

THE IMPACT OF EU-FUNDED FRAMEWORK PROGRAMMES ON GREEK FIRMS

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ABSTRACT

Framework Programmes (FPs) constitutes the main research and innovation policy tool at the European level supporting collaborative R&D projects with partners from all EU Member States, associated and third countries. The study of FPs impact is attracting increasing attention from European Commission and individual countries as well. There are various types of impact that are examined in European Commission's evaluations and impact assessments of FPs and relevant national studies, such as scientific/technological, innovation and economic, networking, societal, and policy impact. This paper focuses on the dimension of innovation and economic impact, and specifically on factors that affect the utilization by Greek business firms of the innovation developed in the context of specific Horizon 2020 projects. It also examines whether the innovation utilization has led to gains regarding specific dimensions of the firm's economic performance. The data for our empirical analysis are drawn from a large-scale survey conducted in 2022 in Greek business firms with at least one participation in Horizon 2020. Partial Least Squares – Structural Equation Modeling (PLS-SEM) was used to test our conceptual model. Several factors are found to facilitate the innovation utilization developed in the projects and thereby to contribute to the improvement of specific firms' economic performance dimensions. In particular, a firm that has higher absorptive capacity (R&D intensity) and undertakes the role of technology development, technological services provision and trial use of research results in the context of the project, has higher propensity to utilize the project's innovation output and in turn to achieve economic benefits. In addition, the investment of additional financial and human resources also favour innovation utilization.

KEYWORDS: FPs Impact, Research Joint Ventures, Greek firms, Innovation utilization, Large-scale survey

INTRODUCTION

Since their introduction in 1984, the Framework Programmes (FPs) have been basic pillars of European scientific and technological development by supporting all kinds of R&D, mainly in high technology sectors, favouring the participation in Research Joint Ventures (RJVs) of various organizations from different European countries^[1]. The study of FPs impact is attracting increasing attention. Impact was first included as a selection and award criterion for research in the 7th FP and gained importance as a core evaluation standard in Horizon 2020 and Horizon Europe. The European Commission systematically carries out ex-ante, mid-term, and ex-post evaluations of the FPs at a global level (i.e., these evaluations cover participant countries across EU Member States, associated countries, and third countries). Only recently some countries have started to conduct FPs evaluations at a national level^[2]. For countries like Greece that exhibit a stable and intense presence in the FPs^[3], the need to shed further light on the impact of FPs is imperative.

There are various types of impact that are examined in European Commission's evaluations and impact assessments of FPs and relevant national studies (scientific/technological, innovation and economic, networking, societal, policy impact etc.)^[2,4]. In this paper, we focus on the dimension of

innovation and economic impact, and specifically on the factors that affect the utilization by Greek business firms of the innovation developed in the context of Horizon 2020 projects. This issue is of high importance as the funding/policy tool of FPs can be leveraged at national level through an appropriate development strategy in order to enhance firms' innovation performance and international competitiveness.

In particular, the paper investigates the effect of these factors on the utilization by each firm of the innovation output of a specific completed project that is of high importance for the firm. It also examines whether the innovation utilization has led to some gains regarding specific dimensions of the firm's economic performance. We give emphasis to factors that relate to the firm's R&D strategy and capability as well as to an important aspect of its broader business strategy i.e. its extroversion to international markets. Moreover, we examine factors concerning the firm's strategy for participating in FPs that includes the motive of innovation and business development as well as the roles it undertakes in the project (research, technology developer/provider, user of research results). Furthermore, our analysis includes factors with regard to the project's characteristics such as the Technological Readiness Level (TRL) in the beginning of the project as well as actions that were foreseen and implemented in the context of the project so as to promote innovation utilization/commercialization. Besides, the firm's size, age and economic sector are used as control variables. Figure 1 depicts the paper's conceptual model.

METHODOLOGY

The data for our empirical analysis are drawn from a large-scale survey conducted in 2022 (between February and July) in 103 Greek business firms that had participated in at least one Horizon 2020 project¹. The survey aimed at providing insights on various dimensions of a specific Horizon 2020 project's impact on participating firms and investigating other factors related to their strategy for participation in FPs (motivation, targeting, roles in the projects etc.) as well as the added value of European research programs compared to national research programs. The questionnaire was addressed to the executive with the highest knowledge regarding firm's participation in FPs, i.e. either the R&D manager or another responsible executive for these projects. In fact, in the cases of micro or small firms and/or start-ups, the appropriate respondent was usually the owner/founder of the firm. A pilot testing of the questionnaire was undertaken in four eligible firms through face-to-face interviews to improve its clarity and flow.

The survey was conducted online, namely a web-based version of the questionnaire was developed – and completed by the firms - using the online tool "QuestionPro". After the survey completion, a laborious data cleaning and quality control procedure – including telephone follow-up - was carried out to minimize measurement errors and missing values. The response rate is 24.8% and the survey sample is representative of the population in terms of sector and size. The majority of firms (55%) belong to knowledge-intensive services (KIS), 18% to manufacturing, 13% to less KIS and 14% to other sectors. Furthermore, 64% of firms are small or micro firms, 15% are medium and 21% are large, whereas 22% of the sample firms are young (≤ 10 years).

The description of our conceptual model variables follows. Firstly, innovation impact i.e. innovation utilization, is captured via three binary indicators that reflect whether the company: a) has commercially exploited a product and/or service innovation developed in the project, b) has utilized this product/service innovation internally in order to develop other products/services, and c) has utilized internally a process and/or organizational innovation developed in the project so as to improve its operation. The economic impact is measured through three 5-point Likert-type scale indicators (1: not at all; 5: to a great extent) i.e. the extent to which firm's participation in the project

has led to: a) productivity enhancement, b) revenues increase, and c) new customers attraction.

Regarding independent variables, the firm's R&D strategy/capability is assessed through its R&D expenditures as % of its turnover in a specific year (2020). In addition, firm's extroversion is captured via its export intensity in the same year i.e. % of turnover that corresponds to exports. The motive of innovation and business development for participation in FPs is measured through the following two 5-point Likert-type indicators (1: not at all; 5: to a great extent): a) faster development and market introduction of new products/services, and b) entering a new market / improving the company's position in an existing market. In addition, we investigate the effect of firm's role in the project by using three different binary variables that take the value of 1 if the firm had conducted the specific role and 0 otherwise. The first one relates to the conduction of basic or/and applied research, the second one regards the role of technology/know-how developer or/and technological services provider, and the third one concerns the trial use of research results.

With regard to project's characteristics, firstly we check for the effect of TRL in the beginning of the project using a 3-point ordinal variable, namely this indicator takes the value of 1 for TRL between 1 and 3 (research stage), the value of 2 for TRL between 4 and 6 (development stage), and the value of 3 for TRL 7 or 8 (deployment stage). Concerning actions that take place in the context of the project to assist innovation utilization/commercialization, we have constructed three variables. The first one regards the provision of additional resources and is composed of two binary indicators: a) investment of additional resources (human, financial etc.) by the company or other entity for innovation scale-up, and b) additional funding from venture capitals, business angels etc. The second one consists in the prototype development (one binary indicator), an action that contributes to technology maturity enhancement. The third one refers to actions for increasing innovation's business readiness (three binary indicators): a) business plan, b) market research, and c) feasibility study.

Finally, we control for firm's size (through the natural logarithm of full-time employees), for firm's age (number of years since its foundation) and for the firm's sector through three dummies: a) manufacturing, b) KIS, c) less KIS. Namely, the corresponding indicator equals to 1 if the firm belongs to the specific sector and 0 otherwise.

We used Partial Least Squares – Structural Equation Modeling (PLS-SEM) with "SmartPLS" software to test our conceptual model. The rationale behind the selection of this econometric approach is that our conceptual model includes a mediator variable (i.e. innovation impact) and also PLS-SEM is less restrictive - than Covariance-Based SEM - regarding small sample sizes and the type of measurement indicators. In particular, the conceptual model includes not only Likert-type or continuous scales but also binary indicators.

RESULTS AND DISCUSSION

Firstly, some few descriptive statistics are presented regarding the project's innovation output and the utilization of this output by firms. In particular, almost the total of the projects for which firms responded led to the development of at least one type of innovation (95%). Furthermore, 78% of the projects resulted in product or/and service innovation and 59% of the projects led to process and/or organizational innovation. In addition, the firms' ratio that utilized each innovation type internally is much higher than the firms' ratio that proceeded to its commercial exploitation. The corresponding percentages are 66% and 26% for product/service innovation, and 54% and 19% for process/organizational innovation. Namely, most firms utilize the knowledge produced in the projects to enhance their innovation capabilities in long term rather than commercialize directly the

projects' innovation output.

Regarding PLS-SEM results, firstly the validity and reliability of the measurement model is confirmed, namely each latent variable is adequately represented by the specific indicators used to measure it (due to limited space the relevant results are not presented here). Therefore, we proceed to the evaluation of the structural model that regards the relationships between independent variables and the innovation and economic impact.

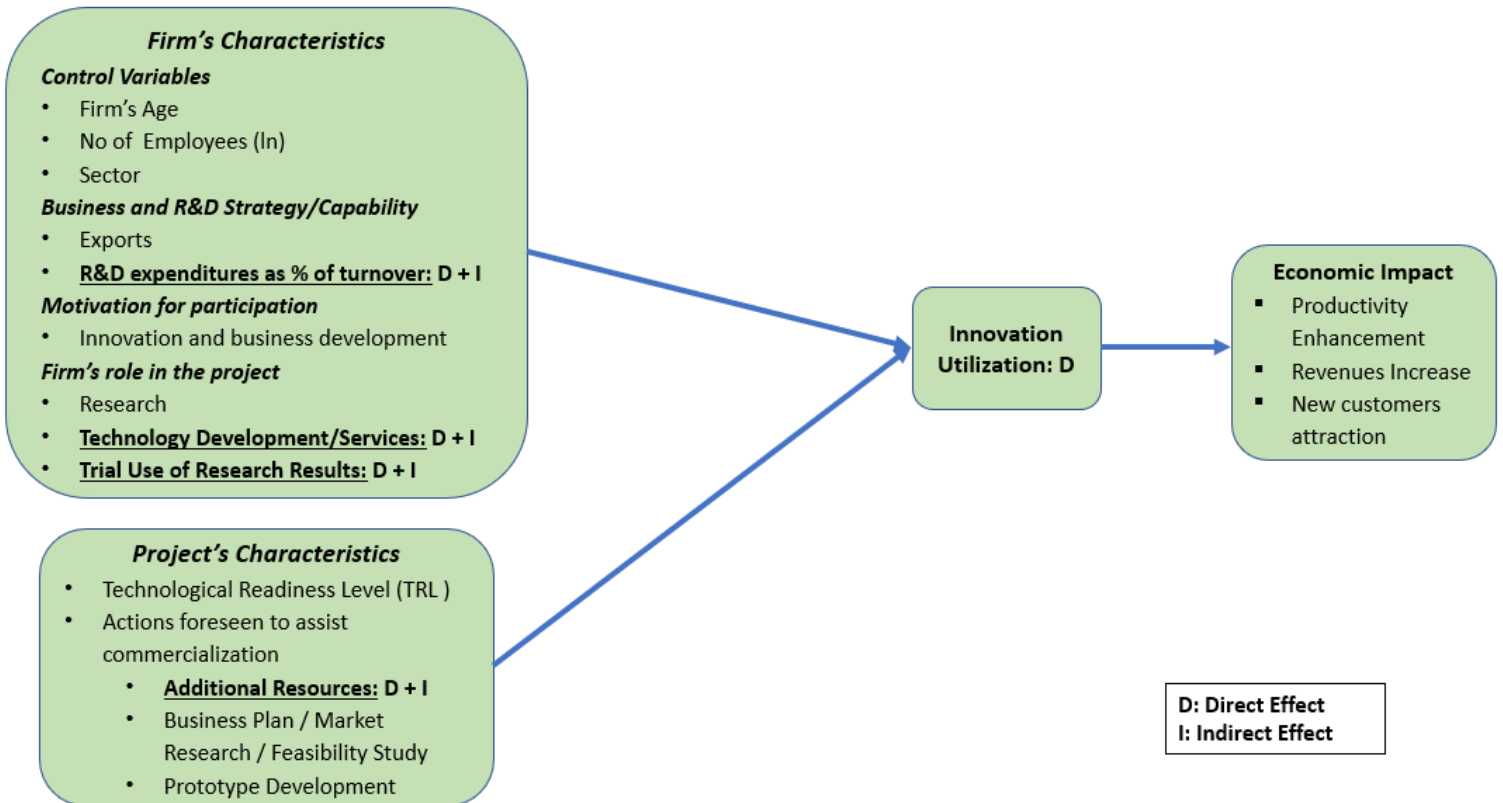


Figure 1. Factors influencing Innovation & Economic Impact (PLS-SEM results)

The results of the structural model are presented in Figure 1 and in greater detail in Table 1. First of all, firms with higher extent of project's innovation utilization tend to attain higher economic performance gains through their participation in the project. This fact seems reasonable as by utilizing the innovation output of the projects, the firm may enhance the value of its products/services and/or advance its production and business processes, and in this way broadens its customers pool, and increase its revenues and productivity.

Table 1. Factors influencing Innovation & Economic Impact (PLS-SEM results)

Independent Variables	Dependent Variable	
	Innovation Impact (Innovation Utilization)	Economic Impact
Control Variables		
Firm's Age	-0.006	-0.005 (I)
No of Employees (Ln)	-0.014	-0.012 (I)
Sector_Manufacturing	0.039	0.035 (I)
Sector_KIS	0.116	0.104 (I)
Sector_Less KIS	0.212	0.191 (I)
Business and R&D Strategy/Capability		
Exports	0.016	0.015 (I)
R&D expenditures as % of turnover	0.103**	0.093* (I)
Motives for Participation in FPs		
Innovation and business development	0.025	0.023 (I)
Firm's Role in the project		
Role_Research	-0.062	-0.055 (I)
Role_Technology Development/Services	0.205**	0.184** (I)
Role_Trial Use of Research Results	0.165**	0.148*(I)
Project's Characteristics		
TRL_3 Categories	0.063	0.056 (I)
Actions_Additional Resources	0.256**	0.230* (I)
Actions_BusinPlan_MarketResearch_FeasStudy	0.052	0.093 (I)
Actions_Prototype Development	0.104	0.047 (I)
Innovation Impact	-	0.898***
N	103	103
R ²	0.383	0.133
Adjusted R ²	0.300	0.125

***: $p < 0.01$ **: $p < 0.05$ *: $p < 0.10$

Regarding the factors for which we examine their direct effect on innovation utilization and their indirect effect on economic performance gains, the firm's R&D activity intensity seems to positively

affect innovation utilization and economic benefits. That is, a company with significant R&D strategy and capability, is probably characterized by a high absorptive capacity so that it can utilize the knowledge and research results produced in the projects, either through their direct commercial exploitation or by utilizing them internally for the development of other products /services and the enhancement of its processes. Furthermore, firms that had the role of new technology/know-how developer and/or technological services provider within the projects, a fact that constitutes an indication of their developed technological capabilities, have higher tendency to attain innovation benefits and through these to improve aspects of their economic performance. The same applies to firms that made trial use of research results. Namely, firms that select and are able to conduct activities beyond the research part of the project tend to utilize the project's innovation output to a higher degree.

On the other hand, the motive of innovation and business development for participating in FPs as well as the degree of firm's extroversion to international markets seem not to be determining factors for innovation utilization. The same applies to the three control variables. With regard to size, this result indicates that the availability of financial and human resources in general, a fact that usually characterizes larger firms, is not critical for achieving innovation and in turn economic benefits from this type of projects. Instead, the critical influential factor is the firm's research capacity based on the availability of high quality human capital with research knowledge and skills.

Regarding the projects' characteristics, the PLS-SEM results underlines the importance of investing additional resources for innovation utilization and economic performance gains attainment for firms participating in European research projects. On the contrary, the effect of the other two types of actions is not significant. Finally, a higher TRL at the beginning of the project does not necessarily lead to higher innovation and economic impact for the firms.

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ⁱ In the context of NETonKIE project, a similar survey was conducted in 157 research teams of Universities and Research Centres.