The important thing is not to win but to participate:

The case of a competitive grant race benefiting scientists without awarding them

Charles Ayoubi
Chair in Economics and Management of Innovation - École Polytechnique Fédérale de Lausanne
charles.ayoubi@epfl.ch

Michele Pezzoni
Université Côte d'Azur, CNRS, GREDEG, France;
ICRIOS, Bocconi University, Milan, Italy;
BRICK, Collegio Carlo Alberto, Torino, Italy
michele.pezzoni@unice.fr

Fabiana Visentin
Chair in Economics and Management of Innovation - École Polytechnique Fédérale de Lausanne ;
BRICK, Collegio Carlo Alberto, Torino, Italy;
fabiana.visentin@epfl.ch

Preliminary Version – Please do not circulate without permission

Abstract

With the growing debate among scientists about the utility of the increasing time spent on securing funds for their research, inquiring about the value of participating in competing grant races has become a major concern within the scientific community. Scholars are mainly focused on the drawbacks associated with the fundraising activity and on the impact of receiving research funds, but the effect of being merely involved in a grant race and its potential benefits have often been overlooked. In this paper we analyze if researchers who decided to apply for a grant perform differently from the ones who did not. We rely on unique rich data on a Swiss funding program, SINERGIA, and find that simply being involved in an application has a positive effect on scientists' publication activity. Moreover, the time and effort spent in preparing the proposal seems to be an incentive to establish a co-authorship with co-applicants regardless of the results of the competition. Interestingly, we also find that the funding decision has no impact of the productivity of the researchers.

1. Introduction

In a period of increased selectivity of public grants, the scientific community is debating about the utility of spending energy and time in participating to grant competitions where there are few chances to get awarded. In this context, it is crucial to consider two relevant questions: First, *is the application process only costly for the scientists or do scientists benefit from applying regardless the final result of the competition?* Then, *does being awarded have an impact on the subsequent researcher's scientific production?* This paper aims to address these two questions exploiting unique data on a Swiss competitive grant.

In the debate of the scientific community on the opportunity to participate in competing grant races, recently, Ioannidis provocatively stated that "the research funding system is broken: researchers don't have time for science anymore. Because they are judged on the amount of money they bring to their institutions, writing, reviewing and administering grants absorb their efforts" (Ioannidis, 2011). Similarly, Stephan (1996) claimed that "grant applications divert scientists from spending time doing science" and reported an insightful example "a funded chemist in the U.S. can easily spend 300 hours per year writing proposals". She added that "while some of this effort undoubtedly generates knowledge, much of it is of a 'bean counting' nature and adds little of social value." (Stephan, 1996). In a New York Times article, Dr. Ness affirmed that scientists today are closer "to small-business owners, rather than people trying to satisfy their curiosity about how the world works" (The New York Times, April 6 2012).

These criticisms are based on the high costs that scientists sustain in applying for competitive grants that are considered as wasted costs if the competition turns out to be unsuccessful. However, what if scientists also find some benefit in simply being part of a funding competition process. Highly competitive grants require an extensive commitment in the submission phase. Scientists are asked to spend time in elaborating an appealing research idea and in accurately planning its execution to persuade the evaluators that they will fulfill the promised deliverables. In this paper, we ask if these incurred efforts have a return regardless of the competition results. Specifically, we compare two groups of scientists with the same characteristics differing only in the decision to participate or not to a grant competition. Using a Differences-in-Differences approach, we analyze if scientists who decided to apply perform differently from others.

For our analysis, we use a novel dataset of 255 grant applications to a Swiss funding program called SINERGIA. The dataset includes 775 scientists in Engineering and Science & Medicine who applied in the period 2008-2012. For those scientists, we collected information about their grant applications (number of co-applicants involved, discipline, amount requested, score assigned by the grant selection committee and final decision about the funding assignment), their biographical characteristics (gender, age and nationality) as well as their publication records. From the publications, we extracted information about the scientists' productivity and co-authorships. Then, within the population of all the publishing scientists affiliated to one of the twelve major Swiss universities, we selected the scientists with observable characteristics as close as possible to the applicants in our sample.

We find that when applying for a SINERGIA grant, regardless of the result of the application, scientists increase their productivity in term of number of publications but decrease the average quality of their publications. SINERGIA is a grant program sponsoring team collaboration and researchers are asked to submit a common project to access funds. Given the nature of the grant analyzed, we looked at the probability that a researcher finalizes a co-authorship with her co-applicants. We observe that applying for a SINERGIA grant stimulates researchers to foster their collaboration with co-applicants.

If on one side scientists question about the utility of participating in a competitive grant competition, on the other side, there is a rising attention of national funding agencies in distributing efficiently their budgets that is mainly driven by the growing desire of governments to control public money spending. For instance, since the early nineties, the U.S. government is asking funding agencies to report the outcomes of the projects publicly supported. The U.S. Government Performance and Results Act of 1993 clearly states that "the Director of the Office of Management and Budget shall require each agency to prepare an annual performance plan covering each program activity set forth in the budget of such agency. Such plan shall – […] establish performance goals to define the level of performance to be achieved by a program activity; […] establish performance indicators to be used in measuring or assessing the relevant outputs, service levels, and outcomes of each program activity" (sec. 2803). As an example of an action taken to respond to such government regulatory interventions, one of the largest American evaluation programs assessing the impact of public investment in research, STAR METRICS, was launched to provide taxpayers with precise information on the value of their investments (Lane, 2010).

Despite a growing demand for a comprehensive evaluation of publicly supported scientific research, extant studies do not provide convergent findings on the effect of receiving funds on researchers' scientific outcomes. Scholars find a general positive impact of being awarded but do not agree on the quantification of the productivity gains. For instance, Gush et al. find that funding is associated with a 3 to 5% increase in annual scientific publications and a 5 to 8% increase in citations-weighted papers (Gush et al., 2015). Jacob and Lefgren (2011) find an increase of 7% on recipients' productivity over 5 years after the grant awarded. Azoulay et al. (2015) find that 10 million U.S. dollars of NIH funding generate 2.3 patents.

Having accessed the effects of applying for a grant, our paper aims to bring new insights into this debate by focusing on the subsample of applicants and considering the effect of being awarded a grant. Some scientists who submit a common grant application continue to work together even if their application is not successful, however receiving the funds represent a relevant incentive to realize the potential collaborations claimed in the application phase. As one would expect, we find that the probability of co-authoring with at least one other scientist listed in the common application is higher within awarded teams. However, being awarded has no impact on the scientists' productivity in terms of quantity or quality of their publications.

The rest of this paper is organized as follows: Section 2 presents an overview of the existing literature, Section 3 describes the empirical context, Section 4 discusses the main variables and the empirical method, Section 5 presents the empirical findings, and Section 6 concludes.

2. Overview of the existing literature

As stated by Stephan (2010), since scientific research has the properties of a public good that would be underfinanced without public intervention, the public authorities have developed several approaches to overcome this issue and secure funding for the scientific community. In an overview of the funding environment in the United States as well as in some other developed countries, Stephan points out the difficulty in selecting the scientists who could make the best use of the public funds. Funding agencies are thus concerned with the best allocation and use of the funds distributed. In this context, there is an increasing need for studies targeting to evaluate the efficiency of the funding scheme in place (Jaffe, 2002).

The economics literature on the impact of public funding on scientific outcomes is mainly empirical, focusing primarily on the impact of funding on the quantitative and qualitative productivity of researchers measured respectively by the number of publications produced and the number of citations received by researchers. In a comprehensive review, Jaffe (2002) identified the main technical difficulties encountered when attempting to evaluate such a funding policy. First, there might be information availability issues since it is often hard to have detailed information about the full population of scientists potentially applying for public funding. Second, even with the accessibility to such data, a bias remains concerning the evaluation of the net impact of the funds since the naturally most productive scientists are probably also the ones having a higher probability to be funded. Third, it is not easy to choose the evaluation measures since the benefits of well-funded scientific research goes beyond the mere number of the publications and the citations received. The benefits are also very high in terms of spillovers and learning but these aspects are usually quite hard to measure.

Because of the arduousness of overcoming the mentioned technical difficulties, studies are sparse and not convergent. In a leading paper, Arora & Gambardella (2005) use United States data to evaluate the impact of receiving a National Science Foundation (NSF) grant on the productivity outcomes of researchers in economics. Using data on successful and unsuccessful applicants to a NSF grant between 1985 and 1990 they find a positive impact of being funded on young applicants but not on senior ones. More recently, Jacob & Legfren (2011), use twenty years of National Institute of Health (NIH) data on successful and unsuccessful applicants and find a very limited impact of funding on the number of publications produced by researchers even suggesting no selection bias between awarded and non-awarded scientists since OLS, IV and differences-in-differences -using propensity score matching- approaches all yield very similar results.

A recent paper by Gush et al. (2016), evaluates the impact of funding on three potential outcomes, namely quantitative productivity (number of publications), qualitative productivity (number of citations received by the publications) and the career outcomes (probability of staying in academia and subsequent contracts) of the funded researchers compared to researchers participating in a grant process and receiving the funds. The main results of the paper are a modest effect of being funded on the quantitative productivity (6 to 15% increases in the number of publications) and a stronger one on qualitative productivity (11 to 22% increases in the number of citations) but no clear impact on the career outcome.

Azoulay et al. (2013) point out the fact that receiving funds is not only about having more money to run the research; it is also a signal to peers and to other funding sources of the quality of the researcher. This signaling effect is shown to be much stronger for scientists with limited visibility beforehand than for well-established researchers. It is therefore interesting to note that, when evaluating the impact of funding, the results obtained capture both a signaling effect and a more direct effect linked to the greater amount of funds to run research.

When a project is funded, the quantity and the quality of the research produced are usually desired outcomes but seeding for further project through enhanced collaborations and learning among the members of a research project could also be desired. As shown by Lee & Bozeman (2005) in a study based on academics in research centers in the United States, projects that are funded by grants are correlated with a greater number of collaborations and greater quantitative productivity. More recently, Carayol and Lanoe (2013), also find that receiving extra funds for research stimulates the co-authorship networks of the awarded scientists especially on an international level. To run their analysis, they construct a control sample of scientists matched with the awarded ones using a propensity score matching approach. They also find that in some particular fields the awarded scientists extend their fields of knowledge further than the non-awarded ones.

The literature evaluating research funding programs focuses on the effect of being awarded a grant. This literature intends to answer the concern about the efficiency of funding programs by comparing awarded scientists and non-awarded ones in various scientific outcomes. However, since the process of applying for a grant is demanding and time consuming, taking part in a grant race could by itself have a significant impact on the outcomes of scientists. The resulting effect of receiving a grant hence includes both the effect of the application process efforts and the benefit of the monetary reward. To disentangle these two effects, in this paper, we first compare applicants to non-applicants then, in the subpopulation of applicants, we compare awarded to non-awarded scientists[1].

To our knowledge, extant studies do not include an analysis of the application process and its potential effects. We therefore complement the existing literature by investigating the impact of applying for a grant on the subsequent scientific outcomes of the scientists. In the two steps of our analysis, we evaluate the scientific outcomes along three dimensions: number of paper produced (quantitative productivity), number of citations received (qualitative productivity) and the probability of co-authoring with a co-applicant (success of collaboration).

3. Context and empirical setting

The Swiss National Science Foundation (SNSF) is the main national funding agency in Switzerland. It plays in the country the same role of the National Science Foundation (NSF) in the United States or the European Research Council in Europe. The SNSF supports researchers' activities and their careers and SINERGIA program is one of the flagship programs in its portfolio. It was launched in 2008 and designed to promote team collaboration. As mentioned in the application guidelines, scientists are required to collaborate as a condition for securing research funding, i.e., scientists need to submit a proposal for a "research work carried out collaboratively" (SNSF, 2011).

In most cases, a SINERGIA project involves four or five scientists led by a main proponent coordinating the overall project. All disciplines are eligible for funding through the program. Applicants propose interdisciplinary projects or projects where co-applicants belong to the same field, but are specialized in different sub-fields. The criteria considered in evaluating the application are the value added by the joint research approach, the research complementarities of the applying groups, and the coherence of the projected collaboration. Applications are screened in a two-step evaluation process. In the first step, external reviewers assign a provisional score to each application. In the second step, an internal committee of the SNSF, the Specialized Committee for Interdisciplinary Research, based in Bern, assigns a final

[1] In the main text we limit our analysis to evaluating the global effect of being awarded on a scientist's outcomes. For a further analysis of the marginal effect of funds received see Section A of the Supplementary Material.

score to each application using an alphabetical scale, where A is the highest score, and D the lowest. Applications are ranked and funds are assigned until the annual budget quota is reached.

This study relies on *all* grant applications submitted to the SNSF in the period 2008-2012. The SNSF provided us with grant application data, including the final scores assigned and final funding decisions and basic demographic information on the applicants (gender, nationality and birth year). We complemented this information with applicants' publication records using the Elsevier's Scopus database. To perform our analysis, we selected applications in Engineering, Science and Medicine[2]. Our final sample is represented by 255 grant applications, including 775 distinct applicants. Table 1 reports the key figures describing the applications and Table 2 reports the applicants' characteristics.

Table 1: Key figures for the applications characteristics (Number of applications=255).

	Mean	***Std. Dev.***	***Min***	***Max***
N. of co-applicants	4.19	1.59	2	11
Swiss team	0.13	0.33	0	1
Extant co-applicant collaboration	0.37	0.34	0	1
N. of disciplines	3.30	2.16	1	11
Engineering	0.36	0.48	0	1
Science & Medicine	0.64	0.48	0	1
Awarded	0.45	0.50	0	1
Grade A	0.09	0.28	0	1
Grade D	0.15	0.36	0	1
Amount requested (in million CHF)	1.67	0.76	0.35	6.85

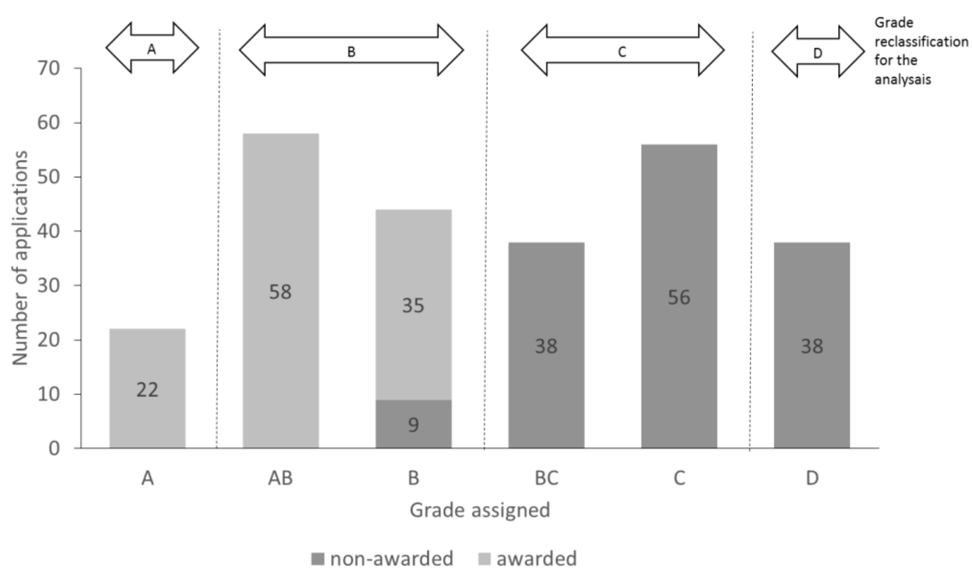
Table 2: Key figures for the applicants' characteristics (Number of applicants=775).

	Mean	***Std. Dev.***	***Min***	***Max***
Age	47.46	8.05	30	69
Female	0.16	0.36	0	1
Publication count pre-application	31.31	27.30	1	225
Team size pre-application	5.13	1.54	1	10.4
Average citations per paper received pre-application	2.51	2.18	0.04	27.55

[2] In this study, we excluded from the original sample applications in the Humanities and Social Sciences because book contributions represent a large part of the field publication outcomes and are not collected with accuracy in the Elsevier's Scopus database. Applications in the Humanities and Social Sciences represent 19% of the total sample.

The representative applicants' project team in our sample is a small one. A team is composed, on average, by 4 members, with a minimum of 2 and maximum of 11 members. Considering the team composition, about 13% of the teams have only Swiss members, while the others are multi-national teams. When we look at previous collaborations among applicants at the time of application, we observed that in 37% of the cases, there was at least one co-authorship relation among team members. When classified by discipline, 36% of the applications are in Engineering, whereas the rest are in Science & Medicine. Within the two broad disciplines, each application is classified into sub-disciplines. An application counts, on average, 3.30 sub-disciplines; only 20% of the applications involves only one discipline, while the most diversified application involves 11 disciplines. A SINERGIA grant covers personnel costs, research costs, coordination costs and, to a limited extent, investment costs. The average amount requested per application is 1.67 million of CHF, with a minimum of 0.35 million CHF and a maximum of 6.85 million CHF. Figure 1 represents the distribution of the number of grant applications by score assigned and the final funding decision. A total of 9% of the applications obtained the maximum score, A, and 45% of the applications were awarded.

Figure 1: Distribution of the number of grant applications by score assigned and final funding decision.



The SINERGIA funding program targets established researchers. In most cases, applicants are associate or full professors with good publication records. They should demonstrate their ability to conduct excellent quality independent research. The average age of an applicant is 47 years, with a minimum of 30 and a maximum of 69 years old. The average number of applicants' publications is 31[3]. An average applicant has received 2.51 citations per paper at the application time. When we look at the gender distribution, 16% of applicants in our sample are female.

Moreover, to identify the effect of applying for a grant we needed to construct a control sample of researchers who could be potential applicants to the SINERGIA grant but did not apply. To do so, we retrieve a group of potential applicant scientists with a profile similar to the one of the applicants in our sample that would have been eligible to apply but did not apply for a SINERGIA grant. We collected information about more than 38,000 authors affiliated to the twelve major Swiss institutions[4] who are active in the period 2008-2012. Our control sample is then composed of 735 distinct controls for our 775 applicants. The number of matched controls is lower than the number of applicants because one control can be assigned to more than one applicant. The search method adopted is detailed in the next section.

4. Methodology

In order to estimate both the effects of applying for a grant and receiving the funds we rely on a difference-in-differences (DD) approach where we compare the changes in scientists' outcomes between before and after applying. The identifying assumption is that scientists' outcome trends would be the same in absence of the treatment represented by applying to the grant programme or receiving the funds[5].

We measure a scientist's outcome along three dimensions. The first two dimensions examined are the publication quantity and quality. We measure the publication quantity counting the papers published by a scientist in the five-year window after the SINERGIA application year (*Publication Count*). We measure the publication quality as the average number of citations

[3] We consider publication records from 2003 to the year of application.

[4] University of Neuchatel, ETH, EPFL, University of Lausanne, University of Fribourg, University of Genève, University of Bern, University of Basel, University of Lugano, University of Zurich, University of Lucerne, University of St. Gallen.

[5] In the section B of the supplementary material we present a set of robustness check that propose alternative estimation methods in evaluating the impact of applying to a grant and being awarded a grant, respectively. Our main results remain stable across the different econometric exercises.

received by scientist's papers published in the five-year window after the application year (*Average citations per paper*). The SINERGIA grant peculiarities allow us to go beyond the standard bibliometric outcomes such as *Publication Count* and *Average citations per paper*. SINERGIA grant program is designed to incentivize inter-institutional collaborations among researchers, a dimension of the researcher's scientific activity that is hardly captured by standard bibliometric indices. To measure successful scientific collaborations as a scientist's outcome, we consider the work relationship consolidated with her SINERGIA co-applicants through a co-authorship. Specifically, we measure a successful collaboration as a dummy that equals one if a scientist co-authors at least one paper with her co-applicants in the five-year window after the application year (*Co-applicant collaboration realized*) and equals zero if she does not. We use these variables to compute differences-in-differences (DD) estimates of the effect of applying for a SINERGIA grant.

To formally evaluate whether applying has an effect on the subsequent scientist's outcomes, we estimate an Ordinary Least Squares (OLS) model for the following equation:

$$Researcher's\ outcome_{it}=\beta_0+\beta_1 Applying_i + \beta_2 PostApplication_{it} + \beta_3(Applying_i * PostApplication_{it}) + \beta_4(N.\ of\ co\text{-}applicants_i)+\varepsilon_{it}$$

(Equation 1)

where i and t refer to the scientist i evaluated at time t. We observe the scientist in two periods, before her application ($t=0$) and after her application ($t=1$). To estimate the variation in the scientist's outcomes for non-applicants, we use for each control the application year of her matched applicant as a reference.

$Applying_i$ is a dummy that equals 1 if scientist i is an applicant to SINERGIA and equals 0 otherwise. $PostApplication_{it}$ is a time dummy that takes a value of 0 if the scientist i's outcomes are observed before her application ($t=0$), and a value of 1 if the scientist's outcomes are observed after ($t=1$). The interaction term $Applying_i * PostApplication_{it}$ marks a scientist i who experienced the application and whose outcomes are observed after the application time. We also control for the size of the team of scientist *i* with the variable (*N. of co-applicants*$_i$)[6]. Finally, we add *Application year* fixed effects and the applicant's *Affiliation* fixed effects.

Searching for a group of potential applicants: The construction of the control group

We find a matched control, i.e. a potential applicant, for each of the applicants in our sample. To identify a potential applicant, i.e. a scientist marked with the dummy *Applying* equals to zero, we proceed in two steps. First, we define a large pool of scientists eligible to apply for SINERGIA. Second, we extract from the pool the scientists who match the profiles of the applicants in our sample.

We consider as eligible scientists all the publishing scientists affiliated to one of the twelve major Swiss universities. From all the publications of the scientists affiliated to those universities in the period 2003-2015, we retrieve more than 38,000 authors who are active in the period 2008-2012. We exclude the 775 researchers appearing as SINERGIA applicants in our records and the remaining authors represent the pool of potential applicants to be matched with the 775 actual applicants.

To extract from the initial pool of scientists the most appropriate control for each applicant we apply sequentially a series of four filters. First, we exclude all the matches between the applicant and her coauthors[7]. Second, we calculate the share of journals where both the applicant and her control have published. We exclude those controls for which the share of journals in common with the applicant is lower than 10%. In doing so, we identify the controls who are active in the same research field of the focal individual. Third, we select the control with the closest number of publications to the applicant at the submission time. If more than one control has the same number of publications as the applicant, we select the control with the closest average number of citations per article. We end up with 735 distinct controls for our 775 applicants. The number of matched controls is lower than the number of applicants because one control can be assigned to more than one applicant.

[6] Non-applicants are associated with teammates mirroring the teammates of the corresponding applicant. In other terms, if the scientist *i* is the non-applicant matching the applicant scientist *j* we associate to *i* the controls of the *j*'s teammates. Hence if scientist *i* has four co-applicants for instance, *j* too would have four co-applicants.

[7] Removing co-authors insures that the scientific outcomes are not indirectly affected by the ones of the matched applicant.

After having evaluated the impact of applying, we focus our attention on the subsample of applicant scientists and we consider the effect of being awarded by estimating the following equation:

$$Researcher's\ outcome_{it} = \beta_0 + \beta_1 Awarded_i + \beta_2 PostApplication_{it} + \beta_3 (Awarded_i * PostApplication_{it}) + \beta_4 Researcher's\ Characteristics_i + \beta_4 Application\ Characteristics_i + \varepsilon_{it}$$

(Equation 2)

where *i* and *t* refer to the scientist *i* evaluated at time *t.* We observe the scientist in two periods, before the application (*t=0*) and after the application (*t=1*).

$Awarded_i$ is a dummy that equals 1 if scientist *i* was awarded a SINERGIA grant and equals 0 otherwise. $PostApplication_{it}$ is a time dummy that takes a value of 0 if the scientist *i*'s outcomes are observed before the application (*t=0*), and a value of 1 if the scientist's outcomes are observed after (*t=1*). The interaction term $Awarded_i * PostApplication_{it}$ marks a scientist *i* who was awarded a grant and whose outcomes are observed after the application time.

The scientist's characteristics included in the regression model are her age at the year of application (*Age*) and gender, defined as a dummy that equals one if the researcher is a female and zero otherwise (*Female*). The application characteristics include controls for the quality of the application, namely a dummy variable that is equal to one if the application obtained the highest grade assigned by the selection committee (*Grade A*) and a dummy that is equal to one if the application obtained the lowest grade (*Grade D*). We add a dummy that equals one if all the applicants are Swiss (*Swiss team*), a dummy that equals one if there is at least one female researcher among the co-applicants (*At least one female researcher in the team*), the *Amount requested* in CHF, the number of co-applicants listed in the application document (*N. of co-applicants*), the number of disciplines listed in the application (*N. of disciplines*), a dummy that equals one if the application is in the domain of Science and Medicine and zero if the application is in the domain of Engineering (*Science and Medicine*), and the average distance in terms of travel time between the researcher's affiliation and the co-applicants' affiliations

(*Distance hours*). Finally, we control for *Application year* fixed effects and applicant's *Affiliation* fixed effects.

Table 3 shows the summary statistics for the scientists' outcomes analyzed and the control variables. The statistics are reported by scientists' group, namely applicants versus non-applicants and awarded versus non-awarded.

Table 3: Descriptive statistics for the researchers' outcomes analyzed and the controls included into the regressions.

Variable	**Awarded (469)**	**Non Awarded (591)**	**Applicant (1060)**	**Non-Applicant (1060)**
Researcher's outcomes				
Publication count pre-application	30.22	34.34	32.52	30.06
Average citations per paper pre-application	4.61	4.02	4.28	4.36
Co-applicant collaboration pre-application	0.36	0.42	0.39	0.05
Publication count post-application	36.28	38.64	37.60	30.60
Average citations per paper post-application	2.82	2.36	2.56	3.76
Co-applicant collaboration post-application	0.71	0.61	0.66	0.04
Controls included into the regressions				
Applicant characteristics				
Age	47.28	47.85	47.59	-
Female	0.13	0.16	0.15	-
Application characteristics				
Awarded	1.00	0.00	0.44	-
Grade A	0.18	0.00	0.08	-
Grade D	0.00	0.28	0.15	-
Swiss team	0.12	0.09	0.11	-
At least one female researcher	0.37	0.43	0.40	-
Amount Requested in Million CHF	1.86	1.71	1.77	-
N. of co-applicants	4.77	4.80	4.79	-
N. of disciplines	3.11	3.66	3.42	-
Science & Medicine	0.59	0.61	0.60	0.60
Distance hours	4.48	4.24	4.35	-

5. Results

Table 4 considers the impact of applying for a SINERGIA grant. Columns 1 to 3 report the results for the estimation of Equation 1 where the researcher's outcome are the publication count (in logarithm terms), *Log(Publication Count),* the average number of citations received per paper (in logarithm terms), *Log(Average citations per paper),* and the dummy Co-applicants' collaboration realized (*Co-applicant collaboration realized*).

By observing the scientists after the application time, we see that scientists who applied to a SINERGIA grant are more productive in quantitative terms than scientists who did not apply. However, applicants' papers receive, on average, less citations than non-applicants' one. Applicants have a higher probability to establish a co-authorship with their co-applicants than non-applicants. Regarding the controls, being part of a larger team increases the chance of observing a co-authorship among co-applicants.

Table 4. Regression results for the estimation of Equation 1. We compare applicants vs. non-applicants to the SINERGIA grant.

VARIABLES	(1) *OLS Estimation* Log(Publication Count)	(2) *OLS Estimation* Log(Average citations per paper)	(3) *Probit Estimation* Co-applicant collaboration realized (=1)
Applicant*Post application	0.41***	-0.31***	0.23***
	(0.031)	(0.025)	(0.029)
Applicant	-0.32***	0.20***	0.17***
	(0.037)	(0.043)	(0.046)
Post application	-0.23***	-0.18***	-0.037
	(0.025)	(0.024)	(0.024)
Log(N. of co-applicants)	-0.0079	-0.16**	0.21***
	(0.086)	(0.075)	(0.041)
Constant	3.48***	1.48***	-
	(0.16)	(0.15)	
Observations	4,240	4,240	4,240
R-squared	0.062	0.136	0.32
Dummy Application year	yes	yes	yes
Dummy Affiliation	yes	yes	yes

Robust standard errors in parentheses; marginal effects reported for the Probit estimation in column 3
*** p<0.01, ** p<0.05, * * p<0.1

Table 5 presents the results of the estimation comparing awarded versus non-awarded scientists, namely the estimations of the model reported in Equation 2. On average, awarded scientists do not perform better than non-awarded ones in terms of quantity and quality of their scientific production, but they have a greater chance to establish a co-authorship with their co-applicants. Specifically, an awarded scientist has 18% more chances to establish a co-authorship with her co-applicants. Considering the control variables, the application characteristics do not affect significantly the scientist's outcomes with few exceptions. Specifically, a scientist who is part of an application project obtaining the highest score (*Grade A*) has a 14% productivity gain in terms of publication than the other scientists and her work receives 37% more citations. Moreover, we find that the amount requested (*Log(Amount Requested)*) –which partly accounts for the size of the project- has a positive and significant effect on the average number of citations received per paper and a slightly negative effect of the probability of establishing a co-authorship with a co-applicant. On the contrary, we surprisingly find that the number of co-applicants - another proxy of the size of the project- raises the chance to establish a co-authorship with co-applicants and has no significant effect on the quantitative and qualitative productivity. A scientist in *Science & Medicine* is on average less productive in terms of number of publications, but her publications receive more citations. Finally, we find that a greater geographical distance among the co-applicants has a positive effect on the average number of citations received per paper. This last result is possibly due to the greater geographical dispersion of authors inducing a higher visibility internationally and thus more citations received.

When we examine the applicant's characteristics, we observe that older researchers publish a greater number of papers, receive fewer citations and are less likely to establish a co-authorship relationship with her teammates. Additionally, female researchers are less productive than their male colleagues.

Table 5. Regression results for the estimation of Equation 2. We compare awarded vs. non-awarded scientists.

	(1) *OLS Estimation* Log(Publication Count)	(2) *OLS Estimation* Log(Average citations per paper)	(3) *Probit Estimation* Co-applicant collaboration realized (=1)
Awarded*Post application	0.034	0.086	0.18***
	(0.043)	(0.053)	(0.044)
Post application	0.16***	-0.53***	0.20***
	(0.029)	(0.036)	(0.028)
Awarded	-0.16*	-0.037	-0.23***
	(0.083)	(0.11)	(0.072)
Grade A	0.14*	0.37***	0.047
	(0.081)	(0.073)	(0.071)
Grade D	-0.10	-0.058	-0.032
	(0.084)	(0.11)	(0.061)
Age	0.025***	-0.0089***	-0.0033*
	(0.0029)	(0.0026)	(0.0019)
Female	-0.24***	0.039	-0.014
	(0.052)	(0.057)	(0.039)
Swiss team	-0.066	0.046	-0.012
	(0.090)	(0.070)	(0.067)
At least one female researcher	-0.051	0.017	0.021
	(0.050)	(0.053)	(0.034)
Log(Amount Requested)	0.027	0.15*	-0.094*
	(0.075)	(0.085)	(0.049)
Log(N. of co-applicants)	-0.0030	-0.031	0.30***
	(0.085)	(0.10)	(0.068)
Log(N. of disciplines)	-0.011	0.031	-0.020
	(0.046)	(0.054)	(0.027)
Science & Medicine	-0.14**	0.54***	-0.061
	(0.059)	(0.066)	(0.049)
Log(1+Distance hours)	0.037	0.085**	-0.020
	(0.032)	(0.041)	(0.025)
Constant	1.75*	-0.54	-
	(1.02)	(1.17)	
Observations	2,120	2,120	2,120
R-squared	0.144	0.285	
Dummy Application year	yes	yes	yes
Dummy Affiliation	yes	yes	yes

Robust standard errors in parentheses; Marginal effects reported for the Probit estimation in column 3
*** p<0.01, ** p<0.05, * * p<0.1

Robustness checks

A possible concern is that in comparing applicant versus non-applicant scientists, the heterogeneity of the former category might bias our results. Specifically, applicant scientists include awarded and non-awarded scientists that might behave in a different way. Table 6 reports a robustness check where we include as controls the variable *Awarded* and the interaction term *Awarded*Post application*. The new results are consistent with the results reported in Table 4, in particular applicants, regardless the funding decision, appear to be more productive in terms of number of paper published and having a greater probability to establish co-authorship with their co-applicants. Applicants' papers tend to receive fewer citations.

Table 6. Regression results for the estimation of Equation 1. We compare applicants vs. non-applicants to the SINERGIA grant. We include a control for the applicants who are awarded.

	(1) *OLS Estimation* Log(Publication Count)	(2) *OLS Estimation* Log(Average citations per paper)	(3) *Probit Estimation* Co-applicant collaboration realized (=1)
Applicant*Post application	0.39***	-0.35***	0.18***
	(0.037)	(0.034)	(0.032)
Awarded*Post application	0.034	0.086	0.12***
	(0.042)	(0.053)	(0.032)
Applicant	-0.27***	0.18***	0.23***
	(0.057)	(0.063)	(0.052)
Awarded	-0.12	0.047	-0.13***
	(0.084)	(0.11)	(0.039)
Post application	-0.23***	-0.18***	-0.037
	(0.025)	(0.024)	(0.024)
Log(N. of co-applicants)	-0.0085	-0.15**	0.21***
	(0.085)	(0.074)	(0.042)
Constant	3.48***	1.48***	-
	(0.15)	(0.15)	
Observations	4,240	4,240	4,240
R-squared	0.063	0.142	0.33
Dummy application year	yes	yes	yes
Dummy Affiliation	yes	yes	yes

Robust standard errors in parentheses; Marginal effects reported for the Probit estimation in column 3
*** p<0.01, ** p<0.05, * * p<0.1

To estimate the effect of applying, we identify a control sample of potential applicants matching the characteristics of the applicants in our sample. In the matching we follow a series of criteria described into details in the section *Searching for a group of potential applicants: The construction of the control group*. Table 4 reports the results of our estimation where the main matching criterion in searching a control for an applicant is having a high share of journals where both the applicant and her control have published. To verify the robustness of our results, regardless the matching criteria used, we extract a second sample of controls where the main criterion in searching is having the closest number of publications to the applicant at the submission time. Table 7 reports the basic statistics describing the sample. Table 8 reports the results of the estimation of Equation 1 using this second sample of controls. The results are in line with the ones reported in Table 4 confirming the robustness of the initial approach and showing that the matching criteria chosen for the control sample extraction is independent of the final results.

Table 7. Descriptive statistics for the control sample extracted by using the number of publications as main matching criterion in the selection of the controls.

Variable	**Applicant (1060)**	**Non-Applicant (1060)**
Researcher's outcomes		
Publication count pre-application	32.52	32.07
Average citations per paper pre-application	4.28	4.09
Co-applicant collaboration pre-application	0.39	0.02
Publication count post-application	37.60	31.60
Average citations per paper post-application	2.56	3.51
Co-applicant collaboration post-application	0.66	0.01
Controls included into the regressions		
Applicant characteristics		
Age	47.59	-
Female	0.15	-
Application characteristics		
Awarded	0.44	-
Grade A	0.08	-
Grade D	0.15	-
Swiss team	0.11	-
At least one female researcher	0.40	-
Amount Requested in Million CHF	1.77	-
N. of co-applicants	4.79	-
N. of disciplines	3.42	-
Science & Medicine	0.60	0.60
Distance hours	4.35	-

Table 8. Regression results for the estimation of Equation 1. We compare applicants to non-applicants. The control sample has been extracted by using the number of publications as main matching criterion in the selection of the controls.

	(1)	(2)	(3)
	OLS Estimation	*OLS Estimation*	*Probit Estimation*
	Log(Publication Count)	Log(Average citations per paper)	Co-applicant collaboration realized (=1)
Applicant*Post application	0.46***	-0.36***	0.18***
	(0.041)	(0.032)	(0.041)
Awarded*Post application	0.034	0.086	0.089***
	(0.042)	(0.053)	(0.024)
Applicant	-0.38***	0.28***	0.22***
	(0.060)	(0.055)	(0.066)
Awarded	-0.12	0.037	-0.094***
	(0.083)	(0.11)	(0.027)
Post application	-0.30***	-0.17***	-0.077*
	(0.029)	(0.027)	(0.042)
log(N. of co-applicants)	-0.014	-0.14*	0.14***
	(0.083)	(0.077)	(0.025)
Constant	3.64***	1.33***	-
	(0.15)	(0.15)	
Observations	4,240	4,240	4,240
R-squared	0.062	0.118	
Dummy Application year	yes	yes	yes
Dummy Affiliation	yes	yes	yes

Robust standard errors in parentheses; Marginal effects reported for the Probit estimation in column 3
*** p<0.01, ** p<0.05, * * p<0.1

6. Discussion and conclusion

In a period of increased selectivity of public grants, scientists have raising concerns about the utility of spending energy and time in participating to grant competitions where there are few chances to get awarded. In this paper, we analyze if scientists who decide to apply for a grant, and put the effort necessary to do so, perform differently from the ones who did not.

Interestingly, we find that participating in a competitive grant selection per se has a positive effect on the scientist's number of publications, and the probability of collaborating with co-applicants. Surprisingly, applicants receive on average fewer citations per paper than non-applicants.

Highly competitive grant selection processes require a lot of commitment in preparing the applications. Scientists invest time and effort in interacting with their co-applicants developing new ideas and establishing the seeds for long lasting collaborations, regardless the result of the competition. These positive externalities lead us to claim that the important thing is not to win; it's to participate in the sense that there is a significant added value of putting the effort needed for applying to a SINERGIA grant. However, we observe as a drawback the reduction in the average number of citations that applicants' papers received. This result could be driven by the fact that, in applying to multi-disciplinary projects like SINERGIA, scientists are asked to enter in new fields where reputation requires time to be established. In other terms, applicants to a SINERGIA grant usually being the scientists most inclined to explore new fields of research, they need more time to build visibility and recognition for their innovative scientific production which limits the number of citations they receive. Hence we are probably not capturing all the potential long term impact of the research produced with the constrained short window we are considering in our study (5 years). Further research in that direction is needed to precisely identify the underlying reasons of this decrease in the number of citation received when applying for a grant.

This studies aims at opening the way to better consideration of the application effect on scientific outcomes and future studies could further investigate the mechanisms that lead applicants and non-applicants to perform in a different way.

Having assessed the value of applying to a competitive grant for scientists, we consider the impact of the funding decision for applicants. Doing so, we contribute to the controversial literature on the effect of receiving funds on researchers' scientific outcomes. We find that being awarded has no effect on the scientific productivity of grant recipients, neither in terms of quantity nor in terms of quality of papers produced. However co-applicants who are part of an awarded project have greater chance to co-author with each other than co-applicants who are part of a non-awarded project. In other words, financial resources have no impact on the individual productivity but provide an incentive to consolidate the collaboration started in the application phase. These results might be explained by the fact that scientists are not strictly dependent on the resources of a specific grant, like the SINERGIA one. Scientists might access to alternative financial resources to sponsor their research, however if a grant is released, scientists are incentivized to finalize the collaborations planned when they submitted their projects.

References

Arora, A., David, P.A., Gambardella, A., 2000. Reputation and competence in publicly funded science: estimating the effects on research group productivity, in: The Economics and Econometrics of Innovation. Springer, pp. 141–176.

Arora, A., Gambardella, A., 2005. The impact of NSF support for basic research in economics. Annales d'Economie et de Statistique 91–117.

Ayoubi, C., Pezzoni, M., & Visentin, F. (2017). At the Origins of Learning: Absorbing Knowledge Flows from Within or Outside the Team? Journal of Economic Behavior & Organization**.** Volume 134, February 2017, Pages 374–387

Azoulay, P., Zivin, J.S.G., Li, D., Sampat, B.N., 2015. Public R&D investments and private-sector patenting: evidence from NIH funding rules. National Bureau of Economic Research.

Carayol, N., and M. Lanoe. 2013. "The Impact of Blue Skye Project Based Funding of Academic Research." *mimeo*. Université Bordeaux IV

Defazio, D., Lockett, A., Wright, M., 2009. Funding incentives, collaborative dynamics and scientific productivity: Evidence from the EU framework program. Research Policy 38, 293–305. doi:10.1016/j.respol.2008.11.008

Graves, N., Barnett, A.G., Clarke, P., 2011. Funding grant proposals for scientific research: retrospective analysis of scores by members of grant review panel. BMJ 343, d4797–d4797. doi:10.1136/bmj.d4797

Gush, J., Jaffe, A.B., Larsen, V., Laws, A., 2015. The Effect of Public Funding on Research Output: the New Zealand Marsden Fund (Working Paper No. 21652). National Bureau of Economic Research.

Ioannidis, J.P., 2011. More time for research: fund people not projects. Nature 477, 529–531.

Jacob, B.A., Lefgren, L., 2011. The impact of research grant funding on scientific productivity. Journal of Public Economics 95, 1168–1177. doi:10.1016/j.jpubeco.2011.05.005

Jaffe, A.B., 2002. Building programme evaluation into the design of public research-support programmes. Oxford Review of Economic Policy 18, 22–34.

Lane, J., Bertuzzi, S., 2011. Measuring the Results of Science Investments. Science 331, 678–680. doi:10.1126/science.1201865

Lee, S., Bozeman, B., 2005. The Impact of Research Collaboration on Scientific Productivity. Social Studies of Science 35, 673–702. doi:10.1177/0306312705052359

Stephan, P., 2010. The Economics of Science: Funding for Research, ICER Working Paper 12/2010.

Supplementary Material

Section A - The impact of the amount awarded

In the main text, we evaluate the effect of being awarded a grant, regardless the amount received. This section of the Supplementary Material aims to go further in the analysis by assessing the impact of the amount awarded (*Amount Awarded*) to each applicant with respect to her scientific outcomes. Following the main analysis we are considering three scientific outcomes, namely *Publication Count, Average citations per paper,* and *Co-applicant collaboration.*

To do that, we estimate the following equation over 430 applicants, corresponding to the 114 awarded applications of our sample:

$$\textit{Researcher's outcome}_i = \beta_0 + \beta_1 \textit{Amount Awarded}_i + \beta_2 \textit{Researcher's Characteristics}_i + \beta_3 \textit{Application Characteristics}_i + \varepsilon_i$$

(Equation A1)

Where each researcher's outcome is evaluated after the application time and the variable *Amount Awarded* is the amount of Swiss Francs (CHF) assigned to the project application selected by the committee of experts at SNSF.

Similarly to the analysis reported in the main text, the scientist's characteristics included in the regression model are her age at the year of application (*Age*) and gender, defined as a dummy that equals one if the researcher is a woman and zero otherwise (*Female*). We include also controls describing the scientist's profile at the application time. Specifically, we consider the stock of publications (*Publication Count*) [8], citations (*Average citations per paper*), and a dummy that equals one if there was at least one preexistent co-authorship with a co-applicant and zero otherwise (*Extant Co-applicant collaboration*). The application characteristics include a dummy that equals one if all the applicants are Swiss (*Swiss team*), a dummy that equals one if there is at least one female researcher among the co-applicants (*At least one female researcher in*

[8] The variables describing the scientist's profile at the application time are computed in the five-year window before the application year.

the team), the *Amount requested* in CHF, the number of co-applicants listed in the application document (*N. of co-applicants*), the number of disciplines listed in the application (*N. of disciplines*), a dummy that equals one if the application is in the domain of Science and Medicine and zero if the application is in the domain of engineering (*Science & Medicine*), and the average distance in terms of travel time between the focal researcher's affiliation and the co-applicants' affiliations (*Distance Hours*). Additionally, we control for the number of collaborators, i.e. Post-docs, PhD students and staff scientists, hired thank to SINERGIA funds (*N. of collaborators*).

Since in estimating the impact of *Amount Awarded* on researcher's outcomes, an endogeneity issue might raise from the possible correlation between the main variable of interest (*Amount Awarded*) and the researcher's individual characteristics (Arora and Gambardella, 2005) we implement an instrumental variable approach (Jaffe, 2002).

For the instrumental variable estimation strategy, we identify as excluded instrument the highest grade assigned to the application by the selection committee (*Grade A*). We expect the correlation between being assigned the highest grade, i.e. *Grade A*, and the *Amount Awarded* to be positive since applications with the highest grade are subject to budget cuts of less extent[9]. The validity of the instrument, namely the absence of correlation with the unobserved scientist's characteristics that might affect her productivity, relies on three arguments. First, SINERGIA is a prestigious grant that attracts only well-reputed researchers. Evaluators are asked the difficult task to compare applications that do not differ much in term of quality and the selection ended up to be affected by a random component. Second, producing scientific outcomes is an activity characterized by a high uncertainty of the results. Promising projects might result in failures, while badly evaluated projects might lead to important and fruitful scientific discoveries. Third, the selection committee of the SINERGIA applications aims to promote other aspects than publication productivity, such as scientific collaboration of researchers and interdisciplinary research. The resulting grades assigned with respect to multiple criteria are expected to be uncorrelated with the outcomes evaluated.

[9] We calculated the budget cut amount as the difference between the amount requested in the application and the amount assigned by the committee to the project. The correlation between *Grade A* and budget cuts equals -0.14.

Table A1 considers the impact of the amount received for an awarded researcher. The first column reports the results of the first stage equation necessary to estimate the econometric model described in Equation A1 with an instrumental variable approach. We see that receiving the maximum score (*Grade A*), pays on average 19% more funds. A researcher who is part of bigger team (*N. of co-applicants* and *N. of collaborators*) receives more funds. Researchers in *Science & Medicine* benefit of larger funds than researchers in Engineering.

Columns 2 to 4 show the second-stage estimates for the distinct researcher's outcomes measures. All models include a set of controls for the application characteristics as well as a set of controls for the applicant's characteristics. Moreover, we include the affiliation of the applicant in order to control for the reputation provided by the affiliation. Time dummies are included to control for calendar year specificities. Standard errors clustered by application are reported in parenthesis. The amount assigned does not affect significantly the researcher's outcomes along all the three dimensions evaluated. Considering the controls, the application characteristics for the sub-sample of awarded researchers do not affect significantly researchers' outcomes, with the only exception for the average distance of travel time between the co-applicants' affiliations. When we examine the applicant's characteristics, we observe similar results as the ones in the main analysis (DD). In particular, we find that older researchers publish fewer papers, receive fewer citations and are less likely to establish a co-authorship relationship with their teammates. Female researchers receive 19% more citations per paper than male colleagues. In the post-application period, researchers with a greater publication stock at the application time publish more papers and are cited more. Having a pre-existing co-authorship with co-applicants reduces the number of citations received, but raises the chance to co-author with the co-applicants after the application time. Finally, the number of citations at the application time is positive correlated with the number of post-application publications and post-application citations received.

The OLS estimations (available upon request) are consistent with the IV estimations. We test for the presence of endogeneity of the variables *Amount Awarded* in the three regressions presented in Table A1, columns 2-4. The *Durbin-Wu-Hausman* does not reject the null hypothesis that the variables are exogenous. The values of the test are reported on the bottom-part of Table A1. The result of this statistical test shows that the variable *Amount Assigned* is not affected by endogeneity problems suggesting that, conditional on being awarded a grant, the amount received is independent of the subsequent scientific outcomes.

Table A1: Instrumental variables estimate for the effects of receiving a greater amount of money on the researchers' productivity. We consider the sub-sample of awarded researchers.

	First Stage log(Amount Assigned)	Log(Publication Count)	Log(Average citations per paper)	Co-applicant collaboration realized (=1)
log(Amount Assigned in Million CHF)		-0.084	0.45	-0.090
		(0.33)	(0.32)	(0.41)
Grade A	0.19***			
	(0.051)			
Applicant's characteristics				
Age	0.0018	-0.014***	-0.0074**	-0.0046*
	(0.0016)	(0.0032)	(0.0032)	(0.0026)
Female	-0.016	-0.021	0.19***	-0.018
	(0.030)	(0.072)	(0.074)	(0.052)
log(Publication count pre-application)	0.0047	0.78***	0.079**	0.045*
	(0.017)	(0.040)	(0.034)	(0.027)
log(Average citations per paper received pre-application)	0.0028	0.068**	0.63***	-0.018
	(0.019)	(0.031)	(0.050)	(0.033)
Extant co-applicant collaboration	0.041	-0.017	-0.11**	0.38***
	(0.028)	(0.053)	(0.051)	(0.045)
Application characteristics				
Swiss team	0.013	-0.011	-0.0090	-0.035
	(0.059)	(0.085)	(0.077)	(0.079)
At least one female researcher	-0.017	-0.031	0.035	0.017
	(0.038)	(0.048)	(0.055)	(0.054)
log(N. of co-applicants)	0.28***	0.073	0.00049	0.14
	(0.080)	(0.11)	(0.10)	(0.14)
log(N. of collaborators)	0.41***	0.020	-0.21	0.018
	(0.057)	(0.15)	(0.15)	(0.19)
log(N. of disciplines)	-0.0026	-0.0090	-0.044	0.063*
	(0.034)	(0.041)	(0.044)	(0.037)
Science & Medicine	0.20***	-0.011	0.027	0.10
	(0.061)	(0.092)	(0.086)	(0.11)
log(1+distance Hours)	-0.014	-0.046	-0.019	-0.061
	(0.029)	(0.033)	(0.035)	(0.042)
Constant	-1.29***	1.78***	0.71	0.55
	(0.15)	(0.45)	(0.45)	(0.57)
Observations	469	469	469	469
R-squared	0.646	0.660	0.639	0.231
Durbin-Wu-Hausman test		0.87	0.25	0.99
Dummy Application year	Yes	Yes	Yes	Yes
Dummy Affiliation	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Section B - Estimating the effects of applying for a grant and being awarded: Robustness checks with alternative estimation methods

In the main text we estimate the effects of applying for a grant relying on a difference-in-differences (DD) approach. A possible concern about the validity of our results could come from some endogeneity issues and self-selection problems. We therefore run two robustness checks, one for each part of our analysis in this section.

Estimating the effects of applying for a grant: Instrumental variable approach

As a first robustness check, we run an alternative estimation of the effect of applying using the following equation:

$$\textit{Researcher's outcome}_i = \beta_0 + \beta_1 \textit{Applying}_i + \beta_2 \textit{Researcher's Characteristics}_i + \varepsilon_i$$

(Equation B1)

where *i* refers to the scientist *i*. Her scientific outcomes are evaluated after the application time and her characteristics are included as controls. The dummy $\textit{Applying}_i$ is a dummy that equals 1 if scientist *i* is an applicant to SINERGIA and equals 0 otherwise.

Precisely, we implement an instrumental variable approach to overcome the endogeneity issue possibly raised by the dummy *Applying*. Better researchers might self-select themselves for applying since they believe they have higher chances to succeed in being founded.

In the instrumental variable approach, we consider as excluded instrument the dummy *Network Applicant* that equals one if at least one of the co-authors of the researchers analyzed or, one of their co-authors' co-authors, have applied for a SINERGIA grant in the five years preceding the application submission[10]. The *Network Applicant* variable is expected to be a strong instrument since is negatively correlated with the probability that the focal researcher applies to SINERGIA. The reason for the observed negative correlation is that a potential applicant needs to find partners for her application. She is expected to search for her co-applicants in her professional network. If the researchers in her network have already applied, they are less likely to be part of another application regardless of the result of their application. If

[10] For the non-applicant we consider as application year the year when her matched applicant made her submission.

they were awarded there is no need for them to apply again. And if they were not awarded they might be discouraged to apply again. In both cases, the pool of potential co-applicants of the focal researcher is reduced with a detrimental effect on her probability to apply because she has a smaller pool of partners for the application. Hence, we expect *Network Applicant* to be a valid instrument because the probability of having SINERGIA applicants in the co-authorship network is not correlated with the unobserved characteristics of the focal researcher that impact on her productivity.

As controls for the researchers' characteristics we include the stock of publications (*Publication Count*), citations (*Average citations per paper*), and a dummy that equals one if there was at least one preexistent co-authorship with a co-applicant and zero otherwise (*Co-applicant collaboration*)[11].

Table B1 reports the estimates. Column 1 shows the results of the first stage estimates. We see that a researcher that has at least one colleague in her co-authorship network that applied to SINERGIA proposal (*Network Applicant*) has 20% fewer chance to apply. Having a greater number of publications or having already collaborated before, increases the probability of applying. On the contrary, working in larger teams, having a greater number of citations reduces this probability.

The columns 2 to 4 show the second stage estimates for different outcomes measures. Confirming the result of the main analysis, we observe that applying has a positive impact on the quantitative productivity (measured by publication count) and on the probability of co-authoring with the other team members. We also still find that applying has a negative effect on the on the number of citations received. We confirm our results suggesting that highly competitive grant selection processes can incentivize researchers to work on building research teams with co-applicants independently of the funding decision.

We also control for differences between awarded and non-awarded applicants by adding the *Awarded* dummy. We find that being awarded has a positive impact only on the probability of establishing a co-authorship with co-applicants and on the average number of citations

[11] The variables describing the scientist's profile at the application time are computed in the five-year window before the application year.

received per paper. This result confirms that the observed positive effect of applying on publication counts is not guided by awarded applicants[12].

We test for the presence of endogeneity of the variable *Applicant* in the three regressions presented in Table B1, columns 2-4. The *Durbin-Wu-Hausman* does not reject the null hypothesis that the variables are exogenous. The values of the test are reported on the bottom-part of Table B1.

Table B1: Regression results for the productivity of applicant vs. non-applicant researchers. IV estimations

	First Stage Applicant	Log(Publication Count)	Log(Average citations per paper)	Co-applicant collaboration realized (=1)
Applicant		0.43*	-0.67***	0.36***
		(0.22)	(0.19)	(0.11)
Awarded	0.50***	-0.0053	0.25**	0.16**
	(0.020)	(0.12)	(0.10)	(0.068)
Network applicant	-0.20***			
	(0.022)			
Application characteristics				
log(N. of co-applicants)	-0.082***	0.023	-0.032	0.059**
	(0.022)	(0.045)	(0.045)	(0.027)
log(Publication count pre-application)	0.033***	0.84***	0.022	0.013
	(0.010)	(0.020)	(0.017)	(0.0092)
log(Average citations per paper received pre-application)	-0.032***	0.084***	0.65***	0.016
	(0.010)	(0.020)	(0.023)	(0.011)
Extant co-applicant collaboration	0.35***	-0.036	0.12*	0.46***
	(0.020)	(0.084)	(0.071)	(0.048)
Constant	0.38***	0.33**	0.52***	-0.060
	(0.054)	(0.15)	(0.14)	(0.072)
Observations	2,120	2,120	2,120	2,120
R-squared	0.479	0.525	0.529	0.557
Durbin-Wu-Hausman endogeneity test		0.94	0.16	0.61
Dummy Application year	Yes	Yes	Yes	Yes
Dummy Affiliation	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

[12] We run the same analysis excluding the dummy awarded and results are virtually unchanged.

Estimating the effects of being awarded a grant: Instrumental variable approach

We run a similar robustness check for the second part of our analysis concerning the effect of being awarded conditional on having applied. To do so, we estimate the following equation:

$$Researcher's\ outcome_i = \beta_0 + \beta_1 Awarded_i + \beta_2 Researcher's\ Characteristics_i + \beta_2 Application\ Characteristics_i + \varepsilon_i$$

(Equation B2)

where *i* refers to the scientist *i*. Her scientific outcomes are evaluated after the application time and her characteristics are included as controls. The dummy $Awarded_i$ is a dummy that equals 1 if the applicant *i* is awarded a SINERGIA grant and equals 0 otherwise.

In estimating equation B2, the endogeneity might raise from the fact that grants are not randomly distributed, i.e. better quality researchers and applications are expected to be awarded in priority and those researchers and applications are also the ones expected to have greater outcomes.

In order to overcome the endogeneity issue related to the variable *Awarded*, we implement an instrumental variable approach. We consider as excluded instrument the grade assigned by the evaluation committee to the application (*Grade assigned*) that is expected to be correlated with the probability of being awarded and uncorrelated with the unobserved determinants of a researcher's outcomes (Jaffe, 2002). Receiving an A assures to be awarded while receiving a D exclude the application from the selection. The grade assigned is a valid instrument for similar reasons as in the case of Grade A for Amount Awarded. Moreover, the extant literature gives support to the claim that the grade assigned is not correlated with the project outcomes. Graves et al. (2011) state, as conclusion of their empirical study, that "Allocating funding for scientific research in health and medicine is costly and somewhat random". Moreover, Gush et al. (2015) find that "the selection process does not appear to be effective in discriminating among […] proposals in terms of their likely success".

Table B2 presents the results from the IV estimation of the model reported in Equation B2. The first column reports the results of the first stage estimates. We see that receiving a grade higher by one point is associated with a 27% increase in the probability of being awarded; suggesting that the excluded instrument we choose is strong enough.

The remaining columns 2-4 in Table B2 show the second-stage estimates for the five distinct outcome measures. Confirming our findings in the main text, the results of this estimation suggest that being awarded a SINERGIA grant has a positive and significant effect on the probability to consolidate a co-authorship relationship with co-applicants. An awarded applicant gains 15% more chances to establish a co-authorship with at least one of her grant co-applicants.

As for the results on the controls, both on the application level and on the applicant's level, we find similar results to the ones in the main regression (Table 5).

As for the first part of the analysis, we test for the presence of endogeneity of the variable *Awarded* in the three regressions presented in Table B2, columns 2-4. The *Durbin-Wu-Hausman* does not reject the null hypothesis that the variable *Awarded* is exogenous. The values of the test are reported on the bottom-part of Table B2. The result of this statistical test shows that the two variables, *Awarded* is not affected by endogeneity problems.

Table B2: Instrumental variable estimates for the effects of being awarded on the researchers' productivity (We are comparing awarded vs. non-awarded researchers).

	First Stage	Log(Publication Count)	Log(Average citations per paper)	Co-applicant collaboration realized (=1)
Awarded		-0.015	0.13***	0.15***
		(0.039)	(0.039)	(0.039)
Grade [A=1-D=6]	0.27***			
	(0.0079)			
Applicant's characteristics				
Age	0.00022	-0.013***	0.0011	-0.0079***
	(0.0013)	(0.0022)	(0.0023)	(0.0016)
Gender (female)	0.0082	-0.055	0.051	0.0092
	(0.020)	(0.045)	(0.050)	(0.037)
log(Publication count pre-application)	-0.039***	0.76***	0.027	0.036**
	(0.013)	(0.025)	(0.023)	(0.017)
log(Average citations per paper received pre-application)	-0.012	0.052***	0.66***	0.021
	(0.015)	(0.020)	(0.029)	(0.019)
Extant co-applicant collaboration	-0.044**	-0.012	0.028	0.44***
	(0.022)	(0.033)	(0.034)	(0.031)
Application characteristics				
Swiss team	0.051	-0.026	-0.033	-0.022
	(0.052)	(0.059)	(0.051)	(0.056)
At least one female researcher	0.014	-0.015	0.058	0.025
	(0.031)	(0.033)	(0.038)	(0.030)
log(Amount Requested)	0.012	-0.036	0.0026	0.030
	(0.049)	(0.039)	(0.039)	(0.039)
log(N. of co-applicants)	-0.017	0.029	0.011	0.025
	(0.074)	(0.050)	(0.061)	(0.052)
log(N. of disciplines)	0.00040	0.0032	0.022	0.050**
	(0.028)	(0.026)	(0.030)	(0.023)
Science & Medicine	-0.032	-0.027	0.11***	-0.047
	(0.046)	(0.036)	(0.043)	(0.040)
log(1+distance Hours)	0.0014	-0.043**	0.0058	-0.057**
	(0.024)	(0.020)	(0.026)	(0.024)
Constant	-0.46	2.28***	-0.14	0.34
	(0.65)	(0.54)	(0.54)	(0.54)
Observations	1,060	1,060	1,060	1,060
R-squared	0.735	0.624	0.607	0.261
Durbin-Wu-Hausman endogeneity test		0.59	0.62	0.52
Dummy Application year	Yes	Yes	Yes	Yes
Dummy Affiliation	Yes	Yes	Yes	Yes

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Other alternative estimations

For both parts of the analysis we also run OLS estimations (available upon request). The results we find are consistent with the IV estimations. This is consistent with the absence of endogeneity that we tested for in the two parts.

Previous studies apply a *regression discontinuity design* (RDD) approach when investigating the effect of being awarded a grant on the scientists' productivity (see for instance Jacob and Lefgren, 2011). This approach is not suitable in our case. The main reason is that we do not have a ranking of the applications but six classes of grades, from A to D, with intermediate grades (AB,BC, and CD). In order to implement the RDD approach, we should identify a threshold indicating the "last application that would be funded if the funding decision were made in order" (Jacob and Lefgren, 2011). We know that the threshold is located in the grade class B because in grade classes above B all the applications are awarded, i.e. AB and A, while in grade classes below B none of the applications is awarded, i.e. BC, C, CD, and D. Unfortunately, we cannot rank the applications within class B to position correctly the threshold. This limitation is related to the procedure used to select applications graded B at SNSF. In fact, the applications graded B pass a second round of evaluation where the committee re-evaluate each application but without producing a ranking.