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Who gets Horizon 2020 research grants? Propensity to apply and probability to succeed in a two-step analysis

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Abstract

This paper presents a timely analysis of participation in the 8th European Framework Program (EU FP) Horizon 2020. Our dataset comprises the whole population of research organizations in Norway, and makes it possible to distinguish between non-applicants, non-successful applicants and successful participants. We argue that it is important to distinguish two stages of the participation process: the self-selection stage in which organizations decide whether they like to apply for EU funding, and the second stage in which the European Commission (EC) selects the best applications for funding. Our econometric results indicate that: (1) the propensity to apply is enhanced by prior participation in EU FPs and by complementary national funding schemes; (2) the probability to succeed is strengthened by prior participation as well as the scientific reputation of the applying organization.

Keywords: Horizon 2020; EU Framework Programs; research funding; research policy; higher education institutions; public research organisations.

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1. Introduction

Since the first European Framework Programme (EU FP) was established in 1984 with the objective of strengthening scientific and technological collaborations in Europe, its importance has been ever increasing (Breschi, Cassi, Malerba, & Vonortas, 2009; Ortega & Aguillo, 2010). The budget has grown from just below 4 billion Euros in the first framework programme (FP1) to closely 80 billion Euros in the 8th and current programme, Horizon 2020. After 2007, with the establishment of the European Research Council, EU FPs are progressively becoming a central source for both applied and basic research (Nedeva, 2013).

With the increasing importance of EU research funding, national policy makers in European countries have put domestic participation in EU research at the centre of the research policy agenda. In Norway, for instance, the Government has in recent years explicitly pointed out increased participation as an imperative part of national strategies for internationalisation of research. As of early-2015, Horizon 2020 received 36,000 applications from all Member States, and just below 5,000 of these were granted funding. Norwegian researchers were involved in 1,530 applications, and only 216 were granted funding. This amounts to 1.79% of the available competitive funds– which is still below the national goal of at least 2% (Norwegian Ministry of Education and Research, 2014). For national policy makers, Norwegians and others alike, the need to understand what determines participation in EU FP, and how this can be strengthened, is high on the agenda.

A strand of academic research has recently started to investigate the factors that affect participation in EU FPs. One of the factors pointed out in this research relates to the formation of collaborative networks and the enduring nature of these (e.g. Defazio, Lockett, & Wright, 2009; Protogerou, Caloghirou, & Siokas, 2010). Some research organizations in Europe have been found to persistently participate in EU-funded research and function as central nodes in EU FP networks (Paier & Scherngell, 2011; Protogerou et al., 2010; Roediger-Schluga & Barber, 2008).

Among the factors that have been investigated to explain these patterns, scientific capabilities of applying institutions (and in particular academic reputation and scientific productivity) appear to be crucial (Geuna, 1998; Henriques, Schoen, & Pontikakis, 2009; Lepori, Veglio, Heller-Schuh, Scherngell, & Barber, 2015; Nokkala, Heller-Schuh, & Paier, 2011). Another important dimension studied in this literature refers to the characteristics and structure of national funding, since these may have complementarity or substitutability effects with international funding from the EU (Luukkonen & Nedeva, 2010)

Due to limitation in terms of data availability, extant literature has so far analysed the determinants of participation in EU FP by focusing solely on the sub-sample of applicants and neglecting all other research organizations that have decided not to apply for funding to EU FPs in the first place (e.g. because of lack of interest, time and/or resources). However, the latter group is potentially important for this type of analyses. Research organizations that decide not to apply to EU FP may provide new insights on the underlying motivations to apply and the related hampering factors.

Therefore, the main point argued by the present paper is that, in order to advance our understanding of the determinants of participation in EU funded research, it is important to consider two distinct stages of this participation process. The first is the self-selection process according to which some organizations decide to apply for funding to EU programs, while many other organizations decide not to do so. The second stage is the selection process carried out by EC authorities, at the end of which some of the applicants are successful and are granted one or more EU projects, whereas most other applicants are not. By distinguishing these two stages of the participation process, we aim at analysing the extent to which the factors highlighted in previous research have different effects on the two stages of the participation process.

Our empirical analysis focuses on the whole population of Norwegian research organizations. We have collected data on all 1,402 applications submitted by Norwegian research organizations to Horizon 2020 during the 2014–early 2015. We aggregate this data at the organizational level and match it with detailed national R&D statistics for the whole population of public research organizations (PRO) and higher education institutions (HEI) in Norway, as well as registry data on their previous participation in FP6 (2003–2006), FP7 (2007–2013), and national funding from the Research Council of Norway (period of 2013–early 2015).

The empirical results show that the factors highlighted in previous literature matter, but they do so differently in the two stages of the participation process: the propensity to apply to H2020 is enhanced by prior participation in EU FPs and by complementary national funding schemes; whereas the probability to succeed and get funding is strengthened by prior participation as well as the scientific reputation of the applying organization.

The paper is organised as follows: section 2 reviews the relevant literature on EU FP participation, and it points out our theoretical framework and hypotheses; section 3 presents the empirical context, data and indicators; section 4 discusses the econometric results; and section 5 summarizes the main findings and policy implications of the paper.

2. Theory and hypotheses

2.1 The literature on participation in European framework programmes

Participation in EU FPs has been placed high on the political agenda in the last few years. This has attracted the interest of researchers to understand the determinants and impact of EU research programs. The literature ranges from policy oriented papers and evaluations to academic studies of EU FP participation's effect on scientific productivity and innovation, as well as determinants for participation at the organizational level.

Large parts of the literature has focused on the establishment of networks and the collaborative structures underlying participation in EU FPs (Breschi et al., 2009; Breschi & Cusmano, 2004; Defazio et al., 2009; Hoekman, Scherngell, Frenken, & Tijssen, 2012; Paier & Scherngell, 2011; Protogerou et al., 2010; Roediger-Schluga & Barber, 2008). This is because EU FP programs typically hold forth a prerequisite of collaboration between different research organizations and users in order to be considered eligible for funding.

A part of the literature on collaborative networks has analysed the additionality effects, in terms of increased scientific and innovative output, resulting from participation other than the formation of networks itself (Luukkonen, 1998, 2000; Polt & Streicher, 2005). Focusing on private companies, Matt, Robin, and Wolff (2012) argued that participations in EU FPs are unlikely to contribute to radical new scientific knowledge, but are more likely to support networks in exploratory research than if the organizations form networks outside the EU frame. Defazio et al. (2009) argued that EU FP funding itself has a more direct effect on research productivity rather than collaboration within the network. It was only after the funding period had ended that they found collaboration to affect the level of productivity.

Other studies, like Di Cagno, Fabrizi, and Meliciani (2014), argue that EU FP participation has an effect on the transfer of knowledge and R&D spillovers. A case study of university participation reiterates the results from the firm oriented studies: Primeri and Reale (2012) argued that the main output from participation was scientific papers, far less commercial products or processes. The main argument for participation was the opportunity to collaborate with colleague's abroad, but also contribute to new scientific discoveries.

A common result in studies of collaborative networks in EU FPs is the observation of continued persistence of some organizations that hold central roles in different networks continuously over time, suggesting that prior participation matters for successful projects (Breschi & Cusmano, 2004; Godø, Langfeldt, & Kaloudis, 2009; Paier & Scherngell, 2011;

Protogerou et al., 2010; Roediger-Schluga & Barber, 2008). In particular, the highly reputed and large institutions in Europe seem to dominate in participations (Annerberg et al., 2010). This has let several to suggest cumulative effects or a “Matthew effect” for organizations with already dominating positions in the research landscape (Protogerou et al., 2010). Two sets of factors have been discussed as possible determinants of EU FP participation, and in particular for these persistence and cumulative effects.

One part of the literature has focused on the composition of national research systems and the national funding structure as a dimension affecting successful participations in EU FPs, investigating in particular whether there is commensurability between national and EU R&D policies (Dinges & Lepori, 2006; Luukkonen & Nedeva, 2010). National R&D schemes with a high degree of international orientation are said to have positive effects for the capacity building of researchers in applications to the EU (Dinges & Lepori, 2006). Whether national policies are converging towards EU policies and if this promote participation in EU FPs has been a topic for several, see e.g. the studies for France, (Laredo, 1998), Norway (Langfeldt, Godø, Gornitzka, & Kaloudis, 2012) and Finland (Hakala, Kutinlahti, & Kaukonen, 2002). The conclusions are more or less about the same: internationalisation of national R&D schemes would lead to a greater mobilisation and participation in EU-funded projects. As an example Langfeldt et al. (2012, p. 95) found that for parts of the 6th and the 7th EU FP, where calls were closely related to Norwegian R&D policies and schemes, a high degree of participation was found. By contrast, Lepori et al. (2015) and Geuna (1998) controlled for country effects and did only find slight evidence of it affecting participation in EU FP for European HEIs.

Another part of the literature has instead emphasized the importance of organizational characteristics and capabilities as key determinants of participation and success in EU FPs (Hakala et al., 2002). Drawing on the literature of cumulative mechanisms (Viner, Powell, & Green, 2004), Geuna (1996) suggested that the participation process was driven by reputation of the organization. The few subsequent studies addressing factors at the organizational level (Geuna, 1996, 1998; Lepori et al., 2015; Nokkala et al., 2011) have shown that the distribution of participation is indeed skewed. These works show that a few universities account for most of the participation in EU funding in each country. One common characteristic is that these are also among the top universities in Europe (Henriques et al., 2009). A key determinant, they all argue, is influenced by the institution’s level of scientific productivity – both in terms of number of publications per full-time equivalents (FTE) (measure of productivity) and number of citations per publication (measure of reputation, or

scientific impact). Other factors at the organizational do also seem to matter, and in particular the size of the applying organization, and its scientific field (Geuna, 1998; Hakala et al., 2002; Lepori et al., 2015).

2.2 Hypotheses

Previous studies of the determinants of EU FP participation have focused on the organizational-level and country-specific factors that explain why some project applications receive funding whereas others do not. These works have typically made use of databases of applicants to EU FPs, often linked to other national data sources on research organizations' characteristics and capabilities. One main issue with this standard approach is that, due to the lack of relevant data, it only focuses on the applicants and neglects all other research organizations that have decided not to apply for funding to EU FPs.

The main idea put forward in this paper is that, in order to advance our understanding of the determinants of participation in EU funded research, it is important to consider two distinct stages of this participation process. The first is the self-selection process according to which some organizations decide to apply for funding to EU programs, while many other organizations decide not to do so. The second stage is the selection process (analysed in previous research noted in section 2.1 above) by which some of the applicants are successful and are granted one or more EU projects, whereas most other applicants are not. In other words, at any time, the population of research organizations in a given country is divided into three distinct groups: (1) non-applicants; (2) unsuccessful applicants; (3) successful applicants. Extant literature has so far only focused on the second and third group, while our paper has also availability of data for the first group, and this enables us to distinguish the two stages of the selection process.

Our paper does not intend to introduce new explanatory factors, but it seeks to investigate the extent to which the factors highlighted in previous research have different effects on the two stages of the participation process. Our empirical analysis takes into account a large number of variables and control factors previously investigated in this literature, but it focuses in particular on the three explanatory dimensions that have been emphasized in recent works: (1) whether the organization has previously participated in a EU FP project (indicating persistence and cumulativeness effects); (2) national funding characteristics (e.g. complementarities between national and EU funding schemes and R&D policy.) and (3) the organizational research capabilities (e.g. reputation and scientific productivity). We thereby put forward three pairs of hypotheses, each of which focuses on

one of these explanatory dimensions, and points out whether we should expect them to be more relevant in the first stage of the participation process, in the second, or in both.

First, we look at the role of prior participation in EU FPs. In line with extant literature, we point out this as a fundamental factor strengthening research organizations' ability to get EU funded projects. We argue that previous participation in FPs is an important determinant for both stages of the participation process, although for different reasons. Regarding the first (self-selection) stage, when research organizations consider whether or not to invest time to develop a new EU project application, they make an assessment of the amount of time and resources they have to invest in the application work, and compare these costs with the expected (uncertain) benefits from participation. An organization that applies to EU FP for the first time has to sustain a series of *sunk costs*, related to the need to gather information and knowledge on the application procedure, as well as network and team building. By contrast, an organization that has already participated in the recent past will not incur in these sunk costs to the same extent, and it will therefore be more likely to work on a new application.

Once an organization has decided to apply, cost-benefit considerations will no longer be relevant, and the selection process will be affected, first and foremost, by the quality of the project team and its application. These factors, in turn, are arguably strengthened by prior participation, since an organization that has taken part in an EU-funded collaborative project in the recent past has surely benefitted from *learning effects* regarding the application procedure, the EU's research priorities, and the quality of potential partners. These learning effects are likely to strengthen the organization's ability to submit a good quality proposal and hence get funding. We summarize these arguments by means of the following hypotheses.

H1.1: Previous participation in FPs increases the probability that an organization applies to H2020.

H1.2: Previous participation in FPs increases the probability that an organization succeeds in getting H2020 funded projects.

Second, we shift the focus to national funding characteristics. As noted in the previous section, research organizations' ability to participate in EU FPs may be affected by the characteristics and structure of national funding, and in particular the extent to which there exist complementarities between national and EU funding schemes, and the degree of

international orientation of national science and research policy. We agree with previous analyses of this point, but we advance the specific argument that the structure of national funding matters in the first stage of the participation process, but not in the second.

It is clear that the availability of research funding is a primary motivation in the self-selection stage in which organizations decide whether or not they like to apply to EU FP. One possibility is that with plentiful domestic funding there is potentially no need to seek funds elsewhere. However, on the other hand, the availability of national funding may have complementarity effects by increasing the pool of resources that can be invested for international project applications. If national authorities place particular focus on the importance of EU programs in the attempt to increase the degree of internationalization of the national research system (as indeed it is the case in several European countries), political priorities, discourse and specific financial support schemes may increase research organizations' willingness to take higher risks and invest time to develop an EU project application. However, these considerations are arguably not relevant for the second stage of the participation process. Once an organization has made its cost-benefit analysis and decided that it wants to submit a new project application, the probability that the latter will succeed will not be affected directly by the structure and characteristics of national funding. The peer-review selection procedure made by the EC will mostly focus on the quality and relevance of the project team and the submitted proposal, and it is reasonable to argue that the latter will not be affected in a substantial manner by the characteristics of national R&D policy. Hence, we point out that:

H2.1: Funding granted by national institutions increases the probability that an organization applies to H2020.

H2.2: Funding granted by national institutions does not increase the probability that an organization succeeds in getting H2020 funded projects.

Third, we turn the attention to the role of organizational research capabilities. This is one important factor that has gained more relevance in recent research, and which refers to two more specific aspects: the scientific reputation of an organization (e.g. as measured by its citations and impact factor) and its scientific productivity (e.g. the number of publications or publication points it has produced in the recent past). Again, we agree on the general relevance of this dimension, but we make the specific argument that research capabilities will

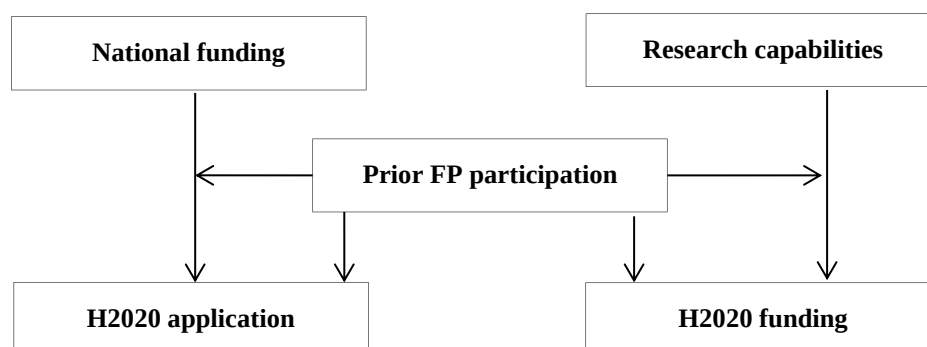
matter differently in the two stages of the participation process: they will mostly be irrelevant in the self-selection stage (or even go in the opposite direction than what it is pointed out by previous works), while they will be highly relevant in the second stage.

Regarding the first stage, when an organization makes an assessment on the opportunity to invest time in a new EU project application, the fact that the entity has on average a strong scientific reputation and/or productivity will not obviously increase its propensity to apply. On the one hand, it may be thought that EU research may give the opportunity to participate in international academic networks, which will in turn lead to expected benefits in terms of more publications and citations in the years ahead. On the other hand, however, researchers often point out that participation in EU projects is costly, since these projects demand substantial time for managing and reporting procedures. Anticipating these costs, researchers, and particularly so more brilliant and productive researchers, are often reluctant to join EU applications because this type of activities may take time and energy away from basic and internally-funded academic research. If this is the case, we argue, strong research capabilities will not increase organizations' propensity to apply; if anything, they might decrease it. However, when we shift the focus to the second stage of the participation process, this line of argument does obviously not hold. In the selection procedure determining which applications should be accepted for funding, research capabilities (reputation and/or productivity) will typically be a core element that increases the probability of success. We therefore formulate the following hypotheses.

H3.1: Stronger research capabilities do not increase the probability that an organization applies to H2020.

H3.2: Stronger research capabilities increase the probability that an organization succeeds in getting H2020 funded projects.

Figure 1: Theoretical framework and hypotheses



3. Context and data

3.1 The Norwegian research system

Policy makers often compare the national research performance of Norway with other small economies in Europe like Denmark, Finland, Sweden, Netherland and Austria. The reason is that the structure of the system and the funding mechanisms are to a certain degree similar (Langfeldt et al., 2012; Norwegian Ministry of Education and Research, 2015).

The Norwegian R&D sector consists of multiple university colleges of varying size, eight large universities, a large number public research organisations, hospitals³, public entities and a broad array of private firms – all with the possibility of participating in EU FP (Research Council of Norway, 2015). Ever since the Norwegian researchers began to participate in EU FPs, national budgetary appropriations for participation and mobilising schemes has increased considerably (Gornitzka & Langfeldt, 2008; Langfeldt et al., 2012). An outspoken goal is to increase the degree of R&D funding from EU FPs, both at the governmental policy level and at the institutional level (Gornitzka & Langfeldt, 2008; Norwegian Ministry of Education and Research, 2014). In the 7th Framework Program, Norwegian researchers brought back 1.67 per cent of the available funding. The goal of Norwegian policy makers, is that by the end of Horizon 2020 Norwegian participants should have reached a return of 2 per cent of all the available research funding (Norwegian Ministry

³ Hospitals without university function are formally a part of the PRO sector, while those with university teaching are considered a part of the HEI sector (Research Council of Norway, 2015, p. 46).

of Education and Research, 2014). The ever growing importance of internationalisation of research, especially towards the EU FP, has received considerable political interest (Langfeldt et al., 2012).

For policy makers, Norwegian and in other European countries alike, there is considerable importance in improving the participation rate as well as to understand the factors hindering and driving engagement and grant funding in EU FP. To increase participation the Research Council of Norway (RCN) has established and administers two specific EU mobilising incentives. Both are aimed to increase Norwegian R&D organizations' propensity to apply for EU FP. The so-called project establishment support scheme, "PES2020", is a financial instrument which enables research organizations to literary buy time to draft a better proposal to EU FP. The scheme is available to all organizations conducting research in Norway. The second incentive is also a financial structure, and has been exclusively developed towards PROs. As EU FP project funding never cover the full-costs of a project at the Norwegian cost level, this leaves many Norwegian PROs, particularly those with little or no core funding, with a deficit in the project budget. The "STIM-EU" incentive is aimed to avoid this. Although the scheme has been reconfigured over the years it provides a research entity with additional funding, based on the amount of total granted EU FP funding. Even though funding is only granted after a successful EU FP proposal, it incentivises the organization to apply. In addition to the direct mobilising incentives, the RCN administers a wide array of other programs and schemes which are structured to have an indirect effect on mobilising for EU FP participation. These are intended to strengthen the capacities of the researcher and its organization, ultimately making them a better suited competitor for subsequent EU FP grants.

3.2 Data

The analysis is based on data on project applications to the 8th European Framework Program Horizon 2020. The application data was collected from the European Commission's data warehouse, ECORDA. The database contains information that is similar to what is publicly available in the Community Research and Development Information Service (CORDIS; cordis.europa.eu). This applies particularly to data on participations in the 6th and 7th framework programme. However, for the current framework programme Horizon 2020, data in the CORDIS database is not readily available, nor sufficiently updated. Access to ECORDA is restricted to the Commission itself and to the Ministries and Research Councils in the member- and associated countries. ECORDA contains information on applicants that

are confined by rules of confidentiality, unless presented in aggregated form – particularly for the information on applicants that choose to apply but ends up with a rejection.

The dataset we have collected for the present study is composed of 1,402 applications made by Norwegian research organizations for the first period of the framework programme (2014–February 2015⁴). Applications from profit seeking enterprises such as private companies and public entities (municipalities and other public authorities) have been excluded, and our dataset focuses solely on non-profit research organizations, consisting of higher education institutions (HEIs, 810 applications), PROs (516), and hospitals (76).

It is important to emphasize that previous studies on EU FP participation only focused on HEIs, although with the exception of a few grey papers (Godø et al., 2009). However, for countries like Norway, Germany, Italy and France, where a large portion of the research sector is made by PROs, the inclusion of these alongside HEIs is warranted, as noted by Geuna (1998, p. 685). This is an important addition to the literature that our dataset enables to make.

Of the total population of 1,402 applications, 192 are registered as “granted”, 1,108 as “rejected” and 100 as “reserved”. The “reserved” status means that the EC has placed the application on a waitinglist in case the grant winner is removed for some reason. In some (rare) instances, the applicant on the reserved list is offered the grant. This means that some of the applications classified as reserved could sometimes be funded, but in this study these are not considered as part of the successful group. In the retrieved data, organizations are listed by their legal name. It was relatively straightforward to exclude profit-seeking organizations, like private firms, since we have information of the full population of HEIs and PROs.

The application data offers a unique insight on the success and failures of organizations applying for funding. In previous publications (Geuna, 1998; Lepori et al., 2015; Nokkala et al., 2011), only information on the granted applications for project participation has been used for analysis. Most recently Lepori et al. (2015) used the large EUPRO database (Primeri & Reale, 2012; Protogerou et al., 2010; Roediger-Schluga & Barber, 2008). This database contains highly detailed information on applications, but they are all on granted projects. This does not make it possible to tell if an organization that has not been granted a project has applied for EU FP funding or not in the first place. The

⁴ The data retrieved was published in ECORDA in July 2015, but it contains project applications only until February 2015. The EU Commission has decided that there must be a time lap from the application deadline until data is published by approximately 5 months.

disadvantage with this data approach is that it puts non-successful applicants in the same category as those who choose not to apply for EU FP funding at all, and hence does not make it possible to distinguish between the stage of self-selection (application decision) and the stage of actual selection made by the EC. The dataset used in the present paper, by contrast, can identify whether each Norwegian research organization has applied or not to the H2020 program, whether it has received a rejection or an approval decision, and how many projects it has been granted. Hence, our database enables a two-stage analysis of the participation process that we have proposed in the previous section. Data from Horizon 2020 was matched with data from several additional sources. Two central national datasets have been used. First, we collected publicly available R&D statistics at the organizational and faculty level for the year of 2013 from the Nordic Institute for Studies in Innovation, Research and Education (NIFU; foustatistikbanken.nifu.no). The data is similar to the European Tertiary Education Register (ETER), but contains more details on Norwegian R&D organizations. We collected information on the whole population of HEIs (41 university colleges and 8 universities), hospitals including university hospitals (36) and PROs (96). As eight of the HEIs are large universities, we decided to treat these at the level of faculty. Choosing not to do so would skew the data as these universities are both large in terms of productivity, funding and staff size, when compared to other HEIs and PROs. All subsequent information for these large universities in the analysis is thus at the faculty level (the number of faculties in Norway is 58). In total, the sample consists of 231 organizations (99 HEIs, 36 hospitals and 96 PROs). Second, to assess possible complementarities between national R&D schemes and EU FP, we collected information on all research project grants from the Norwegian Research Council (RCN) for the period of 2013–2015. We also collected information on the specific support schemes that Norwegian authorities have put in place to foster participation in EU FP, such as STIM-EU and PES2020 (see section 3.1). We can also control for the indirect effect of other thematic research programs at the RCN that can possibly have complementarity effects with EU funded research, such as the research program KLIMAFORSK. Other thematic programs might possibly also be relevant, but we did not have enough observations to include them in the analysis.

3.3 Variables

The dependent variable in the first step of the analysis is a binary measure indicating *if an organizations has applied for a H2020 research project or not*. The dependent variable in the

second step of analysis is a count variable indicating *the number of successful applications (i.e. granted projects)*.

Regarding the main explanatory variables, *FP6 funding* and *FP7 funding* are indicators of prior participation (granted projects) to the 6th FP (2003–2006) and the 7th EU FP (2007–2013). The next two explanatory variables account for organizational research capabilities. *Reputation* is the average number of citations per publication for the period of 2010–2014. The bibliometric data were derived from Elsevier's SciVal database (scival.com).⁵ *Publication points* are the number of publication points awarded to an institution for the year 2013 divided by the number of full-time equivalents academic staff (FTEs). In Norway, a part of the funding system for research organizations is based on the number of publications that an institution is able to produce every year. These publications are given points according to how highly a journal is ranked. Performance of each institution, even down to the department level, is registered and publicly available online from the Norwegian Scientific Index (CRISTin; cristin.no).

Shifting the focus to the variables measuring national support and other (non-EU) funding means, the main variables that we use in our regression model are the following: (1) *national funding*, which includes funds from the Norwegian Research Council and other national funding agencies (excluding core and private company funding); (2) *PES2020*, *STIM-EU*, and *KLIMAFORSK*, which are dummy variables describing whether the organization has received funding from these specific RCN instrument during the period of 2013-2015. As noted above, both *STIM-EU* and *PES2020* are direct financial schemes with the policy objective of mobilising more applications to EU FP. Furthermore, to control for additional funding means, we also include two variables measuring the *share of funding received from private companies*, and the *share of funding received from other organizations abroad (excluding firms and EU)*.⁶

Among the set of control variables, we include first of all the *scientific orientation* and *size* of the organization, as both have been shown to be relevant determinants of participation in EU FPs (Geuna, 1998; Hakala et al., 2002; Lepori et al., 2015). *Scientific*

⁵ For this variable, we have positive citation data for only 89 institutions, because there is a set threshold of minimum 500 publications to be included in this database. We set reputation for missing organizations at 0, as done by Lepori et al. (2015, p. 2156).

⁶ Lepori et al. (2015) used external funding as an indicator for third-party funds, including external funding from the EU, Research Council and private companies. We choose to treat these variables separately and divide them by total funding to get a measure of the amount of funding by total revenue.

orientation variables are measured as the amount of funding allocated to the specific scientific discipline to which the organization belongs as a share of total funding. This is a pre-constructed measure in the Norwegian R&D statistics, which indicates the dominant scientific specialisation of the institution (social sciences, humanities, medicine and health, technology, mathematical and natural sciences). *Size* is the number of full time equivalents of academic staff in R&D activities (FTE). The measure excludes technical and administrative staff. Data was retrieved from the R&D statistics for 2013. Next, as prior studies on EU FP determinants have mainly focused on HEIs (e.g. Geuna, 1998; Lepori et al., 2015; Nokkala et al., 2011), we like to see if HEIs and PROs (both included in our dataset) behave differently. We have therefore included a dummy variable to control for organizations classified as HEIs in the application data (1: HEI; 0: PRO). Furthermore, to control for *regional location* of the research organization, we add dummy variables for Norwegian regions in accordance to Eurostats NUTS 2 classification system (Eurostat, 2008).⁷

Table 1 provides descriptive information on the variables included in the analysis, and table 2 reports the correlation coefficients. Table 1 shows that 56% of Norwegian research organizations have applied for participation in Horizon 2020 during the first period of this new EU FP program (i.e. between 2014 and February 2015). 130 organizations have applied to H2020, of these 62 organisations have at least one project participation funded. The average number of projects granted among these are 0.83.

⁷ Some of our explanatory variables have skewed distribution, and in particular those measuring R&D capabilities, financial conditions, and size. We log transformed these variables before entering the regression model.

Table 1: Descriptive statistics

	N	Mean	Std.Deviation	Min	Max
<i>Dependent variables</i>					
Application (dummy)	231	0.560	0.497	0	1
Granted projects (count)	149	0.83	2.480	0	25
<i>Persistence</i>					
FP7 participation	231	5.34	16.515	0.00	206
FP6 participation	231	3.02	7.973	0.00	74
<i>R&D capabilities</i>					
Reputation	231	3.045	4.351	0.00	18.4
Publication points	183	1.207	0.904	0.00	6.4
<i>National funding schemes</i>					
National funding	222	18.329	18.874	0.00	100
PES2020	231	0.280	0.449	0	1
STIM-EU	231	0.140	0.351	0	1
Klimaforsk	231	0.190	0.397	0	1
Firm funding	222	9.314	17.643	0.00	91.3
International funding	222	2.918	9.029	0.00	100
<i>Control variables</i>					
Size	222	91.783	147.458	0.50	1371.8
Higher education institution	231	0.430	0.496	0	1
Humanities	231	0.108	0.246	0.00	1
Social sciences	231	0.277	0.340	0.00	1
Mathematics and natural sciences	231	0.145	0.236	0.00	1
Medicine	231	0.162	0.280	0.00	1
Technology	231	0.259	0.372	0.00	1
<i>Regional dummies</i>					
Oslo and Akershus	231	0.424	0.495	0	1
Ostlandet	231	0.091	0.288	0	1
Agder and Rogaland	231	0.074	0.262	0	1
Vestlandet	231	0.156	0.364	0	1
Trondelag	231	0.143	0.351	0	1
North Norway	231	0.113	0.317	0	1

Table 2: Correlation matrix

	Application	Granted projects	Reputation	Publication points	Firm funding	National funding	International funding	FP7 participation	FP6 participation	STIM-EU	PES2020	Klimaforsk	Size	HEI	Humanities	Social sciences	Mathematics and natural sciences	Medicine	Technology
Application	1	0.526 ^C	0.404 ^C	-0.079	0.411 ^C	0.388 ^C	0.432 ^C	0.618 ^C	0.510 ^C	0.310 ^C	0.409 ^C	0.367 ^C	0.613 ^C	0.181 ^C	-0.066	0.150 ^B	0.391 ^C	0.265 ^C	-0.071
Granted projects		1	0.326 ^C	-0.039	0.267 ^C	0.378 ^C	0.381 ^C	0.645 ^C	0.614 ^C	0.378 ^C	0.303 ^C	0.374 ^C	0.525 ^C	0.044	-0.013	0.020	0.392 ^C	0.152 ^B	-0.013
Reputation			1	0.024	0.132 ^B	0.165 ^B	0.271 ^C	0.440 ^C	0.418 ^C	0.004	0.043	0.195 ^C	0.656 ^C	0.508 ^C	0.239 ^C	0.075	0.582 ^C	0.313 ^C	0.060
Publication points				1	-0.403 ^C	-0.109	-0.221 ^C	-0.074	-0.111	-0.259 ^C	-0.092	0.029	-0.164 ^B	0.267 ^C	0.095	0.036	-0.156 ^B	0.039	-0.086
Firm funding					1	0.434 ^C	0.442 ^C	0.348 ^C	0.332 ^C	0.335 ^C	0.414 ^C	0.173 ^C	0.351 ^C	-0.121 ^A	-0.154 ^B	0.070	0.215 ^C	0.141 ^B	-0.076
National funding						1	0.502 ^C	0.461 ^C	0.531 ^C	0.378 ^C	0.398 ^C	0.387 ^C	0.327 ^C	-0.130 ^A	-0.180 ^C	0.330 ^C	0.288 ^C	-0.037	-0.146 ^B
International funding							1	0.532 ^C	0.573 ^C	0.419 ^C	0.440 ^C	0.307 ^C	0.409 ^C	-0.097	-0.124 ^A	0.137 ^B	0.322 ^C	-0.061	-0.038
FP7 participation								1	0.693 ^C	0.484 ^C	0.417 ^C	0.402 ^C	0.657 ^C	0.016	-0.023	0.033	0.428 ^C	0.171 ^C	0.019
FP6 participation									1	0.366 ^C	0.341 ^C	0.488 ^C	0.590 ^C	-0.026	-0.064	0.033	0.381 ^C	0.029	-0.057
STIM-EU										1	0.438 ^C	0.205 ^C	0.205 ^C	-0.329 ^C	-0.228 ^C	-0.008	0.136 ^B	-0.132 ^B	-0.002
PES2020											1	0.257 ^C	0.220 ^C	-0.165 ^B	-0.171 ^C	0.125 ^A	0.121 ^A	0.065	-0.023
Klimaforsk												1	0.323 ^C	-0.006	-0.058	0.077	0.386 ^C	-0.089	-0.076
Size													1	0.343 ^C	0.218 ^C	0.197 ^C	0.533 ^C	0.411 ^C	-0.102
HEI														1	0.488 ^C	0.311 ^C	0.378 ^C	0.329 ^C	-0.009
Humanities															1	0.156 ^B	0.179 ^C	0.202 ^C	-0.164 ^B
Social sciences																1	0.043	0.053	-0.357 ^C
Math. & nat. sciences																	1	0.184 ^C	0.052
Medicine																		1	-0.237 ^C
Technology																			1

^A Correlation is significant the 0.10 level, ^B at the 0.05 level, or ^C at the 0.01 level (2-tailed)

4. Results

4.1 Econometric model

Our empirical model is estimated in two steps. The first stage estimates the probability that an organization applies for a H2020 research grant (dependent variable: APPLICATION dummy). This first step is carried out on the whole population of Norwegian HEIs and PROs. The second stage focuses instead only on the sub-sample of research organizations that have applied for a H2020 research grant, and it estimates the probability that an organization is granted one or more EU-funded projects (dependent variable: GRANTED, count indicator). The model is then specified by the following two equations:

$$\Pr\{\text{APPLICATION}_i\} = \alpha + \beta \text{PERSISTENCE}_i + \gamma \text{RDCAPABILITY}_i + \delta \text{NATFUNDING}_i + \eta[\text{CONTROLS}_i] + \varepsilon_i \quad (1)$$

$$\text{Nr}\{\text{GRANTED}_i\} = \zeta + \theta \text{PERSISTENCE}_i + \lambda \text{RDCAPABILITY}_i + \pi \text{NATFUNDING}_i + \rho[\text{CONTROLS}_i] + \mu_i \quad (2)$$

The explanatory variables included in the two equations are the same: previous participation in EU FP (PERSISTENCE), research capabilities, and in particular reputation and scientific productivity (RDCAPABILITY), and national funding conditions (NATFUNDING). The vector of control variables (CONTROLS) include, as indicated in the previous section, indicators of organizational size, scientific domain, type of organization (HEI vs. PRO) and regional location. The reason for including the same set of regressors in the two equations is precisely that we seek to investigate the extent to which the factors highlighted in previous research have different effects on the two stages of the participation process. We also include in the two equations a set of interaction variables in order to analyse whether prior participation in FP moderates the effect of the other variables on the probability to apply and/or be awarded a H2020 project.

The advantage of this econometric specification *vis-à-vis* previous works is twofold. First, equation 1 is meant to provide new insights on the factors that affect research organizations' propensity and motivation to apply for EU funded projects, and hence understand what national and European authorities could do in order to mobilize domestic organizations towards greater participation in H2020. To the best of our knowledge, this

aspect has not been investigated in previous research, arguably due to the unavailability of data distinguishing applicants from non-applicants.

Second, equation 2 has been analysed in previous works (e.g. Geuna, 1998; Lepori et al., 2015). However, while extant research has typically estimated this type of equation on the whole population of research organizations (i.e. including applicants as well as non-applicants), we estimate it here by focusing only on the sub-sample of project applicants. By doing this, we argue, we will get an unbiased estimate of the effects of the explanatory variables of interest on the probability to receive H2020 funding.⁸

We estimate equation 1 using a logit model, and equation 2 using a zero-inflated Poisson regression model (ZIP). The ZIP-model is useful when there is a fair amount of null observations in the outcome variable (Greene, 1994). As the success rate for project applications to EU FP is quite low, many observations hold the value of 0 (no funded application). The ZIP-model accordingly accounts for such a high presence of null observations. The Vuong test in our regressions confirms that the ZIP specification is significantly better than a standard Poisson regression (Perumean-Chaney, Morgan, McDowall, & Aban, 2013). The test was significant ($P = <0.001$) in all regressions.⁹

⁸ In previous research, due the absence of data enabling to distinguish between non-applicants and unsuccessful applicants, both of these groups were combined together and typically given a value of 0 in the regressions, whereas successful applicants were given a positive integer value (1 if the dependent variable was defined as a dummy, and values equal or greater than 1 if the variable was measured as a count). However, combining together non-applicants and unsuccessful applicants in the same regression tends to underestimate the estimated slopes of interest (the larger the mean of a given explanatory variable for the group of non-applicants, the larger the bias). We overcome this issue by estimating equation 2 only on the sub-sample of applicants. Table 3 reports the median of our explanatory variables for four different groups of observations: (1) non-applicants; (2) unsuccessful applicants; (3) applicants that have been awarded one project; (4) applicants that have been awarded more than one project. The table shows that, for the group of non-applicants, the three variables publication points, national funding and size have positive median. Hence, our econometric approach leads to a more precise estimate for these three variables in particular.

⁹ We have also estimated equations 1 and 2 jointly by means of a Heckman sample selection model (Heckman, 1979). However, this approach demands the dependent variable in the second step to be dichotomous. Considering the present study's fairly small sample, using a dummy dependent variable greatly diminishes the data variability. Sample selection models that account for count outcomes are still under development, and are not incorporated yet in standard econometric software. We have tried to use the sample selection model wrapper (SSM) based on generalised linear latent and mixed models (GLLAMM), developed by Miranda and Rabe-Hesketh (2006), but the procedure was unable to produce the required output. We are currently investigating the possibility to implement this procedure.

Table 3: Median values of main explanatory variables by group (H2020 participation).

Variables	No application	Applied – no success	Granted: 1	Granted: 2 or more
FP7 participation	0,000	1,000	4,500	15,000
FP6 participation	0,000	0,000	2,000	8,500
Reputation	0,000	1,450	2,750	6,350
Publication points	1,231	0,972	1,034	0,951
National funding	5,855	12,247	19,317	27,790
PES2020	0,000	0,000	0,000	1,000
STIM-EU	0,000	0,000	0,000	0,500
Klimaforsk	0,000	0,000	0,000	1,000
Firm funding	0,000	2,440	5,327	5,679
International funding	0,000	0,287	1,274	1,486
Size	17,400	56,400	85,100	169,770
Higher education institution	0,000	1,000	0,500	0,000
N	101	68	26	36

4.2 Estimation results

Tables 4 and 5 present the results of the econometric estimations of equation 1 and 2 respectively. Before discussing the results of the tests of the hypotheses formulated in section 2.2, it is interesting to look briefly at the estimated coefficients of some of the most important control variables. In particular, SIZE has often been pointed out as a relevant explanatory factor in previous research (Lepori et al., 2015). Our estimates point out an interesting difference in the effects of this variable in the first and in the second equation. The variable has the expected positive sign in equation 1 (see table 4), and the estimated coefficients are large and significant in all regressions. By contrast, the variable has lower and weakly significant estimated coefficients in equation 2 (see table 5). A similar pattern holds for the HEI dummy variable, that distinguishes higher education institutions from PROs. Taken together, these results indicate that larger research organizations, and in particular HEIs, have a greater propensity to apply for EU FPs, arguably due to the economies of scale they can enjoy in the phases of developing, managing and administering new applications to H2020. These may lead to cost advantages that can be crucial in the first stage of the participation process (self-selection), but not necessarily in the subsequent selection process (where it is quality, more than size, that matters).

Turning now to the set of main explanatory variables considered in this paper, the indicator of prior participation in EU FPs (PERSISTENCE) has positive and estimated coefficients both in table 4 and in table 5. The magnitude of these estimated coefficients is large, one of the largest in the battery of regressors. This confirms that prior participation in EU FP is a fundamental factor strengthening both Norwegian research organizations' propensity to apply to H2020 *and* their ability to get H2020 projects. As pointed out in our propositions H1.1 and H1.2 (see section 2.2), the variable is highly relevant in both stages of the participation process, although we contend it to be so for different reasons. In the first (self-selection) stage, having previously participated in an EU-funded project implies that the organization does not have to sustain again the sunk costs to gather information and knowledge on the application procedure, as well as network and team building costs. In the second stage, prior participation matters because an organization that has previously been partner in an EU project can arguably benefit from learning effects regarding the application procedure, the EU's research priorities, and the quality of potential partners, and these learning effects will increase the quality of the application and its chances to get funded.

The second set of explanatory variables of interest relates to national funding characteristics. The specific hypothesis we formulated in section 2 is that that the structure of

national funding matters in the first stage of the participation process, but not equally so in the second. To test these propositions (hypotheses H2.1 and H2.2), let us compare estimation results for the relevant variables in table 4 and table 5. The national funding variable (share of research grants received from national funding agencies) does not turn out to have a significant effect in equation 1. Interestingly, however, the variable is important and significant when we interact it with the PERSISTENCE variable (prior participation in EU FP7). This pattern indicates that previous participation positively moderates the effect of national funding availability on the propensity to apply to the new programme H2020. In other words, the expected complementarity effects between national and EU funded research emerge more clearly for those organizations that have previously sustained sunk information and network building costs (*alias*: if an organization already knows how to play the EU game, availability of complementary national funds will further encourage it to continue to participate). Table 4 also confirms that the variable *PES2020*, one of the specific policy schemes in place in Norway to encourage participation in EU funded research, has a positive, significant and strong estimated coefficients.

It is then interesting to point out the corresponding results for equation 2 (table 5): the national fund availability variable is not significant (neither alone, nor in interaction with PERSISTENCE), whereas the *PES2020* variable is still positive, significant, but its estimated coefficient has a much lower magnitude than the corresponding results in table 4. On the whole, these patterns are in line with the hypotheses formulated in section 2.2, that external funding granted by national institutions increases the probability that an organization applies to H2020 (by making available additional resources to invest in the application process), but do not increase substantially the probability that an organization succeeds in getting H2020 funded projects (since the latter depends largely on the quality of the submitted application more than the financial conditions of the applying entity).

Finally, we shift the focus to the results on the variables accounting for organizational research capabilities, namely the organization's academic reputation (measured by its citations and impact factor) and its scientific productivity (measured by the number of publication points it has produced in the recent past). The argument we advanced in section 2 was that research capabilities matter differently in the two stages of the participation process, and it is therefore important to distinguish these impacts: we argue that this dimension will only be relevant in the second (selection) stage (in line with what found in extant research), but it will not matter in the first stage. To test this idea, let us compare again the estimation results for equation 1 and equation 2. In table 4, the reputation variable is not significantly

correlated to the propensity to apply for EU funding. The scientific productivity (publication points) variable is not significant either. Interestingly, however, when we interact this indicator with the PERSISTENCE variable, we find a negative, strong and significant effect. This result may be interpreted by arguing that researchers often perceive participation in EU projects as a costly, demanding and bureaucratic process, and may therefore be reluctant to join EU-funded research. To the extent that more productive researchers are highly focused on academic results and publication activity, high scientific productivity will not increase organizations' propensity to apply to H2020, but may turn out to decrease it.

However, as expected, the results of the estimations for equation 2 tell a different story, which is more in line with the results of previous research. Table 5 shows that the reputation variable, when interacted with the indicator of prior participation in FP6, has a positive and significant estimated coefficient. This suggests that scientific reputation matters in the selection of proposal submitted to H2020, and particularly so if high scientific reputation is combined with learning effects arising from having previously participated in EU-funded projects. Although the reputation variable turns out to be important in equation 2, the publication variable is again not significant, indicating that having a large number of publications does not increase the probability to be successful in the H2020 contest, whereas having high scientific impact (reputation) does. In summary, in line with our theoretical argument (H3.1 and H3.2), we find that stronger research capabilities (as measured by reputation) do not increase the probability that an organization applies to H2020, but they do increase the probability that an organization succeeds in getting H2020 funded projects.

Table 4: Results of step 1. Dependent variable: application (dummy). Estimation method: logit.

	Baseline	Interaction 1	Interaction 2	Interaction 3	Full model
FP7 participation	1.302 (0.032)**	-0.788 (0.449)	4.001 (0.012)**	1.587 (0.061)*	2.099 (0.228)
FP6 participation	0.465 (0.481)	0.585 (0.421)	0.375 (0.581)	0.502 (0.450)	0.059 (0.941)
Reputation	0.080 (0.859)	0.266 (0.570)	0.220 (0.639)	0.241 (0.660)	1.062 (0.125)
Reputation * FP7 particip.				-0.275 (0.600)	-0.211 (0.743)
Publication points	0.545 (0.600)	0.604 (0.581)	1.371 (0.222)	0.608 (0.561)	2.608 (0.053)*
Publication points * FP7 particip.			-3.206 (0.039)**		-8.756 (0.002)***
National funding	0.114 (0.751)	-0.126 (0.735)	0.124 (0.746)	0.104 (0.772)	-0.082 (0.848)
National funding * FP7 particip.		0.893 (0.032)**			2.646 (0.002)***
PES2020	1.708 (0.031)**	1.714 (0.041)**	1.771 (0.033)**	1.629 (0.043)**	1.661 (0.077)*
STIM-EU	0.421 (0.717)	-0.482 (0.707)	0.191 (0.881)	0.314 (0.790)	-3.088 (0.129)
Klimaforsk	1.654 (0.114)	1.619 (0.154)	1.575 (0.141)	1.621 (0.123)	1.415 (0.264)
Firm funding	0.805 (0.028)**	0.902 (0.023)**	0.841 (0.034)**	0.872 (0.027)**	1.295 (0.013)**
International funding	-0.586 (0.216)	-0.631 (0.203)	-0.783 (0.128)	-0.605 (0.208)	-1.377 (0.052)*
Size	1.175 (0.015)**	1.365 (0.007)***	1.223 (0.014)**	1.158 (0.016)**	1.863 (0.003)***
Higher education institution	1.826 (0.049)**	1.716 (0.066)*	1.678 (0.073)*	1.861 (0.047)**	1.635 (0.105)
Humanities	-3.269 (0.347)	-3.821 (0.299)	-3.594 (0.348)	-3.286 (0.350)	-6.749 (0.193)
Social sciences	-1.648 (0.607)	-1.623 (0.627)	-1.561 (0.665)	-1.559 (0.631)	-2.084 (0.643)
Mathematics and natural science	-3.426 (0.338)	-4.735 (0.214)	-4.183 (0.302)	-3.634 (0.321)	-9.340 (0.090)*
Medicine	0.240 (0.942)	0.155 (0.964)	0.001 (1.000)	0.277 (0.934)	-0.661 (0.885)
Technology	-2.235 (0.498)	-2.321 (0.502)	-2.812 (0.446)	-2.235 (0.500)	-4.475 (0.339)
Oslo and Akershus	0.481 (0.626)	0.535 (0.592)	0.563 (0.575)	0.428 (0.669)	1.021 (0.363)
Agder and Rogaland	-1.765 (0.165)	-2.117 (0.109)	-1.915 (0.143)	-1.842 (0.152)	-2.747 (0.067)*
Vestlandet	-1.471 (0.179)	-1.671 (0.149)	-1.564 (0.159)	-1.624 (0.157)	-2.324 (0.078)*
Trondelag	-0.822 (0.452)	-0.818 (0.464)	-1.020 (0.367)	-0.812 (0.459)	-1.356 (0.270)
North Norway	-0.015 (0.990)	-0.110 (0.929)	0.205 (0.866)	-0.063 (0.958)	0.025 (0.985)
-2 Log likelihood	92.463	88.229	88.167	92.203	74.632
Nagelkerke R-squared	0.75	0.76	0.76	0.75	0.81

Observations: 177. Significance levels in parentheses: * 0.10 level; ** 0.05 level; *** 0.01 level. A constant is included in all regressions.

Table 5: Results of step 2. Dependent variable: number of granted projects (count). Estimation method: zero-inflated Poisson.

	Baseline	Interaction 1	Interaction 2	Interaction 3	Full model
FP7 participation	0.313 (0.068)*	0.253 (0.141)	0.376 (0.027)**	0.297 (0.084)*	0.281 (0.104)
FP6 participation	0.388 (0.032)**	-0.256 (0.582)	0.107 (0.712)	0.060 (0.801)	-0.130 (0.809)
Reputation	0.089 (0.573)	0.125 (0.422)	0.182 (0.260)	-0.282 (0.250)	-0.316 (0.262)
Reputation * FP6 particip.				0.233 (0.023)**	0.242 (0.033)**
Publication points	-0.382 (0.598)	-0.506 (0.477)	-1.554 (0.115)	-0.673 (0.353)	-0.814 (0.401)
Publication points * FP6 particip.			0.364 (0.304)		-0.078 (0.836)
National funding	-0.116 (0.546)	-0.184 (0.410)	-0.234 (0.309)	-0.080 (0.679)	-0.171 (0.497)
National funding * FP6 particip.		0.204 (0.110)			0.072 (0.585)
PES2020	0.778 (0.009)***	0.789 (0.007)***	0.457 (0.114)	0.684 (0.024)**	0.521 (0.081)*
STIM-EU	-0.467 (0.148)	-0.449 (0.160)	-0.234 (0.481)	-0.262 (0.444)	-0.193 (0.575)
Klimaforsk	-0.064 (0.769)	0.035 (0.870)	0.010 (0.962)	0.053 (0.809)	0.109 (0.628)
Firm funding	-0.030 (0.840)	-0.041 (0.777)	0.103 (0.472)	-0.087 (0.575)	0.064 (0.679)
International funding	0.119 (0.559)	0.286 (0.178)	-0.013 (0.943)	0.046 (0.818)	-0.029 (0.878)
Size	0.109 (0.650)	0.075 (0.757)	0.069 (0.787)	-0.080 (0.742)	-0.090 (0.718)
Higher education institution	0.900 (0.090)*	1.236 (0.015)**	0.462 (0.396)	0.907 (0.077)*	0.626 (0.265)
Humanities	-3.109 (0.300)	-4.640 (0.130)	-0.608 (0.840)	-2.053 (0.449)	0.233 (0.938)
Social sciences	0.334 (0.628)	0.110 (0.872)	1.176 (0.087)*	0.345 (0.618)	0.695 (0.327)
Math. & natural science	0.600 (0.307)	-0.075 (0.900)	0.868 (0.175)	0.559 (0.339)	0.409 (0.545)
Medicine	0.740 (0.301)	0.552 (0.444)	0.937 (0.212)	0.829 (0.257)	1.085 (0.153)
Technology	1.110 (0.157)	0.494 (0.502)	1.185 (0.134)	1.288 (0.091)*	0.761 (0.340)
Oslo and Akershus	1.988 (0.069)*	1.316 (0.238)	1.104 (0.341)	1.883 (0.083)*	0.889 (0.440)
Agder and Rogaland	3.152 (0.011)**	2.598 (0.034)**	2.141 (0.090)*	3.098 (0.011)**	1.932 (0.126)
Vestlandet	2.545 (0.022)**	1.873 (0.098)*	1.716 (0.139)	2.385 (0.031)**	1.309 (0.257)
Trondelag	2.154 (0.053)*	1.629 (0.146)	1.311 (0.259)	2.300 (0.038)**	1.390 (0.230)
North Norway	1.920 (0.094)*	1.091 (0.343)	0.889 (0.446)	1.567 (0.165)	0.424 (0.717)
Log likelihood	-102.652	-101.219	-101.181	-98.624	-95.929
Vuong test of ZIP vs. standard Poisson	5.52 (<0.001)***	5.36 (<0.001)***	5.34 (<0.001)***	6.52 (<0.001)***	6.58 (<0.001)***

Observations: 113. Significance levels in parentheses: * 0.10 level; ** 0.05 level; *** 0.01 level. A constant is included in all regressions.

5. Conclusions

The paper has presented a timely analysis of Norwegian research organizations' participation in the Horizon 2020 program during the first months of its implementation. Our dataset consisted of 1,402 applications for the period 2014–2015, including both non- and successful applications, which were matched with R&D statistics for the whole population of higher education institutions and public research organisations in Norway. We analysed this database by means of a two-step econometric analysis of the propensity to apply (stage 1) and probability to succeed (stage 2), focusing on three main explanatory dimensions: prior participation in EU FPs, complementarity with national funding schemes, and scientific capabilities. What have we learned from this exercise – what are the main contributions and implications for research policy?

The main point put forward in this paper is that it is indeed important to distinguish two different stages of the participation process: the self-selection stage in which research organizations decide whether or not they like to invest time and resources to develop a new project application, and the selection stage in which the EC evaluates and selects the best proposals. Both conceptually and empirically, these two stages differ, and different factors explain the propensity to apply *versus* the probability to succeed in the H2020 contest.

Regarding the first stage, our results point out two key dimensions that determine research organizations' propensity to apply: one is whether they have previously participated in EU FPs, which indicates whether they have already sustained application-related sunk costs in the recent past. The other is the availability of national funding, which may act as a complementary channel and provide additional resources that foster application efforts. These results provide new insights in the literature on participation in EU-funded research, and have potentially important implications for policy.

A first implication is for national authorities: since there exist important complementarities between national and international funding, the most effective way in which domestic funding agencies can promote internationalization of research is not by outsourcing completely research funding tasks to EU authorities, but rather by strengthening national funding programs. A second implication is for EU authorities who manage the H2020 program. Our results suggest that this new program has not been able yet to mobilize Norwegian researchers with strong scientific reputation and productivity, and actually the propensity to apply is negatively related to organizations' scientific productivity. This may possibly have to do with the fact that the H2020 program is often perceived by researchers as

rather applied in nature and quite demanding in terms of networking and management procedures. A question for EU authorities is then whether the program should have a more academic focus and easier management rules in order to attract a greater number of productive researchers in the future.

Regarding the second stage of the participation process, the main advantage of our econometric approach *vis-à-vis* previous research is that, by carrying out the estimations only on the sub-sample of applicants, we are able to obtain more precise, unbiased, estimates of the relationships of interest. In particular, our results point out two main factors that strengthen research organizations' probability to succeed: prior participation in EU FPs (indicating persistence and learning effects related to previous EU projects), and scientific reputation. Differently from extant research, however, we do not find any significant correlation between publication results and probability of success. These results raise another question for research policy.

For national authorities, it is important to emphasize the distinction between the role of academic reputation and scientific productivity. In many European countries, including Norway, allocation of national funding to HEIs and PROs is currently based, among other criteria, on research organizations' scientific productivity (number of publication points). However, if national authorities want to increase internationalization of their research system and domestic participation in H2020 programs, it would seem sound to revise the funding allocation scheme in order to give more weight to academic reputation (quality, impact, citation indexes) and less so to the number of publication points as such. This would give an explicit signal to national organizations that scientific quality and impact matter more than productivity, and thus spur further efforts in this direction, as well as a stronger success rate in the H2020 contest.

Before concluding the paper, we like to acknowledge two limitations of this work. The first is that, since the paper aims at providing a timely analysis of the first available data on H2020 participation, we are not able to incorporate data for a long period of time and for the whole duration of the program, and hence our assessment should be verified and extended when new data on H2020 participation will be made available in the coming years. A second caveat is that our analysis has focused on Norwegian research organizations, for which we have availability of rich and good quality data and information. Some of our results, though, may possibly be affected by the specific characteristics of the Norwegian research system, and hence not necessarily hold for a larger sample of European countries. It is therefore

important that future research will reassess our two-step approach and hypotheses, and analyse its validity for the case of other European economies.

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