reported in the literature they studied, those related to the treatment of unobservable firm heterogeneity were particularly important.

The case of the performance of Korea's Next Generation Network project was studied in 2017 (Eungdo et al., 2017). The researchers conducted a quantitative performance analysis using the proposed model in order to evaluate the performance of large-scale and publicly funded projects. The practical model suggested a standard matrix framework of indices that evaluates the performance of particular elements in an industrial ecosystem in vertical categories and the economic and technological outcome of those elements in horizontal categories. On the basis of the application of a balanced scorecard, the study used mixed methodologies such as social network analysis, inter-industry analysis, and the analytic hierarchy process to measure the performance of large-scale and publicly funded R&D projects.

The input and output additionality of national and European Union (EU) R&D programmes both separately and in combination was evaluated (Radicic & Pugh, 2017). Using a sample of small and medium-sized enterprises from twenty-eight European countries they discussed on the emergence of policy mix to contribute to understanding the effectiveness of innovation policy.

Data from approved and rejected applicants to two R&D funding instruments in Portugal was also explored and further evidence on R&D subsidy programmes directed to firms and S&T organisations was provided, by identifying the determinants of grant decisions by the public agency (Silva et al., 2017).

Methodological problems in measuring research productivity at the national level were investigated by comparing official R&D statistics for 18 countries from the OECD with publication data from the Web of Science. The paper questioned the approach where R&D statistics are used as an input variable and publications as an output variable to draw conclusions about the productivity or efficiency of national research and innovation systems (Aksnes et. al, 2017).

A counterfactual approach was applied, using the potential-outcome framework, to study two distinct R&D policy interventions targeting SMEs that were implemented in the Italian region

of Tuscany, between 2000–2006 using European Regional Development Funds (Caloffi et. al, 2018). The research data came from the Statistical Archive of Active Enterprises (ASIA), maintained by the Italian Institute of Statistics (ISTAT). They found that once public support is no longer available, the two subsidies have different effects on different types of SMEs. Two hypotheses were examined: First, the probability to continue to invest in R&D is higher for firms receiving subsidies for a collaborative R&D project than for firms receiving subsidies for an individual R&D project, and second the ex-post networking effects are higher for firms receiving subsidies for a collaborative R&D project than for firms receiving an individual R&D subsidy.

The indirect impact of R&D subsidies on firm external collaboration breadth was examined by applying a two-stage methodology on their cross-sectional and longitudinal data from the Spanish Panel of Technological Innovation Survey (PITEC) for years 2010–2013 in which the 2008–2011 and 2013–2016 plans were in place (Chapman et. al, 2018). In the first stage, they used data from 2007 to 2013 in estimating a matching procedure to examine the average and differential impact of R&D subsidies on external collaboration breadth, while accounting for selection bias on observables. In the second stage, they used further data from 2002 to 2010 on firm collaboration experience in estimating OLS regressions examining whether collaboration experience magnifies the indirect impact of R&D subsidies on external collaboration breadth.

Externally studentized residuals (descriptive statistics and correlations of variables) were used to analyze data from 269 IT entrepreneurial firms in China - all IT firms that went public on China's ChiNext Board (Growth Enterprise Board) and SME Board (Small and Medium-Sized Enterprise Board) from 2004 till 31 December 2015. It was found that R & D subsidy has an inverted U-shape effect on IPO performance, while non-R & D subsidy has a positive effect on IPO performance. Furthermore, both state ownership and patent intensity moderate the inverted U-shape relationship between R & D subsidy and IPO performance. In contrast, neither of them moderates the positive relationship between non-R & D subsidy and IPO performance (Chen et. al, 2018).

The effects of public research and development (R&D) subsidies and how the governance of such grants influences those effects were studied through Logit regressions on a firm-level panel dataset between 1998 and 2007 in China which consisted of Innofund-backed firms and all state-owned and non-state-owned industrial firms with annual sales of at least 5 million RMB (US$750,000). They found that public R&D subsidies tend to support more productive firms and the productivity of these government-backed firms is improved further after they get the government support (Guo et. al, 2018).

A geographical perspective and a combination of two counterfactual approaches - 'difference in differences' (DiD) and 'propensity score –were applied to a data set of 10.000 firms in Czechia during the period 2007–2014 to find that R&D support has a higher net effect on companies operating in regions with lower R&D intensity. Also it was found that direct R&D support in this advanced regional innovation system is associated negatively with firms' competitiveness (Květoň & Horák, 2018).

By means of a balanced panel for 94 French departments (excluding Corsica and overseas departments) over the period 2001–2011, was measured the macroeconomic impact of the French R&D policy mix on business R&D using regional data by applying the spatial Durbin model with structural breaks and fixed effects. The existence of a negative spatial dependence among R&D investments in regions was observed. It was also noticed that national subsidies are the only instrument that is able to generate significant crowding-in effects. On the contrary, it seems that the design, size and spatial allocation of funds from the other instruments lead them to act as beggar-thy-neighbor policies (Montmartin et. al, 2018).

The effect of Europe's largest multilateral subsidy program for R&D-performing small and medium-sized enterprises and the causal effect of public R&D grants on firm growth was studied using propensity score matching to condition on project evaluation scores. Their data derived from official Eurostars application records provided by EUREKA combined with employment and sales data from Bureau van Dijk's Amadeus database and included R&D-performing small and medium-sized enterprises (SMEs). The results of their research showed that R&D grants had no average effect on job creation and sales growth, but treatment effects were heterogeneous and positive for high-quality projects (Hünermund & Czarnitzki, 2019).

The first comprehensive analysis was undertaken by National Institute of General Medical Sciences (NIGMS) to examine the geographic distribution of its Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) funding and assess its relationship to outcomes associated with investment in the SBIR/STTR portfolio (Onken et al., 2019). Through administrative data from existing large-scale databases, the researchers performed the first in-depth evaluation of the outcomes of NIGMS's investment to reaffirm that economic activity in R&D and research output tend to cluster in geographic regions where knowledge can be generated and shared more efficiently.

The propensity score matching (PSM) technique was applied to all projects funded by publicly-funded Research Councils (UKRCs) over the 2004–2016 in order to study the effects of UK public support for R&D and innovation on the performance of UK firms. A positive effect was observed on the employment and turnover growth of participating firms, both in the short and in the medium term. (Vanino et al., 2019). While they explored impacts across different types of firms, they found stronger performance impacts for firms in R&D intensive industries and for smaller and less productive firms.

By using panel data from Spanish manufacturing firms and by applying the notion of knowledge sourcing, it was proposed that the policy-induced effects of R&D subsidies on the knowledge-sourcing process increase firms' innovation outcomes. The article presented evidence that by changing the knowledge sourcing of firms, national R&D subsidy programmes in Spain also favor more firm innovation, measured by patent applications and new product launches (Afcha & Lucena, 2020). The researchers further documented that the granting of R&D subsidies does not affect firm innovation directly but rather through inducing changes in the firm's R&D effort and openness to technology markets.

The impact of multiple performance pressures on the firm's resource allocation and R&D

investment was examined by testing a model from the perspective of behavioral agency theory, in which inconsistency in long- and short-term performance pressure facilitates the accumulation of organizational slack (Diwei et al., 2020). The researchers further tested the impact of an increase in organizational slack on the firms' R&D investment intensity. They found that high inconsistency in performance pressure and low managerial ownership jointly facilitate the accumulation of organizational slack.

Finally, by analyzing a sample of 1,344 observations of 224 international joint ventures (IJVs), over a period of 6 years (2012–2017) and by applying hierarchical moderated regression analysis (HMRA), it was showed that IJVs with political ties tend to invest more in R&D than their counterparts without political ties. It was also observed that this positive relationship grows stronger with high market turbulence, but wanes under high governmental policy turbulence (Yang et al., 2020)

3. Data

Greece invested as much as 13.4 billion euros in R&D for the time period 2011-2018, as presented in Figure 1 below.
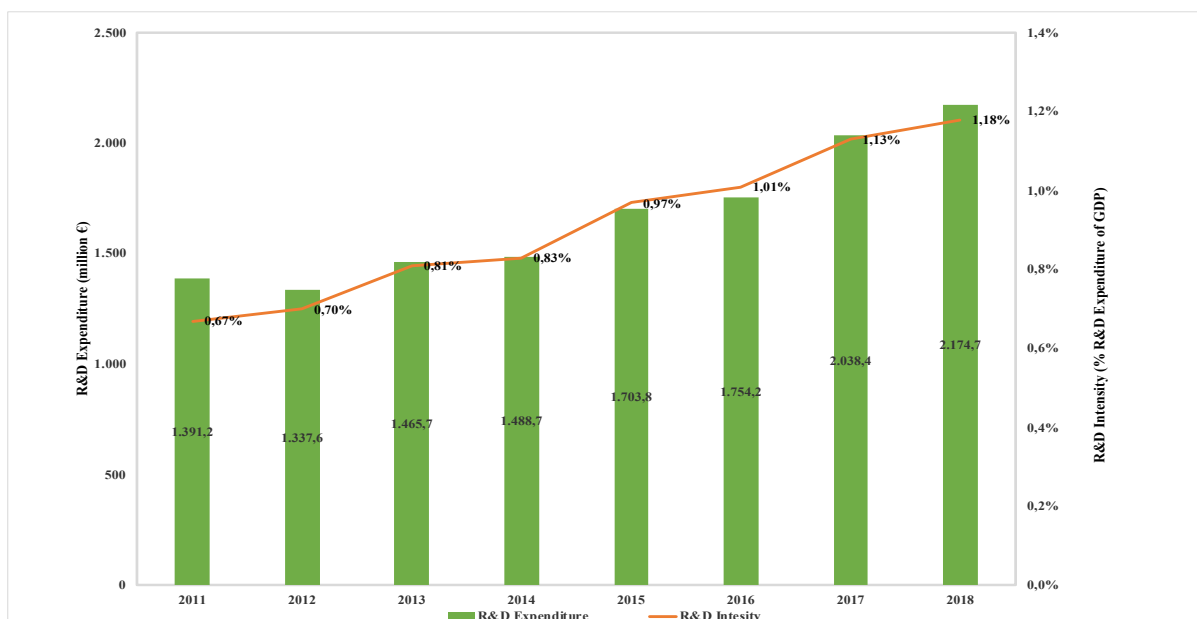

Figure 1. R&D Expenditure and R&D intensity (R&D Expenditure as % GDP), 2011 – 2018

Source: National Documentation Center

Over the last eight years, R&D expenditure in Greece has recorded a significant increase, according to the National Documentation Centre data, and, given that the GDP has been significantly decreased due to the economic downturn in the country, the R&D expenditure intensity indicator is constantly increasing. In 2018 the R&D expenditure percentage of GDP amounts to 1.18%, almost double the percentage of 0.67% for 2011. Despite the considerable increase, expenditure falls short behind the European average (2.07%), thus in 2018 Greece ranks 18th among EU member states. According to Eurostat, in 2018 the EU member states expended a total of € 318 billion on R&D. The "R&D intensity" indicator, which expresses

R&D expenditure as a percentage of GDP, increased to 2.06% in 2017 compared to 2.04% in 2016. Thirteen years ago (2007), the corresponding indicator was 1.77%.

Funding actions implemented and are still being implemented under the Partnership Agreement for the Development Framework of the 2007-2013 and 2014-2020 programming periods have played a key role in research funding for the period 2011-2020. In accordance with the Frascati manual (2015), such funding actions form a separate category of one of the main sources of R&D expenditure financing, i.e. the state funding (National Strategic Reference Framework – N.S.R.F.).

Table 1. R&D Expenditure by government- N.S.R.F., 2011-2018

Year	2011	2012	2013	2014	2015	2016	2017	2018
Government: NSRF (million EUR)	124,72	137,76	296,54	308,12	388,07	101,60	72,37	149,80

Source: National Documentation Center

Through the funding actions of these two partnership agreements, approximately 1.97 billion euros were distributed to research project implementing bodies which were mainly public research institutions and technology institutions, enterprises and partnerships of the above mentioned and had their project headquarters throughout the Greek territory.

The interest of the entities implementing research and development projects for the funding actions of NSRF 2007-2013 was particularly high. 11,217 funding beneficiaries submitted 11,018 research funding proposals to raise funding amounting to € 2.7 billion. Approximately 18.7% of the proposed projects (2,064) and 30.2% (3,386) of funding beneficiaries claiming public funding of € 546.3 million were approved. In the end, 1,949 projects were successfully implemented from those that initially received approval (94.4%) with a public expenditure of 405.7 million euros. The particular projects implemented by 3,259 research entities as well as their specific characteristics constitute the sample of our research.

Such entities, being funding beneficiaries, are mainly classified into three main categories: (a) research institutions, (b) businesses and (c) other research institutions. Research institutions include Higher Education Institutions, Research Centres and Institutes, Technological Institutes and Research Academic Institutions irrespective of their legal status (governed by public or private law) or how they are funded. Businesses which have been legally incorporated, include entities engaged in an economic activity and operate either as legal entities irrespective of their type (e.g. SA, LTD, General Partnership, Private Company, Social Cooperative Enterprise), or as sole proprietorships. Other research entities include Public Services falling under the Central Administration, Legal Entities governed by Public Law (such as Museums, Public Hospitals, the Academy of Athens, the National Library, the National Art Gallery, etc.), Legal Entities governed by Private Law, which have been established pursuant to Law or Presidential Decree and are granted by the State and certain Public Benefit Purpose Foundations.

The 1,949 research proposals are funded by the operational programs "Competitiveness and Entrepreneurship", "Human Resources Development" and "Education and Life Long Learning" of the Partnership Agreement for the Development Framework (NSRF), for the 2007-2013 programming period. Such particular operational programs were managed by the General Secretariat of Research and Technology (G.S.R.T.) and the Special Managing and Implementation Service in the areas of Research, Technological Development and Innovation (R.T.D.I.). During this period there were 37 calls for actions regarding R&D activities which are shown in Table 2.

Table 2. National R&D projects funding actions, (NSRF 2007-2013)

Development Proposals of Research institutions – KRIPIS
Aristia I and Aristia II
Creation of Innovation Clusters - A Greek Product
A Single Market: The Planet" – Pilot phase
Development Program Industrial Research and Technology (PAVET) 2013,
Creation – Support of new innovative enterprises, mainly knowledge-intensive enterprises
(Spin off και Spin out)
European Strategy Forum for Research Infrastructures-E.S.F.R.I.
Greece-France Bilateral R&T Cooperation 2009 & 2013
Greece-Germany Bilateral R&T Cooperation 2013-2015
Greece-Israel Bilateral R&T Cooperation 2013-2015
Greece-China Bilateral R&T Cooperation 2013-2014
Greece-Hungary Bilateral R&T Cooperation 2009
Greece-Romania Bilateral R&T Cooperation 2011-2012
Greece-Slovakia Bilateral R&T Cooperation 2011-2012
Greece-Turkey Bilateral R&T Cooperation 2010-2011
Greece-Czech Republic Bilateral R&T Cooperation 2011-2013
Supporting Postdoctoral Researchers, Supporting employment of research personnel in enterprises
Supporting newly established firms in their research and development activities
European R&T Cooperation – ERA-NET – 1st-2nd-3rd-4th Call – for Proposals
European R&T Cooperation - MarinERA - Marine Fisheries
European Nanoelectronics Initiative Advisory Council- ENIAC
Advanced Research and Technology for Embedded Intelligence and Systems- ARTEMIS
European R&T Cooperation -Joint Programming
Innovation vouchers for SMEs "Vouchers for SMEs"
Cooperation 2011 – "Partnerships of Production and Research Institutions in sectors of Focused Research and Technology",
Cooperation 2009– "Act I: Small and Medium-scale Collaborative Projects" and Act II: "Large-scale Collaborative Projects
Support Groups of SME's in their research and development activities, science and technology festival
Funding of proposals that were positively evaluated in the 3rd, 4th and 5th Call of Proposals for the ERC Grant Schemes

Source: G.S.R.T.- R.T.D.I.

The beneficiaries of the research funding were established to implement their research projects in the 13 Regions of the Greek Territory, while the scientific scope of the research proposals funded was related to engineering science, human science, agricultural science, science, medical science and social sciences and were included in the following areas of Research Technological Development and Innovation (R.T.D.I.) as shown in Table 3 with the corresponding data.

Table 3. Distribution of absorbed public expenditure by type of beneficiary, by RTDI sector and by region of implementation

Description	Number of beneficiaries of research projects	Budget of Projects (€)	Public Expenditure for Projects (€)
Research institution	1.665	286.394.217	286.183.964
Business	1.560	195.279.356	118.757.162
Other Research institutions	34	871.867	800.618
Total	**3.259**	**482.545.440**	**405.741.745**
Space and Security Technologies	92	17.710.883	13.849.456
Agriculture-Fisheries-Livestock Farming-Food and Biotechnology	523	68.687.060	56.245.095
Energy	316	46.185.601	38.562.817
Social and Economic Development Dimension	88	12.247.996	11.733.463
Transportation	112	11.542.175	9.209.372
Nanotechnology - Nanoscience and Microelectronics	301	54.436.035	46.554.243
Cultural Heritage	101	16.180.192	14.628.624
Environment	351	48.496.651	41.726.574
Health	561	96.818.249	84.813.298
High-Value Added Products and Production Technologies focusing on Traditional Industries	172	16.760.511	13.635.439
Information and Communication Technologies	597	86.063.404	67.366.680
Other sectors	45	7.416.683	7.416.683
Total	**3.259**	**482.545.440**	**405.741.745**
Attica	1.435	233.942.180	191.011.565
Eastern Macedonia & Thrace	101	13.160.221	11.077.071
Western Greece	282	40.405.623	36.057.820
North Aegean	39	5.208.884	4.725.632
Epirus	68	8.998.443	8.146.940
Western Macedonia	38	3.619.068	2.759.461
Thessaly	179	16.287.484	14.699.370
Ionian Islands	11	1.264.135	861.007
Central Makedonia	612	78.962.483	65.156.397
Crete	350	59.028.557	56.731.469
Peloponnese	53	8.068.421	5.919.439
Central Greece	84	12.799.154	8.035.087
South Aegean	7	800.787	560.486
Total	**3.259**	**482.545.440**	**405.741.745**

Source: G.S.R.T.- R.T.D.I.

During the 2007-2013 programming period, 3,259 research projects with a total budget of € 482.5 million were implemented and public expenditure amounting to € 405.7 million was paid to the beneficiaries. Most of the public expenditure, about EUR 286.2 million (70.6% of total public expenditure) intended to finance research projects, was paid to the country's research institutions during the specific time period. Enterprises eligible for funding received € 118.8 million (29.2% of total public expenditure) and other research institutions received €0.8 million (0.2% of total public expenditure).

With reference to Research Technological Development and Innovation sector, most of the funding beneficiaries implemented projects related to the 'Information and Communication Technologies" sector (579, 18.3%) and the minority of them engaged in projects concerning the "Other sector" category with the least absorption, EUR 7.4 million, while the largest absorption was from beneficiaries who opted for projects related to the "Health" sector amounting to EUR 84.8 million.

Regarding the criterion of the beneficiaries' region, it emerged that most of the beneficiaries who received funding belonged to the "Attica" region (1,435, 44%), while the fewest belonged to the "South Aegean" region (7, 0.2%). Most of the public funding was received by beneficiaries based in the "Attica" region, EUR 191 million (47%), while the smallest part of the public funding was received by beneficiaries based in the "South Aegean" region, 0.56 million euro (0.13%).

4. Methodology

First, a descriptive analysis on the data of the R&D funded projects is performed in order to present the basic characteristics per sector as well as per geographical area of the funded projects. A key element is the absorbance rate of the initially requested funds which is a measure of adequacy of the submitted proposals. The differences in absorbance rate by sector and by region are indicative of where the future efforts should be directed.

Secondly, we perform a deterministic analysis trying to extract the relation between the initial evaluation of the projects and some eventually realized facts, namely, the fund absorbance and the performance in specific outcome indicators using regression analysis. For the implementation of the above regressions, we were based on the evaluation and absorption data of 293 research projects implemented in the framework of the funding actions of the research and development projects "Cooperation 2009" and "Cooperation 2011" projects. The characteristics of such actions are presented in detail below. The action "Cooperation 2009" was implemented within the framework of the Operational Programme "Competitiveness and Entrepreneurship" (EPAN-II), of the Partnership Agreement for the Development Framework, for the 2007-2013 programming period and aimed at supporting the cooperation between Greek enterprises and Greek research institutions, by funding partnerships that conduct research and technological projects promoting the competitiveness and externality of Greek enterprises.

The research proposals for funding were selected following an evaluation procedure initiated by the preliminary audit, in which the proposals are checked for completeness and their formal specifications in accordance with the requirements set out in the call for proposals and the Implementation Guide of the action, the main evaluation and the hierarchy of proposals. The evaluation of the proposals was carried out by evaluation committees consisting of two members from the Register of Certified Evaluators and was comparative. The evaluation criteria for each research proposal are as follows:

Criterion A: Scientific and technical excellence of the proposed project. The minimum acceptable score of each research proposal for this criterion was 20 points and the maximum score it could receive was 35 points.

Criterion B: Experience and credibility of the partnership, and quality, ability of the project implementation. The minimum acceptable score of each research proposal for this criterion was 20 points and the maximum score it could receive was 30 points.

Criterion C: Experience and credibility of the partnership, and quality, ability of the project implementation. The minimum acceptable score of each research proposal for this criterion was 20 points and the maximum score it could receive was 30 points.

Proposals are graded on a scale of 0-100 points. The total score was calculated as the sum of the individual scores on the three criteria above. The highest score a proposal could receive was 100 points, while the lowest acceptable total score was 65 points. A proposal must be awarded the minimum acceptable score in each of the three individual criteria and the total score in order to be able to be approved for funding.

The action "Cooperation 2011" was implemented within the framework of the Operational Programme "Competitiveness and Entrepreneurship" (EPAN-II), of the Partnership Agreement for the Development Framework, for the 2007-2013 programming period and aimed to improve competitiveness, business externality and quality of life, the enhancement of the link between the research and production, the interdisciplinary approach, the specialization of the research staff, as well as the international cooperation through networking and collaboration with stakeholders from European and other countries. The beneficiaries of the action were enterprises of all sizes and research institutions (Universities, Technological Education Institutes (TEIs), Research Centres, Institutes). The action targeted domestic partnerships of dynamic enterprises of all sizes, Research Centres, Institutes, Universities, Technological, Public, and other entities for the implementation of R&D projects in focused sectors.

The research proposals for funding were selected following an evaluation procedure initiated by the preliminary audit, in which the proposals are checked for completeness and their formal specifications in accordance with the requirements set out in the call for proposals and the Implementation Guide of the action, the main evaluation and the hierarchy of proposals. The evaluation of the proposals was carried out by Evaluation Committees by "thematic / sectoral" area, consisting of three (3) - five (5) expert members with research and / or industrial experience related to the subject of the project to be evaluated, as well as the

assistance of international reviewers / evaluators. The evaluation examined the relevance of the subject matter of each proposal to the scientific and technological priorities of the call, the completeness of each proposal from the perspective of scientific, technical and economic impact and the activities of the proposed project. The evaluation was comparative and the evaluation criteria for each research proposal were as follows:

Criterion A: Quality – credibility of the partnership, with a weighting factor of 30%

Criterion B: Scientific and technical excellence of the proposed project, with a weighting factor of 30%

Criterion C: Contribution to the country's economy and productivity and impact on the operation and progress of the participating enterprises, with a weighting factor of 40%

Each criterion was scored on a scale of 0 to 4. Half point scores could be awarded (such as 0.5, 1.5, 2.5, 3.5). The total score for each proposal was calculated as the sum of the scores of the three criteria, multiplied by the corresponding weighting factor. We use the data of the two programmes "Cooperation 2009" and "Cooperation 2011" so as to study the relationship between the evaluation process and the obtained result. In other words, whether the projects proposals that are evaluated with good scores eventually present good results when they are completed.

In the first case, we investigate the existence of a relationship between the initial evaluation of research projects, prior to their implementation with the absorption of the funds used for their implementation. Simple regressions were carried out with the absorption of the public expenditure for each project as a dependent variable and the total score each research project received to clarify the relationship between absorption and evaluation. We tried also a simple regression model with the absorption of the public expenditure for each project as a dependent variable and the rating that each research proposal received separately for each evaluation criterion as independent variables, in order to study which of the three evaluation criteria is most relevant to the final absorption of each project.

In the second case, we investigate the existence of the relationship between the initial evaluation of research projects prior to their implementation with the effectiveness of each project measured by specific indicators to measure immediate outcomes. Immediate outcome measurement indicators help to monitor and evaluate research proposals implemented within the framework of grant programmes in each programme period and for each action individually, as they measure the efficiency and effectiveness of interventions, arising from the impact of the funded actions on the research projects. The purpose of such indicators is to ensure that the strategic planning of each programme is implemented to achieve the objectives of the individual strategies of the Development Programs / Actions set and that the funding is allocated according to the planning and promotes the production of the desired output, immediate outcomes and impacts. The effectiveness indicators are determined by the NSRF Integrated Monitoring System for Indicators and in fact for the NSRF 2014-2020 programming period, as their monitoring is mandatory according to the regulation of the European Social Fund.

In this case study, the common indicators of immediate outcome measurement for the funding actions 2009 and 2011 are: A) "New jobs created during project operation", (measured in full-time equivalent (FTE), and is defined as the ratio of working hours actually spent on R&D during a specific reference period divided by the total number of hours conventionally worked in the same period by an individual or by a group). B) "Number of research and technological development projects" (measured in numbers), C) "Number of projects of cooperation between enterprises and research institutes" (measured in numbers), D) "Number of research jobs created" (measured in full-time equivalent) E) "Induced Investments (private)" (measured in million euros), and F) "Jobs created during project implementation" (measured in equivalent man-years).

Simple regressions were carried out with the total score that each research project received upon the evaluation and selection procedure by the management body as the dependent variable and the final cost-effectiveness indicators of each project as the independent variables with the aim of studying whether and to what extent the evaluation of each project is linked with its effectiveness per indicator.

5. Results and Discussion

5.1 Results of the Descriptive Analysis

Table 4 illustrates the descriptive statistics indicators (mean, standard deviation, maximum and minimum value) of data on the absorption of public expenditure by type of beneficiary.

Table 4. Descriptive statistics for the absorption of public expenditure by type of beneficiary

Type of Beneficiary	N	mean	Std. Dev	Min	max
Research institution	1.650	86.02	17.60	0.00	305.00
Business	1.545	78.83	34.07	0.00	853.20
Other Research institutions	31	46.04	40.11	0.00	98.39

We can observe that Research Institutes and Business participate almost equally while the other research institutions have a much lower share. Regarding the absorption of public expenditure, the Research Institutes are found to be more capable than Businesses (mean 86% vs 79%) by type of beneficiary, while Other Research Institutes are much lower (46%).

The superiority of the research institutions over the enterprises regarding the absorption of research funds from operational programmes are mainly due to four factors. Initially, such superiority is attributable to the different aid schemes received; the different amount of funding received over the last twenty years; the way they are organized and operate; the obstacles faced by the enterprises during the time period under review, attempting to be funded for innovative products and services that they produce and offer.

The intensity of the aid (public expenditure) that each beneficiary receives in the context of its funding from a funding action usually depends on five factors. Primarily by the type of the institution requesting the funding, i.e. whether it is a public research institution or a private enterprise; in case the beneficiary is an enterprise then its size; the number of collaborations

created between institutions (public or private partnerships) for the implementation of a research project; the type of research it will carry out, i.e. whether it is basic, industrial or experimental development; the activities it will be called upon to develop in the context of the project implementation. Public research institutions may receive a rate of aid that can amount to 100% of their project budget. In case of basic research, such actions are implemented at 100% public expenditure. In case of industrial research and / or experimental development, the institutions may be funded at a rate of 100% only if the project results are widely disseminated.

Enterprises, on the other hand, can receive subsidies of up to 100% of the project budget in very few cases. Depending on the type of research they carry out, they can be funded, on average, up to 45% for experimental development, up to 70% for industrial research and up to 100% for basic research. Depending on their size, they can receive aid up to 60% of the project budget in the case of large and medium-sized enterprises and up to 75% in the case of small enterprises. The remaining part of the required funding (25% -55%) of their research projects should be covered by payment of own participation, which additionally burdens the liquidity of enterprises and creates the need to seek own or foreign capital.

Based on the available data on the expenditure of R&D resources per implementation sector in the period 2001-2016 (year of completion of the NSRF 2007-2013) the research institutes of the country always received more resources for R&D from the enterprises, which ensured their continuous and uninterrupted research activity and the development of increasing know-how for the implementation of research projects, in contrast to the enterprises whose research funding was not secured on an annual basis.

Significant differences are observed regarding the way of organization and operation of research institutions versus enterprises. The research institutions occupy more specialized scientific staff and more qualified in procedures to receive a subsidy who, due to their long-term involvement, have developed a special know-how that allows them to participate continuously with research proposals in respective funding announcements, receive high scores in the evaluation and selection procedures and realize high rates of absorption of the projected public expenditure as opposed to enterprises having executives with low level of knowledge and training in technical issues with regard to receiving grants.

In addition, according to a relative study, just a few years before the beginning of the 2007-2013 operational programme the enterprises did not have a positive view of such funding programmes. For the enterprises, such funding was occasional and scattered, characterized by slow evaluation flows and payments of public expenditures, a dysfunctional framework and bureaucratic procedures, limited time to submit proposals, bearing a high risk of failure and lack of incentives to maintain long-term partnerships between the enterprises and the research institutions. In combination with the problems of lack of liquidity and limited access to banking financing that the enterprises faced due to the economic crisis that prevailed in the country, the above reasons hindered the implementation of research projects by enterprises.

The aforementioned results confirm the dominant position of the country's research institutions in the absorption of research funds from operational programmes. In addition, the need to encourage enterprises to absorb research funds from co-financed resources should be highlighted, which, in combination with the highly increased own resources they use for research and development in recent years, may lead to even more positive research results. According to the international practice, the role of the State is important for the promotion and facilitation of research in enterprises. This is why the appropriate public financial interventions should be made immediately, as well as other initiatives that contribute positively to the innovative activity of enterprises. Moreover, the business support scheme should be immediately considered and improved, and the barriers to funding should be removed. Finally, a more rational allocation of research funds should be made.

Figure 2 below shows the average absorption of public expenditure per R.T.D.I. sector. The average public expenditure absorption for all sectors receives values between 77% and 89%. Specifically, 26.4% of the beneficiaries had an average absorption of over 85%, 55.3% of the beneficiaries had an average absorption of between 80% and 85%, while an average absorption below 80% represented 18.3% of the beneficiaries of the funding actions of research proposals. The R.T.D.I. sectors with the highest absorption are: Cultural Heritage with 88.98%, High-Value Added Products and Production Technologies focusing on Traditional Industries with 86.35% and Information and Communication Technologies with 85.55%, while the sectors with the lowest average absorption of public expenditure are the sectors of Energy, Transportation and Space and Security Technologies with values of 78.42%, 77.60% and 77.26%, respectively.

Average absorption rate per project for each R.T.D.I. sector

Sector	Rate
Cultural Heritage (100)	88,98%
High-Value Added Products and Production Technologies focusing on Traditional Industries (171)	86,35%
Information and Communication Technologies (595)	85,55%
Other Sector (45)	83,68%
Agriculture-Fisheries-Livestock Farming-Food and Biotechnology (523)	82,99%
Environment (349)	81,54%
Health (544)	80,74%
Nanotechnology - Nanoscience and Microelectronics (301)	80,62%
Social and Economic Development Dimension (87)	79,21%
Energy (309)	78,42%
Space and Security Technologies (92)	77,60%
Transportation (110)	77,26%

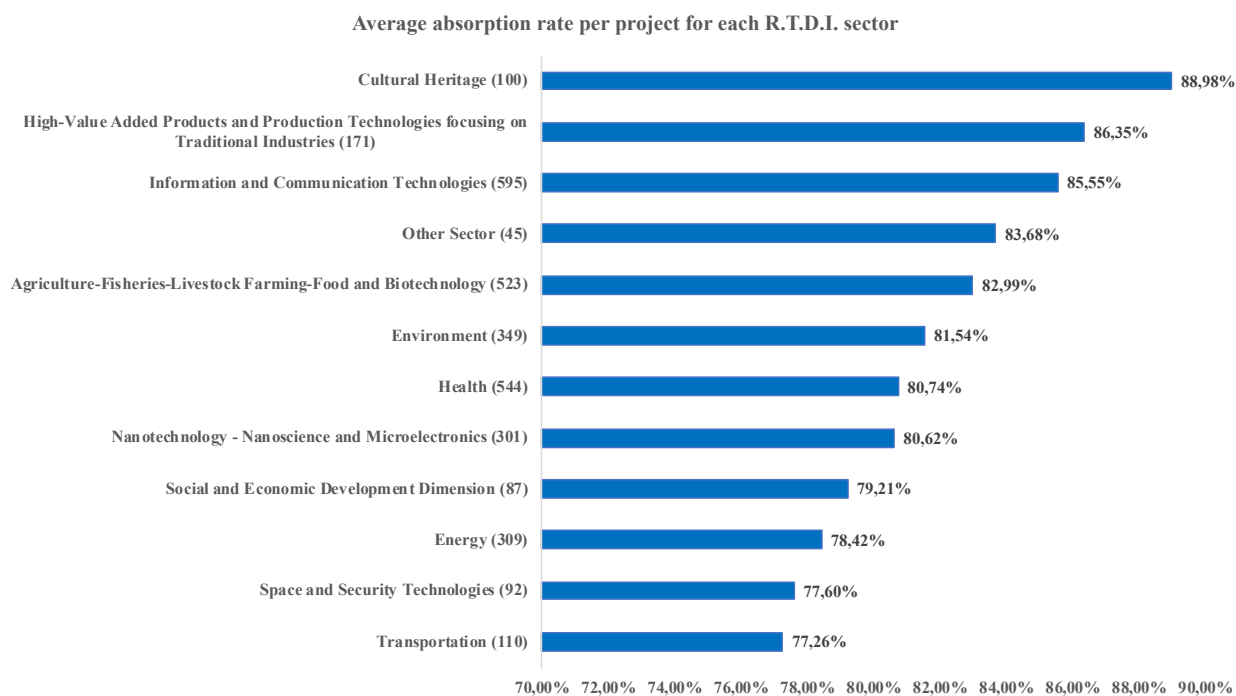70,00% 72,00% 74,00% 76,00% 78,00% 80,00% 82,00% 84,00% 86,00% 88,00% 90,00%

Figure 2. Average absorption rate per project for each R.T.D.I. sector

Based on the rates of absorption of public expenditure presented, funding for research projects in the field of "Information and Communication Technologies" may involve less risk in the management and allocation of the available funds. Over time, the specific R.T.D.I. sector records high performance in the field of business innovation compared to other sectors.

Table 5 below shows the average absorption of public expenditure per region (according to where the headquarters of beneficiary implementing the research proposal is located). It can be noted that the majority of the regions have an absorption between 80% and 85% including the large regions of Attica and Central Macedonia. The geographical distribution of the absorbance rate is depicted graphically in the map of Greece in Figure 3.

Table 5. Descriptive statistics for the absorption of public expenditure by region of implementation of the research project

Region of Implementation	N	Mean	Std. Dev	min	max
South Aegean	7	65.82	43.77	0.00	100.00
Central Greece	82	74.55	28.04	0.00	100.00
Peloponnese	52	80.54	28.30	0.00	168.76
Crete	346	81.24	21.46	0.00	104.27
Attica	1.418	81.71	31.85	0.00	853.20
Western Greece	278	82.11	23.97	0.00	177.67
Thessaly	178	82.68	27.31	0.00	210.79
Western Macedonia & Thrace	100	83.12	23.30	0.00	100.00
Central Macedonia	609	83.90	22.56	0.00	243.33
Epirus	68	84.61	20.70	0.00	100.00
Western Macedonia	38	85.39	20.07	2.35	100.00
Ionian Islands	11	85.74	19.34	30.05	97.46
North Aegean	39	90.30	13.34	38.08	100.00

In some regions we observe that the maximum values amount above 100%. Several cases during the implementation of the projects, the funding bodies (G.S.R.T.- R.T.D.I., MIA-R.T.D.I.) decide to finance with extra funds certain sectors or regions or specific projects, thus significantly change the rate of absorption of public expenditure.

The high absorption rates of public expenditure in the Regions of Attica, Central Macedonia and Crete could be considered expected given that according to the data of the National Documentation Centre during the years 2003-2017 most of the total R&D expenditure of the country (81%) is spent in the specific Regions. The majority of the research institutions, the research centres and the enterprises in the country are established in such Regions. On the

other hand, the high absorption values received by the research institutions located in the South Aegean Regions (90.3%), Ionian Islands Region (85.74%) are considered unexpected, as in such regions the least money is spent on R&D and the index. Furthermore, the expenditure intensity of these expenditures is much lower (0.77% and 0.50%) than the national average (0.97) for the period under review.
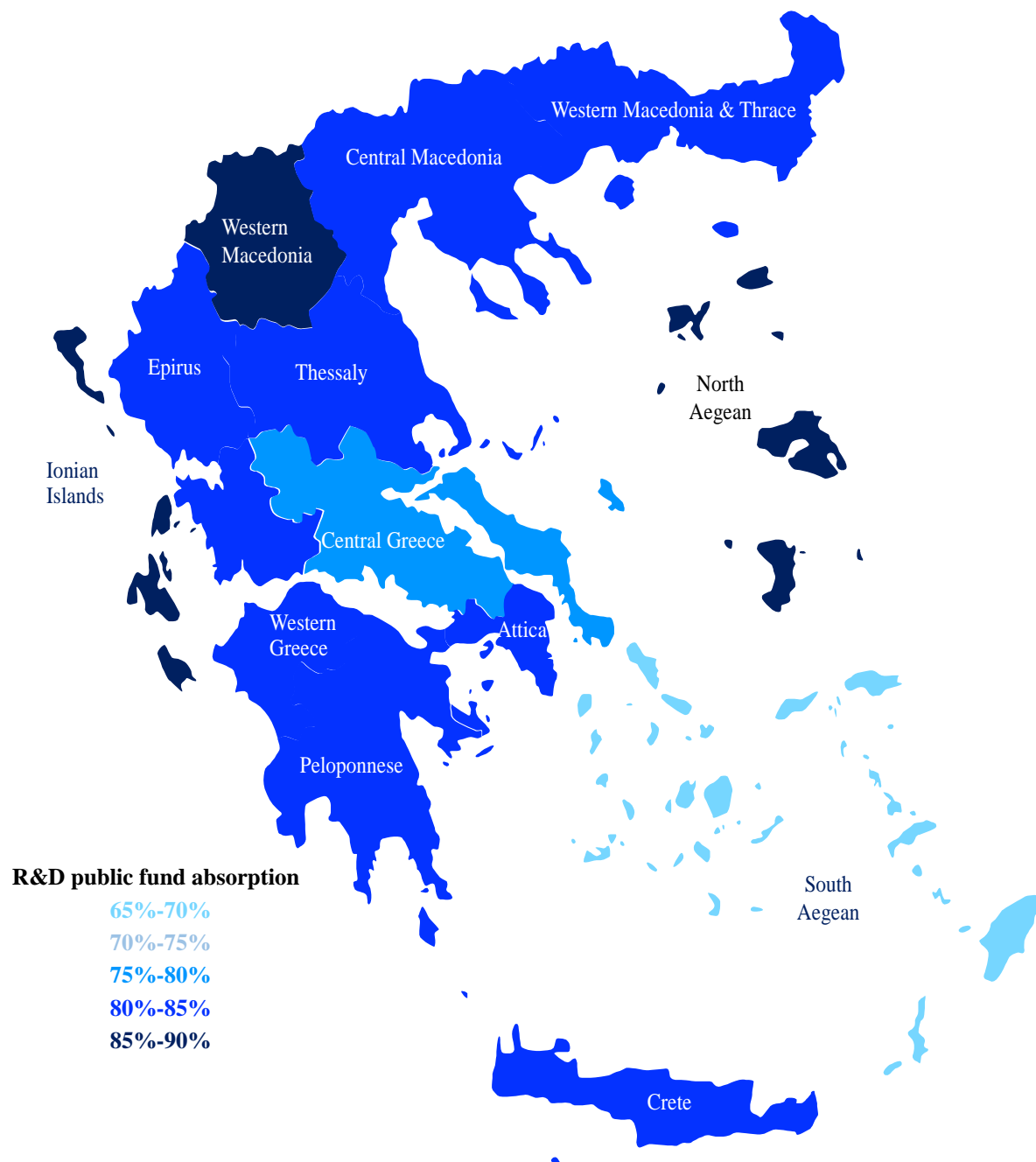

Figure 3. Absorption of public expenditure by region of implementation of the research project in Greece

The following table 6 presents the average values of the effectiveness indicators determined per 100,000 euros of an implemented research and development project, at the level of the

R.T.D.I. sector for the "Cooperation 2009" and "Cooperation 2011" funding actions. The effectiveness indicators were presented in detail in section 4.

Table 6. Descriptive statistics for effectiveness indicators by R.T.D.I. Sector, (per 100.000 euros), data for Actions "Cooperation 2009" and "Cooperation 2011"

R.T.D.I. Sector	N	Mean					
		A	B	C	D	E	F
Agriculture-Fisheries-Livestock Farming-Food and Biotechnology	49	1.71	0.64	0.64	4.63	0.06	3.84
Energy	38	0.92	0.26	0.25	2.36	0.05	4.91
Social and Economic Development Dimension	7	1.95	0.38	0.38	4.43	0.05	2.38
Transportation	22	1.30	0.41	0.41	2.76	0.15	2.98
Nanotechnology - Nanoscience and Microelectronics	36	0.88	0.23	0.23	2.48	0.05	2.60
Cultural Heritage	9	1.26	0.29	0.29	3.59	0.06	3.28
Environment	32	1.01	0.26	0.34	2.75	0.05	3.08
Health	53	0.87	0.20	0.19	2.56	0.04	2.72
High-Value Added Products and Production Technologies focusing on Traditional Industries	10	0.78	0.18	0.18	2.71	0.05	2.70
Information and Communication Technologies	36	1.21	0.20	0.20	3.06	0.07	4.29
Space and Security Technologies	5	1.69	0.11	0.14	3.77	0.15	4.71

Based on the data of Table 6 the R.T.D.I. sectors receiving the highest values in the indicator "New jobs created during project operation" are the Social and Economic Development Dimension and the Agriculture-Fisheries-Livestock Farming-Food and Biotechnology with 1.95 and 1.71 FTE per 100.000 euros of R&D implemented project, respectively. In the indicators "Number of research and technological development projects" and "Number of projects of cooperation between enterprises and research institutes" the highest performance is noticed in research projects whose subject matter is related to Agriculture-Fisheries-Livestock Farming-Food and Biotechnology (0.64) and Transportation (0.41) R.T.D.I. sectors. Most jobs (per 100.000 euro of R&D implemented project) are based on the "Number of research jobs created" indicator as most jobs during the implementation of the research and development project are implemented by agencies operating in the fields of Agriculture-Fisheries-Livestock Farming-Food and Biotechnology and Energy with 4.63 and 4.91 full-time equivalents respectively. Finally, research projects whose subject matter is related to R.T.D.I. sectors of Transportation (0.15) and Space and Security Technologies (0.15) receive the highest values in the Induced Investments (private) indicator.

The data obtained from the statistical processing of the characteristics of the projects under study allowed us to draw useful conclusions regarding the absorption of research funds, the evaluation and the effectiveness of research projects. The absorption and effectiveness indicators that have been identified can be used in the future by the evaluators and experts of

the research proposals as they can assess the realism of each proposal with the feasibility of the values of the efficiency indicators presented in them and proceed in a more rational way with the distribution of the public expenditure by type of beneficiary, region of implementation and R.T.D.I. sector.

In addition, the prices that the enterprises received in the absorption indicators in combination with the obstacles they face in funding their research activities should concern the policy makers for the research in the planning of the next funding programmes. The aid scheme that companies receive based on the type of research, the number of collaborations they carry out and the R.T.D.I. sector should be significantly improved in an attempt to enhance the performance of the enterprises. Finally, the state should ameliorate the business funding environment, through the use of appropriate legislative and fiscal reforms from respective funding programs and probably consider changing the objectives of business research in anticipation of better results for the research they carry out.

5.2 Results of the Deterministic Analysis

As it was mentioned in the deterministic analysis, we use the data sets from two actions (Cooperation 2009 and Cooperation 2011) for which we have complete data, i.e. a-priori, for the evaluation phase as well as a-posteriori, for the implementation phase. Table 7 below shows the descriptive statistics indicators (mean, standard deviation, maximum and minimum value) of the evaluation criteria of the research proposals for the action "Cooperation 2009", as well as the rate of absorption of public expenditure. The projects studied were a total of 156. The descriptive measures correspond to the three criteria for evaluating the action presented above, the total score of each research proposal and the rate of public expenditure absorbed for each project.

Table 7. Descriptive characteristics of the evaluation data and the absorption rate of the public expenditure for action "Cooperation 2009"

	N	Mean	Standard Deviation	Min	Max
Absorption Rate of Public expenditure (%)	156	82.42	12.78	24.03	138.40
Scientific and technical excellence of the proposed project	156	28.25	3.35	20.00	35.00
Experience and credibility of the partnership, and quality, ability of the project implementation	156	26.11	2.22	20.00	30.00
Results of the proposed project	156	28.20	2.85	21.60	34.00
Project Total Score	156	82.55	6.76	67.20	98.00

Table 8 below shows the descriptive statistics indicators (mean, standard deviation, maximum and minimum values) of the evaluation criteria of the research proposals for "Action Cooperation 2011", as well as the absorption rate of public expenditure. The projects studied

were a total of 137. The descriptive measures correspond to the three criteria for evaluating the action presented above, the total score of each research proposal and the rate of public expenditure absorbed for each project.

Table 8. Descriptive characteristics of the evaluation data and the absorption rate of the public expenditure for action "Cooperation 2011"

	N	Mean	Standard Deviation	Minimum	Maximum
Absorption Rate of Public expenditure (%)	137	75.75	15.50	3.80	97.78
Quality – credibility of the partnership	137	3.53	0.41	2.00	4.00
Scientific and technical excellence of the proposed project	137	3.42	0.49	2.00	4.00
Contribution to the country's economy and productivity and impact on the operation and progress of the participating enterprises	137	3.48	0.45	2.00	4.00
Project Total Score	137	3.59	1.39	2.35	4.00

Table 9 below presents the results of simple linear regression with the absorption rate of public expenditure as the dependent variable and the score of the three evaluation criteria separately, as well as the total score of the projects of Actions "Cooperation 2009" and "Cooperation 2011"as the independent variables.

Table 9. Results of simple linear regressions of the absorption rate of the public expenditure with the score in the three evaluation criteria and the total score

Action "Cooperation 2009"	R^2
Absorption rate of the public expenditure with the score in Criteria A: "Scientific and technical excellence of the proposed project"	0.003
Absorption rate of the public expenditure with the score in Criteria B: "Experience and credibility of the partnership, and quality, ability of the project implementation"	0.010
Absorption rate of the public expenditure with the score in Criteria C: "Results of the proposed project"	0.007
Absorption rate of the public expenditure with the total score of each project	0.009
Action "Cooperation 2011"	R^2
Absorption rate of the public expenditure with the score in Criteria A: Quality – credibility of the partnership	0.011
Absorption rate of the public expenditure with the score in Criteria B: Scientific and technical excellence of the proposal	0.011
Absorption rate of the public expenditure with the score in Criteria C: Contribution to the country's economy and productivity and impact on the operation and progress of the participating	0.007
Absorption rate of the public expenditure with the total score of each project	0.016

The implementation of simple linear regressions of the absorption rate of public expenditure with the three evaluation criteria separately showed that none of the three criteria had a statistically significant effect on the absorption rate of public expenditure of each project for both actions. Furthermore, regarding the implementation of the simple linear regression of the absorption rate of public expenditure with the total score of each project, it emerged that also the score did not have a statistically significant effect on the absorption rate of public expenditure. The latter is also depicted in the two charts of Figure 4 and 5 where we can observe graphically the absence of any correlation.
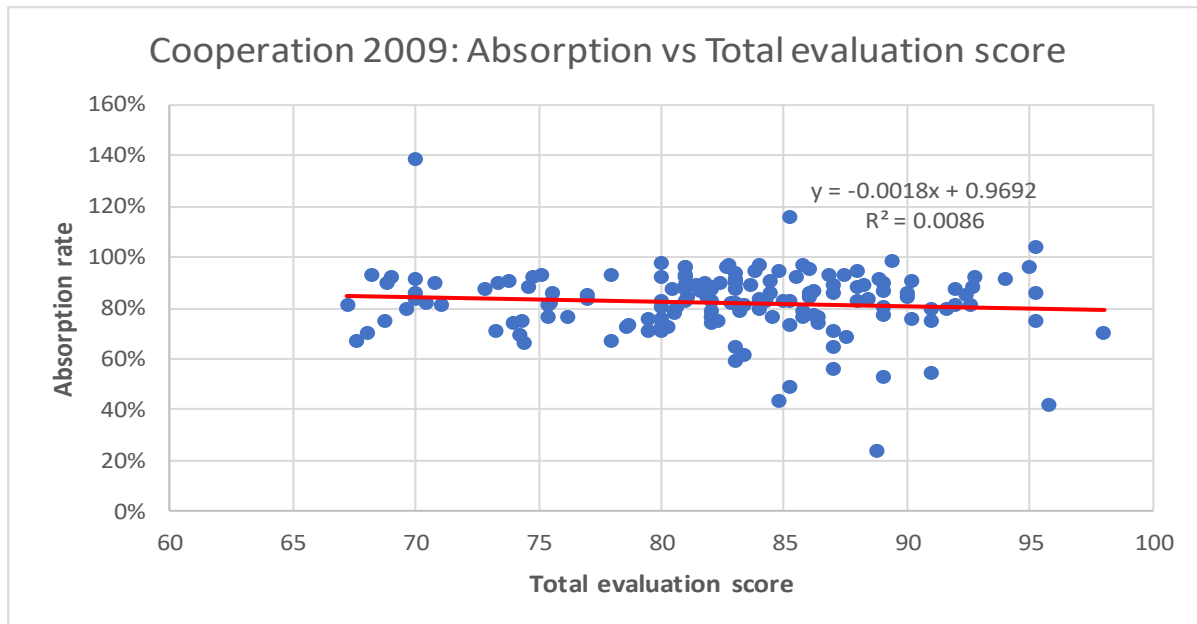
Figure 4. Results for simple linear regression of the absorption rate of public expenditure with total score of each project for the Action "Cooperation 2009"
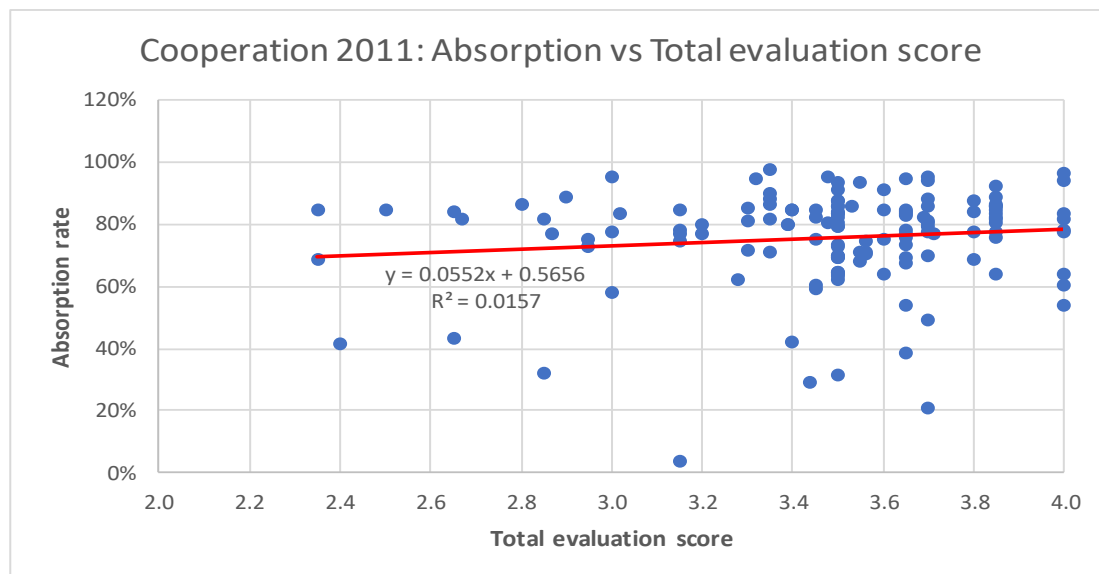

Figure 5. Results for simple linear regression of the absorption rate of public expenditure with total score of each project for the Action "Cooperation 2011"

Regarding the relationship between the initial evaluation and the effectiveness indicators, Table 10 presents the results of simple linear regressions with the total evaluation score of each project as the dependent variable and the effectiveness indicators produced by the implementation of each project of the actions "Cooperation 2009" and "Cooperation 2011" as independent variables.

Table 10. Results of simple linear regressions for the total score of the project with the respective effectiveness indicators of each project, data for Actions "Cooperation 2009" and "Cooperation 2011"

	R^2	
	Cooperation 2009	Cooperation 2011
Total score of each project with indicator "New jobs created during project operation"	0.008	0.018
Total score of each project with indicator "Number of research and technological development projects"	0.112	0.009
Total score of each project with indicator "Number of projects of cooperation between enterprises and research institutes"	0.085	0.009
Total score of each project with indicator "Number of research jobs created"	0.000	0.025
Total score of each project with indicator "Induced Investments (private)"	0.020	0.016
Total score of each project with indicator "Jobs created during project implementation"	0.015	0.001

The absence of correlation between the initial evaluation and the resulting effectiveness indicators is also apparent for both actions. The specific findings should concern the institutions that design and implement research funding projects, which in turn should adopt procedures for evaluating and allocating available funds that will lead to both greater fund absorption and greater efficiency of projects. Such practices may include, for example, high resource absorption and many scientific publications, jobs, patents and collaborations between research institutions.

6. Conclusions

Maximizing the absorption of research resources from funding sources, such as the Partnership Agreement for the Development Framework funding actions, is the primary objective of each country seeking to increase R&D expenditure and approach the European common target of 3% of GDP for research expenditure. The attainment of this aim is further impeded since the allocation of funding resources is subjected to restrictions by region and specific R.T.D.I. areas as each country has to allocate its available resources to those research proposals active and expecting both maximum absorption and maximum scientific output at the same time. In this paper, we have studied research absorption data using actual data from 3,259 grant beneficiaries of funding actions implemented under the Partnership Agreement for the Development Framework for the 2007-2013 programming period and we have

identified absorption indicators by type of Beneficiary, by R.T.D.I. sector and by region of implementation, drawing useful conclusions linked to the absorption of resources.

The study of the absorption of public expenditure showed that the beneficiaries who drew most funds were those that the subject of their research proposals was related to the R.T.D.I. sectors of Cultural Heritage, High-Value Added Products and Production Technologies, focusing on Traditional Industries and Information and Communication Technologies. Additionally, on the basis of the region of implementation of the research proposals, the absorption rate for the majority of the regions was between 80% and 85% (including the Attica and the Central Macedonia region which have the majority of applied proposals) while beneficiaries based in the Regions of North Aegean, Ionian Islands and Western Macedonia were above the average. The study of effectiveness indicators showed that the highest performance in most of them is obtained by the R.T.D.I. sector of agriculture-Fisheries-Livestock Farming-Food and Biotechnology.

Based on the results of the study on the absorption of public expenditure by type of beneficiary, the need to improve the funding framework of enterprises has arisen. Improvement can be achieved initially with the increase of the percentage of funding per research project, even at a rate of 100%, regarding the R.T.D.I. sectors with optimal results in the efficiency indicators, as well as with the creation of the appropriate environment by the state in order to increase R&D expenditure on the part of the enterprises. The reduction of bureaucracy, the provision of additional incentives such as tax exemptions for research expenditure, as well as the increase of synergies between enterprises and research institutions, mainly through the utilization of specialized research staff and the exchange of know-how on technical issues of grants receiving can contribute positively towards this direction.

The regression analysis for the 293 research projects implemented in the context of the funding actions of R&D projects "Cooperation 2009" and "Cooperation 2011" showed that neither the individual criteria scores nor the overall rating of each project had a significant impact on the absorption rate as well as on their effectiveness. This conclusion might indicate a modification in the evaluation process as it seems that the initial evaluation fails to predict the eventual outcome of the R&D projects and this is something that must be taken into account in the evaluation process of future research projects.

In future research we can initially use the absorption indicators identified by type of beneficiary, by scientific field and region in designing new funding actions, as well as in formulating research allocation policies in an attempt to maximize their use. In addition, new evaluation processes should be tested in order to provide more robust results. Finally, when the data become available for the more recent R&D programmes, it should be studied accordingly, in order to draw conclusions regarding their sectoral and regional distribution and their effectiveness in relation to their evaluation phase.

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