Public Policy Portuguese Journal
2016, Volume 1, Number 1, pp. 6-27

www.umpp.uevora.pt

Productivity and employment in firms' access to public funding to support innovation[1, 2]

Anabela Santos
Université Libre de Bruxelles, iCite
asantos@ulb.ac.be (corresponding author)

Michele Cincera
Université Libre de Bruxelles, iCite and ECARES
mcincera@ulb.ac.be

Paulo Neto
Universidade de Évora, UMPP, CEFAGE-UÉ and CIEO-UALG
neto@uevora.pt

Maria Manuel Serrano
Universidade de Évora, UMPP and SOCIUS-CSG/ISEG-UL
mariaserrano@uevora.pt

ABSTRACT

Innovation is at the heart of the Europe 2020 Strategy, in order to promote higher levels of employment and productivity. Special attention is given to increasing the effectiveness of innovation policy instruments, mainly as some authors found evidence that productivity could be negatively affected by subsidies.

The aim of the study is to assess how the expected impact on firm productivity and employment is taken into account, when firms apply for public funding for innovation. The analysis is based on the case study of the Portuguese Innovation Incentive System in the Alentejo region. In order to understand which factors influence the public decision to financially support private investment, we estimated a logit model based on firms' and applications' characteristics, controlling for the macroeconomic environment. The results indicate that government preferences for promoting exports, exploiting firms R&D results and stimulating the level of qualified employment are shown to be more relevant than the impact on firm productivity. Furthermore, the [illegible] and financial charges on the loan, is almost twice as much for non-SMEs as for SMEs.

Keywords: Public funding, Innovation, Productivity, Employment
JEL classification: L53, O31, O38, D24.

[1] This work was supported by the Portuguese national funding agency for science, research and technology (FCT), under the Project UID/SOC/04521/2013.
[2] The present article is an extended and significantly improved version of the papers presented to the 24th APDR Workshop "Entrepreneurship and Performance in a Regional Context" held in Lisbon, on March 17 2016 (Santos, Cincera, Neto and Serrano, 2016a) and the RSA Workshop "Learning from Implementation and Evaluation of the EU Cohesion Policy" held in Brussels, on June 13 2016 (Santos, Cincera, Neto and Serrano, 2016b).

INTRODUCTION

Increasing employment, productivity and social cohesion are the main targets of the Europe 2020 Strategy, and innovation plays an important role in this. Two ways to increase firm competitiveness or productivity is through a more qualified workforce or through innovative investment (e.g. introducing new technologies or developing new working processes).

Under the Community Support Frameworks 2007 – 2013, Portugal received around €21.5 billion from the European Commission in order to promote jobs, innovation, competitiveness and productivity (Observatório do QCA III, 2007). Nevertheless, the country's performance is still far below the EU average. For the period 2014 - 2020, Portugal will receive around €25 billion, to stimulate growth and create jobs.

One justification of public support for Research & Development & Innovation (RDI) is due to the presence of market failings. Public intervention aims to fill the financial gap, in order to improve knowledge production and come as close as possible to the socially optimal level. To achieve this goal, governments give special attention to increasing the effectiveness and efficiency of innovation policy instruments.

The paper focuses on understanding how the expected impact on firm productivity and employment is taken into account, when firms apply for public funding for innovation. More precisely, the study intends to answer the following research questions: *i) Is improved productivity and the creation of new jobs contemplated in all the applications submitted and selected? ii) How have these objectives been taken into account in the selection process? iii) How much has each new job created cost?*

The analysis is based on the case study of *Portuguese Innovation Incentive System* (SI Innovation) and on the applications submitted between 2007 and 2013 by firms intending to implement an investment project in Alentejo. The dataset was built with cross-information from Information System of the National Strategic Reference Framework (NSRF) Incentive Scheme and statistical data from official entities (e.g. Statistics Portugal and Bank of Portugal).

The methodological approach combines several techniques such as descriptive statistics, mean differences, binary logit model and cost-effectiveness indicators. Explanatory variables are connected to firms' characteristics (namely, size, activity sector, financial performance and risk level), applications' characteristics and expected impact on applicant firms, and macroeconomic factors (such as, interest rate in the Portuguese capital market, regional GDP variation and regional concentration of skilled workers).

The paper is structured as follows. After this introduction, Section 1 explains how the EU 2020 Strategy is implemented in the Portuguese Alentejo Region and discusses the background theory about the determinants of receiving public support, considering productivity, innovation and employment. Section 2 presents data collection and the methodological approach implemented. Section 3 presents the results and their discussion, and Section 4 presents the main conclusions and some policy recommendations.

1. BACKGROUND THEORY

1.1. From the Europe 2020 strategy to Regional and Innovation Policy in Portuguese Alentejo Region

The main priorities of the Europe 2020 strategy are smart, sustainable and inclusive growth for the European Union. With these three targets, the European Commission intends to develop an economy based on knowledge and innovation – smart – promoting a more resource-efficient, greener and more competitive economy – sustainable – and fostering a high-employment economy delivering social and territorial cohesion – inclusive (European Commission, 2010:4).

To achieve these targets, in March 2010 the European Commission created for the period 2014-2020, seven flagship Initiatives: i) Digital Agenda for Europe; ii) Innovation Union; iii) Youth on the move; iv) Resource-efficient Europe; v) An industrial policy for the globalization era; vi) An Agenda for new skills and jobs; vii) European platform against poverty.

In March 2012, the EU Commission presented the Common Strategic Framework (CSF) in order to help Member States and their regions in programming and setting clear investment priorities for the next financial planning period from 2014 until 2020. The main purpose of the CSF is to provide clearer strategic direction to the programming process at the level of Member States and regions, and is therefore expected to contribute proportionally to the European objectives established by the Europe 2020 Initiative. A central issue of this framework is also to "increase coherence between policy commitments made in the context of Europe 2020 and investment on the ground" (European Commission, 2012).

Under the Common Strategic Framework, considered as a mandatory ex ante

conditionality, for member states and their respective regions was the construction of Smart Specialization Strategies. According to the Cohesion Policy 2014-2020, Smart Specialization Strategies (S3) are a prerequisite, but beyond a prerequisite, S3 will be the logical rational framework, both strategic and tactical, forming the basis for the definition of regional/national guidelines on social, economic, technological, scientific, cultural and regional planning. "In the context of Europe 2020, smart specialization emerges therefore as a key element for place based innovation policies" (European Commission, 2012: 8).

Success in achieving Europe 2020 goals will be determined by decisions made at local and regional levels, and Regional policy[1]is vital in mobilizing the full innovation potential of EU regions (European Commission, 2011:2). Regions across Europe have different endowments, capabilities and performance. Therefore, there are potentially major advantages in using strategies that exploit an original and globally competitive specialization niche (European Commission, 2011:2). Smart Specialization Strategies can help regions to concentrate resources on a few key Research and Innovation (R&I) priorities and ensure more effective use of public funds (European Commission, 2011:2).

Through its "Strategy for Research and Innovation for a Smart Specialization 2014-2020", Portugal focuses its national smart specialization strategy on the following economic activities: i) Production technologies and production industries; ii) Automotive, aeronautics and space; iii) Multi-functional forestry; iv) Sustainable fishing; v) Valorization of marine ecosystems and links with renewable energy; vi) Deep sea mining; v) Coastal tourism, culture, sport and leisure; vi) Sustainable exploitation of natural resources, especially water; vii) Health & health tourism; viii) Tourism with a focus on ICTs to create national value chains; ix) Clustering of cultural & creative industries to achieve impact; x) Eco-construction linked to 'habitat' IAPMEI, FCT, ANI and COMPETE (2014). The S3 Strategic Priorities adopted by the Alentejo are the following: i) Food and forestry; ii) Economy of mineral, natural and environmental resources; iii) Heritage, cultural and creative industries and tourism services; iv) Critical technologies, energy and smart mobility; v) Technologies and specialized services of the social economy CCDRA (2014).

In the Portuguese Alentejo region, Regional Policy instruments, and consequently Smart Specialization Strategy, are managed by the Commission for Coordination and Regional Development of the Alentejo (CCDRA) and financial resources are allocated through the Alentejo Regional Operational Program (PO Alentejo). The present paper focuses on three of the nine priorities of this program, these being i) Competitiveness and SME internationalization; ii) Research, technological development and innovation and iii) Employment and economic enhancement of endogenous resources.

An important instrument under the PO Alentejo is the Portuguese Innovation Incentive System (SI Innovation). At the national level, the SI Innovation is included in the National Strategic Reference Framework (NSRD) 2007 – 2013 and, within this, in the Operational Program for Competitiveness Factors (COMPETE). The budget allocated to SI Innovation, between 2007 and 2013, was close to 2 billion euros, which represents about 10% of the total NSRD budget and 50% of the total COMPETE budget (Comissão de Acompanhamento do POFC, 2015:30).

By assigning subsidized loans[2], the SI Innovation has the main goal of promoting firm innovation, to boost their internationalization and to stimulate qualified entrepreneurship. Public support for innovation is given in the last phase of the innovation process, when R&D becomes patentable (outcomes) and/or gives rise to a new marketable service or good. This explains why the cost of patent application is an eligible expense and R&D expenditure is not subsidized under SI Innovation[3].

The beneficiaries of SI Innovation are companies from the manufacturing industry, commerce, services, tourism, energy, transport and logistics sectors. Public support is distributed by means of calls, whereby firms submit an application and the selection process is based on four main

[1] The EU regional Policy is "a strategic investment policy targeting all EU regions and cities in order to boost their economic growth and improve people's quality of life" (EC, 2014: 1-3). Financial resources are used to support small and medium-sized enterprises (SME) to become more innovative and competitive, to create new and permanent job opportunities, to finance strategic transport and communication infrastructures, to modernize the education system and to promote a more environmentally-friendly economy (EC, 2014: 3).

[2] A subsidized loan is a repayable subsidy, as a loan, but without any interest and finance charges.

[3] Direct public support for R&D is given under the "Incentive System for Technology Research and Development in companies".

criteria: i) Quality of the project; ii) Impact of the project on the company's competitiveness; iii) Contribution of the project to national competitiveness and; iv) Contribution of the project to regional competitiveness and territorial economic cohesion. Within these fields, we can highlight the followings dimensions in the regulation of SI Innovation: i) increased productivity; ii) representativeness in the international market; iii) exploitation of R&D results; and iv) creation of highly-skilled jobs, wealth and employment in the region.

1.2. Productivity, Innovation and Subsidy

Productivity measures the quantity of output per input unit. Capital (K) and Labor (L) are included in inputs and output represents the volume of production obtained from inputs. When productivity involves a measure of value, authors commonly use the labor productivity concept, which corresponds to the added value[1]per employee (Sakamoto, 2010:49).

According to Sakamoto (2010:52-53), a main reason for improving productivity could be a higher standard of living. This author explains that standard of living can be improved by working fewer hours, higher wages, and more and better jobs, and which is possible with an increase in labor productivity. From a government perspective, there is a clear incentive to increase productivity, due to its implications for economic development and growth. Nevertheless, firms' motivation for increasing productivity is essentially associated with competitiveness, because an increase in their productivity could lead to the reduction of output production cost. Therefore, a main question of interest is how firms can improve their productivity?

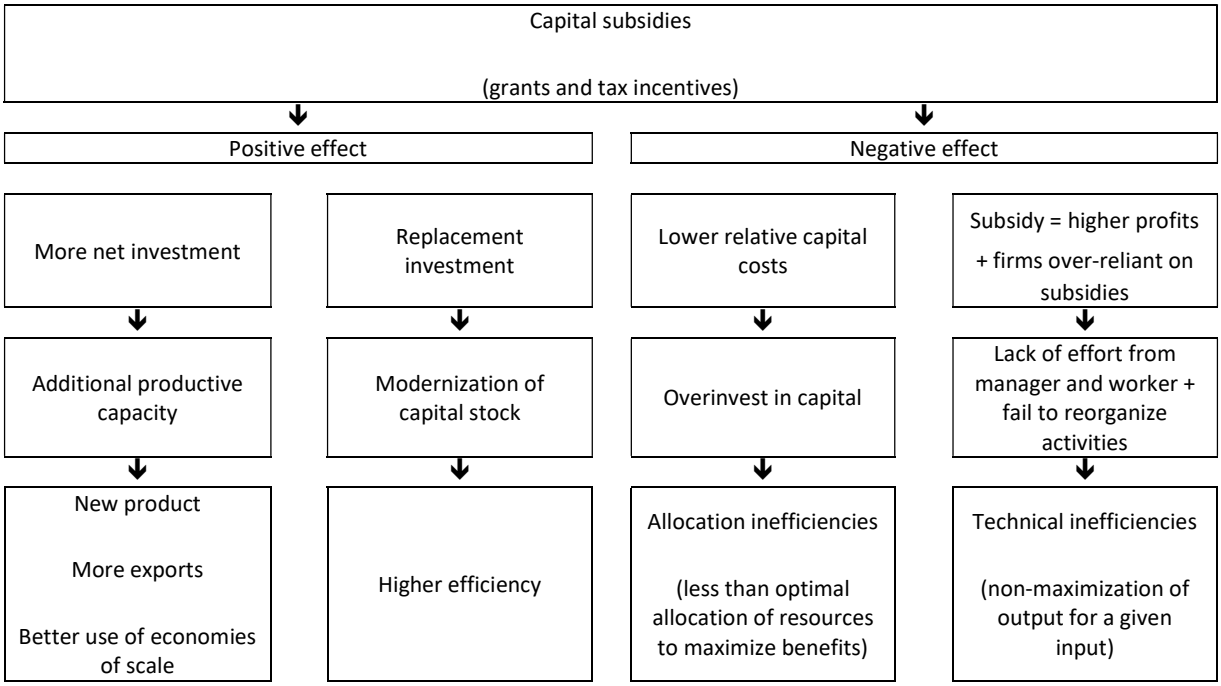
In order to maximize the impact of inputs on output, firms can use technological advances and/or increase the skills of their workforce. In both cases, they expect a reduction in the time to produce each unit of output. Innovation appears as a means to develop new technologies or processes and is linked to investment (e.g. R&D activities or new equipment).

Financing innovation is often an issue (see e.g. Cincera, 2003; Cincera and Ravet, 2010). According to Hölzl and Peneder (2013: 734), imperfections in capital markets are the second cause of underinvestment in innovation activities and firms face financing constraints as a result of asymmetric information. Asymmetric information in the financial markets is due, on one hand, to the risks and uncertainties inherent to R&D activities (Cincera and Ravet, 2010), and on the other hand, to the entrepreneur's difficulty in providing a clear and credible commitment to the investor (Hölzl and Peneder, 2013: 734). When the quality of a project is not easily recognized, investors refuse credit or raise the interest rate due to the higher project risk (Hölzl and Peneder, 2013: 734).

Public policies to support entrepreneurship and innovation play a vital role when firms have difficulties in accessing finance. Erden & Holcombe (2005) demonstrated that public investment can have a leverage effect on private investment, especially when access to bank credit is limited. Some firms, particularly small and innovative ones, have more constraints and difficulties in accessing finance, since they tend to have riskier projects and business models (Lee, Sameen and Cowling, 2015). In the presence of market failings, public support aims to fill the financial gap in order to promote innovation and competitiveness, through increased productivity. However, public subsidies can not only have a positive effect on firms' productivity but also a negative one (Figure 1).

[1] Added value represents the production factor remuneration (wages, interest and profit) or the revenue less intermediate consumption.

FIGURE 1. IMPACT OF CAPITAL SUBSIDIES ON PRODUCTIVITY



Source: Authors' own elaboration based on Bergström (2000) and Harris and Taylor (2005).

On one hand, if subsidies allow firms to invest in technological development, firms can increase their productive capacity, which combined with a better use of economies of scale lead to productivity increases (Bergström, 2000:184). On the other hand, subsidies can also have a function of investment replacement, allowing firms to make more efficient use of input resources, but without an increase in productive capacity (Harris and Taylor, 2005). However, subsidies can also make firms less productive for at least two reasons: i) first, "because a subsidy gives the recipient firms an incentive to change the mix of capital and labor" (Bergström, 2000: 184), through providing capital at a lower relative cost or as compensation for new job creation. In this case, subsidies can lead to allocation inefficiencies if subsidized firms over-invest in capital (Bergström, 2000: 184) or overshoot the optimal amount of employment in order to gain a subsidy (Bernini and Pellegrini, 2011:264); ii) second, subsidization can also induce technical inefficiencies, if the subsidy is perceived by firms as an additional source of profits and if this potential of new income leads to a lack of effort by managers and workers (Bergström, 2000: 184). In this case, when firms are over-reliant on subsidies, they may also tend to fail in reorganizing their activities (Harris and Taylor, 2005).

One challenge of EU regional and innovation policy is to find a trade-off between employment growth and improved productivity. Indeed, some authors (Dew-Becker and Gordon, 2012) found a negative correlation between the growth of labor productivity and employment per capita across EU-15. So an increase in employment, through new job creation stimulated by subsidies, can induce a decrease in labor productivity if the employment level grows faster than productive capacity. How can governments manage this trade-off? How is productivity and employment taken into account when governments award a grant? Which factors are determinant in the allocation of firm subsidies?

1.3. Who gets public support? Productivity and employment in the selection process

The scientific literature on regional, industrial and innovation policies identifies the following main characteristics for firms receiving subsidies: age, employment level (firm size), productivity, previous experience of receiving subsidies, the qualification of human capital, patent stock, past R&D activities and export intensity. On average, government tends to have two main behaviors in the selection process: i) selecting firms that are already best performers (e.g. with higher levels of exports, patent stock, skilled jobs and R&D activities or productivity), based on the "picking the winner" principle and ii) financially supporting firms characterized by greater financial constraints, for instance, smaller firms or firms located in the poorest regions.

As regards the main target of the paper - productivity and employment in the selection process - some authors (see e.g. Bergström, 2000; Bernini and Pellegrini, 2011) found that firms selected for grants tend to be less labour productive in the pre-intervention period, which could be in line with the principle that governments choose to help firms with more needs, i.e. with a previous lower performance. Nevertheless, for other authors, selected firms have higher productivity (e.g. Harris and Taylor, 2005; Sissoko, 2011) or higher productivity growth in the year before the subsidy is awarded (Karhunen and Huovari, 2015). For those cases, one possible explanation could be that more productive firms submit better projects.

Employment level, used to measure firm size, could have a positive or negative impact on the likelihood of receiving some public support (Table 1). Large firms benefit from greater innovation and management capacity, which means greater potential to reach positive economic outcomes (Hud and Hussinger, 2015), but typically, policy instruments are more focused on providing support to small and medium-sized firms (Czarnitzki and Lopes Bento, 2011). Indeed, small firms may be more credit-constrained (Cincera, 2003; Lee *et al.*, 2015), and the public agency may be willing to favor small firms for this reason (Busom, 2000).

TABLE 1. PRODUCTIVITY AND EMPLOYMENT LEVEL IN A FIRM'S PROBABILITY OF GETTING A SUBSIDY

Authors	Country, policy orientation and model	Impact of explanatory variables
Bergström (2000)	▪ Sweden ▪ Industrial Policy ▪ Logit model	(+) Value added (Y) (+) Capital Stock (K = Total assets) (+) Number of employees (L) (+) Age (= Year firm was founded) (-) Productivity (Y/L) (+) Capital intensity (K/L)
Harris and Taylor (2005)	▪ Ireland ▪ Industrial Policy ▪ Probit model	(-) N.° of employees (+) Productivity (K/L) (+) Age
Bernini and Pellegrini (2011)	▪ Italy ▪ Regional Policy ▪ Logit model	(-) Productivity (= output per employee) (+) and (-) Employment (squared) (+) and (-) own Capital (cubed) (+) Large firm
Sissoko (2011)	▪ France ▪ Innovation Policy ▪ Logit model	(+) Age (+) N.° of employees (+) Productivity (= TFP) (+) Export intensity (+) Growth rate of capital investment
Karhunen and Huovari (2015)	▪ Finland ▪ Innovation Policy ▪ Probit model	(+) Turnover (+) N.° of employees (+) Labor productivity growth (= value added per employee) (+) Export experience (-) Foreign capital ownership (+) Share of skilled workers (+) Subsidy history

Source: Authors' own elaboration based on Bergström (2000), Harris and Taylor (2005), Bernini and Pellegrini (2011), Sissoko (2011) and Karhunen and Huovari (2015).

Turning to the other characteristics of firms getting subsidies, young firms also have more limited access to the capital market and insufficient financial resources to invest in innovative projects (Aschhoff, 2009). In order to fill the market gap, innovation policy usually gives special attention to start-up companies (Czarnitzki and Lopes Bento, 2011). However, "more experienced firms are more aware of the value of innovation and may present better proposals, becoming thus more likely to be selected by the agency" (Busom, 2000:126). According to Busom (2000: 126), "the fact that experience related variables are significant suggests that subsidies might not be the best policy to induce firms that did not have previous R&D activities to get them started".

Previous experience in innovation projects, measured by past R&D activities or in other funding programs, could have a positive impact on the probability of receiving (new) public support, because public authorities tend to follow the "pick the winner" principle, with the aim of minimizing the risk of failure (Czarnitzki and Fier 2002; Aerts and Thorwarth, 2008; Aschhoff, 2009; Czarnitzki and Lopes Bento,

2011). Firms' patent stock is another indicator of successful R&D activities with an expected positive impact on the probability of getting a subsidy (Aerts and Thorwarth, 2008).

An additional indicator of the quality of the firm's innovative capacity is the presence of highly qualified personnel. Indeed, the ability to develop and implement an R&D project is strongly related to the skills of the firm's human capital (Blanes and Busom, 2004).

Firms that are part of an enterprise group are more likely to benefit from potential spillover effects as a result of network linkages (Czarnitzki and Lopes Bento, 2011), which could also influence government evaluators to select this kind of firm (Hud and Hussinger, 2015). However, firms with foreign capital ownership are found to be less likely to obtain an innovation subsidy (Karhunen and Huovari, 2015). According to Busom (2000:126), one possible explanation could be that core R&D activities may be located in another country, and those carried out in the country giving the subsidy may be mostly focused on development, with little innovative content.

Firms more active in foreign markets, measured by export intensity, may also be more innovative than others (Aerts and Thorwarth, 2008; Czarnitzki and Lopes Bento, 2011; Sissoko (2011); Karhunen and Huovari (2015), Hud and Hussinger, 2015) and are consequently more likely to achieve higher performance and more successful projects.

In the analysis and model developed in sections 3 and 4, we include firms' characteristics in the year before submitting the application, such as their size, innovative capacity and foreign trade experience. Other indicators used by banks when assessing credit risk, namely the return on equity and the solvency ratio of applicant firms (see e.g. Louizis *et al.*, 2012; Chaibi and Ftiti, 2015), are also included in order to control for the effectiveness of SI Innovation in counteracting debt and equity financing constraints. Indeed, firms with historically lower levels of these indicators are less attractive for new investors or banks, because they show lower performance and more financial vulnerability. Macroeconomic factors in the year of submitting the application, measured by the interest rate in the Portuguese debt capital market, regional[1]GDP variation and the concentration of skilled employees are also taken into account with the aim of controlling for external factors which affect SMEs' access to finance and growth.

A novelty introduced in the present paper is to include in the analysis the investment project characteristics, namely the expected impact on firm productivity and employment. Indeed, in the studies cited above, authors only assess the probability of getting a subsidy taking into account firms' characteristics in the year before receiving the grant, with few authors providing a precise analysis of the process of selecting applicants for public support.

2. DATA AND METHODOLOGY

The analysis is based on the case study of *Portuguese Innovation Incentive System* (SI Innovation) and on applications submitted between 2007 and 2013 by firms intending to implement an investment project in the Alentejo region. The sample includes both applications evaluated and managed at the regional (450 observations)[2] and national level (177 observations).

The dataset was built with cross-information extracted from the Information System of the NSRF Incentive Scheme, Statistics Portugal (INE) and the Bank of Portugal. The first data source provided information about firm and application characteristics, the second source provided information on regional macroeconomic conditions and the third source provided information concerning the cost of external financing in Portugal.

The methodological approach adopted combines several techniques such as descriptive statistics, mean differences in a binary choice model and cost-effectiveness indicators. Each of these techniques plays a specific role in answering the research questions initially set.

Sample description and the *t* tests on the equality of means - between approved and non-approved applications - are used to answer the first research question: *Is improved productivity and the creation of new jobs contemplated in all the applications submitted and selected?*

A binary logit model is used to understand which factors influence the probability of having an application approved, therefore allowing a response to the second research question: *How have improved productivity and the creation of*

[1] In Alentejo sub-region NUTS level 3.

[2] Previous studies (Santos, Cincera, Neto and Serrano, 2016a; Santos, Cincera, Neto and Serrano, 2016b) only focus on applications evaluated and managed in Alentejo at the regional level.

new jobs been taken into account in the selection process?

This analysis is based on binary choice models because y_i has only two possible values, coded as 1 if the application is approved and 0 if not. The model (1) describes the probability of receiving public support taking into account the individual characteristics of each application (x_i). Explanatory variables belong to four groups: i) firm characteristics; ii) application characteristics; iii) foreseen impact of the investment project and iv) macroeconomic conditions (for more details see Table 2).

$$P\{y_i = 1|x_i\} = G(x_i, \beta) \quad (1)$$

The cost-effectiveness indicator, which represent the ratio between outcomes (e.g. new expected jobs created) and inputs (e.g. subsidized loan), lets us estimate the *cost associated with the creation of new jobs* – the third research question initially set.

TABLE 2. VARIABLE NAME AND DESCRIPTION

	Variable name	Variable description
Firms' characteristics	job_pre	Number of employees in the firms in the year before submitting the application.
	firm size	Micro, small and medium firms and non-SMEs. Dummy variable. Micro-firms are the omitted reference category.
	nr_partner	Number of firm partners.
	solvability_pre	Solvability ratio (equity/debt) in the year before submitting the application
	roe_pre	Return on Equity ratio (net income/equity) in the year before submitting the application.
	rd_pre_yes	*Has the company a history of R&D activities in the year before submitting the application?* Dummy variable, where Yes = 1 and No = 0.
	patent_ pre_yes	*Has the company already a patent stock in the year before submitting the application?* Dummy variable, where Yes = 1 and No = 0.
	export_pre_yes	*Has the company a history of R&D activities in the year before submitting the application?* Dummy variable, where Yes = 1 and No = 0.
	submit_before	*Has the company submitted an application to the Innovation Incentive System before this one?* Dummy variable, where Yes = 1 and No = 0.
Project characteristics	activity sector	Activity sector of the application: manufacturing industry, tourism activities, service sector and other. Dummy variable. *Other_sectors* is the omitted reference category.
	ln_investment	Total amount of investment foreseen by the company on the application form. Variable expressed as a logarithm.
	Network	*Is the project included in the networking project?* Dummy variable, where Yes = 1 and No = 0.
Project impact (foreseen)	Productivity	Variation of labor productivity (difference between gross added value per employee after and before project implementation) foreseen as result of the investment project. Values expressed in millions of euros.
	skill_job	Variation of skilled jobs (number) foreseen by the applicant as the result of investment project. Under the program regulation, a highly qualified worker is a person with at least a post-secondary pre-tertiary level of education.
	no_skill_job	Variation in non-skilled jobs (number) foreseen by the applicant as the result of investment project.
	Export	Variation in export intensity (ratio between international turnover and total turnover) foreseen by the applicant as the result of investment project.
	Rd	Variation in R&D intensity (ratio between R&D expenditure and turnover) foreseen by the applicant as the result of investment project.
	Patent	Variation in patent stock per employee foreseen by the applicant as the result of investment project.
Macroeconomic conditions	interest_r	Average interest rate in Portugal in the year of submitting the application.
	gdp_var	Variation in regional GDP at NUTS 3 level in Alentejo in the year of submitting the application.
	reg_skill_job	Share of skilled jobs (proportion of employed population with higher education) at NUTS 3 level in Alentejo in the year of submitting the application.
	Time fixed effect	Year of submitting the application. Dummy variable. The year 2008 is the omitted reference category.

Source: Authors' own elaboration.

Note: All monetary variables are at constant price (base 2006).

3. RESULTS AND DISCUSSION

3.1. Data description

The sample has 627 observations – 450 applications evaluated and managed at the regional level plus 177 applications evaluated and managed at the national level - which correspond to the number of applications submitted to the Portuguese Innovation Incentive System, between 2007 and 2013, for investment projects located in the Portuguese Alentejo region NUTS 2 (Appendix 1). The approval rate of applications submitted was 52%.

Concerning firms' characteristics, it appears that 539 applications were submitted by SMEs, representing 86% of all applications submitted (50% are micro, 26% are small and 10% are medium-sized firms) and 88 applications were submitted by non-SMEs, representing 14% of applications submitted in the period of observation. It seems that applicants are private firms, with an average number of three partners and nine years of activity. New firms, with no activity in the pre-intervention period, submitted more than 53% of applications in the Alentejo region. About 20% of applications were made by firms that had submitted another application to the same program previously, which means that some firms[1] (103 firms in 504 applicants) have submitted more than one application.

Concerning the activity sector, applications submitted by firms were distributed as follows: manufacturing industry (43%), service sector (18%) and tourism activities (31%). Those three sectors account for around 92% of the 627 applications submitted. Only 10% of the applications presented by firms are incorporated in a networking project.

The investment considered in the application is on average €4.1 million and the subsidized loan near to 50% of investment in approved applications. Aspirants to public support contemplate an increase of 17.6 jobs per application and 45% of these new jobs will be occupied by skilled workers.

Regarding innovation indicators, only 3% of applicants have a patent portfolio and 10% a past of R&D. Only 28% of financial requests are submitted by firms with internationalization experience.

The 627 projects in the sample foresaw on average an increase in innovation (measured by the rise of R&D expenditure and patent stock) and competitiveness capacity (regarding export intensity and labor productivity growth). Firms expect to increase their patent stock by 462.5%, R&D activities by 272.6%, export intensity by 318.2% and labor productivity by 561.5%.

3.2. Productivity and employment in application submission

Almost all the applications submitted (94%) predicted an increase in labor productivity and the creation of new jobs (Appendix 1). Investment projects forecasting an increase in skilled jobs are slightly fewer (89%). Excluding micro-firms, the number and share of approved applications with an increase in labor productivity (53% versus 47%) and jobs are higher (52% versus 48%)(Appendix 1).

On average, applicants expect an increase of €87.6 thousand in their labor productivity (Table 3). There is no statistical difference between approved and non-approved applications, except for medium-sized firms, where the increase in labor productivity is expected to be €43.1 thousand higher.

[1] The total number of applications submitted is 627 and the number of firms applying is 504.

TABLE 3. VARIATION IN LABOR PRODUCTIVITY, EMPLOYMENT LEVEL AND SKILLED JOBS FORESEEN IN SUBMITTED APPLICATIONS, BY FIRM SIZE AND STATUS IN SELECTION PROCESS

	All submitted applications		Approved Applications		Non-approved Applications		Mean diff	p-value	
	Obs.	Mean	Obs.	Mean	Obs.	Mean			
△ Productivity (x€1.000)									
Micro	311	90.3	139	104.9	172	78.5	26.4	0.182	
Small	163	111.0	92	88.6	71	139.9	-51.3	0.293	
Medium	63	59.3	33	79.9	30	36.7	43.1	0.095	*
Non-SMEs	90	55.9	26	60.3	26	44.9	15.4	0.611	
Total firms	627	87.6	328	89.1	299	86.0	3.1	0.850	
△ Jobs (n.°)									
Micro	311	10.1	139	12.5	172	8.2	4.3	0.004	***
Small	163	15.1	92	16.6	71	13.1	3.5	0.249	
Medium	63	21.2	33	29.5	30	12.1	17.4	0.046	**
Non-SMEs	90	45.6	26	65.8	26	37.4	28.4	0.110	
Total firms	627	17.6	328	20.2	299	14.8	5.5	0.0551	*
△ Skilled jobs (n.°)									
Micro	311	4.9	139	6.3	172	3.8	2.5	0.000	***
Small	163	6.5	92	6.7	71	6.2	0.5	0.754	
Medium	63	6.1	33	8.2	30	3.7	4.5	0.026	**
Non-SMEs	90	22.3	26	20.7	26	26.0	-5.3	0.749	
Total firms	627	7.9	328	9.4	299	6.3	3.1	0.169	

Source: Authors' own elaboration based on data extracted from Information System of the NSRF Incentive Scheme.
Note: ***, **, * indicate if the means are significantly different between "approved" and "non-approved" applications at the level of 1%, 5% and 10% respectively, based on t-Test.

The increase in labor productivity is higher for micro and small firms compared to medium-sized firms and non-SMEs and this result is statistically significant for all submitted applications (€97.4 versus €57.3 thousand) and for approved ones (€98.4 versus €66.9 thousand) (Table 4).

TABLE 4. DIFFERENCES IN PRODUCTIVITY VARIATION BETWEEN FIRM SIZES

	All submitted applications						Approved applications					
	Micro | micro & small | SMEs		Comparison group		Diff Mean		Micro | micro & small | SMEs		Comparison group		Diff Mean	
	Obs.	Mean	Obs.	Mean			Obs.	Mean	Obs.	Mean		
△ Productivity (x€1.000)												
Micro vs small and medium	311	90.3	226	96.6	-6.3		139	104.9	125	86.3	18.6	
Micro vs non-micro	311	90.3	316	85.0	5.3		139	104.9	189	77.5	27.4	
Micro and small vs Medium and non-SME	474	97.4	153	57.3	40.1	**	231	98.4	97	66.9	31.5	*
SME vs non-SME	537	92.9	90	55.9	37.1		264	96.1	64	60.3	35.8	*

Source: Authors' own elaboration based on data extracted from Information System of the NSRF Incentive Scheme.
Note: ***, **, * indicate if the means are significantly different between "approved" and "non-approved" applications at the level of 1%, 5% and 10% respectively, based on t-Test.

Concerning increased employment (Tables 3 and 5), this is on average proportional to firm size, bigger firms foreseeing a greater increase in jobs and vice-versa (e.g. an average increase of 12.9 new jobs for SMEs compared to 45.6 new jobs for non-SMEs). Applications approved for micro and medium-sized firms envisage a statistically significant greater increase of jobs (total and skilled workers) than those non-approved, representing the mean difference of 4.3 and 2.5 for micro firms and 17.4 and 4.5 for medium-sized firms.

On average, around 45% of new jobs created will be filled by skilled workers. Micro-firms, compared to small and medium-sized firms, foresee hiring a higher proportion of skilled workers (48.6% versus 37.8%, respectively) and this difference is statistically significant.

However, when analysing approved applications this trend is not statistically significant, which means that in the end (after the selection process) the increase in the proportion of skilled workers is greater in bigger firms (Table 5).

TABLE 5. DIFFERENCES IN EMPLOYMENT VARIATION BETWEEN FIRM SIZES

	All submitted applications						Approved applications					
	Micro | micro & small | SMEs		Comparison group		Diff Mean		Micro | micro & small | SMEs		Comparison group		Diff Mean	
	Obs.	Mean	Obs.	Mean			Obs.	Mean	Obs.	Mean		
△ Jobs (n.°)												
Micro vs small and medium	311	10.1	226	16.8	-6.7	***	139	12.5	125	20.0	7.5	***
Micro vs non-micro	311	10.1	316	25.0	-14.9	***	139	12.5	189	25.9	-13.4	***
Micro and small vs medium and non-SME	474	11.8	153	35.6	-23.8	***	231	14.1	97	34.7	-20.6	***
SME vs non-SME	537	12.9	90	45.6	-32.7	***	264	16.0	64	37.4	-21.4	***
△ Skilled jobs (n.°)												
Micro vs small and medium	311	4.9	226	6.3	-1.4	**	139	6.3	125	7.1	0.4	
Micro vs non-micro	311	4.9	316	10.9	-6.0	***	139	3.3	189	11.7	-8.4	*
Micro and small vs medium and non-SME	474	5.4	153	15.6	-10.1	***	231	6.4	97	16.5	-10.0	***
SME vs non-SME	537	5.5	90	22.3	-16.7	***	264	6.7	64	20.7	-14.1	***
△ Share skilled jobs (%) = △ skilled jobs / △ jobs												
Micro vs small and medium	311	48.6%	226	37.8%	10.8%	**	139	50.3%	125	35.4%	14.9%	
Micro vs non-micro	311	48.6%	316	43.5%	5.1%	***	139	26.3%	189	45.2%	-18.8%	*
Micro and small vs medium and non-SME	474	46.1%	153	43.8%	2.3%	***	231	45.6%	97	47.4%	-1.8%	***
SME vs non-SME	537	42.7%	90	48.8%	-6.0%	***	264	41.5%	64	55.3%	-13.8%	***

Source: Authors' own elaboration based on data extracted from "Information System of the NSRF Incentive Scheme".
Note: ***, **, * indicate if the means are significantly different between 'approved' and 'non-approved' applications at the level of 1%, 5% and 10% respectively, based on t-Test.

3.3. Determinants of selection process

Regarding the correlation matrix (Appendix 2), we can identify a moderate to high correlation between some variables. Firm age is positively correlated with firm size, measured by the number of employees (corr = 0.4) and with previous experience in foreign trade (corr = 0.6). Firm size is also highly correlated with the number of skilled workers (corr = 0.9) and with the expected impact on total new job creation (corr = 0.6) and new skilled jobs (corr = 0.8). A high correlation also exists between the number of skilled jobs and the foreseen increase in this workforce (corr = 0.9). Patent stock per employee is negatively correlated with the foreseen increase in patent stock (corr = - 0.5). R&D intensity is very highly correlated with the foreseen increase in R&D intensity (corr = -0.9). To sum up, this means that older firms are bigger and are also more likely to sell in foreign markets. Bigger firms have a higher number of skilled employees and foresee a greater increase in the total number of new workers. Firms with a higher number of skilled jobs forecast a greater rise in this category of workforce. Entities with a

higher patent stock per employee predict a lower increase and similarly firms with lower R&D intensity predict a higher increase.

In order to avoid potential problems of multicollinearity, the number of employees in the year before submitting an application was not included in the model and firm size was transformed in a categorical variable, according to the EC recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises. Firms' age and the number of skilled employees in the pre-intervention period were also not included in the model, due to their moderate-high correlation with other variables. The characterization of firm patent stock and R&D intensity before a subsidized loan were transformed in a binary variable, which assumes a value of 1 if firms have a patent stock or R&D intensity and 0 otherwise.

The final model (2) used to assess which factors influence the decision to approve an application, under the SI Innovation in Alentejo region, takes into account the two main dimensions in analysis – increased productivity and employment level – and also other selection criteria mentioned in the program regulation, such as representation in the international market and exploitation of R&D results. As mentioned previously in section 3, firm and investment project characteristics, as well as macroeconomic factors, were also included in the model.

$$\begin{aligned}\Pr(\text{Approved application} = 1|\ldots) &= \mathrm{G}(\beta_0 + \beta_1 small + \beta_2 medium + \beta_3 no\ sme + \beta_4 partner + \beta_5 roe + \beta_6 solv \\ &+ \beta_7 expSI + \beta_8 exportPre + \beta_9 r\&dPre + \beta_{10} patentPre + \beta_{11} networking \\ &+ \beta_{12} \ln invest + \beta_{13} \triangle skill\ job + \beta_{14} \triangle skill\ job^2 + \beta_{15} \triangle no\ skill\ job \\ &+ \beta_{16} \triangle exportation + \beta_{17} \triangle productivity + \beta_{18} \triangle rd\ intensity + \beta_{19} \triangle patent \\ &+ \beta_{20} sector_i + \beta_{21} Year_i)\end{aligned} \quad (2)$$

Table 6 shows the coefficients and marginal effects of Logit estimations. Model 1 includes time and sector fixed effects. Model 2 contains independent variables linked with macroeconomic conditions and sector fixed effects. Due to the moderate-high correlation between macroeconomic variables and time fixed effects, these were not included in Model 2.

The result of the Ramsey test, for omitted variables, and of the Hosmer-Lemeshow test illustrate that the models are correctly specified and the functional forms are correct (Table 7). No problem of heteroscedasticity and multicollinearity was detected, based on the White Test and on the results of variance inflation factors (VIF) for the independent variables. So the coefficients and marginal effect can be interpreted correctly.

Assessment of the results starts with the impact of productivity and employment variation on the probability of having an application approved. The variation in skilled jobs, as a result of the investment project, shows an inverted U-shaped relationship with the probability of receiving the public incentive. This means that increasing the number of skilled jobs has a positive effect on the decision to fund an investment project, but at a higher level the effect tends to inverse and the probability of having an application selected decreases. In contrast, the variation in non-skilled jobs shows a small but significant negative impact on the outcome variable, but only when time fixed effects are used in the model. This difference between both variables (skilled and non-skilled worker variation) could reveal a government preference for increasing only qualified employment. However, the preference for funding projects which foresee a greater increase of this workforce has its limits, perhaps because hiring a higher number of new skilled workers could be riskier due to requiring a larger additional income to justify this and to make new jobs profitable.

TABLE 6. LOGIT ESTIMATION RESULTS

Variables	Model 1				Model 2			
	Coef.		St. Error	dy/dx	Coef.		St. Error	dy/dx
Small	0.057		0.257	0.011	0.116		0.259	0.021
Medium	-0.869	**	0.390	-0.159	-0.734	*	0.387	-0.134
no_sme	0.414		0.379	0.076	0.441		0.378	0.081
nr_partner	0.144	***	0.050	0.026	0.142	***	0.050	0.026
roe_pre	-0.047		0.129	-0.009	-0.040		0.128	-0.007
solv_pre	-0.002		0.003	0.000	-0.002		0.003	0.000
exp_si	0.546	**	0.253	0.100	0.574	**	0.251	0.105
export_pre_yes	0.966	***	0.296	0.177	0.836	***	0.292	0.153
rd_pre_yes	0.612		0.390	0.112	0.685	*	0.387	0.125
pat_pre_yes	-0.265		0.742	-0.049	-0.222		0.750	-0.041
Networking	1.715	***	0.389	0.315	1.787	***	0.374	0.327
ln_invest	0.363	***	0.091	0.067	0.336	***	0.090	0.061
var_skill_job	0.035	***	0.016	0.006	0.035	**	0.016	0.006
var_skill_job2	-8.39E-05	**	3.44E-05	0.000	-8.32E-05	**	3.45E-05	0.000
var_no_skill_job	-0.008	*	0.004	-0.001	-0.007		0.004	-0.001
diff_export	1.714	***	0.406	0.314	1.542	***	0.398	0.282
diff_gav_job	-0.752		0.477	-0.138	-0.627		0.466	-0.115
diff_rd_intensity	0.086		0.067	0.016	0.069		0.055	0.013
diff_patent_stock	2.020	**	0.959	0.371	2.213	**	0.979	0.405
interest_r	-		-	-	-0.479	***	0.156	-0.088
reg_job_skill	-		-	-	-0.289	***	0.075	-0.053
gdp_var	-		-	-	6.231	**	2.699	1.140
Constant	-4.326	***	0.719		2.380		1.513	
Observations	622				622			
Time fixed effects	YES				NO			
Sector fixed effects	YES				YES			
Pseudo R2	0.2140				0.2157			
Log likelihood	-338.12				-337.41			

Source: Authors' own elaboration based on STATA output.
Note: ***, **, * significance level at 1%, 5% and 10% respectively.

TABLE 7. RESULTS OF SPECIFICATION TEST

	Model 1	Model 2
% Correctly classified	74.1%	73.2%
Mean VIF	1.47	1.37
Ramsey Test	0.41	0.11
Hosmer–Lemeshow test	0.72	0.58
White Test	0.07	0.15

Source: Authors' own elaboration based on STATA output.

The impact of investment projects on firm productivity in Model 1 and Model 2 is not a determinant factor in the selection process (not significant variable). However, as we saw in section 4.2, it is possible to have different behavior according to firm size. When interaction terms are introduced (see estimations in Appendix 3), the results show that in applications submitted by SME, the foreseen variation in firms' productivity has a negative impact on the likelihood of receiving public support[1]. One possible explanation could be that in the selection process, new job creation has greater priority than increased labor productivity.

[1] In the presence of interaction terms, the coefficient *no_sme* is conditional to *var_gav_job* equaling zero and, in the same way, the coefficient *var_gav_job* is conditional to *no_sme* being equal to zero. In turn, the interaction term coefficient estimates the difference between the effect of *var_gav_job* when firms are *no_sme* and the effect of *var_gav_job* when firms are not *no_sme*. In Model 10 the interaction term and *no_sme* categories are both non-significant variables so interpretation only concerns the coefficient of *var_gav_job,* which represents the effect when *no_sme* = 0 (or *sme* = 1).

Different behavior according to firms' size, concerning the impact of skilled jobs on outcome, can also to be seen in the logit estimation in Appendix 3. The effect of this explanatory variable is negative for small firms and positive for medium firms, compared to the reference category (other firms). A minor non-linear relationship, similar to Model 1 and Model 2, was found for SMEs compared to non-SMEs in Model 9. These results could suggest two things. First, the increase in skilled jobs is only a relevant criterion for SMEs, because in the pre-intervention period they are less performing in terms of a qualified workforce[1]. Second, within the SME category, the impact of skilled jobs on the likelihood of being funded is higher for medium-sized than for micro and small-firms, perhaps because despite micro and small-firms being most in need they do not have the structural capacity to increase skilled jobs at the same level as medium-sized ones.

Regarding the other firm and application characteristics in the selection process, firm size, measured by categorical variables, is not always significant. Only medium-sized firms are less likely to get a subsidy than micro-firms. The number of firm partners, which in our sample is linked with smaller firms, also has a positive impact. So on average, the neediest firms are more likely to obtain public support, which reveals, as Busom (2000) highlighted, that public agencies favor small firms, because they are more financially constrained (effective selection process).

Previous experience in the SI Innovation procedure increases the probability of having an application approved by 10%. The positive relationship between experience of subsidies and being a funded firm was demonstrated by other authors, such as Aerts and Thorwarth (2008), Aschhoff (2009) and Hud and Hussinger (2015), based on the "pick the winner" principle. Nevertheless, in our model this conclusion is not necessarily good news. On one hand, this could reveal that the public incentive goes more to the same companies, and that firms could receive more than one subvention under the SI Innovation. Or it could reveal that firms familiar with the application process could have easier access to public support because they know which factors to emphasize on the application form.

The amount of investment has a positive impact on the probability of being funded. If we take into account that, firstly, the amount of investment represents the sum of public incentive (percentage of the eligible investment) and private expenditure (equal to the remainder), and secondly, the aim of the program is to stimulate innovative investment, it is expected that government will tend to approve applications with a higher amount of expenditure because this implies a greater private effort. This conclusion is also in line with Aerts and Thorwarth (2008:13), who found that receiving a subsidy has a positive impact on R&D efforts because funded companies show higher R&D expenditure than non-funded ones. Similarly, Santos, Serrano and Neto (2015) also find that the amount of funded investment has a positive impact on the probability of firm survival, because higher investments tend to be better planned. Because they are more risky, they need a higher additional cash-flow to be economically viable. So when governments choose to fund projects with a higher amount of investment, this tends to maximize the outcome: greater private effort and a low failure rate.

Firms' innovative capacity is assessed by R&D intensity in the pre-intervention period and by the foreseen increase in patent stock per employee. In turn, having a patent portfolio before submitting an application and foreseeing an increase in R&D activities are not taken into account in the selection process (not significant variables). These results are line with the objective of the program to support innovation in the last phase of the process, when R&D becomes patentable and/or gives rise to a new marketable service or good.

Previous experience in foreign trade increases the probability of having an application approved, as also found by Aerts and Thorwarth (2008) and Czarnitzki and Lopes Bento (2011). Parallel to this, the foreseen difference in export intensity also shows, as expected, a positive impact on that likelihood. Indeed, one goal of the program is to boost firms' presence in international markets, and in order to ensure this, selection is based on a "pick the winner" principle, those already best performing are the ones most likely to achieve this goal.

Factors that influence the credit risk and the decision to give a bank loan, such as solvability ratio and return on equity, seem not to influence the government evaluator in funding projects.

Finally, introducing regional macroeconomic characteristics in the analysis, the results of Model 2 show that when the Portuguese

[1] Bigger firms, measured by the number of employees, are those with a higher number of skilled workers (corr = 0.9).

financial market has a lower interest rate and when the regional economy shows a growth in GDP, the probability of having an application approved increases. This could suggest a complementary effect of the public instrument in order to accelerate growth in periods when capital is available at a lower price. On the other hand, investment projects located in regions with a lower share of skilled workers are less likely to be financially supported by the program, which reveals an effective selection process because the neediest regions are helped most.

3.4. Distribution of subsidized loans and cost of new jobs

Concerning the distribution of subsidized loans by firm size, Table 8 shows that within SME categories the amount of public support per employee decreases when firm size increases and this is also the case for the average amount of investment per employee. The share of subsidized loans is also greater for smaller firms, which means it decreases when firm size increases.

TABLE 8. INVESTMENT, SUBSIDIZED LOAN AND COST OF NEW JOBS, BY FIRM SIZE AND ACTIVITY SECTOR, IN APPROVED APPLICATIONS

Categories	Investment by job [1]		Subsidized loan by jobs [1]		Share of subsidized loan			loan/new jobs [2]	
	Obs	Mean	Obs	Mean	Obs	Mean	Max	Obs	Mean
Average (all firms)	324	157,525 €	324	71,601 €	328	50%	75%	307	135,670 €
Firm size									
Micro	139	174,694 €	139	93,197 €	139	56%	75%	136	109,509 €
Small	91	131,555 €	91	62,983 €	92	51%	75%	86	126,946 €
Medium	33	73,539 €	33	35,863 €	33	48%	65%	30	123,609 €
Non SMEs	61	202,580 €	61	54,581 €	64	37%	60%	55	220,579 €

Source: Authors' own elaboration based on data extracted from Information System of the NSRF Incentive Scheme.
Note: [1] Ratio between investment (or subsidized loan) by employment level in post-intervention period.[2] Only estimated for firms predicting an increase in employment.

Subsidized firms take financial advantage of the public support twice. Firstly, subsidized loans have no cost (loan without any interest and finance charges). Secondly, if firms meet the financial targets planned in the application, up to 75% of the subsidized loan could be transformed in a grant. The cost-effectiveness ratio between the amount of subsidized loan (input) and new jobs created (outcome) gives a proxy variable for the cost of new jobs. Tables 8 and 9 show that the amount of subsidized loan granted per new job created is surprisingly higher for bigger firms and especially for non-SMEs than for SMEs. On average, non-SMEs received a lower amount of subsidy by employment level (Table 8), but they are awarded more per new job created (Table 9).

TABLE 9. DIFFERENCE IN SUBSIDIZED LOAN PER NEW JOB BETWEEN FIRM SIZES

	Micro | micro & small | SMEs		Comparison group		Diff mean	
	Obs	Mean	Obs	Mean		
Micro vs small	136	109,509 €	86	126,946 €	-17,437 €	
Micro vs small & medium	136	109,509 €	116	126,083 €	-16,574 €	
Micro vs non-micro	136	109,509 €	171	156,477 €	-46,968 €	**
Micro & small vs medium & non-SME	222	116,264 €	85	186,355 €	-70,091 €	***
SME vs non-SME	252	117,138 €	55	220,579 €	-103,441 €	**

Source: Authors' own elaboration based on data extracted from Information System of the NSRF Incentive Scheme.
Note: Only estimated for those foreseeing increased employment.***, **, * indicate if the means are significantly different between groups at the level of 1%, 5% and 10% respectively, based on t-Test.

4. CONCLUSION

The Portuguese Innovation Incentive System was an important instrument of the Portuguese National Strategic Reference Framework 2007-2013, developed with the aim of stimulating innovation and promoting competitiveness.

Between 2007 and 2013, 627 applications to SI Innovation were submitted for investment projects in Alentejo region. Almost all the applications (94%) foresaw an increase in labour productivity and the creation of new jobs. The 328 applications approved foresaw an investment of €1.837 million, at constant price (base = 2006), and the creation of more than 6.600 new jobs in the region.

The selection process seems to focus more on increasing the international competitiveness of Alentejo firms, measured by improved export

intensity, and by the foreseen innovative capacity of applicants in transforming R&D results into patentable products. Surprisingly, the expected project impact on productivity has a negative effect on SMEs' probability of being funded by the program. This means that firms which forecast a lower increase in productivity are those most likely to have an application approved. On the other hand, the project's estimated effect on employment has a different impact on the probability of having an application selected depending on qualifications and on firm size. On average, hiring new skilled employees has a positive effect on the likelihood of having an application approved, whereas increasing the number of non-skilled jobs has a negative one. The qualifications of the new workforce is only a relevant criterion for SMEs.

Government evaluators adopt a "picking the winner principle" regarding foreign trade experience and the amount of investment in the project, which means they are cautious and select projects with a potentially low risk of failure in order to maximize the expected outcome. Nonetheless, entities in charge of evaluating applications prefer to finance the neediest firms and projects implemented in the neediest regions. Smaller firms (micro *versus* medium firms) and projects implemented in more disadvantaged regions for a qualified workforce are more likely to have an application approved. Firm characteristics influencing credit risk, such as profitability and solvency ratio, are not relevant factors in being selected for innovation subsidies, which means that firms' financial performance in the pre-intervention period is not relevant.

Public support for innovation in the Portuguese Alentejo region seems to be complementary to macroeconomic trends, when the cost of capital in the market is lower and the regional economy is growing, the probability of having an application approved increases.

The cost of new jobs created, measured by the amount of subsidized loan per new job, is surprisingly higher for bigger firms. For example, comparing non-SMEs (220.579€) with SMEs (117.138€), we can see that the former has a significantly higher cost (almost double) for the government, measured at least by exemption from interest and financial charges on the loan. This result suggests that the share of subsidized loans awarded to non-SMEs is not the most effective, because they are less financially constrained than smaller firms.

To sum up, the paper makes an assessment of how the expected impact on firm productivity and employment is taken into account, when firms apply for public funding for innovation, controlling for other factors. Regarding the main dimension analysed, we can conclude that a trade-off between higher levels of employment and productivity is necessary, in order to achieve growth and competitiveness in the region.

Future research should attempt to expand the present analysis to all applications submitted to SI Innovation between 2007 and 2013 in Portugal, in order to assess if some differences exist between Portuguese regions.

ACKNOWLEDGEMENTS

The authors are grateful to the Management Authority of the Alentejo Regional Operational Program 2007-2013 for the information and data provided about the Portuguese Innovation Incentive System. Special thanks go to Peter Berkowitz (DG-Regio), Wolfgang Petzold (Committee of the Regions), Nicola Francesco Dotti (Université Catholique de Louvain and Vrije Universiteit Brussel), Frank Crowley (University College Cork) and Oto Potluka (University of Basel) for valuable comments and suggestions on the earlier version.

REFERENCES

Aerts, K. and Thorwarth, S. (2008). "Additionality effects of public R&D funding: "R" versus "D"", FBE Research Report MSI_0811, K. U. Leuven - Faculty of Business and Economics, pp. 1-19.

Aschhoff, B. (2009). "Who Gets the Money? The Dynamics of R&D Project Subsidies in Germany", *ZEW Discussion Papers*, No. 08-018 [rev.], p. 37.

Bergström, F. (2000). "Capital Subsidies and the Performance of Firms", *Small Business Economics*, Vol. 14(3), pp. 183-193. doi: 10.1023/A:1008133217594.

Bernini, C.; Pellegrini, G. (2011). "How are growth and productivity in private firms affected by public subsidy? Evidence from a regional policy", *Regional Science and Urban Economics*, Vol. 41(3), pp. 253-265, doi:10.1016/j.regsciurbeco.2011.01.005.

Blanes, J. V. and Busom, I. (2004). "Who participates in R&D subsidy programs?: The case of Spanish manufacturing firms", *Research Policy*, 33(10), pp. 1459-1476, doi:10.1016/j.respol.2004.07.006.

Busom, I. (2000). "An Empirical Evaluation of the Effects of R&D Subsidies", *Economics of Innovation and New Technology*, Vol. 9, pp. 111-148, doi:10.1080/10438590000000006.

CCDRA (2014). *Uma Estratégia Inteligente para a Região Alentejo,* Comissão de Coordenação e Desenvolvimento Regional do Alentejo, Évora.

http://s3platform.jrc.ec.europa.eu/regions/PT18/tags/PT18?s3pv=1).

CCDRA (2015). Os Fundos Comunitários na Região do Alentejo no período 2007/2014 – Alguns resultados e impactos, Comissão de Coordenação e Desenvolvimento Regional do Alentejo, Évora. http://webb.ccdra.gov.pt/docs/ccdra/gestao/Funds_Comun_Alentej_2007_2014.pdf (Accessed on 24th February 2016).

Cerqua, A.; Pellegrini, G. (2014). "Do subsidies to private capital boost firms' growth? A multiple regression discontinuity design approach", *Journal of Public Economics*, 109, pp. 114-126, doi:10.1016/j.jpubeco.2013.11.005.

Cincera, M. (2003)."Financing constraints, fixed capital and R&D investment decisions of Belgian firms". In P. Butzen, and C. Fuss, *Firms' Investment and Finance Decisions: Theory and Empirical Methodology, Cheltenham*, Edwar Elgar, UK, pp.129-147.

Cincera, M.; Ravet, J. (2010). "Financing constraints and R&D investments of large corporations in Europe and the US", *Science and Public Policy*, Vol. 37(6), pp. 455-466, doi: 10.3152/030234210X508642.

Chaibi, H.; Ftiti, Z. (2015). "Credit risk determinants: Evidence from a cross-country study", *Research in International Business and Finance*, Vol. 33, pp. 1-16, doi:10.1016/j.ribaf.2014.06.001.

Comissão de Acompanhamento do POFC (2015). Relatório de Execução 2014 do COMPETE, POFC - Programa Operacional Fatores de Competitividade, 304 p.

COMPETE Website: http://www.pofc.qren.pt/areas/incentives-to-companies/innovation (accessed on 15th February 2016).

Criscuolo, C.; Martin, R.; Overman, H. G.; Van Reenen, J. (2016). "The Causal Effects of an Industrial Policy", *CEP Discussion Paper* N.º 1113, Centre for Economic Performance - London School of Economics and Political Science, pp. 63.

Czarnitzki, D. and Fier, A. (2002). "Do Innovation Subsidies Crowd Out Private Investment? Evidence from the German Service Sector", *Applied Economics Quarterly*, Vol. 48 (1), pp. 1-25.

Czarnitzki, D. and Lopes Bento, C. (2011). "Innovation subsidies: Does the funding source matter for innovation intensity and performance? Empirical evidence from Germany", *LISER Working Paper Series*, 2011-42, 43 p.

Dew-Becker, I.; Gordon, R. J. (2012). "The Role of Labor-Market Changes in the Slowdown of European Productivity", *Review of Economics and Institutions*, vol. 3(2), Article 1, p. 1-45, doi: 10.5202/rei.v3i2.74.

Erden, L.; Holcombe, R. G. (2005). "The effects of Public Investment on private investment in developing economies", *Public Finance Review*, Vol. 33 nº 5, September 2005, p.p. 575-602.

European Commission (2010). "Europe 2020 - A European strategy for smart, sustainable and inclusive growth, Communication from the Commission", Communication from the Commission, Brussels 3th March 2010.

European Commission (2011). ''Regional Policy for Smart growth in Europe 2020", European Commission, Directorate-General for Regional Policy, Brussels, pp. 32.

European Commission (2012). "Guide to Research and Innovation Strategies for Smart Specialisation", Regional Policy, May. Brussels: European Commission.

European Commission (2014). "The European Union Explain: Regional Policy", European Commission, Luxembourg.

European Commission, COM (2012) 496 final. Amended proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL laying down common provisions on the European Regional Development Fund, the European Social Fund, the Cohesion Fund, the European Agricultural Fund for Rural Development and the European Maritime and Fisheries Fund covered by the Common Strategic Framework and laying down general provisions on the European Regional Development Fund, the European Social Fund and the Cohesion Fund and repealing Council Regulation (EC) No 1083/2006.

González, X. and Pazó, C. (2008). "Do public subsidies stimulate private R&D spending?", *Research Policy*, Vol. 37, pp. 371-389, dx.doi.org/10.1016/j.respol.2007.10.009.

Hölzl, W. and Peneder, M. (2013). "Financing innovation", *Encyclopedia of Creativity, Invention, Innovation and Entrepreneurship*, Springer New York, pp. 734-738, doi: 10.1007/978-1-4614-3858-8_487.

Hud, M. and Hussinger, K. (2015). "The impact of R&D subsidies during the crisis", *Research Policy*, 44(10), pp. 1844-1855, doi:10.1016/j.respol.2015.06.003.

IAPMEI, FCT, ANI and COMPETE (2014). *Estratégia de Investigação e Inovação para uma Especialização Inteligente 2014-2020*, Instituto Apoio às Pequenas e Médias Empresas Industriais, Fundação para a Ciência e Tecnologia, Agência Nacional de Inovação e Programa Operacional Fatores de Competitividade. Lisboa, e http://s3platform.jrc.ec.europa.eu/regions/PT?s3pv=1).

INE (2009). *Statistical Yearbook of Alentejo Region 2008*. Lisboa: Instituto Nacional de Estatística.

INE (2015). *Statistical Yearbook of Alentejo Region 2014*. Lisboa: Instituto Nacional de Estatística.

INE (Statistics Portugal) website: http://www.ine.pt (accessed on 29th January 2016).

Jorge, J.; Suárez, C. (2011). "Influence of R&D subsidies on efficiency: the case of Spanish manufacturing firms", *Cuadernos de Economía y Dirección de la Empresa*, Vol. 14, pp. 185-193, doi:10.1016/j.cede.2010.11.001.

Karhunen, H. and Huovari, J. (2015). "R&D Subsidies and productivity in SMEs", *Small Business Economics*, Vol. 45 (4), p. 805-823, doi:10.1007/s11187-015-9658-9.

Lee, N; Sameen, H. and Cowling, M. (2015). "Access to finance for innovative SMEs since the financial crisis", *Research Policy*, 44(2), pp. 370-380, doi:10.1016/j.respol.2014.09.008.

Louzis, D.; Vouldis, A.; Metaxas, V. (2012). "Macroeconomic and bank-specific determinants of non-performing loans in Greece: a Comparative study of mortgage, business and consumer loan portfolios", *Journal of Banking & Finance*, Vol. 36(4), pp. 1012-1027, doi:10.1016/j.jbankfin.2011.10.012.

Paunov, C. (2012). "The global crisis and firm' investments in innovation", *Research Policy*, vol 41 (1), pp. 24-35.

PORDATA website (Database of Contemporary Portugal): http://www.pordata.pt(accessed on 29th January 2016).

Powers, D. A.; Xie, Y. (2008). *Statistical Methods for Categorical Data Analysis*, 2nd Edition, Emerald Group Publishing Ltd, 200 p.

Sakamoto, A. (2010). "Definition of Productivity/Requirements for Improving It", Beyond world-class Productivity - Industrial engineering practice and theory, Springer London, pp 49-64, doi: 10.1007/978-1-84996-269-8_4.

Santos, A.; Serrano, M. M. and Neto, P. (2015). "A long-term mortality analysis of subsidized firms in rural areas: an empirical study in the Portuguese Alentejo region", *Eurasian Economic Review*, 6 (1), pp. 125 -151, doi: 10.1007/s40822-015-0035-4.

Santos, A.; Cincera, M.; Neto, P. & Serrano, M. M. (2016a). "The Selection Process of Applications to the Portuguese Innovation Incentive System: Who Gets Financial Support?". In Proceedings of 24th Workshop APDR – Entrepreneurship and Performance in Regional Context. Lisboa, Universidade Lusófona, 17 March, pp. 212-225. [http://www.apdr.pt/publicacoes/atas-proceedings/].

Santos, A.; Cincera, M.; Neto, P. & Serrano, M. M. (2016b). "Who Gets Public Support to Innovation? Evidence from the Portuguese Alentejo Region". In Nicola Francesco Dotti (Editor). *Learning from implementation and evaluation of the EU Cohesion Policy: Lessons from a research-policy dialogue* (pp. 60-76). Brussels: RSA Research Network on Cohesion Policy (www.regionalstudies.org) [ISBN 978-2-9601879-0-8].

APPENDIX

Appendix 1. Descriptive statistics

TABLE I. DESCRIPTIVE STATISTICS

Variable	Obs	Mean	Std. Dev.	Min	Max
Micro	627	0.50	0.50	0	1
Small	627	0.26	0.44	0	1
Medium	627	0.10	0.30	0	1
no_sme	627	0.14	0.35	0	1
nr_partner	627	2.93	2.13	1	13
Age	627	9.09	14.14	0	101.6
nat_cap	627	0.90	0.27	0	1
job_pre	627	44.11	227.09	0	3475
var_job	627	17.62	35.62	-31	399
var_no_skill_job	627	9.70	27.61	-118	400
skill_job_pre	627	6.21	39.56	0	670
var_skill_job	627	7.92	28.31	-2	480
gav_job_pre	627	15.59	59.21	-476.0	1089.5
diff_gav_job_pre	627	0.09	0.21	-1.1	3.6
roe_pre	627	0.02	0.68	-12.5	4.2
solv_pre	627	3.90	45.86	-0.8	1102.9
rd_int_pre	625	0.14	2.09	0	47.1
diff_rd_int	625	-0.13	2.08	-47.1	0.1
rd_pre_yes	627	0.10	0.31	0	1
export_int_pre	627	0.11	0.25	0	1.0
diff_export	627	0.35	0.31	-0.4	1.0
export_pre_yes	627	0.28	0.45	0	1
patent_stock_pre	625	0.01	0.09	0	2
diff_patent_stock	624	0.02	0.14	-1.9	1.5
pat_pre_yes	627	0.03	0.16	0	1
Invest	627	4167.44	12306.40	9.03	199815
industry_g	627	0.43	0.50	0	1
service_g	627	0.18	0.39	0	1
trade_g	627	0.04	0.18	0	1
tourism_g	627	0.31	0.46	0	1
all_other_sector_g	627	0.04	0.19	0	1
interest_rate	627	6.67	0.70	5.4	7.6
reg_job_skill	627	11.52	1.41	8.6	13.1
gdp_var	627	-0.02	0.04	-0.16	0.14
y_2007	627	0.00	0.06	0	1
y_2008	627	0.17	0.38	0	1
y_2009	627	0.10	0.31	0	1
y_2010	627	0.11	0.31	0	1
y_2011	627	0.19	0.39	0	1
y_2012	627	0.20	0.40	0	1
y_2013	627	0.23	0.42	0	1

Source: Authors' own elaboration based on data extracted from "Information System of the NSRF Incentive Scheme".

TABLE II. APPLICATIONS (N. ° AND %) WITH A FORESEEN INCREASE IN LABOR PRODUCTIVITY, EMPLOYMENT LEVEL AND SKILLED JOBS, BY FIRM SIZE AND STATUS IN SELECTION PROCESS

	All submitted applications		Approved applications		Non-approved applications	
	N.° applications	% Total [1]	N.° applications	% Total [2]	N.° applications	% Total [2]
△Productivity> 0						
Micro	297	95%	133	45%	164	55%
Small	156	96%	91	58%	65	42%
Medium	62	98%	33	53%	29	47%
Non-SME	76	84%	57	75%	19	25%
Total firms	591	94%	314	53%	277	47%
New jobs						
Micro	304	98%	136	45%	168	55%
Small	152	93%	86	57%	66	43%
Medium	56	89%	30	54%	26	46%
Non-SME	79	88%	55	70%	24	30%
Total firms	591	94%	307	52%	284	48%
New skilled jobs						
Micro	284	91%	128	45%	156	55%
Small	144	88%	85	59%	59	41%
Medium	54	86%	28	52%	26	48%
Non-SME	78	87%	56	72%	22	28%
Total firms	560	89%	297	53%	263	47%

Source: Authors' own elaboration based on data extracted from "Information System of the NSRF Incentive Scheme".
Note: [1] Share compared to all submitted applications by firm size. [2] Share compared to all submitted applications with a foreseen increase in productivity or new jobs or new skilled jobs by firm size.

Appendix 2. Correlation matrix

TABLE III. CORRELATION MATRIX

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1	=	Micro	1.00																																			
2	=	Small	-0.59	1.00																																		
3	=	medium	-0.33	-0.20	1.00																																	
4	=	no_sme	-0.41	-0.24	-0.14	1.00																																
5	=	Age	-0.39	0.02	0.19	0.37	1.00																															
6	=	nr_partner	-0.16	0.27	0.11	-0.22	0.03	1.00																														
7	=	exp_si	-0.03	-0.06	0.06	0.07	0.11	0.07	1.00																													
8	=	networking	0.09	-0.04	-0.04	-0.04	-0.02	0.04	0.08	1.00																												
9	=	Invest	-0.16	-0.07	-0.04	0.35	0.01	-0.04	-0.02	-0.03	1.00																											
10	=	roe_pre	-0.01	0.01	-0.08	0.07	0.04	-0.04	0.04	0.01	0.03	1.00																										
11	=	solv_pre	-0.01	0.05	-0.02	-0.03	-0.03	0.04	-0.02	0.01	0.00	-0.01	1.00																									
12	=	job_pre	-0.19	-0.09	0.03	0.35	0.39	-0.09	0.14	-0.02	0.06	0.03	-0.01	1.00																								
13	=	var_job	-0.21	-0.04	0.03	0.32	0.11	-0.02	0.08	0.01	0.21	0.02	0.00	0.56	1.00																							
14	=	skill_job_pre	-0.14	-0.06	0.01	0.27	0.34	-0.07	0.12	-0.03	0.02	0.02	-0.01	0.94	0.52	1.00																						
15	=	var_skill_job	-0.11	-0.03	-0.02	0.21	0.19	-0.04	0.10	-0.02	0.10	0.01	-0.01	0.81	0.65	0.90	1.00																					
16	=	gav_job_pre	-0.14	-0.01	0.06	0.16	0.22	0.04	0.04	-0.04	0.01	0.02	-0.02	0.15	0.22	0.07	0.05	1.00																				
17	=	diff_gav_job_pre	0.01	0.07	-0.04	-0.06	-0.18	0.04	-0.05	-0.05	0.15	-0.01	0.01	-0.07	-0.01	-0.04	0.05	-0.31	1.00																			
18	=	rd_pre	-0.13	-0.06	0.01	0.25	0.18	-0.08	0.11	-0.02	0.03	0.01	-0.01	0.28	0.17	0.22	0.11	0.14	-0.06	1.00																		
19	=	diff_rd	-0.08	-0.01	0.01	0.11	0.03	-0.02	-0.01	-0.03	0.14	0.02	0.00	0.15	0.43	0.02	0.03	0.25	-0.03	0.11	1.00																	
20	=	rd_pre_yes	-0.21	-0.07	0.13	0.28	0.31	-0.03	0.09	0.01	0.01	-0.07	-0.02	0.30	0.17	0.26	0.16	0.15	-0.07	0.43	0.13	1.00																
21	=	patent_stock_pre	0.03	0.00	-0.01	-0.03	-0.03	-0.01	-0.01	-0.02	-0.02	0.01	0.00	-0.01	-0.01	-0.01	-0.01	0.00	0.00	0.00	-0.01	0.06	1.00															
22	=	diff_patent_stock	0.07	-0.02	-0.03	-0.05	-0.07	-0.07	0.07	-0.02	-0.03	0.01	-0.01	-0.02	-0.04	-0.01	-0.01	-0.03	0.01	0.00	-0.01	-0.01	-0.49	1.00														
23	=	pat_pre_yes	-0.09	-0.04	0.09	0.09	0.06	-0.04	0.03	-0.01	-0.02	0.02	-0.01	0.07	0.01	0.05	-0.01	0.04	-0.04	0.49	-0.02	0.23	0.47	-0.09	1.00													
24	=	export_int_pre	-0.28	-0.02	0.24	0.22	0.32	-0.02	0.13	0.00	0.03	0.02	-0.03	0.21	0.12	0.17	0.06	0.15	-0.08	0.30	0.09	0.35	0.01	0.03	0.17	1.00												
25	=	diff_export	0.15	0.05	-0.07	-0.22	-0.36	0.09	-0.06	0.03	0.02	-0.04	-0.01	-0.21	0.02	-0.19	-0.03	-0.15	0.28	-0.14	-0.01	-0.17	-0.01	0.00	-0.09	-0.42	1.00											
26	=	export_pre_yes	-0.42	0.06	0.31	0.25	0.57	0.04	0.11	0.02	-0.03	-0.01	-0.04	0.26	0.05	0.20	0.06	0.20	-0.15	0.23	0.04	0.39	-0.02	-0.02	0.15	0.69	-0.44	1.00										
27	=	y_2007	-0.06	0.10	-0.02	-0.02	0.02	-0.01	-0.03	-0.02	-0.01	0.01	0.00	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02	0.00	-0.01	-0.01	-0.02	0.04	0.03	1.00									
28	=	y_2008	-0.09	0.00	0.03	0.10	0.09	-0.03	-0.14	-0.15	0.12	0.01	0.09	0.05	-0.01	0.01	-0.02	0.04	-0.08	0.03	0.11	0.08	-0.03	0.03	0.05	0.02	-0.21	0.04	-0.03	1.00								
29	=	y_2009	0.05	-0.07	0.06	-0.03	0.03	-0.06	0.01	-0.04	0.00	0.02	0.00	-0.03	-0.01	-0.02	-0.03	-0.06	-0.05	-0.03	0.00	0.02	-0.02	0.01	-0.02	-0.06	-0.11	-0.05	-0.02	-0.15	1.00							
30	=	y_2010	-0.03	-0.08	0.04	0.11	0.07	-0.08	-0.01	0.01	0.00	0.04	-0.02	0.17	0.08	0.18	0.15	0.02	-0.04	0.14	-0.03	0.04	0.11	-0.01	0.09	0.02	-0.11	0.06	-0.02	-0.16	-0.12	1.00						
31	=	y_2011	0.05	-0.02	-0.03	-0.02	-0.09	-0.09	-0.05	0.09	-0.05	-0.03	-0.03	-0.05	0.04	-0.04	-0.02	-0.04	0.01	-0.04	-0.02	-0.02	-0.03	0.00	-0.02	0.00	0.07	-0.03	-0.03	-0.22	-0.16	-0.17	1.00					
32	=	y_2012	0.03	0.03	-0.01	-0.08	0.01	0.10	0.09	0.28	-0.08	-0.05	-0.03	-0.07	-0.07	-0.06	-0.05	0.06	0.07	-0.06	-0.04	-0.04	0.03	0.01	-0.02	0.03	0.03	0.02	-0.03	-0.23	-0.17	-0.17	-0.24	1.00				
33	=	y_2013	0.00	0.09	-0.07	-0.05	-0.09	0.12	0.10	-0.18	0.01	0.02	-0.01	-0.03	-0.01	-0.03	-0.01	-0.03	0.06	-0.02	-0.02	-0.06	-0.04	-0.05	-0.06	-0.02	0.24	-0.04	-0.03	-0.25	-0.18	-0.19	-0.26	-0.27	1.00			
34	=	interest_rate	-0.04	0.07	-0.03	-0.01	0.00	0.05	-0.07	0.04	0.04	-0.05	0.04	-0.07	-0.06	-0.09	-0.09	0.05	0.01	-0.06	0.06	0.01	-0.06	0.03	-0.02	0.04	-0.03	0.01	0.03	0.64	-0.47	-0.61	0.16	0.29	-0.22	1.00		
35	=	gdp_var	0.01	-0.06	-0.01	0.06	0.01	0.01	-0.06	-0.15	0.08	0.04	0.01	0.02	-0.01	0.03	0.02	-0.05	-0.03	0.05	-0.09	-0.04	-0.01	-0.04	0.00	-0.01	0.05	0.00	0.05	0.02	0.03	0.40	-0.36	-0.33	0.31	-0.40	1.00	
36	=	reg_job_skill	0.05	0.05	-0.05	-0.10	-0.10	0.13	0.12	0.10	-0.08	0.00	-0.06	-0.06	-0.02	-0.04	0.00	0.00	0.13	-0.04	-0.07	-0.09	0.01	-0.04	-0.06	0.00	0.27	-0.04	-0.12	-0.69	-0.33	-0.08	0.01	0.44	0.51	-0.16	-0.02	1.00

Source: Authors' own elaboration based on data extracted from "Information System of the NSRF Incentive Scheme".

Note: Observation = 624.

Appendix 3. Robustness test with interaction terms

TABLE IV. LOGIT RESULTS WITH INTERACTION TERMS BY FIRM SIZE

Variables	Model 5		Model 7		Model 9		Model 6		Model 8		**MODEL 10**	
	Small		Medium		Non SMEs		Small		Medium		**NON SMEs**	
	Coef	St. Error	Coef	St. Error	Coef	St. Error	Coef	St. Error	Coef	St. Error	Coef	St. Error
Small	0.374	(0.293)	0.0653	(0.257)	0.0572	(0.257)	0.190	(0.284)	0.0524	(0.257)	0.0601	(0.258)
Médium	-0.853**	(0.393)	-1.466***	(0.493)	-0.865**	(0.389)	-0.826**	(0.392)	-1.091**	(0.468)	-0.894**	(0.391)
no_sme	0.398	(0.382)	0.499	(0.381)	0.298	(0.441)	0.445	(0.380)	0.408	(0.379)	0.249	(0.409)
nr_partner	0.142***	(0.0503)	0.151***	(0.0507)	0.145***	(0.0502)	0.142***	(0.0504)	0.145***	(0.0503)	0.142***	(0.0503)
roe_pre	-0.0589	(0.130)	-0.0672	(0.129)	-0.0444	(0.129)	-0.0467	(0.129)	-0.0354	(0.131)	-0.0519	(0.130)
solv_pre	-0.00224	(0.00270)	-0.00232	(0.00274)	-0.00227	(0.00270)	-0.00222	(0.00269)	-0.00226	(0.00269)	-0.00223	(0.00269)
exp_si	0.541**	(0.254)	0.531**	(0.254)	0.547**	(0.253)	0.535**	(0.253)	0.550**	(0.253)	0.551**	(0.253)
export_pre_yes	0.958***	(0.297)	0.970***	(0.298)	0.965***	(0.296)	0.948***	(0.296)	0.976***	(0.296)	0.995***	(0.298)
rd_pre_yes	0.630	(0.393)	0.634	(0.398)	0.620	(0.391)	0.631	(0.391)	0.611	(0.391)	0.637	(0.391)
pat_pre_yes	-0.272	(0.741)	-0.237	(0.751)	-0.267	(0.741)	-0.243	(0.743)	-0.210	(0.748)	-0.247	(0.742)
Eec	1.717***	(0.391)	1.769***	(0.393)	1.718***	(0.389)	1.706***	(0.389)	1.720***	(0.389)	1.711***	(0.390)
ln_invest	0.342***	(0.0922)	0.374***	(0.0918)	0.363***	(0.0911)	0.353***	(0.0922)	0.363***	(0.0912)	0.354***	(0.0914)
small_var_skill_job	-0.0540**	(0.0237)	-	-	-	-	-	-	-	-	-	-
medium_var_skill_job	-	-	0.110*	(0.0576)	-	-	-	-	-	-	-	-
no_sme_var_skill_job	-	-	-	-	0.0153	(0.0300)	-	-	-	-	-	-
var_skill_job	0.0612***	(0.0210)	0.0257	(0.0158)	0.0314*	(0.0174)	0.0369**	(0.0162)	0.0337**	(0.0161)	0.0359**	(0.0161)
var_skill_job2	-0.000137***	(4.46e-05)	-6.56e-05*	(3.39e-05)	-0.000107*	(5.90e-05)	-8.70e-05**	(3.47e-05)	-8.08e-05**	(3.46e-05)	-8.43e-05**	(3.44e-05)
var_no_skill_job	-0.00867*	(0.00448)	-0.0101**	(0.00469)	-0.00766*	(0.00413)	-0.00731*	(0.00410)	-0.00791*	(0.00410)	-0.00634	(0.00430)
diff_export	1.721***	(0.407)	1.720***	(0.407)	1.716***	(0.406)	1.689***	(0.407)	1.672***	(0.409)	1.743***	(0.408)
small_diff_gav_job_post	-	-	-	-	-	-	-0.00122	(0.00119)	-	-	-	-
medium_diff_gav_job_post	-	-	-	-	-	-	-	-	0.00422	(0.00528)	-	-
no_sme_diff_gav_job_post	-	-	-	-	-	-	-	-	-		0.00282	(0.00266)
diff_gav_job_1000	-0.583	(0.495)	-0.753	(0.489)	-0.719	(0.480)	-0.107	(0.777)	-0.779	(0.486)	-0.828*	(0.495)
diff_rd_intensity	0.0870	(0.0678)	0.0866	(0.0688)	0.0858	(0.0669)	0.0871	(0.0668)	0.0848	(0.0673)	0.0868	(0.0671)
diff_patent_stock	2.049**	(0.959)	2.025**	(0.957)	2.020**	(0.960)	2.022**	(0.962)	2.008**	(0.963)	2.061**	(0.974)
industry_g	0.492*	(0.270)	0.492*	(0.270)	0.515*	(0.269)	0.478*	(0.271)	0.507*	(0.269)	0.498*	(0.269)
service_g	0.851***	(0.301)	0.856***	(0.299)	0.886***	(0.300)	0.837***	(0.301)	0.872***	(0.299)	0.874***	(0.299)
trade_g	0.250	(0.566)	0.265	(0.570)	0.284	(0.567)	0.245	(0.567)	0.284	(0.567)	0.256	(0.568)
all_other_sector_g	-2.085***	(0.711)	-1.997***	(0.703)	-2.046***	(0.707)	-2.079***	(0.707)	-2.022***	(0.703)	-2.193***	(0.738)
y_2009	1.174***	(0.403)	1.167***	(0.400)	1.137***	(0.400)	1.157***	(0.400)	1.134***	(0.399)	1.139***	(0.400)
y_2010	0.651*	(0.383)	0.677*	(0.383)	0.661*	(0.381)	0.672*	(0.381)	0.655*	(0.381)	0.673*	(0.381)
y_2011	-0.397	(0.325)	-0.404	(0.325)	-0.398	(0.322)	-0.394	(0.323)	-0.400	(0.323)	-0.404	(0.323)
y_2012	-0.828**	(0.346)	-0.821**	(0.346)	-0.803**	(0.344)	-0.780**	(0.344)	-0.796**	(0.344)	-0.808**	(0.344)
y_2013	-0.378	(0.320)	-0.388	(0.320)	-0.386	(0.319)	-0.389	(0.319)	-0.372	(0.318)	-0.380	(0.318)
Constant	-4.302***	(0.724)	-4.355***	(0.723)	-4.318***	(0.720)	-4.294***	(0.723)	-4.306***	(0.719)	-4.275***	(0.722)
Observations	622		622		622		622		622		622	
Pseudo R2	0.2198		0.2196		0.2144		0.2156		0.2151		0.2154	
Log likelihood	-335.65489		-335.75314		-337.99009		-337.45229		-337.67704		-337.56096	
% Correctly classified	73.31%		73.15%		74.12%		74.12%		74.44%		74.28%	
Ramsey test	0.963		0.6869		0.5633		0.5184		0.3911		0.4478	
White test	0.4356		0.2992		0.5635		0.1081		0.1051		0.1227	

Source: Authors' own elaboration based on STATA output.
Note: ***, **, * significance level at 1%, 5% and 10% respectively.