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The SINERGIA Program: A policy evaluation

Policy Brief

Highlights

For the first time, the instrument 'SINERGIA Program' of the Swiss National Science Foundation (SNSF) has been evaluated with rigorous econometric methods.
We found that being awarded a SINERGIA:
• Boosts the probability of co-authoring with project co-applicants.
Being involved in a SINERGIA application:
• Stimulates the individual productivity of a scientist;
• Stimulates the individual to extend her knowledge stock.
By looking at the co-applicants' team micro-dynamics:
• We identify which team characteristics affect the probability that an applicant learns from her project co-applicants .
These findings represent a base of evidence for policymakers to implement further decisions regarding the future of this instrument[1].

Executive Summary

This policy brief summarizes and presents in a non-technical fashion the findings of an academic research study dealing with the evaluation of a funding program. The results show that the SINERGIA Program is effective in stimulating co-applicants' teamwork. The policy brief measures the causal effect of applying and being awarded a SINERGIA to a certain number of relevant outcomes.

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1 The scientific paper 'At the origins of learning: Absorbing knowledge flows from within or outside the team?' reports the details of the investigation of the co-applicants' team micro-dynamics. A summary of the paper is reported in Appendix B. The full paper is included in the report as additional material.

Introduction

Over the past century, the process of knowledge creation has fundamentally changed. Nowadays the teamwork model has mainly replaced the single scientist model of conducting science (Wuchty et al., 2007; Jones et al., 2008). Policymakers have captured these trends and, taking for granted the value of teamwork, have designed specific funding schemes in which researchers are asked to collaborate in teams as a condition for securing research funding.

In the current proposal, we aim to investigate what the effects are of a specific SNSF program, the SINERGIA Program, on a certain number of relevant outcomes for the scientific community. Specifically, we propose a comprehensive exercise of policy evaluation that is relevant for policymakers engaged in designing funding schemes that promote collaboration.

The project is composed of two parts. First, we consider all of the scientists who apply to the SINERGIA Program and we investigate a series of questions comparing awarded and non-awarded applicants. *Does the SINERGIA Program affect grant recipients' productivity? Does the SINERGIA Program affect grant recipients' learning processes? Does the SINERGIA Program affect grant recipients' co-authorship dynamics?* Our preliminary results indicate that being awarded a SINERGIA grant affects recipients' co-authorship dynamics. Specifically, being awarded a SINERGIA grant boosts the probability that an applicant co-authors with her project co-applicants. However, being awarded a SINERGIA grant neither affects grant recipients' productivity, nor does it foster grant recipients' learning processes. In searching for further evidence on these 'no effect' results, we step back from the funding decision time to the application time. In the second part of our study, we investigate whether scientists' decision to apply affects scientists' performance. We compare all the scientists who applied to SINERGIA with a group of scientists with a similar profile who did not apply. We investigate the following series of questions: *Does the application process for the SINERGIA Program affect applicants' productivity? Does the application process for the SINERGIA Program affect applicants' learning processes?* Our findings indicate that scientists who went through the SINERGIA application process, regardless of whether or not they obtained funds, publish more and learn more than scientists who did not apply. Our tentative explanation for this finding is that the application process is time consuming, but at the same time, it represents a stimulus and a learning occasion for scientists.

SINERGIA Program: Goals and institutional setting

The SINERGIA program was launched in 2008 and represents a flagship in the SNSF's funding scheme portfolio. It is designed to promote team collaboration. As mentioned in the application guidelines, researchers are required to collaborate as a condition for securing research funding, i.e., researchers need to submit a proposal for a "research work carried out collaboratively".

In most cases, a SINERGIA project involves three or four researchers 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 of 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 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. Typically, applications receiving a score below B are not funded.

Data

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 Scopus database. To perform our analysis, we selected applications in Engineering, Science and Medicine[1]. Our final sample is represented by 256 grant applications, including 817 applicants.

Table 1 reports the key figures describing the applications and applicants' characteristics.

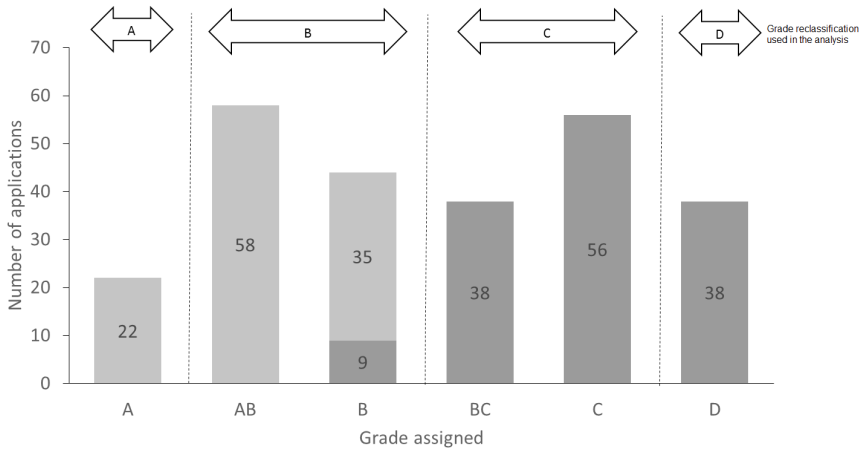
The representative applicants' project team in our sample is a small one. Ninety percent of the teams have less than five members. A team is composed, on average, by 4.38 members, with a minimum of 3 and maximum of 12 members. Considering the team composition, 21 nationalities are represented. About 15% of the teams have only Swiss members, while the others are multi-national teams.

1 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 Scopus database. Applications in the Humanities and Social Sciences represent 19% of the total sample.

The average number of nationalities in a team is 2.47, with a maximum of 6 nationalities. The SINERGIA funding program favors inter-institution collaborations. On average, each group has members from 2.43 different affiliations, with a maximum of 6. According to the SNSF's application requirements, researchers with a foreign affiliation are admitted to apply for the grant only if their competencies and skills are not available in Switzerland. Due to this constraint, when we look at the country affiliations, we note that 80% of the teams include only Swiss affiliations. When classified by discipline, 36% of the applications are in Engineering, whereas the rest are in Science and Medicine. Within the two broad disciplines, each application is classified into sub-disciplines. An application counts, on average, 3.31 sub-disciplines; only 20% of the applications involved only one discipline, while the most diversified application involved 11 disciplines. When we look at previous collaborations among applicants at the time of application, we observed that in 57% of the cases, there was at least one co-authorship relation among team members. When looking at the applicants' gender distribution, in our sample, women constitute 16% of the total. A SINERGIA grant covers personnel costs, research costs, coordination costs and, to a limited extent, investment costs. The average amount requested per application is 1,668,719 CHF, with a minimum of 240,427 CHF and a maximum of 6,854,573 CHF.

Figure 1 represents the distribution of the number of grant applications by score assigned and the final funding decision. A total of 8.6% of the applications obtained the maximum score, A, and 44.9% 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 the majority of cases, applicants are associate or full professors with good publication records. They have to demonstrate their ability to conduct excellent quality independent research. The average age of an applicant is 47.6 years, with a minimum of 30 and a maximum of 69 years old. Only 18% of the entire population of the applicants is below 40. The average number of applicants' publications is 36.49, and 85% of the applicants have more than 10 publications[2].

2 We consider publication records from 2003 to the year of application.

Table 1: Key figures for the applications and applicants' characteristics

Team characteristics at the time of application (Number of teams=256)

	Mean	Std. Dev.	Min	Max
Established team	0.57	0.49	0	1
Team size	4.38	1.63	3	12
Number of disciplines	3.31	2.16	1	11
Average team members' age	47.81	4.65	35.6	59.3
Share of women	0.15	0.20	0	1
Average team members' publication count	37.91	21.37	6.2	133
Grant awarded	0.45	0.50	0	1
High-quality application (grade A)	0.09	0.28	0	1
Low-quality application (grade D)	0.15	0.36	0	1
Amount requested	1,668,719	768,006	240,427	6,854,573

Applicants' characteristics at the application time (Number of applicants=817)

	Mean	Std. Dev.	Min	Max
Age	47.63	8.14	30	69
Female	0.16	0.37	0	1
Number of publication pre-application (from 2003 to the time of application)	36.49	34.89	1	318

Part I: Is winning important? Comparing awarded vs. non-awarded applicants

To assess the impact of receiving a SINERGIA grant, we compare awarded and non-awarded applicants. Using the information contained in applicants' publication records[3], we look at the differences in applicants' (i) scientific productivity, (ii) learning processes, and (iii) co-authorship dynamics.

First, we propose a simple comparison between awarded and non-awarded applicants' outcomes in the period that follows the funding decision. A t-test is used to determine whether being awarded makes 'winners' significantly different from the others. This exploratory analysis provides us with some preliminary insights; however, a simple

3 We opt for the analysis of co-applicants' records in order to assure the comparability between awarded and non-awarded applicants' outcome. The information on project collaborators' is not available when the project is not-awarded and it was not possible to include project collaborators' publications. A key figure reassures us that our choice to consider only co-applicants' publications do not significantly underestimate the outcome of the whole project. We randomly select ten collaborators and an inspection of their publication records revealed that 90% of their scientific papers are joint work with at least a co-applicant. The co-authorship assures the inclusion of their work in our outcome measures. It reveals also that collaborators are not working alone but are key actors in the team production process lead by co-applicants. The close interactions between collaborators and co-applicants are confirmed also on the co-applicants' publication side, about fifty percent of co-applicants' publications list at least a collaborator as co-author.

comparison of awarded and non-awarded applicants is not an evaluation and cannot be used to identify a causal effect of the program. To correctly infer and isolate the impact of the funding support on applicants' outcomes, we have to properly control for the application and applicants' quality. To do so, we exploit the richness of our data, and we complement the exploratory analysis with formal regression specifications that include detailed controls for the application and applicants' characteristics.

Does the SINERGIA Program affect grant recipients' productivity?

We measure the productivity of each scientist in terms of the articles that she publishes. Table 2 reports the exploratory analysis, where a t-test is used to compare the average publications per year and the productivity growth after the funding decision period for applicants who are awarded and not awarded. The comparison reveals that there are no significant differences.

Table 2: Comparison between the average number of publications per year, pre- and post-application period.

Awarded	*A) Average publications count pre-application period*	*B) Average publications count post-application period*	*B-A*	*Obs.*
No	4.77 (Average age at the time of application: 47.49)	7.59	2.82	628
Yes	4.37 (Average age at the time of application: 48.01)	7.06	2.68	494
t-test P-value	0.11 (age 0.28)	0.13	0.51	1122

Table 2.A reports the estimation results for the formal regression specification, which includes the application characteristics and the applicant's characteristics. The complete model estimations confirm that being awarded a SINERGIA grant does not affect the individual's scientific productivity.

Does the SINERGIA Program affect grant recipients' learning processes?

Each scientist enters a project with her knowledge capital, i.e., with a set of information that she uses in her work. The interaction with other team members exposes the scientist to a broader set of knowledge, and provides her with the opportunity to learn something new. To track learning gains, we went beyond the simple publication count and looked at the publication content. Specifically, we measure the initial scientist's knowledge capital as the distinct journals cited in her publications before the time of application. We trace the new knowledge acquired with two measures. First, we consider the proportion of new journals cited by the applicant after the funding decision. Second, we did the same, but excluding articles co-authored with co-applicants. Co-authored publications do not allow us to disentangle an individual's contributions to the cited references; for

this reason, we exclude them. In table 3, we observe that the proportion of new journals cited after the funding decision is about the same for awarded applicants than for non-awarded ones, either excluding or including articles co-authored with co-applicants. This finding is confirmed in Table 3.A by the estimations of the formal regression specification, including all of the detailed controls on the application and applicants' characteristics.

Table 3: Comparison between the shares of new journals cited in post-application publications for awarded and non-awarded applicants.

Awarded	*Share of new journals cited in post-application publications*	*Share of new journals cited in post-application publications not co-authored with co-applicants*	*Obs. (not-coauthored with co-applicants)*
No	59.54%	58.60%	534 (486)
Yes	59.84%	57.41%	442 (403)
t-test P-value	0.83	0.43	976 (889)

Note: We have fewer observations than in table 2 because we restrict our analysis to applicants who have at least one publication before the time of application and one publication after the time of application. This is needed in order to define the knowledge stock and to measure the applicants' learning.

Does the SINERGIA Program affect grant recipients' co-authorship dynamics?

The SINERGIA program is designed to promote active interactions among team members. Co-authorship is a commonly used proxy to measure those interactions leading to relevant and original scientific contributions (Katz and Martin, 1997).

We assess the probability that a pair of awarded SINERGIA co-applicants establishes a co-authorship after the funding decision. Each co-applicant pair represents a potential collaboration pair that a SINERGIA program aims to support. In a poll of all potential collaborations, only a subset engages in actual co-authorships (30%). Table 4 reports the exploratory analysis, where a t-test is used to compare the share of co-applicant pairs who engaged in co-authorships after the funding decision. We compare applicants awarded vs. applicants not awarded.

Table 4: Share of applicant pairs who engaged in co-authorships.

Awarded	*Share of pairs who engaged in co-authorships after the time of application*	*Obs. (pairs of applicants)*
No	25.67%	1266
Yes	35.81%	969
t-test P-value	0.00	2235

Table 4.A shows the results of an econometric model that estimates the probability of co-authorships as a function of being part of a team for which the application was awarded, controlling for the fact that the focal pair has already co-authored before the application. Interestingly, being awarded a SINERGIA grant raises the

chance of establishing a co-authorship with co-applicants (+16%). Having a co-authorship before the application enhances the probability of having a co-authorship after the time of application (+55%).

Part II: Is participating important? Comparing applicants vs. non-applicants

The first part of the analysis reveals that being awarded a SINERGIA grant does not affect the scientist's productivity or her learning processes. Interestingly, receiving funds raises the probability for the project co-applicants to establish co-authorships. Scientists put together their efforts in a joint application, and awarded co-applicants consolidate their relationships in a co-authorship.

The second part of our analysis aims to investigate whether the application per se plays a role in changing an applicant's behaviors. For this purpose, we construct a 'control sample' of potential applicants, i.e., scientists with as similar profiles as possible to the applicants in our sample. For each applicant, we found a 'twin' who did not apply to SINERGIA. The control sample we built includes scientists having a Swiss affiliation, citing the same literature, and having similar scientific productivity as the applicants[4].

We use the control sample we built to replicate the evaluation exercise presented in the first part, but comparing applicants vs. non-applicants.

Does the application process for the SINERGIA Program affect applicants' productivity?

Table 5 presents the results of the t-test that compares the average number of publications per year for applicants and non-applicants[5]. The comparison shows that applicants perform better than non-applicants. The rise in productivity is 0.65 for applicants, compared to 0.09 for non-applicants, and the difference is statistically significant.

4 In order to identify the pool of eligible controls, we considered 167,060 authors of the articles published in the top-100 journals targeted by Swiss scientists. Within this pool of authors, we identified 880 controls for the 880 applicant scientists with similar profiles.

5 Please note that the measure of productivity used in this section refers to the number of articles published in the top-100 journals targeted by Swiss scientists. We adopt this restriction to maintain the consistency with the control sample construction.

Table 5: Comparison between the average number of publications per year, pre- and post-application period.

Appl.	*A) Publication count pre-application period*	*B) Publication count post-application period*	*B-A*	*Obs.*
No	1.34	1.43	0.09	880
Yes	1.35	1.99	0.65	880
t-test P-value	0.90	0.00	0.00	1760

Note: We consider publications that appeared in the top-100 targeted by Swiss scientists.

The rise in productivity is confirmed by the estimation of the formal econometric model in Table 5.A.

Does the application process for the SINERGIA Program affect applicants' learning processes?

Tables 6 and 6.A replicate the same exercise as in tables 3 and 3.A. Applying to a SINERGIA grant raises the share of new journals cited in the follow-up work.

Table 6: Comparison between the share of new journals cited for applicants and non-applicants.

Applied	*Share of new journals cited in post-application publications*	*Obs.*
No	69.41%	834
Yes	70.95%	834
t-test P-value	0.00	1,668

Note: We have fewer observations than in table 4 because we restricted our analysis to applicants who have at least one publication before the time of application and one publication after the time of application. This is needed in order to define the knowledge stock and to measure the applicants' learning.

Conclusion, policy remarks and perspectives on the evaluation for the SNSF

We found that being awarded a SINERGIA project:
a) Does not increase applicants' scientific productivity, as measured by a simple publication count;
b) Does not affect the applicants' learning processes;
c) Boosts the probability of co-authoring with project co-applicants.

Being involved in a SINERGIA application:
d) Stimulates the individual productivity of researchers;
e) Stimulates the researchers' learning processes.

A possible explanation for (a), (b) and (c) could be that non-awarded applicants might find to find alternative resources to preserve their funding flows, such as other public grants or private sponsors. Moreover, the Swiss institutional setting allows well-established professors to be somewhat independent of fundraising activities to support their teams. Thus, not being awarded a grant probably has a limited impact on their research activity. Awarded and non-awarded applicants show the same productivity level and the same opportunities to learn from other scientists. Concerning co-authorship, a possible explanation for the lower probability of co-authoring for non-awarded applicants could be that they are more likely than awarded applicants to revise the initial composition of the team declared on the application. An alternative explanation is that, scientific publications co-authored by all applicants could be a way to document the collaborative activity of the team to the SNSF.

An explanation underlying our findings (d) and (e) could be that scientists involved in SINERGIA applications are exposed to the knowledge, skills and capabilities of the other applicants during the time of the joint writing of the application. Applicants spend time and effort sharing their research ideas with the other team members when they write scientifically relevant projects that will be evaluated by experts in the sector. Moreover, researchers extend their network while collaborating with other academics from other universities in order to produce a well-structured application for the SINERGIA grant. Hence, despite the considerable amount of time put in the production of a good quality application, we can explain the increase in the productivity of the researchers by the new strands of knowledge they have accumulated during this collaboration as well as a number of publications they co-authored thanks to their newly extended network.

What's next? The Truffle Hunter© algorithm

The preliminary results reported in the current policy brief have been discussed during the meeting of the 18th of February in Bern at the SNSF offices. The discussion with the SNSF representatives reveals the potential of the tool kit developed in the Part II of our analysis. In comparing applicants vs. non-applicants, we implement an algorithm for searching scientists with profiles as close as possible to the applicants. A novel use of the algorithm emerged during the discussion. The 'Truffle Hunter©' algorithm could provide a complete list of potential applicants for the next round of the SINERGIA calls, building its predictions on the characteristics of scientists who applied in the past. This information could be useful for the funding agency in three distinct phases of the process of the SINERGIA program management. First, in the promotion phase, the list of scientists might help to identify groups of potential applicants that would be eligible for a SINERGIA grant but did not apply in the past. Their non-application decisions might be related to the lack of information about the program. If this is the case, the SNSF could direct its promotion activities towards their affiliations. Second, in the evaluation phase, the list of scientists might be included in a list of potential referees. Scientists who decided to not apply are experts in their fields and are well-qualified to evaluate projects. Third, a list of scientists similar to the applicants is necessary to conduct an analysis similar to the one presented in the Part II of this report. In this analysis we compare the publication productivity and the learning dynamics of applicants vs. non-applicants. Given the shared interest between EPFL and SNSF in developing the 'Truffle Hunter©' algorithm, we might commit in delivering periodically a list of potential applicants grouped by discipline, affiliation, and academic quality.

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Appendix A

This appendix reports the formal regression specifications that include detailed controls for the application and applicants' characteristics.

Table 2.A: Regression results for the publication count post-application period (Poisson estimations).

	(I)	(II)	(III)	(IV)
VARIABLES	DV: Publication count post-application period		DV: Publication count post-application period (including only publications with at least one co-applicant on the author list)	
Application characteristics				
Awarded (1=Yes, 0 otherwise)	-0.099	0.030	-0.23	-0.029
Grade A (1=the project application obtained A as a grade, 0 otherwise)	0.035	0.029	0.30	0.37*
Grade D (1=the project application obtained D as a grade, 0 otherwise)	-0.099	0.13***	-0.20	-0.049
Log(amount requested)		-0.074*		-0.53***
Log(n. of team members)		0.013		1.07***
Log(n. of disciplines)		0.029		0.072
Biology and Medicine	-0.084	-0.013	-0.28*	0.25**
Application year = 2009	-0.26***	-0.27***	-0.26	-0.29*
Application year = 2010	-0.32***	-0.47***	-0.035	-0.62**
Application year = 2011	-0.56***	-0.81***	-0.23	-0.68***
Application year = 2012	-0.77***	-1.20***	-0.44*	-0.84***
Applicant's characteristics				
Age		-0.016***		-0.019***
Gender (1=Female, 0 otherwise)		-0.076*		-0.20*
log(1+stock of publications pre-application time)		0.80***		0.26***
Applicant i has co-authored with team members before the time of application (1=Yes, 0 otherwise)		3.23***		1.49***
Constant	4.25***	-0.016***	1.94***	6.74***
Number of distinct applicants	817	817	817	817
Number of observations	1122	1122	1122	1122

Note: We estimate a Poisson regression model with clustered standard errors that fit count data well as the publication count (Long and Freese, 2006). The analyses presented are at the applicant-application level. The difference between the number of observations and the number of applicants is due to repeated applications submitted by the same applicant.

To control for the quality of the application, we included a dummy that equals 1 for applications obtaining the maximum score, A, and a dummy that equals 1 for applications obtaining the minimum score, D. To control for the quality of the applicant, we included her stock of publications at the time of application. Columns I and II consider as a measure of scientific productivity all publi-

cations assigned to the applicant i after the funding decision period. To test the robustness of our results, in columns III and IV, we count only the publications where at least one of the co-applicants appears as a co-author. These publications represent the ones that can be reasonably attributed to the joint effort of the team that submitted a SINERGIA application, and they correspond to approximately 10% of the total publication outcomes of the applicants. The results in Columns III and IV are similar to those presented in the first two columns. The only significant result concerns the awarded applications that received a high evaluation from the committee. Applicants who receive a grade of 'A' produce 37% more papers than the others. We also notice that having a previous collaboration is positively correlated with the applicant's productivity. In fact, an applicant with at least one previous co-authorship with another team member produces on average 1.49 times more papers than an applicant that show no sign of a previous collaboration.

Table 3.A: Regression results for the share of new citations (OLS estimations).

	(I)	(II)	(III)	(IV)
VARIABLES	DV: Share of new journals cited	DV: Share of new journals cited	DV: Share of new journals cited in publications not co-authored with co-applicants	DV: Share of new journals cited in publications not co-authored with co-applicants
Application characteristics				
Awarded (1=Yes, 0 otherwise)	0.0049	-0.028*	-0.0092	-0.034**
Grade A (1=the project application obtained A as a grade, 0 otherwise)	-0.016	0.015	-0.026	0.015
Grade D (1=the project application obtained D as a grade, 0 otherwise)	0.018	-0.012	0.019	-0.0066
Log(amount requested)		-0.027*		-0.018
Log(n. of team members)		-0.012		-0.045*
Log(n. of disciplines)		0.014		0.013
Biology and Medicine	0.0073	0.089***	0.0057	0.074***
Application year = 2009	-0.022	-0.046**	-0.022	-0.036*
Application year = 2010	-0.015	-0.041*	-0.051	-0.045**
Application year = 2011	-0.095***	-0.087***	-0.11***	-0.086***
Application year = 2012	-0.16***	-0.13***	-0.19***	-0.14***
Applicant's characteristics				
Age		-0.00044		-0.0011
Gender (female)		-0.0068		-0.0044
Log(1+stock of publications pre-application time)		-0.018***		-0.021***
Log(1+stock of journals cited pre-application time)		-0.099***		-0.099***
Applicant i has co-authored with team members before the time of application		-0.0034		0.033***

Constant	0.66***	1.47***	0.66***	1.44***
Distinct applicants	702	702	634	634
Observations	976	976	889	889
R-squared	0.077	0.634	0.098	0.599

Note: We estimate an OLS regression model. The analyses presented are at the applicant-application level. The difference between the number of observations and the number of applicants is due to repeated applications submitted by the same applicant. We have fewer observations than in table 2 because we restrict our analysis to applicants who have at least one publication before the time of application and one publication after the time of application. This is needed in order to define the knowledge stock and to measure the applicants' learning.

Table 4.A: Regression estimating the probability of observing a co-authorship between co-applicants i and j. We report marginal effects in the table.

	(I)	(II)
VARIABLES	*Pr(co-authorship i and j)*	*Pr(co-authorship i and j)*
Application characteristics		
Awarded	0.15***	0.16***
Dummy co-authorship pre-application	0.61***	0.55***
Dummy co-authorship pre-application * Awarded	-0.099**	-0.062
Female/Female		0.030
Female/Male		0.0030
Avg. age A B		-0.017***
|Age A- age B|		0.0017
Same nationality		-0.011
Same affiliation		0.086***
Same country		0.039
Log(1+avg. publications A B)		0.11***
Log(1+|pub. A- pub. B|)		-0.0097
Log(1+avg. number of journals A B)		0.042***
Log(1+|n. journals A- n. journals B|)		-0.019*
Log(amount requested)		-0.11***
Log(n. of disciplines)		-0.011
Biology and Medicine	0.11***	0.11***
Application year = 2009	-0.089***	-0.13***
Application year = 2010	-0.086**	-0.13***
Application year = 2011	-0.15***	-0.22***
Application year = 2012	-0.19***	-0.25***
Observations	2,235 pairs	2,235 pairs

Table 5.A: Regression results for the publication count post-application period (Poisson estimations).

	(I)	(II)	(III)	(IV)	(V)
VARIABLES	*DV: Publication count post-application period*				
Application	0.34***	0.34***	0.34***	0.34***	0.34***
Application awarded					-0.0085
Log(stock of publications pre-application time)			0.62***	0.62***	0.62***
Application year = 2009		-0.14	-0.17***	-0.17***	-0.17***
Application year = 2010		-0.34**	-0.35***	-0.35***	-0.35***
Application year = 2011		-0.55***	-0.75***	-0.75***	-0.75***
Application year = 2012		-0.57***	-1.01***	-1.01***	-1.01***
Biology and Medicine		-0.36***	-0.100**	-0.100**	-0.10**
Constant	2.11***	2.63***	1.29***	1.29***	1.29***
Distinct applicants	880	880	880	880	880
Observations	1,760	1,760	1,760	1,760	1,760

Table 6.A: Regression results for the share of new citations (OLS estimations).

	(I)	(II)	(III)	(IV)	(V)
VARIABLES	*DV: Share new citations*				
Application	0.055***	0.055***	0.053***	0.053***	0.066***
Application Awarded					-0.027***
Log(stock of publications pre-grant period)			-0.013*	-0.013*	-0.013*
Log(stock journals cited pre-grant period)			-0.081***	-0.081***	-0.081***
Application year = 2009		0.0093	0.0051	0.0051	0.0037
Application year = 2010		0.022	0.015	0.015	0.012
Application year = 2011		-0.038**	-0.018	-0.018	-0.021
Application year = 2012		-0.092***	-0.046***	-0.046***	-0.047***
Biology and Medicine		-0.026*	-0.0095	-0.0095	-0.0098
Constant	0.67***	0.71***	1.04***	1.04***	1.04***
Distinct applicants	834	834	834	834	834
Observations	1,668	1,668	1,668	1,668	1,668
R-squared	0.023	0.080	0.289	0.289	0.292

Appendix B

This Appendix reports a summary of the scientific paper 'At the origins of learning: Absorbing knowledge flows from within or outside the team?' The full paper is available as additional material.

At the origins of learning: Absorbing knowledge flows from within or outside the team?

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Keywords: team, learning, knowledge flows, cognitive distance, social distance, geographical distance

Summary

Empirical studies document a positive effect of collaboration on team productivity. The most common explanation for the teamwork productivity gain is that teamwork stimulates individuals' learning through knowledge sharing among team members. However, little has been done to assess how knowledge flows among team members. Our study addresses this issue by exploring uniquely rich data on a Swiss funding program promoting team collaboration. The novelty of our work relies on the accuracy in measuring knowledge flows within teams with well-defined boundaries. Specifically, we define a team as a group organized by researchers who express their willingness to collaborate by submitting a joint grant application. Each researcher joins the team with her knowledge capital, shares it with her team members and acquires new knowledge from the others. We use researchers' publication records to identify the knowledge components we need for our measures of individual knowledge stocks, individual learning, and knowledge flow among team members.

Following Uzzi et al. (2013), we consider each journal cited in the bibliography of articles published by a researcher as a distinct knowledge component. For each scientist, the sum of all of her knowledge components represents her individual knowledge stock, the acquisition of new components represents her individual learning, and finally, the components acquired from other team members represent the knowledge flows among the team members. We conduct two separate econometric exercises. The first exercise aims to estimate the probability for an individual to acquire new knowledge (to learn). The second exercise aims to estimate, conditional on having acquired new knowledge, the probability that the new knowledge acquired originates from within the team. Learning can be the result of three distinct processes: absorbing knowledge flows from other team members, absorbing knowledge that originates from outside the team or simply being the result of a self-learning process.

We find that the probability for the focal individual to learn is correlated with individ-

ual and team characteristics. Team characteristics also play a role in determining the origin of learning. Concerning the team characteristics, our key findings are related to the relationship between the probability of learning from within the team and the distance of a focal individual from other team members on three dimensions: cognitive, social and geographical. Figure 1 provides the graphical representation of the inverted U-shaped effect of the cognitive distance of the team members on the probability of learning from within the team. This result shows that there is an optimal cognitive distance level favoring learning inside the team. An individual should have a knowledge stock that differs from that of the other team members in order to guarantee some space for learning something new. At the same time, the knowledge stock difference should not be too large so as to avoid the risk of the team members 'speaking a different language' and to insure effective communication. For the other two distance dimensions, we find a negative effect of the social distance of team members on their probability of learning from within the team, whereas there is no effect of geographical distance.

Figure 1: Predicted probability of learning from within the team vs. cognitive distance.