Understanding the selection processes of public research projects in agriculture: the role of scientific merit

1. Introduction

Public expenditure towards agricultural research is one of the main sources of productivity growth and enhances environmental sustainability in both developing as well as developed economies (Hsu et al., 2003; Renkow and Byerlee, 2010; Sparger et al., 2013)[1]. Global public research and development (R&D) expenditure towards agriculture grew only modestly in the 1990s, and increased by 22% during the period 2000-2008, with substantial increases in China and India accounting for close to half of this global increase. On the other hand, the growth rate of public agricultural R&D investments slowed down between 2000-2008 for high-income countries (Beintema et al., 2012), even though their research intensity ratio (i.e. agricultural spending relative to agricultural gross domestic product) had been increasing steadily since the early 1980s[2].

In the European Union (EU) public agricultural research funding has been progressively linked to regional policy, especially via rural development measures (Labarthe and Laurent, 2013). Therefore, given that the rate of public support for agricultural research in developed countries grows slowly (Alston et al., 1998; Beintema et al., 2012; Pardey et al., 2006; Pardey and Beintema, 2001; Spielman and von Grebmer, 2004), understanding how regional public authorities select and fund agricultural research projects is becoming a key issue for policy-makers and researchers alike (Huffman and Evenson, 2006a; Huffman and Evenson, 2006b; Huffman and Just, 1994, 1999a, 2000).

[1] While in developing economies the majority of R&D expenditure originates from public sources, in developed economies private contributions to agricultural R&D are predominant (Piesse et al., 2010). However, in these economies public funds are still a relevant source of support for agricultural R&D activities, especially towards more fundamental research (Piesse et al., 2010).

[2] Beintema et al. (2012) present a detailed assessment of public agricultural R&D spending at the global level, suggesting that 2008 is the latest year for which sufficiently reliable data are available.

Regional public authorities are increasingly concerned with both determining the optimal amount to allocate to research funds, as well as with designing appropriate mechanisms to select research projects (Huffman and Evenson, 2006b; Huffman and Just, 1994, 1999a; Pardey et al., 2006; Pardey and Beintema, 2001; Spielman and von Grebmer, 2004). To match the increased policy relevance, there is a growing body of academic literature that investigates how to best organize the distribution of public funds in agricultural research (Alston et al., 1995; Huffman and Just, 1994, 1999a, 2000; Just and Huffman, 1992). Indeed, improved understanding of the factors affecting the selection and funding processes applied by regional public authorities to allocate agricultural research funds, will be able to further inform the discussion on policy measures to be implemented in this domain.

A major insight from the abovementioned stream of research is that the effectiveness of the provision of public funds to research activities hinges upon the funding mechanisms employed (Alston et al., 1998; Braun, 2003; Huffman and Just, 1999b; Potì and Reale, 2007; Ruttan, 2001; Tabor et al., 1998)[3]. Most public funding authorities employ a portfolio of funding systems with changing environments and emerging needs, which guides the choice of system per case (Lepori, 2011). Compared to different systems[4], the so-called "peer-reviewed competitive grant program", in which researchers compete with each other to receive funds, is becoming more popular (Hoekman et al., 2012; Huffman and Evenson, 2006a; Huffman and Just, 2000). In principle, competitive grants are: more responsive to current needs; provide increased flexibility; offer increased potential to attract the best talent through open competition; can lead to more efficient use of research resources since they rely on professional and peer review; and can better balance and complement other research resources and programs (Alston and Pardey, 1996).

[3] Dalrymple (2002) provides a comprehensive review of the historical literature about the social returns to research investments in the public and private domain.
[4] See Huffman and Just (2000) for a detailed discussion of the different funding allocation mechanisms.

In reality, though, competing for grants can be time-consuming and expensive, and, perhaps more importantly, it can also suffer from external pressures. Such pressures introduce different forms of favouritism in the decision process, and can eventually lead to suboptimal allocation of funds. As such, peer review tends to rely heavily on "old-boy" networks (Alston and Pardey, 1996; Alston et al., 2010). Moreover, competitive grants are usually oriented towards short term projects (3 to 5 years) despite the fact that agricultural research often requires long term funding (i.e. longer than 5 years for breeding programs).

In the "peer reviewed" system, the organizer of the grant competition invites interested parties to submit their research proposals through public calls that set the rules of the game. Research project proposals submitted by groups of researchers are then typically selected by a panel of (academic) researchers and/or experts (reviewers), after which they evaluate the proposals and award funding to those that they deem to be the best (Jayasinghe et al., 2001). In the most common setting, panels composed of individuals both external and internal to the funding agency, judge the proposals in different stages of the process. These reviewers are often experts from academia or research institutes, as well as bureaucrats whose main goal tends to be to check the congruency between the proposals and the submission criteria (Jayasinghe et al., 2001).

Empirical work on the factors that allow a given proposal to be funded has established that the chances of funding depend, among others, on the scientific merit (i.e. academic quality of the proposal), the suitability of the research topic, its societal impact, the proposing team, and the applicant(s)' attributes such as academic affiliation, gender, and age (Ballesteros and Rico, 2001; Cole et al., 1981; Grimpe, 2012; Hoekman et al., 2012; Rasmussen et al., 2006; Reinhart, 2009; Santamaría et al., 2010; Viner et al., 2004). From these studies, two observations are of particular interest within the present work.

Firstly, limited attention has been given to specific funding systems for agricultural projects (the study by Rasmussen et al. (2006) on organic agriculture funding is an exception to this). Given the high investment returns on agricultural research, this lack of relevant work is surprising (Alston et al., 2000; Huffman and Evenson, 2006b). Along the same lines, the share of public research funds going into agricultural research is generally larger than the share sourced from private funds. This is primarily a response to the fact that the agricultural private sector is unlikely to sustain a flow of funds above the socially optimal level (Alston and Pardey, 1996), which in turn occurs because it consists of a large number of small businesses with limited access to financial means and limited internal R&D capabilities (Alston et al., 1998; Huffman and Just, 2000; Pardey and Beintema, 2001). Thus, public funds tend to be the primary means to sustain an adequate flow of investments in agricultural research.

Secondly, the focus of research in this domain has mostly been on the demand side for the funds, e.g. on attributes of the proposal and the proposing team, leaving the supply side largely unexamined. In general terms this means that we know relatively little about how attributes of the reviewers (i.e. academic experts and/or bureaucrats) as well as the reviewing team can affect the funding outcome of any given submitted proposal. In similar settings, such as the allocation of research funding to researchers, evidence suggests that the supply side can *also* be influential in shaping the distribution of funds (Alston et al., 1998; Bornmann and Daniel, 2007; Cole et al., 1977; Jayasinghe et al., 2001; Laudel, 2006; Marsh et al., 2009; Rasmussen et al., 2006). Accordingly, several candidate factors can explain the allocation of research funds by regional authorities. For example, the reviewing team's gender composition, as well as its overall tendency to reject or approve proposals, are relevant factors if we take into account concerns about favouritism and opportunistic behaviour (Sonnert, 1995).

These considerations prompted us to examine how both demand and supply factors can influence the allocation of agricultural funds provided by regional governments. More specifically, we focus on understanding to what extent factors other than scientific quality and merit, influence the outcome of the selection and funding of agricultural research project proposals.

As our case study, we analyse agricultural research funds allocated in the Emilia-Romagna Region (ERR) in Italy. ERR presents an interesting template for our study for a number of reasons. Namely, the "competitive grant" fund allocation procedure followed by the regional authorities at ERR, greatly resembles the procedures followed by many other regional public authorities in Europe (see for instance the cases described in Bornmann and Daniel, 2006; Eickelpasch and Fritsch, 2005; Garcia and Menéndez, 2004; Henningsen et al., 2012), which adds to the generalizability of our results. Furthermore, the large number and diversity of funded projects by ERR (on average, from 2001 to 2006, €12 million was awarded annually, spread over 100 proposals), indicates that a number of factors can play a role in determining which proposal receives funding.

To empirically study the allocation of agricultural research funds of ERR, we were provided with a rich dataset. The dataset not only reports information on both award winners and submitted proposals that did not receive funding, but also reports the amount of funding allocated to each proposal. Drawing from this dataset, we use a Heckman selection model to study the amount received per proposal, while accounting for potential selection bias that could result from examining award winners' submissions only. Furthermore, the dataset reports features of the proposals' applicants, as well as features of the team that reviewed the proposal. Accordingly, we construct a novel empirical model that simultaneously measures the effects of both supply and demand attributes on the likelihood that a proposal gets funds, as well as on the amount it receives if it is funded.

We proceed with the rest of the paper as follows: in the next section we present our theoretical expectations for the factors that shape the allocation of research funds. In Section 3 we elucidate the details of the funding procedure in ERR. In Section 4 we present our data and empirical methodology. In Section 5 we present our results, after which we conclude in Section 6.

2. Factors affecting the selection of research projects in agriculture

Several strands of literature analyse the selection process for different research projects based on a peer-review mechanism (Ballesteros and Rico, 2001; Grimpe, 2012; Hoekman et al., 2012; Rasmussen et al., 2006; Santamaría et al., 2010; Viner et al., 2004). A peer-review mechanism is meant to improve the quality of the selection process because it is mainly based on rewarding the scientific quality and merit of the research project proposals. More than any other stakeholder, peer reviewers are expected to have the scientific know-how and experience that qualifies them to appropriately approximate the potential outcomes of research proposals, thus reducing the *ex-ante* uncertainty related to the selection and funding mechanism (Huffman and Just, 2000). As a result, under a peer review mechanism, research proposals with high(er) scientific quality and merit, as compared to lesser proposals in terms of scientific quality, should be more likely to be selected and receive more funds.

However, since peer review panels can be vulnerable to politicisation, favouritism, and strategic manoeuvring, this expectation has been often challenged, (Bornmann and Daniel, 2005, 2007; Viner et al., 2004). Indeed, an increasing number of academic publications point out that the scientific quality or merit of a research project might not be the most decisive factor in determining a given proposal's fate. For instance, Viner et al. (2004) highlight the presence of the so-called 'Matthew Effect', under which greater recognition is often accorded to projects of established scientists, whilst recognition is withheld from those yet to make their mark. This is also described as "accumulative advantage", to indicate the process in which the initial social status of a scientist/researcher influences their probability of obtaining recognition for their work (e.g. being funded a research project) (Viner et al., 2004). Therefore, beyond scientific merit, attributes of the applicant such as reputation (i.e. being successful in prior funding applications) and scientific status (e.g. often proxied by an objective measure of the actual competence and quality such as the h-index), and/or influence (e.g. the type of research institution endorsing/supporting the applicant) may matter as well (Bertocchi et al., 2014; Bornmann and Daniel, 2005, 2007; Materia and Esposti, 2009; Reinhart, 2009; Viner et al., 2004).

Other critics of the peer-review mechanism argue that the attributes of the reviewers may also be relevant in explaining the fate of a given proposal. For example, Bornmann and Daniel (2005) point out that (i) reviewers rarely reach a unified agreement, often because of relations of power or hierarchy between them, which can impact the reliability of the peer review mechanism; (ii) reviewer's recommendations can be biased since they may be influenced by personal attributes of the applicants (e.g. gender) or of the reviewers themselves. Both critiques imply that a fruitful avenue for improved understanding of the selection and funding of research proposals is the investigation of how attributes of the team of reviewers, as well as the matching between the attributes of the reviewers and the applicants, can influence the fate of a given proposal (Bornmann and Daniel, 2005, 2007; Hartmann and Neidhardt, 1990; Hodgson, 1997; Rasmussen et al., 2006; Reinhart, 2009).

Confronted with such considerations, in this paper we empirically examine how scientific quality and merit, along with other external factors, influence the outcome of the selection and funding of agricultural research project proposals. We define the potential influences of those factors in the selection and funding process as "biases" of the peer-review mechanism. Although different sources of biases are commonly identified and classified in the literature, one principal problem is the general lack of studies where reviewer biases are directly studied in the natural setting of actual referee evaluations (Baxt et al., 1998; Bornmann and

Daniel, 2005). This scarcity of relevant studies, makes it difficult to establish with certainty whether research projects from a particular group of scientists receive better reviews/rewards (and thus has a higher approval rate) due to biases in the review and decision-making procedure, or if favourable review and greater success in the selection procedure is truly a consequence of the scientific merit of the corresponding group of applicants (Bornmann and Daniel, 2005). Furthermore, only a handful of studies address concerns directly linked to the reviewers themselves rather than attributes of the applicant(s), or the project (Bornmann and Daniel, 2007; Jayasinghe et al., 2001). Thus, an all-encompassing analysis of the role of these “biasing” factors in the selection process of research projects based on peer review mechanisms is still lacking (Bornmann and Daniel, 2007; Jayasinghe et al., 2001). Taking these gaps into account, this paper contributes to the existing literature by highlighting and empirically investigating the role of a multitude of factors, on top of scientific merit or quality in a peer review mechanism, that can influence the selection and funding of agricultural research projects. More specifically, we analyse both the selection of projects and the funding amount allocated to each project.

Only a few other papers have jointly looked at those decisions before (Ballesteros and Rico, 2001; Santamaría et al., 2010; Viner et al., 2004) while the small number of relevant contributions calls for more work on the topic. Contrary to previous work (Reinhart, 2009), we do not only analyse how the selection and funding process is influenced by attributes of the applicants themselves, but also by attributes of the team of reviewers. Furthermore, in line with only a limited number of previous works (Bornmann and Daniel, 2007; Jayasinghe et al., 2001; Jayasinghe et al., 2003), in the analysis we incorporate attributes of the reviewers and the reviewing team as a whole. These attributes include the gender composition of the reviewing team, as well as the past history of the team in rejecting and approving applications (Sonnert, 1995).

In all, we expect that taking into account these factors will improve our understanding of the peer review selection and funding processes of agricultural proposals with increased precision. As previously mentioned, to empirically address our research questions we focus on the case of the Emilia-Romagna region in Italy, details of which we present in the next section.

3. The selection process adopted in the Emilia-Romagna Region

The Emilia-Romagna Region (ERR) is one of Italy's largest administrative regions and has been one of the front-runners for the manner in which "competitive grants" in agricultural research have been allocated in the last few decades (Materia and Esposti, 2009)[5].

In 1998, ERR became one of Italy's first regional authorities to adopt a new regulation (Regional Law (R.L.) 28/98) aimed at re-organizing the process of awarding research funding towards more competitive principles. The new regulation introduced a "peer review process" for the evaluation of grant proposals, in which applicants submit proposals according to a prescribed format. They can submit to one of following three general categories: (i) "*study, research and experimentation*" if the application refers to more scientific or research oriented activities; (ii) "*technical assistance*" or; (iii) "*information, documentation and training*" if the application refers to research dissemination activities. In the context of this paper we focus on the selection process for the first type of proposals. The research proposal selection and funding process used by ERR are described in Figure 1.

Figure 1 about here (ERR selection process)

In the first stage of the selection process, research proposals are checked against *formal* eligibility criteria by regional administrative employees, and are then assigned to one or more

[5] Thus, ERR presents an interesting example of how regional authorities allocate "competitive grants", and it resembles to a large degree the procedure followed by other regional public authorities in Europe (Bornmann and Daniel, 2006; Eickelpasch and Fritsch, 2005)

panels of at least three academics, which are to provide an independent scientific assessment. These academics are national experts, nominated by the regional authority on basis of their expertise, and are meant to complement the reviewers in the assessment of the proposals' scientific merit. Each proposal is assigned to one specific panel of academics, with the same panel often assessing more than one project. Academic experts are asked to assess each proposal exclusively on the base of the degree of innovativeness, scientific and technical adequacy, clarity of the scientific objective, relevance of expected results, completeness of scientific information, and expected costs. After the academic reviews are completed, a panel of three reviewers ("triads of regional experts") proceed with the decision making process by integrating academic evaluations with additional assessments (see Table A1), and thus decide the final admittance or rejection decision per each proposal (second stage in the selection process)[6]. Finally, these triads rank the proposals according to their scores, allocating grants until all regional funds intended for research activities are spent (similar to, for instance, the case described in Jayasinghe et al. (2001)).

Note that within the text of the regional law, more relevance is given to some specific regional research organizations that ERR recognizes as key-actors in the implementation of the regional strategy on agricultural R&D. In the context of ERR, all these organizations act as *innovation brokers* (IB)[7] because they coordinate and mediate the interaction between research providers and users (farmers, agri-food companies etc.). Moreover, it is worth noting that in 2004, the regional regulation had been subject to a reform to simplify procedures and to align to new regional priorities in the research domain. As a result, some criteria that had been valid since 2000 were revised and merged, although the overall selection process did not change (see

[6] In the empirical part of our paper (Section 4 and 5), among the additional assessments that the triads assign, we zoom in on the effects of the suitability and integration of the project within the regional context.

[7] Innovation brokers are organizations, formally identified by the ERR, and aim to coordinate and facilitate interaction and cooperation between researchers and other stakeholders, mainly agri-food companies and/or entrepreneurs. As regulated by Regional Law (R.L.) 28/98, research grants through the competitive system are the sole source of funding for these organizations. They do not receive any extra-support from other national or regional authorities.

Appendix - Table A1). In our empirical strategy we take both the role of IBs as well as the reform of the regional regulation on research funding into account.

4. Methods and procedures

To empirically test the impact of scientific merit and attributes of the reviewing team on the allocation of research funds to a given proposal, we build a two-stage Heckman (1979) model. In the first stage we model the probability that a proposal receives funding as conditional on attributes of the proposal, the reviewing team, and other remaining factors we expect to influence the chances of funding. The dependent variable takes the value of 1 for proposals that are admitted to the second round, and 0 otherwise. In the second stage, we study the amount of funds received by proposals that are selected in the first stage. The allocation of funds is again regressed on measures of the scientific merit of the proposal, its suitability and integration with the regional context, the composition of the reviewing team, attributes of the applicants, and other factors including a vector of the expected value of the error term (so-called Inverse Mills Ratio)[8]. Employing the Heckman procedure allows us to control for the selection bias under which proposals that go past the first round are different from non-successful proposals in unobserved features. If such a proposition is indeed true, the proposals of the second round are indeed not randomly selected. The two-stage Heckman procedure addresses such potential selection bias, and thus adds to the robustness of our results.

Table 1 about here

[8] Note that the elements of the design matrix X in the two estimated models are not identical. That is, a number of regressors are relevant only for explaining the receipt of a grant or the amount awarded but not both, as we explain in detail in the following discussion. As such, the former are included only in the first stage model and the latter only in the second stage model.

To capture the effect of the scientific merit of a given proposal on its progress in the reviewing process, we include a variable that measures the rating given by academic experts to each project (*MERIT*)[9] in both models. The MERIT variable is calculated as the percentage of the score assigned to each project by the academic experts (as indicated by the ERR regulation[10]).

More established or successful researchers may have better chances to attract (more) funds. This may hold because either their proposals truly reflect their qualities, or because funding agencies see them as more favourable. Given that we account for the quality of the proposal, our analysis includes the h-index of each principal investigator (PI) (*H-INDEX*) to account for the potential preference of funding sources towards more productive researchers. A positive sign for the associated coefficient would then suggest that they indeed present with a general inclination to fund proposals submitted from this cohort of researchers. We calculate the h-index of the PI at the year the project was submitted, and we use the SCOPUS database to source it. For projects with more than one principal investigator we average the h-index across PIs. In case a researcher is not listed in SCOPUS, or they do not have an h-index at the time the proposal was submitted, the variable takes the value of 0. The index is based on the set of the researchers' most cited papers and the number of citations that they have received in other publications. Essentially, an h-index of say 7 means that a given researcher has 7 publications with at least 7 citations, an h-index of say 15 means that a given researcher has 15 publications with at least 15 citations and so on. Although there are some critics about the use of the h-index (e.g. it does not account for the number of authors of a paper, nor for the typical

[9] See Table A1 in the Appendix for a more detailed representation.

[10] As we noted in section 3, ERR funds three types of projects: research-, experimentation-, and technical assistance projects. For the analysis we focus on research- and experimentation projects. Primarily due to the change in law in 2004, the method of calculation and the evaluation criteria of the scientific merit score for the technical assistance projects differ considerably for projects applied before and after the change in legislature. Due to this, we focus on research and experimentation projects whose scientific merit score is consistently computed across the sample. Regardless, to check the robustness of our results while focusing solely on research and experimentation projects in unreported work, we built two additional models. In the first model we include all observations from all types of projects up to 2004, while in the second model we limit the analysis to observations after 2004. The estimates of these models yield qualitative similar results to those reported in Table 3, suggesting that the exclusion of technical assistance projects from the analysis does not hamper our empirical estimates.

number of citations in different fields), and about SCOPUS (e.g. it does not cover publications prior to 1996), the index is generally regarded as an objective measure of research achievement (Hirsch, 2005, 2007; Martin, 2015; Prathap, 2010).

To capture the effect of how triads of regional experts assess the proposals they evaluate, we use the score they assigned to the project to reflect the overall suitability of the project within the regional context (*SUITABILITY*)[11]. We calculate this variable as the percentage of the score assigned to each project by the reviewers, as relative to the maximum potential score determined by the regulation. We expect that a higher score for this criterion will lead to increased probability of being selected.

To approximate the attributes of the team of reviewers we include three independent variables in the analysis. The first variable measures the percentage of males in the group of reviewers (*GENDERGROUP*). Given the evidence that male reviewers tend to give lower ratings to proposals presented by male or female applicants (Sonnert, 1995), we expect a negative sign for this variable. The second variable measures the number of times the same group of reviewers had reviewed proposals before reviewing the proposal in question (*TIMESGROUP*). Based on extant findings we expect the ratings of reviewers to become more unfavourable for each additional previously reviewed application (Bornmann and Daniel, 2007; Jayasinghe et al., 2001). The third independent variable that enters the analysis aims to measure the number of times the same group of reviewers has previously provided a positive evaluation for projects (*ANGEL*). Although the membership in review panels is rotating, it is possible that the same group of three reviewers has worked together more than once. Under the premise that previous behaviour reflects future intention, we expect ANGEL to capture a general tendency

[11] Data limitations and inconsistency in the score systems before and after 2004 do not allow us to take into account the other criteria (C, D and E) used by reviewers. As showed in table A1, criteria C and D further specify elements already addressed by criterion B, while criterion E deals with features related to the project management. In our view their omission is not biasing the results when it comes to assess selection process (stage 1). They may have an impact in fine-tuning the estimates when it comes to co-financing decisions (stage 2). It is likely to expect that a project showing more detailed link to the regional priorities as well as showing more sounding management features may receive more funds.

for a certain group of reviewers to either favour or reject proposals (Bornmann and Daniel, 2007; Piesse et al., 2010). As such, increasing values of the ANGEL variable should associate with both increased chances for project approval as well as an increase in amount of funds[12].

To complement the independent variables in explaining the chances of success for a proposal, we included a number of additional regressors in the analysis, as we present below. Besides the scientific merit of a given proposal and its impact in terms of suitability for the regional programming and productive system, we expect other attributes of a proposal to influence its chances of being funded, as well as the amount of this funding. We include a variable that measures the total amount of funds requested by the project as the percentage of the total amount of funds provided by the funding agency for the year in question (*COST*). Proposals that require larger amounts may be at a disadvantage in attracting funds because of limited fund availability. Alternatively, more financially demanding projects may present broader or richer research outcomes, which could then indicate increased chances of success. Given that *a priori* extant literature does not allow us to disentangle these two opposing effects, we do not formulate any priors for the expected sign of the *COST* variable. Next, we include a dummy variable for projects related to vegetable production (*VEG*) to account for the general tendency of the Emilia Romagna region to allocate funds in that sector. We therefore expect a positive sign for the *VEG* variable. Finally, we include a control variable to reflect the duration of the proposed project (*MONTHS*). This variable can approximate the unobservable effort and

[12] In order to check whether the attributes of the triads of regional reviewers exert any bias on the score they assign to "suitability", we built two new variables to show the interaction between features of the triads, and the score assigned to suitability. To evaluate the effect of the regional reviewers' gender on this score, we built the interaction term *b_gendergroup*, which is the product of the suitability variable and the variable representing the gender of the (triads of) regional reviewers. To evaluate whether the fact that the same reviewing team has been an angel in the past has had any influence on the score given to suitability we create the *b_angel* variable, which is the product between the two corresponding variables. When we include these variables in the baseline specification, their coefficients are statistically insignificant (results are available upon request). These results suggest that the attributes of the regional reviewers do not exert any effect on the score they assign to suitability. Because the evaluation of the merit of a given proposal is not necessarily objective (Wennerås and Wold, 1997) we investigated the possibility to conduct a similar exercise for MERIT. However, this was not possible because we do not possess full information about personal attributes for the majority of the academics that play a role in the first stage of the selection.

commitment of the researchers. Added to this, it can also indicate the extent to which the project relies on fundamental research, which typically is lengthy with uncertain outcomes. While we expect the commitment of the researchers to increase the chance of a given proposal to succeed in the review process, the uncertain outcomes of fundamental research may discourage the funding agency to allocate funds. Accordingly, we do not form priors for the sign of the *MONTHS* variable.

With regard to attributes of the applicant, we include four variables. To approximate the experience of the applicants, in the model of the first round we include a variable that measures the number of projects that had been granted previously to the applicants (*SUCCESSBEF*). For the model of the second round, we calculate the total amount of funds that has been awarded to the applicants in the past (*SUMBEF*)[13]. We expect our measures of previous success to relate positively with both the chance of receiving a grant and the size of that grant. We base this expectation mainly on the cumulative advantages that repeat winners often realize (Viner et al. 2004). The third control variable that relates to attributes of the applicant is a proxy of power. As discussed previously, regional innovation brokers (IBs) can be in an advantageous position in attracting research funds because their role as mediator between research and practice is explicitly recognized by ERR. By extension, we include a dummy variable that takes the value of 1 if the applicant organization is an IB, 0 otherwise, and expect a positive sign for the associated coefficient (*IB*). Finally, we include a dummy variable that measures the percentage of a proposal's principal investigators (PIs) that are male (*MALEPI*). Previous evidence suggests that male PIs are often better off in peer review processes (Bornmann and Daniel,

[13] Note that both SUCCESSBEF and SUMBEF are calculated by counting the number of successful projects as well as their sum within the sample at hand (2001-2006). Such a construction scheme could, in principle, only underestimate the success measures of proponents that had approved proposals in the early periods of the sample. A detailed inspection of our data revealed that cases of one-time winners were relatively rare for the 2001-2006 period. We do not have any a priori reasoning for similar trends before 2001. Nevertheless, the coefficients of those variables should be interpreted with caution.

2005, 2007; Jayasinghe et al., 2001; Reinhart, 2009), and as a result, we expect a positive sign for *MALEPI*.

To evaluate whether the effect of the applicants' gender (*MALEPI*) on the success of the proposed project is mediated by the gender of the reviewers (*GENDERGROUP*), we include an interaction term that is the product of these two variables (*GENDER_INTER*). We employ this variable to account for the case in which male or female reviewers systematically provide a biased recommendation to female or male applicants respectively (Bornmann and Daniel, 2007; Jayasinghe et al., 2001; Jayasinghe et al., 2003; Sonnert, 1995). Along the same lines, we include an interaction term that is the product of *ANGEL* and *TIMESGROUP* (*ANGEL_INTER*) to evaluate whether the fact that the same reviewing team has been an angel in the past has an influence on the selection and funding of a project. We expect a positive effect, largely because previous studies have consistently shown that systematic tendencies of reviewers exist in the construction of judgements toward proposal evaluations during peer reviews (Bornmann and Daniel, 2007; Piesse et al., 2010)[14]. Finally, we include a variable that takes the value of 1 for proposals submitted after 2004, 0 before, which is the year that the change in regulation took place (*YEAR*). We expect a negative sign for this variable, which would reflect the declining trend in selecting and funding projects after the change in regulation. In sum, we build the following two empirical specifications:

$$SELECT = \gamma_0 + MERIT\gamma_1 + HINDEX\gamma_2 + SUITABILITY\gamma_3 + GENDERGROUP\gamma_4 + TIMESGROUP\gamma_5 + ANGEL\gamma_6 + COST\gamma_7 + VEG\gamma_8 + SUCCESSBEF\gamma_9 + MALEPI\gamma_{10} + GENDER\_INTER\gamma_{11} + ANGEL\_INTER\gamma_{12} + YEAR\gamma_{13} + u_2 \quad (1)$$

[14] In the context of manuscripts, Daniel (2010) showed that some reviewers could be classified as belonging to the category of "assassins" and some to the category of "zealots".

$$COFIN \; = \; \beta_0 + MERIT\beta_1 + HINDEX\beta_2 + SUITABILITY\beta_3 + GENDERGROUP\beta_4 + COST\beta_5 + VEG\;\beta_6 + MONTHS\beta_7 + SUMBEF\beta_8 + \; MALEPI\beta_9 + GENDER_{INTER\beta_{10}} + YEAR\beta_{11} + \; lambda + u_1 \qquad (2)$$

where SELECT equals 1 if the project is selected, 0 otherwise, and $COFIN$ is the amount of co-financing given by the region to the selected projects.

5. Data Sources and Presentation

To form the dependent, independent, and control variables we relied on proprietary data provided by the ERR. The dataset consists of 1221 project proposals (the observations) submitted during the 2001-2006 period. Out of the 1221 submitted proposals 589 projects were admitted to the second round of review. Those projects received approximately €75 million (on average more than €12 million per year), of which €59 million (about €10 million per year) were provided by the ERR. Both the number of projects that received funding, as well as the total amount of funding, decreased progressively over time; from 142 projects approved and funded in 2001 (56% of the total amount of projects submitted) to 70 in 2006 (41%), and from €15,5 to €8,3 million of total funding (of which 13,3 and 6,5 respectively, were provided by the ERR).

The regional research centres acting as intermediaries between science and practice (i.e., innovation brokers) presented 32% of the submitted projects (of which 48% were selected and funded), but also ventures and experimental companies (or laboratories) acquired a considerable amount of approvals for funding (21% and 15% of the total number of projects, respectively). Participation of other actors, more typically involved in research and experimentation projects, was more limited: only 3% of the proposals were presented by universities[15]. The majority of the proposed and selected projects were research projects (55%), most of them coming from IBs. In terms of sectoral project distribution, 59% of the projects were related to the vegetable production sector, 22% to animal production, 14% to farm management and rural development, and the remaining 5% to environment and marketing. On average, for the period 2001-2006 the percentage of co-financing from the ERR to the selected projects remained high (80%), although it decreased somewhat from 86% in 2001 to 78% in 2006.

Table 2 about here

The average MERIT score (the percentage of points received by a given proposal out of the maximum number of points) for the proposals was 0.626 with a standard deviation of 0.141, which indicates that the variability in the MERIT scores was limited, with most proposals receiving a score of 0.72. Nevertheless, some proposals received the highest score of 0.95 (out of 1) and others the lowest score of 0[16]. To report what Table 2 does not represent: the average MERIT score for proposals that went past the first round was 0.71, and the corresponding score for remaining proposals was 0.55; the average SUITABILITY score is 0.597 with a standard deviation of 0.216, indicating that the variability in this score was limited with most proposals receiving a score of 0.

Of the 1217 projects for which it was possible to investigate the gender of the PI(s), 994 projects were proposed by all-male teams while all-female teams proposed 147 projects. 905 of the 1221 projects were proposed before the change in the law (i.e., in the period 2001-2004), most of these in 2001 (253). Out of these 905, half were selected and funded. For the 316

[15] However, it should be noted that even when universities do not present projects directly, they are often involved in the proposals that are presented by other actors (mostly IBs). More often than not, their role encompasses the realization of the research activities once the projects have been approved.
[16] The fact that some projects received the lowest score alleviates concerns that only the better projects are submitted for funding. Along the same lines, the distribution of merit scores has a bell shaped curve, which, again, implies that projects of varying quality were submitted for funding.

projects proposed in 2005-2006, 136 were funded. Almost 59% (723) of the projects were related to vegetable production, 49% (356) of which were selected and funded. Roughly 32% of the projects were proposed by an IB, 52% of which received a positive evaluation and were funded. During the period 2001-2006, only 20 of the 1221 projects presented were evaluated by the same triad of reviewers (*TIMESGROUP*).

6. Results

Table 3 presents the estimates of the two-stage Heckman model. The fit statistics at the bottom of Table 3, suggest that the models indeed have explanatory power, while the statistical significance of the Mills Lambda indicates that the selected and not-selected projects for the second round do differ. Note that the multicollinearity condition index for both models is somewhat elevated, which could raise concerns about inference. As a robustness check, in Tables A3 and A4 we present stepwise models in which the index is well below the worrisome level of 100 (Belsley et al., 1980)[17]. For the most part, the results of those models are in line with the results presented in Table 3, adding to the robustness of our estimates.

Table 3 about here

In line with the expectation that the scientific merit of a given proposal is a strong predictor of the selection and financing of a given proposal, we find that an increase in MERIT score associates strongly with both the probability that a proposal goes to the second round, as well as with the amount of funding allocated to it. To illustrate, an increase of one unit in the score given to the MERIT index, is associated with an increase in funding level of the focal proposal by more than €100,000. To put the figure of €100,000 in perspective, recall that the average

[17] Along the same lines, we also present as Appendix Table A2 the correlation of the variables we use in the empirical analysis

amount allocated to successful proposals, as presented in Table 2, is roughly €102,500. The suitability of the project with the regional context is an additional driving factor in selecting projects: an increase of one unit for the score given to the SUITABILITY index, is associated with more than €135,000 increase in funding. On the other hand, the variable indicating the scientific status of the applicants (H-INDEX) is not statistically significant. This is an important observation indicating that more productive PIs do not experience any advantage when it comes to the selection and funding of their proposals. Combined, these results side with previous evidence on the importance of scientific quality of the research proposals (Reinhart, 2009), but not necessarily of the applicants.

On top of the statistically significant and economically relevant effects of MERIT and SUITABILITY, we still find a number of other factors that influence the review panels' selection of proposals and final allocation of funds. In particular, contrary to what we expected, the estimates indicate that proposals assessed by groups of male reviewers are both more likely to be selected for financing as well as to receive funds. In the same vein, the previous experience of reviewers' panels is conducive to higher chances of a proposal being selected for funding. Furthermore, the general tendency of the same triad of reviewers to act as "angels", is strongly linked to increased chances that a given proposal will be selected for funding. Therefore, in this case, we identify a potential source of bias. We note, however, that all the estimated coefficients that confirm influence of other factors on the selection and allocation processes, are significantly smaller than the MERIT and SUITABILITY coefficients.

The results that describe attributes of the applicant(s) and the project suggest that "biases" about these two sources are rather limited. In particular, we find that the applicant's number of previous successful projects is a statistically significant predictor of the probability that their current proposal is selected for funding. This finding potentially reflects the advantages conferred by accumulated experience and primarily relate to the effects of a learning curve. Interestingly, proposals that originate from IBs do not seem to carry any advantage in terms of chances of being selected. This finding implies that the perceived power of the IB entities does not influence the chances of selection. The duration of the project, the funds awarded to the proposing team in the past, and the gender of the PI did not have explanatory power in either of the models. More financially demanding projects received additional funds but when compared to other projects they do not differ in the chances of being selected for the second round. Somewhat surprising given their popularity in ERR, projects related to vegetable production were less likely to receive funding. This implies that conditional on the remaining effects we control for, projects of that kind appear to be in a disadvantageous position. The negative sign of the year-dummy suggests, as expected, that the selection process became stricter after 2004 and that less funds were allocated to projects.

The interaction terms reveal that while the gender of the PI is not relevant *per se*, male triads are more inclined to assign fewer funds to male PIs while female triads are more benevolent towards female researchers. Finally, the interaction term of the experience of the reviewers' triad and its tendency to give positive evaluations revealed an unexpected effect, even though only marginally statistically significant: less funding is awarded to proposals that were assessed by reviewing teams with more experience in working together and having assessed more proposals positively.

7. Conclusion

Presently, a large body of research has been devoted to analysing the peer review processes by which (panels of) reviewers evaluate proposals. The studies in this line of research have yielded valuable insights, focusing mainly on attributes of the applicants and the project under review. However, the manner in which attributes of the reviewers affect the outcome of peer reviews, as well as how these attributes interact with features of the project and the applicants, remains largely unexplored. Against this background, in our work we conduct the following novel exercise: we study the fate of research proposals by linking attributes of the proposal, the applicants, and the reviewers on the probability that a proposal receives funding as well as, if successful, on the amount of funding it receives. Importantly, as far as we are aware, our study is among the first to investigate the role of scientific merit in peer review based selection process specifically for agricultural research projects.

We base our analysis on projects submitted to the Emilia Romagna Region (ERR) in Italy, where information on its selection process have been systematically recorded from 2001 to 2006. We employ a two-stage Heckman model that simultaneously assesses the role of different factors in the selection as well as funding phase. Our results on selection and funding of agricultural research activities of the ERR support the notion that scientific merit is a prime factor explaining selection and funding amount of agricultural research proposals. Also, the suitability of the proposed research projects with the regional context is a strong predictor for the outcome of the selection and funding processes. Notably, we find that more productive/successful researchers are not more likely to see their projects succeed in the peer review process, indicating that the status of the applicants does not influence the selection process.

However, we also document other influencing factors that to a certain extent can be regarded as sources of biases. This may require further attention in order to improve selection and allocation processes, particularly in the context of the peer review based selection mechanism. More specifically, we discovered that research proposals assessed by groups of male reviewers are both more likely to be selected as well as to receive funds. Previous experience of reviewers' triads also leads to higher chances of a proposal being selected for funding, albeit with a marginal effect. Moreover, the tendency of the same triad of reviewers to act as "angels" is strongly linked to increased chances that a given proposal is selected for funding. Thus, “benevolent triads” are disproportionally and systematically selecting and funding more proposals than other triads. Finally, we reveal that gender composition of triads and their match with proponents’ gender matter too.

In order to reduce those potential sources of biases, a more careful process of reviewers’ triads composition has to be considered by the funding agency. Selection biases due to triad composition may be reduced by more frequent rotation of the triad members, as well as by increasing the number of involved experts. One strategy could be to ask academic experts to use other features of the proposals and not only the scientific merit in the selection process. Also, biases could potentially be reduced if the identities of the applicants were anonymous during the review process.

Our work is not without limitations. First and foremost, we treat the scientific merit scores as exogenous, and data limitations do not allow us an in depth investigation to find out whether the scores assigned to a given proposal depend on the reviewers. Still, when we test whether the suitability scores suffer from similar bias we do not find such evidence. Along the same lines, we did not investigate how the panels’ composition and rotation was determined. The underlying mechanisms that lead to the formation of the panels may be able to explain the decisions of those panels. Finally, our focus on agricultural projects may limit the generalizability of our results to other sectors.

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Table 1. Description of the variables used in the analysis

Variable	Definition
Dependent variables	
SELECT	Probability that a proposal is selected and admitted to funding (1 = yes, 0 = otherwise) in the first stage of the process
COFIN	Amount of funding received in the second stage of the process by proposals that have been selected in the first stage
Explanatory variables	
MERIT	Scientific merit of a given proposal as the percentage of the score assigned to each project by the academic experts on the maximum potential score as indicated by the ERR regulation
H-INDEX	Measure of the scientific status of the principal investigator as the h-index reported till the year of the presentation of each project (source: Scopus, www.scopus.com visited in July 2014-September 2014)
SUITABILITY	Suitability and integration of a given proposal to the regional context as the percentage of the score assigned to each project by the reviewers on the maximum potential score as indicated by the ERR regulation
GENDERGROUP	Percentage of males in the group of reviewers
TIMESGROUP	Number of times the same group of reviewers has reviewed proposals before the proposal in question
ANGEL	Number of times the same group of reviewers has provided a positive evaluation of projects in the past
Control variables	
COST	Total amount of funding requested by the project as a percentage of the total amount of funding provided by the Region for the year in question
VEG	Project related to vegetable production (1 = yes, 0 = otherwise)
MONTHS	Duration of the proposed projects
SUCCESSBEF	Number of projects that had been granted previously to the proponent institution
SUMBEF	Total amount of funding that had been awarded to the proponent institution in the past
IB	Project proposed by regional research centers acting as intermediary between science and practice (1 = yes; 0 = otherwise)
MALEPI	Percentage of principal investigators in a given proposal that are male
Interaction terms	
GENDER_INTER	Interaction effect between the gender of the principal investigator and the gender of the group of reviewers
ANGEL_INTER	Interaction effect between the number of times a group of reviewers has reviewed proposals before and the number of times the same group has provided a positive evaluation on projects in the past
Dummy for change in the law	
YEAR	Year that the change in regulation took place (1 = 2005, 2006; 0 = otherwise)

Table 2. Descriptive statistics

Variables	Obs	Mean	Std.Dev.	Min	Max	Mode (freq)	
Dependent variables							
SELECT	1221	0.482	0.499	0	1	0	(632)
COFIN	1221	102466.6	117606.4	0	1228804	0	(8)
Explanatory variables							
MERIT	872	0.626	0.141	0	0.95	0.72	(15)
H-INDEX	1221	2.623	4.172	0	36	0	(642)
SUITABILITY	871	0.597	0.216	0	0.92	0	(81)
GENDERGROUP	1221	0.710	0.266	0	1	0.66	(511)
TIMESGROUP	1221	4.114	3.889	1	20	1	(359)
ANGEL	1221	0.482	0.425	0	1	0	(450)
Control variables							
COST	1221	0.798	1.011	0.029	16.045	0.74	(3)
VEG	1221	0.592	0.492	0	1	1	(723)
MONTHS	1221	21.320	11.139	0	50	12	(534)
SUCCESSBEF	1221	36.066	50.687	0	168	0	(396)
SUMBEF	1221	4402497	6430292	0	2.04e+07	0	(396)
IB	1221	0.319	0.466	0	1	0	(832)
MALEPI	1217	0.852	0.335	0	1	1	(994)
Interaction terms							
GENDER_INTER	1221	0.611	0.336	0	1	0.66	(433)
ANGEL_INTER	1221	2.011	2.853	0	20	0	(450)
Dummy for change in the law							
YEAR	1221	0.259	0.438	0	1	0	(905)

Table 3. Determinants of project selection (stage I) and co-financing awarding (stage II): the Heckman selection model. Standard errors in parentheses

Variable	Project selection (I stage)			Co-financing (II stage)	
	Coefficient	Marginal effect		Coefficient	
Scientific merit (MERIT)	8.8308	2.6083	***	99272	***
	(1.1957)	(0.3597)		(25339.75)	
Scientific status of the principal investigator(s) (H-INDEX)	0.0170	0.0050		153.42	
	(0.0196)	(0.0057)		(557.39)	
Suitability and integration with the regional context (SUITABILITY)	6.2701	1.8519	***	136482	***
	(0.9710)	(0.2404)		(24350.77)	
Percentage of males in the group of reviewers (GENDERGROUP) (b)	1.8853	0.5568	**	36120.65	**
	(0.8501)	(0.2548)		(14479)	
Number of times the same triad has reviewed projects before (TIMESGROUP) (c)	0.0769	0.0227	***		
	(0.0288)	(0.0082)			
Number of times the triad has provided a positive evaluation in the past (ANGEL) (d)	5.8574	1.7300	***		
	(0.4621)	(0.1878)			
Quota of funding requested on the total amount of funding provided by the Region that year (COST)	-0.0628	-0.0185		113850.2	***
	(0.0803)	(0.0238)		(7137.2)	
Project related to vegetable production (1 = yes, 0 = otherwise) (VEG)	-0.5364	-0.1653	**	-350.43	
	(0.2128)	(0.0695)		(5430.8)	
Duration of the proposed projects (MONTHS)				205.91	
				(212.97)	
Number of projects granted previously to the proponent institution (SUCCESSBEF)	0.0046	0.0013	**		
	(0.0021)	(0.0006)			
Total amount of funding that had been awarded to the proponent institution in the past (SUMBEF)				-0.0002	
				(0.0005)	
Project proposed by regional research centers acting as intermediary btw science and practice (1 = yes; 0 = otherwise) (IB)	0.2480	0.0747		1124.38	
	(0.2216)	(0.0693)		(3626.1)	
Percentage of principal investigators in a given proposal that are male (MALEPI) (a)	0.8791	0.2596		13766.3	
	(0.6956)	(0.2056)		(11103.7)	

(continue table 3)

Interaction among (a) and (b) (GENDER_INTER)	-1.4473	-0.4274		-35803.7	**
	(0.9525)	(0.2815)		(16669.2)	
Interaction among (c) and (d) (ANGEL_INTER)	-0.1170	-0.0345	**		
	(0.0491)	(0.0147)			
Year that the change in regulation took place (1 = 2005, 2006; 0 = otherwise) (YEAR)	-0.6492	-0.1687	***	-25469.98	***
	(0.2420)	(0.0580)		(6343.67)	
Constant	-13.9244		***	-167188.9	***
	(1.4331)			(30284.5)	
Mills Lambda				12770.7	**
				(5262.3)	
Observations:	868			411	
McFadden's Pseudo R2:	0.8027			0.8621	
Wald χ^2 (12):	244.53				
Prob. > χ^2:	0.0000				
Log-pseudolikelihood	-118.4768				
Multicollinearity condition number	49.7459			56.3188	

***, **,: statistically significant at 1% and 5% confidence level, respectively

APPENDIX

Table A1. RL 28/98 Evaluation criteria during different years

Evaluation criteria (2000)	**Evaluation criteria (2004)**
A. Technical and scientific validity A1. Innovativeness A2. Cost of the organizational structure A3. Scientific and technical adequacy of the project (curricula and activities) A4. Description of the objectives A5. Description of the expected results A6. Completeness of technical-scientific information	*A. Technical and scientific validity* A1. Innovativeness A2. Cost of the organizational structure A3. Scientific and technical adequacy of the project A4. Description of the objectives A5. Description of the expected results A6. Completeness of technical-scientific information
B. Suitability and Integration with the regional context B1. Integration between development interventions B2. Vertical supply chain integration B3. Horizontal integration B4. Synergies and integration with other projects, completion of on-going projects or development projects initiated earlier	*B. Suitability and Integration with the regional context* B1. Integration between development interventions B2. Vertical supply chain integration B3. Horizontal integration B4. Synergies and integration with other projects, development projects initiated earlier
C. Adequacy with objectives and priorities of the regional programming	*C. Adequacy with objectives and priorities of the programming* C1. Adequacy with objectives and priorities of the regional programming
D. Adequacy with objectives and priorities of the provincial programming	*D. Efficiency and socio-economic impact of the project* D1. Cost / benefit analysis D2. Socio-economic impact D3. Potential to affect the productive process

E. Efficiency and socio-economic impact of the project E1. Cost / benefit analysis E2. Socio-economic impact (employment, income, improvement of the work quality of the agricultural entrepreneur, saving non-renewable resources, environment, human health, animal, welfare) E3. Potential to affect the productive process	*E - Project management, consistency and degree of co-financing* E1. Degree of co-financing E2. Tools for project monitoring E3. Quality tools adopted in the project E4. Completeness of the information for the purposes of fairness economic evaluation E5. Reliability of the proponent E6. Quality of the work previously done
F. Project management, consistency and degree of co-financing F1. Degree of co-financing F2. Tools for project monitoring F3. Quality tools adopted in the project F4. Completeness of the information for the purposes of fairness economic evaluation F5. Reliability of the proponent F6. Quality of the work previously done	

Sources: regional resolutions n. 462/2000 and n. 1750/2004

Table A2. Correlation matrix

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	SELECT	1																	
2	COFIN	0.01	1																
3	MERIT	0.54	0.02	1															
4	H-INDEX	-0.09	0.074	0.050	1														
5	SUITABILITY	0.46	0.08	0.65	-0.01	1													
6	GENDERGROUP	-0.06	-0.06	-0.09	0.069	-0.08	1												
7	TIMESGROUP	0.02	0.01	-0.02	0.114	-0.01	0.12	1											
8	ANGEL	0.83	0.01	0.46	-0.146	0.41	-0.07	0.02	1										
9	COST	0.02	0.91	0.07	0.068	0.11	-0.10	-0.01	0.03	1									
10	VEG	0.06	-0.07	0.12	0.102	0.09	0.23	0.14	0.08	-0.04	1								
11	MONTHS	-0.08	0.44	0.07	0.167	0.07	0.03	0.09	-0.08	0.44	0.16	1							
12	SUCCESSBEF	0.06	0.14	0.23	0.099	0.18	-0.09	0.00	-0.01	0.18	0.27	0.23	1						
13	SUMBEF	0.07	0.17	0.23	0.093	0.19	-0.12	-0.01	-0.01	0.21	0.16	0.22	0.98	1					
14	IB	0.07	-0.03	0.02	0.139	0.13	-0.02	0.16	0.03	-0.07	0.20	0.02	0.31	0.28	1				
15	MALEPI	-0.02	0.03	-0.05	0.005	-0.02	0.08	0.05	-0.01	0.03	0.06	0.04	-0.02	-0.03	0.07	1			
16	GENDER_INTER	-0.03	-0.04	-0.09	0.039	-0.05	0.73	0.12	-0.03	-0.07	0.19	0.04	-0.09	-0.11	0.06	0.69	1		
17	ANGEL_INTER	0.43	-0.01	0.21	-0.016	0.20	0.03	0.70	0.52	-0.02	0.11	-0.00	-0.06	-0.06	0.15	0.06	0.08	1	
18	YEAR	-0.10	0.07	0.16	0.089	0.03	-0.08	-0.02	-0.13	0.16	0.02	0.15	0.51	0.52	-0.01	-0.03	-0.08	-0.14	1

Table A3. Results of the first stage: Probit estimates of Subset and Full Models (robust Standard Errors)
(dependent variable: y = 1 if the project is selected, 0 otherwise)

Variables	Estimates Subset Models						Estimates Full Model	
	1		2		3		4	
Explanatory variables								
Scientific merit (MERIT)	8.0622	***	8.3965	***	8.4323	***	8.8308	***
	(1.1287)		(1.1701)		(1.1722)		(1.1958)	
Scientific status of the principal investigator(s) (H-INDEX)	0.0169		0.0169		0.0148		0.0170	
	(0.0181)		(0.0185)		(0.0194)		(0.1966)	
Suitability and integration with the regional context (SUITABILITY)	6. 3039	***	5.9800	***	6.0976	***	6.2701	***
	(0.9527)		(0.9907)		(1.000)		(0.9710)	
Percentage of males in the group of reviewers (GENDERGROUP) (b)	0.4408		0.6135		1.6783	**	1.8852	**
	(0.3781)		(0.4013)		(0.8860)		(0.8501)	
Number of times the same triad has reviewed projects before (TIMESGROUP) (c)	0.0235		0.0201		0.0819	***	0.0769	***
	(0.0193)		(0.0193)		(0.0285)		(0.0289)	
Number of times the triad has provided a positive evaluation in the past (ANGEL) (d)	4.9220	***	5.20852	***	5.9732	***	5.8574	***
	(0.3155)		(0.3647)		(0.4667)		(0.4621)	
Control variables								
Quota of funds requested on the total amount of funds provided by the Region that year (COST)			-0.0775		-0.0784		-0.0628	
			(0.0804)		(0.0851)		(0.0803)	
Project related to vegetable production (1 = yes, 0 = otherwise) (VEG)			-0.4441	**	-0.4763	**	-0.5364	**
			(0.2053)		(0.2136)		(0.2128)	
Number of projects granted previously to the proponent institution (SUCCESSBEF)			0.0023		0.0018		0.0046	**
			(0.0018)		(0.0018)		(0.0021)	
Project proposed by regional research centres acting as intermediary (1 = yes; 0 = otherwise) (IB)			0.2793		0.3286		0.2480	
			(0.2184)		(0.2214)		(0.2216)	
Percentage of principal investigators in a given proposal that are male (MALEPI) (a)			-0.1380		0.7141		0.8791	
			(0.2826)		(0.7045)		(0.6955)	
Interaction terms								
Interaction among (a) and (b)					-1.2466		-1.4473	
					(0.9765)		(0.9525)	

(continue table A3)

Interaction among (c) and (d)					-0.1251	**	-0.1170	**
Dummy for the change in the law					(0.0489)		(0.0491)	
Year that the change in regulation took place (1 = 2005, 2006; 0 = otherwise) (YEAR)							-0.6492	***
							(0.2420)	
Const	-12.3750	***	-12.3681	***	-13.5422	***	-13.9244	***
	(1.2177)		(1.2806)		(1.4312)		(1.4332)	
Observations:	871		868		868		868	
McFadden's Pseudo R2:	0.7889		0.7940		0.7969		0.8027	
Wald chi2(12):	271.80		240.93		235.41		244.53	
Prob > chi2:	0.0000		0.0000		0.0000		0.0000	
Multicollinearity condition number	18.72		24.7112		48.9361		49.746	

***, **,: statistically significant at 1% and 5% confidence level, respectively

Table A4. Results of the second stage: Regression estimates (robust Standard Errors)
(dependent variable: co-financing given to selected projects by the Region)

Variable	Estimates Subset Models						Estimates Full Model	
	1		2		3		4	
Explanatory variables								
Scientific merit (MERIT)	77525.10		95444.67	***	93722.26	***	99272.3	***
	(73215.73)		(25578.86)		(25556.3)		(25339.7)	
Scientific status of the principal investigator(s) (H-INDEX)	2886.21		119.797		44.52		153.421	
	(1497.94)		(558.31)		556.68		(557.396)	
Suitability and integration with the regional context (SUITABILITY)	395157.9	***	132840.9	***	134946.6	***	136482	***
	(74210.95)		(25062.52)		(24951.3)		(24350.8)	
Percentage of males in the group of reviewers (GENDERGROUP) (b)	-12594.60		8257.654		41252.6	**	36120.65	**
	(18245.26)		(8723.737)		(15919.1)		(14479)	
Control variables								
Quota of funds requested on the total amount of funds provided by the Region that year (COST)			115003.9	***	114530.6	***	113850.2	***
			(7198.85)		(7211.8)		(7137.19)	
Project related to vegetable production (1 = yes, 0 = otherwise) (VEG)			538.32		965.66		-350.43	
			(5455.4)		(5467.23)		(5430.80)	
Duration of the proposed projects (MONTHS)			178.65		200.04		205.91	
			(217.71)		(214.9)		(212.97)	
Total amount of funds that had been awarded to the proponent institution in the past (SUMBEF)			-0.0012	***	-0.0013	***	-0.0002	
			(0.0004)		(0.0004)		(0.0005)	
Project proposed by regional research centres acting as intermediary between science and practice (IB)			1804.80		2820.8		1124.40	
			(3529.5)		(3586.1)		(3626.2)	
Percentage of principal investigators in a given proposal that are male (a) (MALEPI)			-6640.67		16983.8		13766.3	
			(5791.9)		(11428.6)		(11103.7)	
Interaction terms								
Interaction among (a) and (b)					-40858.5	**	-35803.7	**
					(18256.0)		(16669.2)	

(continue table A4)								
Dummy for the change in the law								
Year that the change in regulation took place (1 = 2005, 2006; 0 = otherwise) (YEAR)							-25469.9	***
							(6343.7)	
lambda1	20333.82	*						
	(13436.53)							
lambda2			13082.2	***				
			(4962.8)					
lambda3					13493.6	***		
lambda4					(5180.4)		12770.7	**
							(5262.3)	
Const	-223038.2	**	-148334	***	-167107.8	***	-167188.9	***
	(87794.63)		(30474.3)		(31044.4)		(30284.2)	
Observations:	412		411		411		411	
McFadden's Pseudo R2:	0.0980		0.8552		0.8568		0.8621	
Multicollinearity condition number	35.5680		51.2176		55.7769		56.6188	

***, **: statistically significant at 1% and 5% confidence level, respectively

Figure 1 – ERR research proposal selection and funding process