How do universities influence the formation of entrepreneurial teams and nurture the development of business ideas?

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Abstract:
This paper investigates informal mechanisms of knowledge transfer (KT) from a local university to entrepreneurial teams comprising students and recent graduates. While the extant literature on university-industry KT largely focuses on formal mechanisms aimed at stimulating entrepreneurial initiatives in high-tech (HT) sectors, it overlooks the effect of university-industry KT on nascent entrepreneurship in low-medium tech (LMT) sectors. To fill this gap in the literature, we carry out a mixed-method analysis that exploits a dataset of 161 new business ideas (and 562 team members) presented at a business plan competition. Our findings highlight that: (i) students take advantage of the knowledge acquired at university to develop business ideas with higher technological content than those planned by non-graduates; (ii) the local university nurtures the formation of ties among students and recent graduates enrolled in the same courses and fosters their efforts to launch new ventures; (iii) non-traditional mechanisms of KT are exploited by nascent entrepreneurs to develop business ideas in the LMT and HT sectors.

Keywords: Student entrepreneurship; Graduate entrepreneurship; Business ideas; Business plan competition; Founding teams

1. Introduction

This paper investigates the extent to which university knowledge transfer contributes to nascent entrepreneurship, and the specific knowledge transfer (KT) mechanisms favoring the development of entrepreneurial ideas.

We expect that non-traditional mechanisms of university-industry KT are frequent in low-medium tech manufacturing and service sectors. We also expect that in these sectors the contribution of university education for entrepreneurship does not rely mainly on the type and coherence of degrees of the teams of graduated nascent entrepreneurs, but also on informal mechanisms and norms emerging in the academic and territorial environment.

The empirical analysis uses data on 161 entrepreneurial ideas presented at an annual business plan competition in the province of Rimini from 2010 to 2017. The contest is organized by a local association involving territorial institutions, industrial and business associations aggregating representing local companies, and the university. At the end of the competition, winning projects receive a financial award conditioned on the creation of a new firm in the local territory.

In Rimini is located one of the Campuses of Bologna University, and a number of proponents of the entrepreneurial ideas got their education and training at the local university. They are potentially exposed to knowledge transfer mechanisms from university services (mainly non-traditional) and resources from local territorial institutions. The majority of business ideas are in low to medium tech sectors, including agro food, fashion, business services, tourism. Business plans are presented by a team of at least three founders of the new companies.

Within this empirical context, we first develop a quantitative descriptive analysis of the characteristics of student and graduate entrepreneurs and of their teams in low-medium and hi-tech sectors. We also conduct a qualitative analysis of informal KT mechanisms based on interviews to founders of start-ups in low-medium tech sectors and two start-ups in hi tech sectors selected in our sample.

Findings highlight a robust relationship between education field and the R&D intensity of entrepreneurial projects. Educational fields are also relevant for the composition of teams, in terms of internal homogeneity or heterogeneity. In addition, evidences show that students and recent graduates take advantage of the knowledge acquired at university to develop more innovative entrepreneurial projects than those planned by non-graduates. Finally, the qualitative analysis identifies relevant non-traditional mechanisms of KT that are being exploited by nascent student entrepreneurs for developing their business ideas in low and medium tech sectors.

2. Theoretical background

2.1 Informal mechanisms of technology transfer for entrepreneurship

Most of the literature on technology transfer mechanisms for sustaining entrepreneurship studied formal mechanisms such us the role of patenting and licensing of university inventions that can be commercially exploited by starting a new firm, or the incubation of university spin-offs (see Rothaermal et al. 2007**,** for a survey of the literature).

However, a few papers in the literature explored informal channels for transferring useful knowledge from university to industry (Link et al., 2007; Grimpe and Fier, 2010), that we broadly define as “non traditional” mechanisms for knowledge transfer.

A few studies, specially dedicated to informal mechanisms for university knowledge transfer and entrepreneurship, highlight some specific channels of interactions between university actors and start-ups or industry personnel. Informal technology transfer mostly

involves varied forms of personal interactions and informal communication processes (Grimpe and Fier, 2010).
Link et al. (2007) empirically analyze the characteristics of informal technology transfer mechanisms in a sample of university scientists and engineers holding a PhD at Carnegie Doctoral/Research Universities, by focusing on the transfer of commercial technology, joint publications with industry personnel and consulting. Grimpe and Fier (2010) analyze the same mechanisms in sample of university scientists with a PhD in Germany. They add dummies for disciplines and find that engineering scientists are more likely to use all three forms of informal technology transfer as compared to the baseline dummy of social scientists.
These mechanisms often complement formal mechanisms of technology transfer (Link et al., 2007, Perkmann and Walsh, 2007; Grimpe and Hussinger, 2008; Bruneel et al., 2010). However, they may also be a substitute when formal mechanisms are more difficult to be used or are less appropriate. Indeed, most of these studies focus on samples of university scientists with a PhD in science and engineering, where it is more likely to use also formal technology transfer mechanisms. There is instead less clear evidence on the use of informal mechanisms in fields with lower degree of science and technology intensity. The study of Meyer-Khramer and Schmoch (1998) compares university-industry interactions in different science-based industries. Within these industries they find that in mechanical engineering, which is characterized as less science based than the others, university industry interactions are very frequent, also because of intense use of formal mechanisms like university patenting.
Another important channel of technology transfer is the movement of people and specifically the hiring of students (Berkovitz and Feldman, 2004). However, Berkovitz and Feldman (2004) recall that the placement of students requires more informal channels and efforts in entrepreneurial universities, which need to provide scientific apprenticeship and intensive professor mentoring to their students.
Building on this literature on informal technology transfer, we contribute to fill the gaps by developing a broader understanding of informal channels for knowledge transfer for entrepreneurship, with a specific focus on LMT sectors.

2.2 Entrepreneurship by university students and graduates

Student entrepreneurship is a relatively new research topic and currently studied according to different perspectives. For instance, the GUESSS - Global University Entrepreneurial Spirit Students' Survey has been founded in 2003 to investigate entrepreneurial intentions of university students. This initiative has allowed research activities aimed at understanding the entrepreneurial intentions of students from different countries, different universities, different type of firms, or different disciplines. However, "the 'gap' between intentions and behavior is not negligible" (Sheeran, 2002: 29), and intentions-based investigations cannot generalize their results to encompass actual behaviors aimed at establishing new firms and are then exposed to over-estimation of the phenomenon (Marchand and Hermens, 2015; Shirokova et al., 2016).
Other studies (Galloway and Brown, 2002; Hsu et al., 2007; Lange et al., 2011; Roberts and Eesley, 2011) has been investigating entrepreneurial behaviors by university alumni. In this case, the focus is on actual behavior, not on intentions. Nevertheless (as noted by Åstebro et al., 2011), sampling on alumni often imply not differentiating on the basis of the time elapsed between the date of graduation and the date of new firm creation: in situations in which a lot of time has passed, it becomes complex to identify the impact of university on entrepreneurial choices. Furthermore, the strand of literature investigating

recent-graduate alumni usually deals with university spinoffs and formal technology transfer mechanisms.
Åstebro et al. (2011) analyze and compare new firms created by recent graduates in science or engineering with those created by their faculty. While results clearly show that the new-venture-creation potential of students is far higher than that of their professors, Åstebro and colleagues narrowed their analysis to students belonging to disciplines which are commonly associated with new firm creation in HT industries.
Beyhan and Findik (2017) study technology new firms created by university students in Turkey. They base their analysis on official indicators, which measure the performances of Turkish universities in terms of creation of new technology firms, and on the Turkish entrepreneurial and innovative university index. The results of their research, although meaningful, are university-centered and based just on technology firms.
Extant literature on student entrepreneurship deals either on student intentions or on entrepreneurial behavior in HT industries and the related formal mechanisms for technology transfer. Phenomena related to student-entrepreneurial behavior in LMT industries, and then to the mechanisms (mostly informal) adopted by universities for transferring knowledge in these domains, remain overlooked.
To fill this gap, this paper investigates the informal mechanisms for transferring knowledge from university to student and recent graduate (SRG) entrepreneurs in LMT industries, with particular reference to nascent SRG entrepreneurs.

3. Research design

3.1 Research context and sample

The empirical analysis is based on data from business plans submitted to Nuove Idee Nuove Imprese (NINI), a yearly business plan competition organized in San Marino and in the Province of Rimini[1] by an association comprising local Chambers of Commerce, Industrial associations, bank foundations, and Universities.
Every year, people interested in establishing new firms are invited to submit their synthetic business ideas to NINI. The business ideas must be submitted by a group of at least 3 cofounders. All the people involved in the groups are then invited to attend a preliminary course on entrepreneurship. After the completion of the course, groups are required to submit a detailed business idea (consisting of a ten-page description), which is evaluated by a technical-scientific committee that eventually selects the best ideas. The selected entrepreneurial groups participate in a second course on entrepreneurship and then submit a detailed business plan together with their full curriculum vitae (CV). The committee analyzes the business plans, convenes the proponents of the business plans for a pitch speech, and selects the three best business ideas that are entitled for an economic prize.
From its foundation in 2002, NINI has gathered 340 business plans, and has financed 43 projects with more than 500.000 € of overall prizes. In this paper, we narrow our focus to the period 2010-2017, a time span along which the rules governing the application stage, the selection of teams to be admitted at the training section, and the awarding of prizes to

[1] The Province of Rimini is located in the Emilia Romagna region and has a population of 337.000. While it is world renowned for its tourism industry, the Province of Rimini hosts important firms belonging to many other industrial domains, such as textile and fashion, buildings, electronics, and services. A Campus of the University of Bologna is located in Rimini, with courses in Management, Economics and Statistics, Humanities, and Life Sciences. The Republic of San Marino is an enclaved microstate, surrounded by the Province of Rimini and the Province of Pesaro-Urbino, with a population of 33.000. Its economy is mostly based on banks and financial services. San Marino hosts a state university (University of San Marino) with courses in Industrial Design and Engineering.

teams remain quite stable. Accordingly, our analysis draws on data generated under relatively homogeneous conditions throughout the period under scrutiny.
The working sample comprises 161 projects and 562 individuals. We retrieve data about the major traits of the entrepreneurial idea from the accompanying business plan. Besides, we gather data on the demographic characteristics of the proponents from their CVs. Drawing on the Global Entrepreneurship Monitor (Reynolds et al., 2005) and the Panel Study on Entrepreneurial Dynamics (Reynolds, 2017), we define these individuals as nascent entrepreneurs. Specifically, a nascent entrepreneur represents "a person who is trying to start a new business, who expects to be the owner or part owner of the new firm, who has been active in trying to start the new firm in the past twelve months and whose startup did not have a positive monthly cash flow that covers the expenses and the owner-manager salaries for more than three months" (Wagner, 2006: 16).
To deepen our understanding of whether and how informal mechanisms of knowledge transfer from universities influence the formation new ventures, we also conducted interviews with 10 former participants. Interviews consisted of semi-structured questions aimed at identifying the most relevant channels of knowledge transmission from university to nascent entrepreneurs, identifying other local sources of knowledge that have been relevant for the development of the business idea.

3.2 Variables and descriptive statistics

The empirical investigation presented in this paper relies on variables that refers to the following levels of analysis: *i)* individual; *ii)* project. In this subsection we describe the variables of interest and provide descriptive statistics on their distribution.
At the individual level (Upper panel in Table 1), we collect data on demographic characteristics like gender, age, and education. Specifically, the variable GENDER singles out that women make up nearly one third (32.4%) of all participants in our sample. The variable AGE shows how old were team members at the time of participation to the business plan competition. The average age of team members is 35.1 years. With respect to the main percentiles of the distribution we observe that the first quartile is 28 years, the median is 33 years, and the third quartiles is 41 years. Hence, a great deal of participants may be expected to have concluded university programs and gained a certain experience in the job market.
We use an ordinal categorical variable, EDUCATIONAL ATTAINMENT, to report the highest educational level of each participant. The five levels of this variable correspond to the following degrees: *i)* Secondary school; *ii)* High school; *iii)* Bachelor; *iv)* Master; v) PhD. Figure 1 reports that most individuals in our sample (49.1%) hold a master degree; 14% have a bachelor; 5.6% a PhD. Overall more than two thirds of subjects (i.e., 371 individuals) have a university background. The remaining share of sample individuals (30.5%) have a level of education corresponding, at most, with the high school.
Drawing on Beyhan and Findik (2017), we define student entrepreneur as the owner or part owner of a firm while she is enrolled in a university degree. Likewise, we define recent graduate as a person who becomes owner or part owner of a firm within five years since the attainment of the highest university degree. We have decided to take five years as a meaningful time frame to highlight behaviors (and informal mechanisms adopted for transferring knowledge) that are more directly connected with the academic experience of the graduate. This does not mean that afterwards university becomes irrelevant but, after five years, other drivers (such as working experience) are more likely to play fundamental roles in the formation of the entrepreneurial idea. In our empirical investigation we combine the two categories mentioned above into a single group comprising student or recent graduate, nascent entrepreneurs (SRGs). The variable STURE_GRADUATE in Table

1 indicates that 36% of sample members qualify as SRGs. Among them, 80.2% graduated at most 5 years before the competition, 15.1% the year after, and the remaining 4.7% two years after. Values reported in Table 1 also reveal that proponents with a university degree obtained more than 5 years before the competition, OLD_GRADUATE, account for 33.5% of all participants. Finally, the residual category of subjects without a university degree, NO_GRADUATE, encompasses 30.5% of members.

For participants holding a university degree, we construct a nominal, categorical variable, EDUCATIONAL FIELD, that singles out the discipline of the highest university degree. This variable involves the broad fields at the first level of the International Standard Classification of Education (UNESCO-UIS, 2014). Figure 2 displays the following distribution of disciplines in our sample: Engineering, manufacturing & construction (31.3%); Business, administration & law (28.8); Arts & humanities (14%); Social sciences, journalism & information (9.4%); Natural sciences, mathematics & statistics (6.2%); ICTs (4%); Health & welfare (3.5%); Services (1.6%); Education (0.6%); Agriculture, forestry, fisheries & veterinary (0.6%).

Finally, we consider the university where the highest degree was obtained and, specifically distinguish cases where such a degree was awarded by one of the local universities, i.e., University of Bologna and University of San Marino, from circumstances where the individual graduated in other universities. The variable LOCAL_GRADUATE in Table 1 clarifies that slightly more than half of subjects with a university degree come from a local university; indeed, 94.8% of subjects in this group got their highest degree from the University of Bologna.

Table 1. Descriptive statistics.

	Obs	Mean	Std. Dev.	Min	Max
			Individual level		
GENDER	562	0.324	0.468	0	1
AGE	534	35.142	9.647	18	66
EDUCATIONAL ATTAINMENT	534	3.287	1.002	1	5
STURE_GRADUATE	534	0.360	0.480	0	1
OLD_GRADUATE	534	0.335	0.473	0	1
NO_GRADUATE	534	0.305	0.461	0	1
LOCAL_GRADUATE	371	0.520	0.500	0	1
			Project level		
SIZE	161	3.491	0.923	2	10
SECTOR_R&D	161	0.404	0.492	0	1
FIRM_FOUNDED	161	0.304	0.462	0	1
IP_PROTECTION	161	0.099	0.300	0	1
DIVERSITY_EDU	154	0.561	0.371	0	1.332
DIVERSITY_EDU-TIME	154	0.493	0.350	0	1.099
DIVERSITY_ISCED	117	0.556	0.373	0	1.386

Figure 1. Distribution of educational attainment.

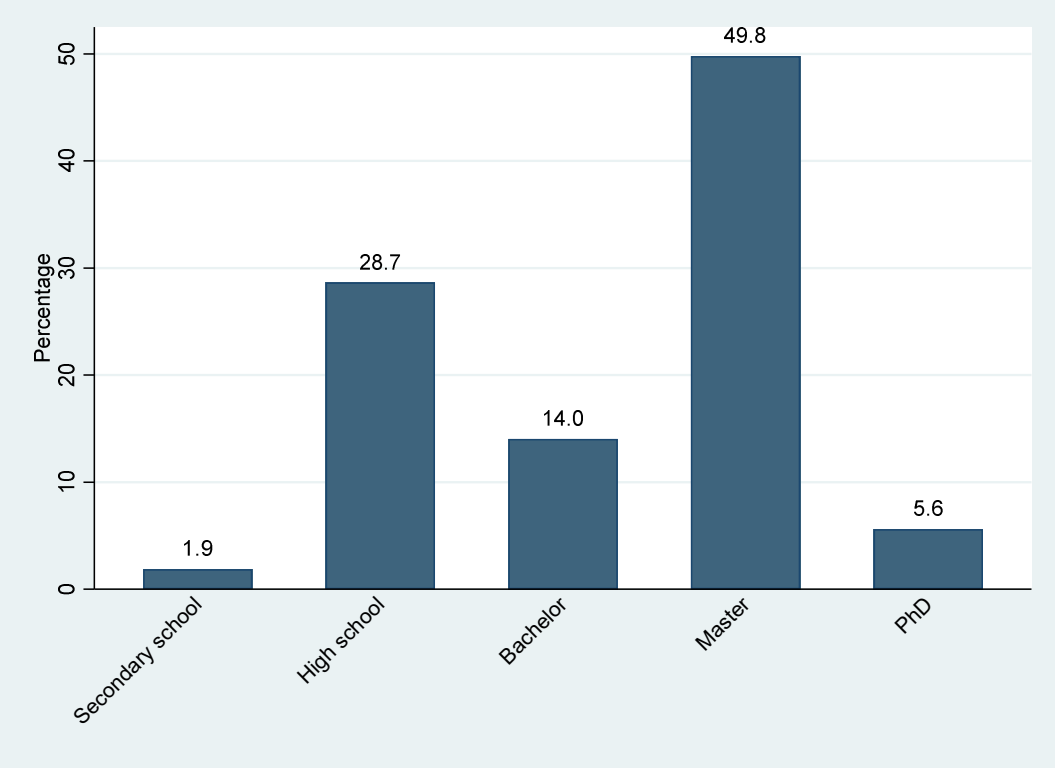
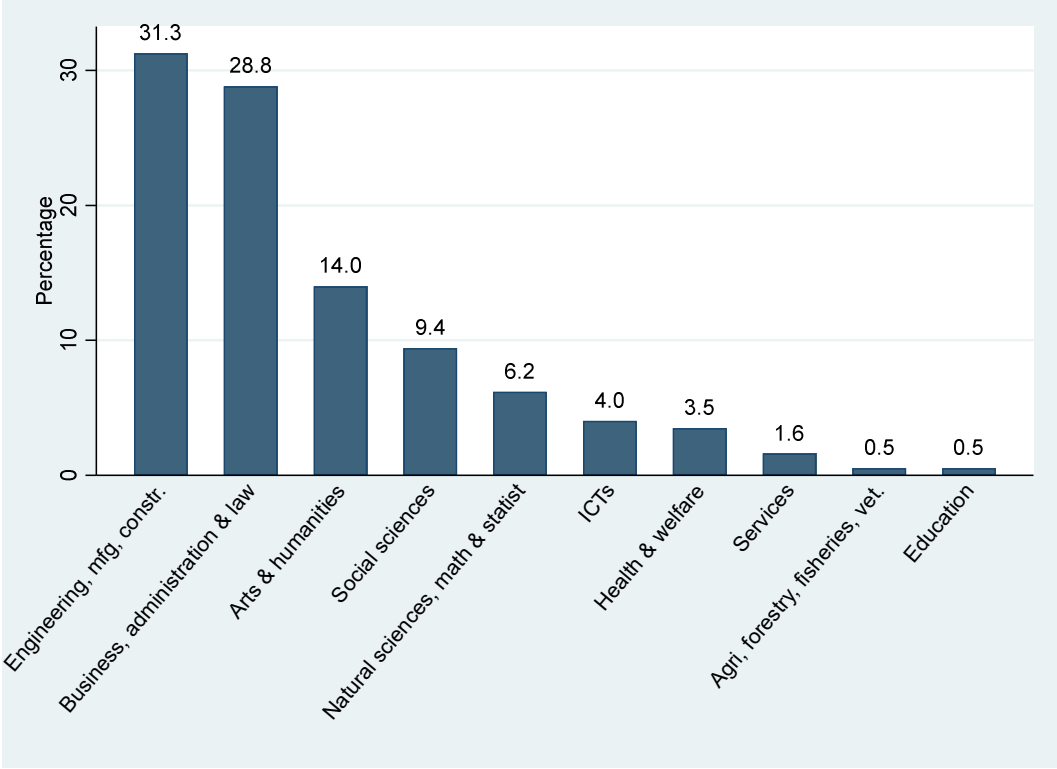


Figure 2. Distribution of educational specialty.



The lower panel of Table 1 shows descriptive statistics for variables measured at the project level. The variable SIZE refers to the number of proponents in each team. Due to the guidelines of the business plan competition, teams that submit a project must comprise at least three members. Thereafter, in our sample we do not have solo founder's projects. Indeed, 108 teams (67.1%) in our sample comprise 3 members, while the remaining teams involve, respectively: 2 members (a team only); 4 members (20.5%), 5 members (8.7%), 6 members (2.5%); and 10 members (a team only).

Our analysis categorizes the 161 projects into industries characterized by varying levels of R&D intensity. To allocate projects to each industry we rely upon the taxonomy of economic activity published by the Italian National Statistical Office (ISTAT, 2009), and the OECD classification of economic activities based on R&D intensity (Galindo-Rueda and Verger, 2016). The assignment procedure unfolds as described below.

We start by assigning a 6-digit code of economic activities (ISTAT, 2009) to entrepreneurial projects submitted with the business plans. The assignment of a specific 6-digit code is based on the three criteria. First, if the proponents of a project formally registered a company with the chamber of commerce, we take the industry code they declared in the registration form; using this criterion we classify 49 projects. Second, when no firm was established, we read the business plan to check if proponents listed other companies as competitors. Whenever they did, we search for data about the mentioned companies and assign to the project the industry code of those entities that the proponents label as direct competitors. Based on this criterion we classify 25 projects. Third, if no firm was founded and the business plan does not refer to any competing firms, we carry out a thorough reading of the text describing the business idea and match this description with the industry code that fits the description. Based on this criterion we classify the remaining 87 projects.

Given that the taxonomy of economic activity adopted by ISTAT and the OECD classification are both based on the International Standard Industrial Classification (ISIC, Rev 4), we can create a correspondence between each 6-digit industry with and the following degrees of R&D intensity: 1) low; 2) medium-low; 3) medium; 4) medium-high; 5) high. For this study, we further aggregate the 5 groups into two clusters and define the binary variable SECTOR_R&D that equals 1 if the project accrues to a medium-high, or high R&D intensity (40.4%), and 0 if the project targets a sector displaying a low, medium-low, or medium R&D intensity.

Table 2 portrays the distribution of projects by divisions of economic activities and levels of R&D intensity. Most of the projects in our sample, 96 (59,6%), belong to a low-medium R&D context. Among them, 24 projects involve professional, scientific and technical activities; 16 projects concern manufacturing; 14 projects refer to administrative and support service activities. As for the projects accruing to a high R&D setting (65), we find that more than two thirds involve information and communication services, whereas 15 projects pertain to manufacturing sectors.

Table 2. Distribution of projects by R&D intensity and division of economic activity

Macro cluster	OECD group of R&D intensity	Division (ISIC, Rev 4)	Number of projects
Low-medium R&D	Low (N=52)	Agriculture, forestry and fishing	4
		Water supply & waste management	2
		Construction, trade, & transportation	10
		Accommodation & food service activities	8
		Information & communication	1
		Real estate activities	1
		Professional, scientific, & technical activities	1
		Administrative & support service activities	13
		Other activities	12
	Medium-low (N=42)	Manufacturing	14
		Information & communication	3
		Professional, scientific, & technical activities	23
		Administrative & support service activities	1
		Other activities	1
	Medium (N=2)	Manufacturing	2
High R&D	Medium-high (N=51)	Manufacturing	6
		Information & communication	45
	High (N=14)	Manufacturing	9
		Professional, scientific, & technical activities	5

Notes: Groups of economic activities within the same divisions can be linked with varying degrees of R&D intensity. See Galindo-Rueda and Verger (2016, 10) for details about groups accruing to each division. Details about the specific group-division linkages in our sample are available from the author upon request.

The variable FIRM_FOUNDED reveals that 49 entrepreneurial projects (30.4%) were exploited through the establishment of a new firm (Table 1). Such an event typically occurs within a narrow time windows with respect to the year in which the team submitted the project.

From additional inspection of the data we find that in 32.7% of the cases the firm is established the same year of the contest; in 28.6 of the cases the founding takes place the year after; in 26.5% it occurs the year before. At the time of writing, spring 2018, most new ventures (36) are still active. As for the distribution of new firms by sectors of economic activity, we find that 27 ventures operate in an industry with a low-medium R&D intensity and one third of them involves professional, scientific and technical activities. Among the 22 new firms accruing to an industry with a high R&D intensity, we find that more than one third offer information and communication services.

Reliance on innovative offerings is not a distinguishing feature of the entrepreneurial projects under scrutiny in this study.

The dichotomous variable IP_PROTECTION in reveals that proponents of only 16 projects (10%) have sought to protect their business ideas by filing a patent and/or a trademark application with the national authorities. A preliminary inspection of our data points out that the investment in intellectual property protection is correlated with the emergence of a new organization. While one quarter of the teams who established a new venture also applied for at least one patent or trademark, only 4 out of the 112 teams for which a firm was not founded have applied for any mechanism of legal protection. Finally, we observe

that teams proposing business ideas in high R&D contexts apply more often for patents or trademarks (15.4%) than teams targeting low-medium R&D settings (6.3%).
To extend the portrait of the sample teams, we construct three measures of within team diversity that are based on the following attributes: *i)* educational attainment; *ii)* holding of a university degree and time since graduation; *iii)* field of education. Because of missing data on the education level for 5% of subjects in the sample, the computation of diversity measures was not feasible for 7 teams. Thereafter, statistics discussed in what follows refer to 154 teams comprising 527 members. First, drawing on the educational attainment of team members, we compute an entropy index (DIVERSITY_EDU) that gauges the within group diversity with respect to this demographic attribute. Second, we use the variables STURE_GRADUATE, OLD_GRADUATE, and NO_GRADUATE to compute an entropy index (DIVERSITY_EDU-TIME) that gauges the within group diversity in terms of education level and time elapsed since graduation. Third, for teams comprising at least two members with a university degree (i.e., 117 teams), we compute an entropy index (DIVERSITY_ISCED) that gauges the within group diversity with respect to discipline of the highest academic degree. The last three rows in Table 1 display descriptive statistics for these variables.

4. Findings

4.1 Features of entrepreneurial teams

In this section we discuss the main evidence concerning selected individuals and team level variables, the development of projects with differential R&D intensity, and the actual founding of a new venture.
The cross tabulation of educational level and the R&D intensity of the project in the upper panel of Table 3 points to the existence of a relationship between educational attainment and technological content of the entrepreneurial idea. Indeed, two thirds of team members with a PhD develop projects in high R&D sectors, whereas the share among proponents with a bachelor degree declines to 46.7%, and it further shrinks to 37.5% among persons with at most a secondary school degree.
Next, we consider the team level variable DIVERSITY_EDU and evaluate whether teams with a project in low-medium R&D sectors differ from what observed for teams targeting high R&D sectors. The average value of DIVERSITY_EDU is 0.539 for the former and 0.592 for the latter; such differences are not statistically different ($t = -0.872$ and p value = 0. 385). Likewise, we do not observe statistically significant differences in the average entropy index between projects that lead to the establishment of a new firm and projects that are not associated with a founding event.

Table 3. Distribution of team members by education level, time since graduation, education field, and R&D intensity of the project.

		R&D intensity of the industry linked to the project		
EDUCATIONAL ATTAINMENT		Low-medium	High	Total
Secondary school	N	5	3	8
	%	62.5	37.5	100
High school	N	94	57	151
	%	62.25	37.75	100
Bachelor	N	40	35	75
	%	53.33	46.67	100
Master	N	150	113	263
	%	57.03	42.97	100
PhD	N	10	20	30
	%	33.33	66.67	100
Total	N	299	228	527
	%	56.74	43.26	100

Graduation & time elapsed		Low-medium	High	Total
NO_GRADUATE	N	99	60	159
	%	62.26	37.74	100
STURE_GRADUATE	N	99	93	192
	%	51.56	48.44	100
OLD_GRADUATE	N	101	75	176
	%	57.39	42.61	100

EDUCATIONAL FIELD *(SRGs)*		Low-medium	High	Total
Engineering, manufacturing & construction	N	23	38	61
	%	37.7	62.3	100
Business, administration & law	N	38	21	59
	%	64.41	35.59	100
Arts & humanities	N	18	8	26
	%	69.23	30.77	100
Natural sciences, mathematics & statistics	N	7	7	14
	%	50	50	100
ICTs	N	1	11	12
	%	8.33	91.67	100
Social sciences, journalism & information	N	7	4	11
	%	63.64	36.36	100
Other fields	N	5	4	9
	%	55.56	44.44	100
Total	N	99	93	192
	%	51.56	48.44	100

Values reported in the middle panel of Table 3 indicate that 192 individuals qualify as SRGs. The other two categories comprise 176 members who earned their highest

university degree more than 5 years before the competition, and 159 subjects without a university degree.

SRGs (STURE_GRADUATE) distribute evenly between projects accruing to a low-medium R&D sector (51.6%) and the ones belonging to a high R&D sector (48.4%). On the contrary, individuals without a university degree (NO_GRADUATE) concentrates more in low-medium R&D projects (62.3%). An intermediate result is observed for individuals with a university degree earned more than 5 years before the business competition (OLD_GRADUATE). This piece of evidence suggests that knowledge acquired at university entails SRGs to develop entrepreneurial ideas with a higher technological content than those proposed by individuals who cannot leverage this type of knowledge, or by individuals with a recent university education.

Figure 3 illustrates the means of our three indicators of diversity in LMT and HT sectors. When considering the team-level variable DIVERSITY_EDU-TIME, we find no evidence that a higher within team variety is linked to projects displaying superior R&D intensity. Indeed, the average DIVERSITY_EDU-TIME for projects with low-medium R&D intensity is 0.468, whereas the average DIVERSITY_EDU-TIME for projects with high R&D intensity is 0.529: such differences are not statistically significant ($t = -1.073$; p value = 0.285). Even in this case, we do not uncover statistically significant differences in the average entropy index between projects for which a new firm was founded and projects that are not associated with a founding event.

A closer inspection of the data reveals that DIVERSITY_EDU-TIME takes on the minimum value of 0 for 45 teams; these groups comprise only individuals belonging to a single category. Specifically, 20 teams involve only SRGs; 12 teams only older graduates; 13 teams encompass only individuals who obtained a high school degree. It is also worth noticing that nearly two thirds of the 45 teams displaying the minimum level of diversity submitted projects in low-medium R&D contexts. On the contrary, DIVERSITY_EDU-TIME takes on the maximum value (1.099) for 12 teams, or 7.8% of the total. Overall, these findings convey the idea that teams in our sample generally comprise mates with similar characteristics in terms of educational level and timing of degree achievement.

With respect to the team-level variable DIVERSITY_ISCED, we don't find evidence suggesting that teams with at least two graduate members that submit projects in low-medium R&D contexts (0.534) differ substantially from teams with projects in high R&D settings (0.586); such differences are not statistically significant ($t = -0.750$; p value = 0.455). Instead, we find mild evidence that teams with at least two graduate members that submit projects linked to an actual firm founding are, on average, more heterogeneous (0.597) than teams with projects not associated with a founding event (0.471); such differences are marginally, statistically significant ($t = 1.725$; p value = 0.087).

Figures in the lower panel of Table 3 shed light on the educational profile of SRGs. We can see that three quarters of the 192 SRGs in our sample hold a degree in the following fields: Engineering, manufacturing & construction (61); Business, administration & law (59); Arts & humanities (26). Individuals within these three groups display systematic differences in their propension to target industries with varying degrees of R&D intensity. 62.3% of SRGs with an engineering degree are involved in high R&D contexts. On the other extreme, 69.2% of SRGs with a degree in arts and humanities participate to projects targeting low-medium R&D contexts. Finally, we find that SRGs with a specialization in business are overwhelmingly concentrated (64.4%) in low-medium R&D sectors. In a nutshell, we uncover a robust linkage between education fields and the R&D intensity of the entrepreneurial project among SRGs.

The value reported in Table 4 reveal that SRGs from specific (aggregated) educational fields end up in teams with quite different degrees of variety as measured by

DIVERSITY_ISCED. More precisely, the last column of Table 4 points out that SRGs in education, arts & humanities, and social sciences (0.700) belong to more heterogeneous teams in terms of educational fields than both SRGs in natural sciences, ICTs, and engineering (0.493) and those in business, administration & law (0.498). The difference in both comparison is statistically significant (first case: t = 2.785; p value = 0.006; second case: t = 2.707; p value = 0.008). The magnitude of these differences does not substantially change when we consider the R&D intensity of the submitted projects. However, we observe that SRGs in business, administration, and law who submit a project in low-medium R&D contexts are part of more homogeneous teams (0.397) than likewise SRGs pursuing a venture in high R&D contexts (0.676); this difference is also statistically significant (t = -3.223; p value = 0.002).

Our investigation highlights two further traits that shape the profile of SRGs with respect to older graduates (Figure 3). First, SRGs submitting a project in low-medium R&D sectors belong to teams that display a lower variety as measured by DIVERSITY_ISCED (0.497) than what observed for older graduates targeting the same sectors (0.646); this difference is statistically significant (t = -2.432; p value = 0.016). Second, SRGs from a local university (i.e., the University of Bologna) enter teams with a lower variety in terms of DIVERSITY_ISCED (0.513) than teams comprising older graduates from the same university (0.666); this difference is also statistically significant (t = -2.769; p value = 0.006).

Figure 3. Average values of within-team diversity measures by type of R&D sector.

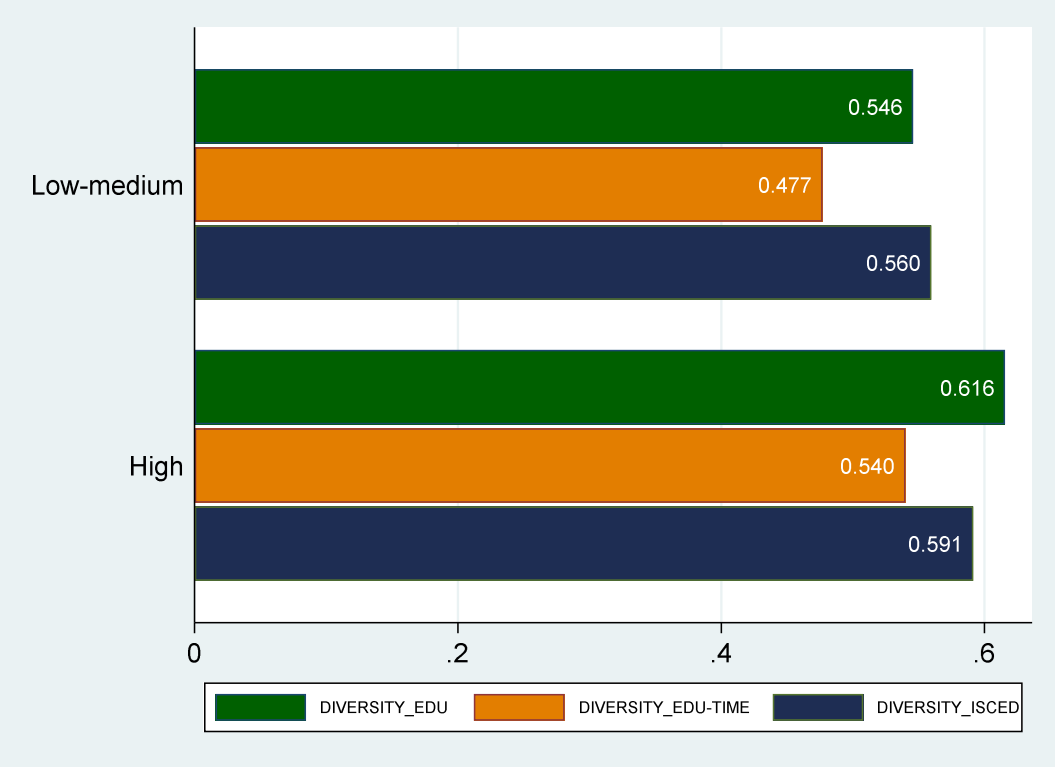


Table 4. Average value of variable DIVERSITY_ISCED by education field of SRGs and R&D intensity of the project.

SRGs field of graduation		*R&D intensity of the project*		Total
		Low-medium	High	
Education, Arts & Humanities, Social sciences	N	24	10	34
	Mean	0.688	0.727	0.700
Business, administration & law	N	37	21	58
	Mean	0.397	0.676	0.498
Natural sciences, ICTs, Engineering	N	29	54	83
	Mean	0.474	0.503	0.493
Other fields	N	3	4	7
	Mean	0.443	0.641	0.556
Total	N	93	89	182
	Mean	0.498	0.575	0.536

Summarizing: our preliminary findings do not point to a systematic association of within team variety, in terms of educational level, and the sector of economic activity of the submitted projects. Similarly, we don't find any association when considering an entropy index that gauges the within team diversity with respect to a categorical variable that distinguishes individuals without a university degree, SRGs, and graduates from more than 5 years. Notwithstanding, we uncover a relationship between educational attainment and the R&D intensity of the entrepreneurial idea. Furthermore, our results suggest that SRGs leverage knowledge acquired at university to develop entrepreneurial ideas with a higher R&D content than those proposed by individuals without a university degree. Besides, SRGs with a background in arts and humanities, and those trained in business, administration & law are more likely to submit projects involving economic activities with a low-medium R&D intensity. Finally, SRGs pursuing an entrepreneurial idea in a low-medium R&D sector build more homogeneous teams in terms of educational specialization than older graduates targeting the same context.

To shed some light on the type of knowledge that SRGs acquire from university and later exploit in entrepreneurial projects, we interviewed a few proponents that shared with us interesting insights on this issue. We narrowed the focus of our investigation to individuals who submitted projects accruing to low-medium R&D sectors, and whose academic background is either in art and humanities, or business. In the next section, we discuss the major findings of this qualitative analysis.

4.2 Interviews on informal mechanisms of knowledge transfer

As previously mentioned, informal mechanisms for knowledge transfer are subtle and quite difficult to investigate, in particular through quantitative analysis. To identify the most relevant informal mechanisms through which university has transferred knowledge useful for the formation of the business idea and the creation of the new firm, we carried out an exploratory qualitative investigation. Hence, among the participants in NINI in the period 2010-2017, we identified 8 SRGs, belonging to 7 different LMT business ideas. We also interviewed 2 SRGs participating in 2 HT projects, to investigate the relevance of informal mechanisms for KT in this kind of ventures. Table 5 presents the characteristics of the interviewees and of their business idea. With respect to the two interviews concerning the same project, we consolidated them into one record, since interviewees

share similar academic backgrounds and have similar feelings about the relevance of the university for the development of their business idea.

Table 5. Characteristics of the interviewees and of their business idea

ID of nascent firm	Year of NINI participation	Activity of the nascent firm	LMT or HT	Field of study of the interviewee	Student or recent graduate when participating in NINI?
1	2010	Fashion design	LMT	Humanities (Fashion)	Student
2	2011	Conception of advertising campaigns	LMT	Business and administration	Student
3	2012	Online store	LMT	Architecture	Recent graduate
4	2013	Educational farm	LMT	Psychology	Student
5	2014	Agriculture and food production	LMT	Engineering	Student
6	2016	App for the digitalization of cultural contents	HT	Business and administration	Student
7	2016	Flight-control systems	HT	Engineering	Student
8	2017	Online services for medical doctors	LMT	Medicine	Recent graduate
9	2017	Consultancy in human resource management	LMT	Business and administration	Recent graduate

We then conducted a thematic analysis (Guest, 2012) on the transcriptions of the 10 in-depth interviews. To this end, we defined 4 macro themes, composed of 18 codes (third-level codes were also identified):

- Mechanisms of knowledge transfer (formal mechanisms; relationships with teachers; relationships with other students; relationships with other graduates; participation in academic research activities; relationships with the final-dissertation supervisor);
- Education (main field of study; education on entrepreneurship-related disciplines; international educational experiences; internships; relevance of the disciplines studied with respect to the formation of the business idea; relevance of the disciplines studied with respect to the establishment of the new firm);
- Other local sources of knowledge (participation in courses on entrepreneurship organized by local institutions; participation in local initiatives aimed at fostering and supporting entrepreneurship; others);
- Other sources of knowledge (participation in courses on entrepreneurship organized by national or international institutions; participation in national or international initiatives aimed at fostering and supporting entrepreneurship; others)

In particular, we segmented the texts and we assigned one or more consistent codes to each segment. Then, we reorganized the texts by putting together all the segments sharing the same code within a new document, thus obtaining a transversal perspective on the same topic. We carefully read and re-read all the texts pertaining to the same code and we highlighted similarities, differences, and trends. The most important results of this analysis are synthesized in Table 6.

Table 6. Summary of evidences from interviews.

ID	Academic mechanisms knowledge transfer	Knowledge from academic education	Other local sources of knowledge	Other sources of knowledge	A short citation on the relevance of university for the creation of the new firm
1	No formal mechanisms exploited; The business idea has been stimulated by a university teacher, who organized a field work (a fashion lab open) as part of his course; Strong relationships with other students participating in the field work; The initial startup team was composed of students participating in the field work; Initially, also the university teacher participated in the founding team; All the initial teammates did their final dissertations on topics related to the business idea	They did not attend any academic course related to entrepreneurship; The academic knowledge related to the fashion industry was fundamental for the formation of business idea, not for the establishment of the new firm	Just a short-term collaboration with a local association supporting Corporate Social Responsibility initiatives	None	"The university is the means that has made this possible, even if it hasn't formally supported us"
2	No formal mechanisms; No relationship with university teachers; Some discussions with other students	University allowed to learn a method for dealing with the management of a firm, some skills related to marketing and strategic management. It was interesting to participate, in the framework of a university course, in seminars related to creativity and entrepreneurship	None	Participation in other business plan competition in Italy	"Without the university, we would have created the enterprise, but not in the way we actually did"
3	No formal mechanisms; No relationships with teachers, students or past students	University has provided valuable, mostly methodological knowledge	Participation in courses on entrepreneurship organized by the local Chamber of Commerce; Participation in a regional program for developing entrepreneurial skills and supporting new business ideas; Participation in other business plan competitions	Vocational courses in project management in Milan	"Once you leave the university, you are alone"
4	No formal mechanisms; Some discussions with teachers; Final dissertation written on topics related to the business idea	Useful for the contents of the job, not for the business idea	None	None	"University has been more important for the development of skills related with my job in the new firm than for the formation of the business idea"

5	No formal mechanisms; No informal mechanisms	University useful for some skills related to some extent to business planning, not for entrepreneurship	Participation in a Youth entrepreneurship program organized by the Republic of San Marino	None	"At the university, I learned a lot of generic knowledge… it has been useful not fundamental"
6	No formal mechanisms; Business idea suggested by university teacher; Final dissertation written on topics related to business idea; Some discussions with teachers and with other students; The project has been developed together with two university colleagues	University has been important in terms of skills, but also with respect to the development of the capability to learn	Participation in a European contest in the framework of Horizon 2020 side actions	The nascent firm has been incubated by a university incubator in Rome, but they quit before participating in NINI	"I actually took advantage of the competences I learned at the university… and this surprised me! And, even when I had to solve problems I was not acquainted with, I discovered that, thanks to my university background, I had the 'forma mentis' to learn and go ahead"
7	No formal mechanisms; Business idea has been developed within a university research lab: the cofounders are researchers that have been working together for years; PhD theses on topics related to the business idea; The university teacher participates in the founding team	University research activities have been a critical success factor for the new firm. The founders recognize they lack competences related to business and administration.	Collaboration with a local bank foundation	A formal discussion with the university for the recognition of the new firm as a university spin-off is currently under way	"Starting up a firm was the only way to ensure the continuity of the research group"
8	No formal mechanisms exploited; Just some discussions with some university teachers; No relationships with students or past students	No university education related to entrepreneurship; The skills developed at the university has been fundamental for the job of medical doctor, not for the business idea	Some relationships with local institutions organizing vocational training on entrepreneurship; Some discussions with local business consultants	None	"The university played a role in the development of my medical skills, not for my propensity towards entrepreneurship"
9	No formal mechanisms provided by university During university studies, many important and valuable discussions with other students, these discussions led to the definition of the business idea and to the identification of cofounders; Discussions with teachers, during and after university studies, have been very important to frame the scope and the goal of the new firm	University courses covering topics related to entrepreneurship have indirectly supported the definition of the business idea and the establishment of the firm	Local environment, dynamic and open to innovation, has acted as a catalyzer for the entrepreneurial endeavor; Participation in local initiatives aimed at incubating new firms	The nascent firm has been incubated and accelerated in Milan and Turin	"The business idea is born and has been nurtured at the university"

This analysis sheds some light on the informal mechanisms that take place between university and SRGs with respect to the creation of new firms in LMT industries.
First of all, if we refer to the impact of university education, it is clear that SRGs entrepreneurs think that the knowledge they acquired is (directly or indirectly) important.

SRGs who did not study topics related to business management and entrepreneurship usually find their university education useful since it either allowed them to specialize on a domain consistent with their business idea or allowed them to learn a method for dealing with actual problems and complexity. In addition, SRGs who have studied business and administration think that they have benefited from courses focusing specific topics related to firm management (e.g. business planning, marketing, strategic management, human resource management). All the interviewees agree on the structural lack of university courses specifically aimed at developing skills on entrepreneurship.

With respect to the mechanisms for knowledge transfer, it seems that SRGs nascent entrepreneurs in LMT industries do not take advantage of formal initiatives provided by universities. The situation is more complex when we refer to informal mechanisms: some SRGs have actively pursued relationships and suggestions from teachers and other students, while others did not succeed in finding any useful relationship or they even did not try to establish relationships. In one case, the university took an active role in stimulating knowledge transfer, thanks to the initiative of a teacher that organized a field work that eventually stimulated the creation of a new business idea.

Another mechanism of knowledge transfer that appears to be unexploited is the alumni network. This can be explained by referring to the absence in most of the observed period of social/professional networks of this kind. However, it is also evident that nascent SRG entrepreneurs in LMT industries are not much interested in establishing relationships with past students.

Many SRG entrepreneurs have found additional sources of knowledge in the local milieu in which they were establishing the new firm. Most of them attended vocational courses related to entrepreneurship or participated in local initiatives aimed at fostering new firms. Nevertheless, it seems that only few SRGs have strategically selected the initiatives to participate in. In many cases, the participation seems to take place because of the availability of an opportunity and not as a consequence of a deliberate decision-making process. Furthermore, almost all the interviewees stated that they found the identification of opportunities very difficult because of the growing number of initiatives aimed at entrepreneurship and of the lack of full information.

Finally, with respect to the exploitation of national (or international) sources of knowledge, it seems that nascent entrepreneurs in LMT industries pursue these opportunities at a very limited extent.

Overall, universities appear to be open to knowledge transfer even with respect to entrepreneurial activities in LMT industries. However, this availability is not translated in formal initiatives, on the contrary, it all depends on the SRGs' willingness to take advantage of the opportunities provided by the academic environment: if the SRG takes an active role, she can greatly benefit from informal relationships with the university, otherwise she will not be provided with specific service or support.

5. Discussion and conclusions

The results of this analysis contribute to the literature on nascent and student entrepreneurship and on university-industry technology transfer by focusing on informal and non-traditional mechanisms for KT that appear appropriate for service and traditional local-specific industries.

They also provide managerial and policy implications for the design of effective university programs and initiatives for KT, of local policies supporting the local production and exploitation of useful knowledge, and the collaborative network of interactions among relevant actors for the competitiveness of the territorial economic system.

The empirical analysis conducted on 161 entrepreneurial ideas allowed to highlight the individual characteristics (with particular reference to academic background) of SRG nascent entrepreneurs and of their entrepreneurial projects. In addition, comparisons have been presented to point out the differences between individuals and projects belonging to low and medium-tech industries and those belonging to high-tech industries.

Evidences show a robust relationship between education field and the R&D intensity entrepreneurial projects, with most of the SRGs in arts and humanities involved in LMT projects, SRGs in business mainly involved in LMT projects, and SRGs in engineering mostly involved in HT projects.

Educational fields seem to be relevant also with reference to the composition of teams, with engineering driving towards homogeneous teams and arts and humanities pushing towards more heterogeneous teams, both in HT and LMT projects. As for SRGs in business, administration and law, they tend to group together in homogeneous teams when developing LMT projects, while they participate in more heterogeneous teams when working on HT projects.

The descriptive analysis in this paper offers insights for the debate on the relationship between the heterogeneity of new venture teams (e.g., educational level and educational specialty), and entrepreneurial outcomes (e.g., the actual founding of a new firm) that deserve further investigations. In line with previous research (Klotz et al., 2014), our findings corroborate the idea that a complex relationship exists between these two factors. On the one side, we observe that SRGs build more homogeneous teams in terms of educational specialty than older graduates who might have accumulated experience in the job market. On the other side, we see that teams that proceed to the stage of firm founding are more homogeneous in terms of educational specialty than teams which do not experience a founding event. Albeit we cannot propose any definitive interpretation of these patterns, at this stage of our analysis, we believe important for future research to investigate the hypothesis that universities provide SRGs with shared language and methods which, under certain conditions, ease the emergence of new firms.

It is also worth noting that results suggest that SRGs take advantage of the knowledge acquired at university to develop more innovative entrepreneurial projects than those planned by non-graduates.

These results reinforce the role of the traditional mission (the one related to the education of students) of the university in supporting entrepreneurship, both in HT and LMT industries. This role is complemented by formal KT mechanisms mostly in case of new firms aimed at HT industries.

To further understand the informal KT mechanisms through which university support nascent entrepreneurs in LMT sectors, we conducted an exploratory qualitative analysis. This analysis shows that university has potential for supporting SRGs entrepreneurial endeavors and that it actually performs many KT activities: educational activities related to entrepreneurship, project works and field works, mentorship by teachers, advises from other students and alumni, to cite only the most relevant ones.

We also find that in HT sectors informal mechanisms are less evident, and their relevance is partially hidden by the use of formal mechanisms for knowledge transfer, at the initial or in later stages of the entrepreneurial process. Informal mechanisms may trigger the development of entrepreneurial ideas, but in the medium long term a more important role in the start-up creation process may be covered by formal mechanisms of KT. By contrast in LMT sectors, informal mechanisms assume a prominent role and their effects tend to be long-lasting. These findings suggest that university provide inputs that SGR utilize with a pro-active behavior in the entrepreneurial process.

Our study presents some limitations that pave the way for future research. First of all, the quantitative analysis is focused on the educational backgrounds of SRGs, thus it may lead to underestimate the impact of work experiences of team members. Further research should investigate this important variable and should also measure the consistency of the educational background of team members with respect to their role in the nascent firm. In addition, this paper does not measure the impact of education-specific variables on the performance of new firms in LMT and HT sectors. Finally, with respect to the qualitative analysis, the limited number of interviews prevents the generalization of results. Additional interviews, involving also SRGs participating in HT ventures, may allow to define a set of informal mechanisms of KT that may be subsequently investigated through a systematic survey of team member and projects, thus providing relevant results for the theoretical conceptualization of these mechanisms. Despite these limitations, the results of this paper shed light on the subtle and overlooked mechanisms of KT through which university fosters and supports student entrepreneurship in LMT sectors.

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