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University knowledge and the creation of knowledge-intensive firms: The moderating effect of the local banking industry

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Abstract

In this paper, we study whether and how the local presence of cooperative banks influences the conversion of university knowledge into the creation of knowledge-intensive firms in a geographical area. To this end, we run a series of negative binomial regressions where the dependent variable is the number of new firms operating in knowledge-intensive sectors established in 792 province-industry pairs in the period 2012-2014. We find that the local presence of cooperative banks affects the exploitation of university knowledge for the creation of knowledge-intensive firms in a certain province. In particular, its effect depends on the extent to which local population tends to behave opportunistically. Specifically, where it is higher the likelihood that individuals behave opportunistically, a higher local presence of cooperative banks fosters the local creation of new firms in knowledge-intensive sectors. Conversely, such effect is negligible in geographical areas where individuals have lower attitude to opportunistic behaviors. We contend that our work has important implications for policy-makers willing to create a suitable environment for knowledge-intensive entrepreneurship.

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Abstract

In this paper, we study whether and how the local presence of cooperative banks influences the conversion of university knowledge into the creation of knowledge-intensive firms in a geographical area. To this end, we run a series of negative binomial regressions where the dependent variable is the number of new firms operating in knowledge-intensive sectors established in 792 province-industry pairs in the period 2012-2014. We find that the local presence of cooperative banks affects the exploitation of university knowledge for the creation of knowledge-intensive firms in a certain province. In particular, its effect depends on the extent to which local population tends to behave opportunistically. Specifically, where it is higher the likelihood that individuals behave opportunistically, a higher local presence of cooperative banks fosters the local creation of new firms in knowledge-intensive sectors. Conversely, such effect is negligible in geographical areas where individuals have lower attitude to opportunistic behaviors. We contend that our work has important implications for policy-makers willing to create a suitable environment for knowledge-intensive entrepreneurship.

1. Introduction

The Knowledge Spillover Theory of Entrepreneurship (hereafter: KSTE) is a rather-new research stream within the entrepreneurship literature, having discussed and empirically documented that local availability of university knowledge fosters entrepreneurship in a geographical area (Audretsch and Lehman, 2005; Bonaccorsi et al., 2013; Bonaccorsi et al., 2014). Among such academic debate, several contributions have recently acknowledged the role of the local context in shaping this process. These contributions have found that the positive effect of the university knowledge on new firm creation is positively moderated by the local availability of high-skilled (Qian and Acs, 2013) and tolerant individuals (Ghio et al., 2015) or by the lower level of competition in the local market (Plummer and Acs, 2014). This paper adds to this debate by investigating how the local banking system magnify (or hamper) the conversion of university knowledge into new knowledge-intensive firms (hereafter: university-based entrepreneurship) in a geographical area.

To this purpose, we ground on the entrepreneurial finance literature which has extensively documented that information asymmetries (Akerlof, 1970) between capital seekers and providers plague the search for external capital by perspective entrepreneurs (Rea, 1989). This holds particularly true in case of perspective entrepreneurs who intend to set up a new firm having new knowledge as competitive advantage (Hall, 2002), and we argue that the situation is even worse when these new firms result from the exploitation of university knowledge. Indeed, this knowledge is just partially formed, not directly created for commercial purposes and hardly to evaluate for non-scientists (Stephan, 2012). In sum, it is hard to deny that a perspective entrepreneur who recognizes an opportunity to create a new firm out of university knowledge suffers from high information asymmetries and encounter great difficulties in attracting external capital. These difficulties are likely to be even more pronounced in contexts where the expectation on others behaving opportunistically is higher (i.e., where the individuals' level of compliance to social norms is low - Knack and Keefer, 1997).

In this context, we study whether and how the local presence of cooperative banks can influence the difficulties that new firms dealing with IAs issues have to face, thus magnifying (or hampering) the university-based entrepreneurship. More specifically, we investigate whether the local presence of cooperative banks facilitates (hinders) the access to banking finance by perspective entrepreneurs who intend to create new firms out of university knowledge. Ultimately, this should reflect a positive (negative) effect on the exploitation of university knowledge for the creation of new knowledge-intensive firms in a geographical area. In this perspective, building on previous works having studied the economic relevance of cooperative banks, two potentially opposite effects emerge. From one hand, the trust building effect relates to the fact that cooperative banks have superior ability to cope with information asymmetries by establishing dedicated trust-based relationships between entrepreneurs and bank managers and thus facilitating the university-based entrepreneurship (Howorth and Moro, 2006; Ferri et al., 2014; Ayadi et al., 2010). From the other hand, the risk aversion effect resides on the evidence that cooperatives are less risky compared to other banks (Hesse and Cihak, 2007), thus suggesting a lower tendency of such banks to invest in risky business projects as in the case of university-based entrepreneurship. As such, the first aim of the present article is to assess which of the two effects is more important in the case of university-based entrepreneurship.

Financial contracts are nothing than an exchange of an amount of money today for a promise of a future economic return (Guiso et al., 2004). As such, the expectations of opportunistic behaviors of borrowers can further harden the access to banking finance for perspective entrepreneurs. We contend that the trust building effect of local cooperative banks is especially important in this situation. In this perspective, the second aim of the present article is to investigate whether the moderating effect of cooperative banks (if any) depends on the extent to which local banks perceive the risk of opportunistic behaviors of borrowers.

To the best of our knowledge, this is the first work that investigates how the characteristics of the local financial system and, in particular, of the local banking industry, mediate the impact of university knowledge on the creation of knowledge-intensive firms at the local level. Given the

relevance of the issue, this is rather surprisingly. Indeed, to create new ventures perspective entrepreneurs must orchestrate a wide array of resources and the financial capital needed to start and run the business figures prominently among these resources. In this respect, the entrepreneurial finance literature has stressed the importance of venture capitalists as specialized investors that can cope with the information asymmetries that hamper the financing of start-ups (Gompers and Lerner, 2001). In the U.S., venture capital has been extremely beneficial to the development of a number of start-ups that grew and employed thousands of people within a few years (e.g., Genentech, Google and Facebook). Nevertheless, it is common wisdom that very few start-ups attract venture capital investment. So, although in theory venture capital seems to be the most suitable form of new firms financing, in practice the use of this form of financing is still limited, especially in European countries (Kelly, 2011). In such a situation, banking capital is a major source of financing¹ and learning more on its role for the exploitation of university knowledge through new firm creation can advance our knowledge on the financing of entrepreneurship in general and of knowledge-intensive entrepreneurship in particular.

In the empirical part of the paper, we focus on Italian provinces (NUTS3 level) and study whether and how the relative presence of cooperative banks in the local banking industry moderates the university-based entrepreneurship in these provinces. To better investigate the extent to which such influencing role (if any) is related to the expectations that banks have on the borrowers' potential opportunistic behaviors, we differentiate Italian provinces basing on the level of the compliance to social norms of the local population.

We think that focusing on the Italian context is particular salient for our study. First, recent literature has shown that university knowledge does play a role in the creation of new firms in Italy. In a recent paper, Calcagnini et al. (2014) have shown that university knowledge influences the location decisions of Italian innovative start-ups. In particular, the authors provide evidence that the

¹ Currently, new forms of financing are emerging like crowdfunding (Colombo et al., 2015) and angel investing (e.g., Kerr et al., 2014). However, given their novelty, we do not already know their real impact on new firm creation.

geographical distance between an innovative start-up and its closest university is negatively affected by the extent of university knowledge spillovers (measured by the number of graduates). In a companion paper (Ghio et al., 2015), we empirically demonstrate that the local availability of university knowledge in a geographical area positively affects the creation of innovative start-ups in the same geographical area. Second, Italy has one of the largest banking industry in Europe in terms of asset (Angelini and Cetorelli, 2003) and banks are the primary source of external finance in the country (Minetti and Zhu, 2011). Furthermore, the composition of the Italian banking industry is rather heterogeneous in terms of firms' size and ownership (Usai and Vannini, 2005; Ferri et al., 2014), with the cooperative banks system being one of the most decentralized and less integrated in Europe (Ayadi et al., 2010)².

To test our hypotheses, we run a series of negative binomial regressions where the dependent variable is the number of new knowledge-intensive firms established in each industry/province in the period 2012-2014.

We find that per se, the local presence of banks adopting relational lending approaches positively affect the conversion of university knowledge into economic knowledge through the creation of knowledge-intensive firms. In other words, our findings suggest that the trust building effect is more important than the risk aversion effect in the case of university-based entrepreneurship. Even more interesting, we find that such moderating effect of the local presence of cooperative banks is crucial in provinces where the level of compliance to social norms is low. Finally, in provinces where the level of compliance to social norms is high, the local presence of cooperative banks does not affect the local university-based entrepreneurship.

The paper proceeds as follows. In the next session, we illustrate the theoretical background and develops of the research hypotheses. Section 3 describes the econometric models used to test the hypotheses and the variables included in these models. In section 4, we discuss the results from the

² Differently from other European countries where cooperative banks have developed central institutions and formed network alliances over time, the segment of cooperative banks in Italy is almost entirely decentralized (Ayadi et al., 2010).

econometric analyses. Section 5 concludes the paper by summarizing its main findings, acknowledging its limitation and sketching directions for future research.

2. Theoretical background and hypotheses development

Several previous articles have discussed the financial constraints faced by new entrepreneurial ventures. The principal argumentation suggested by scholars is the informational opaqueness of such ventures compared to already established firms (Berger and Udell, 2006; Beck and Demigurc, 2006). First, providers of external capital cannot rely on the firm's track record to gauge its (future) economic performances (Schneider and Veugelers, 2010). Second, the traditional instruments that providers of external capital have to limit the risk associated to information asymmetries (e.g., the request for collateral) are unsuitable for new ventures. Finally, providers of external capital suffer from moral hazard, i.e., after having received external financing, entrepreneurs can behave opportunistically by shifting to more risky projects or putting just limited effort in their ventures.

While such arguments hold for any venture, these are particularly significant for firms, which base their competitive advantage on intangible assets (Hall, 2002; Denis, 2004), as in the case of highly innovative ideas out of new knowledge stemming from research activities. Moreover, banks and in general providers of external capital, experience even higher information asymmetries when evaluating the ideas of perspective entrepreneurs who intend to exploit university knowledge for creating new knowledge-intensive firms. Indeed, this knowledge typically requires further development for being converted in innovative products and services and this process is often long and subject to uncertain outcomes (Stephan 2012). As such, the potential commercial value of university knowledge is difficult to assess (Audretsch and Stephan, 1999), especially for non-scientists, as bank managers.

Moving from these premises, we argue that the characteristics of the local banking industry affect the local banks' ability to deal with the information asymmetries and ultimately on banks'

willingness to finance perspective entrepreneurs who intend to create knowledge-intensive firms out of university knowledge. Consequently, we expect that these characteristics moderate the (positive) effect of local university knowledge on the creation of knowledge-intensive firms at the local level.

In particular, we focus on the local presence of cooperative banks, as previous articles suggest that they have peculiar characteristics, which are likely to influence their decision to invest on the local creation of knowledge-intensive firms.

First, cooperative banks have a natural tendency to finance local firms. In this perspective, cooperative banks mainly invest in a limited geographical area, near their customers (Ferri et al., 2014). Second, cooperative banks decide whether to invest or not in companies by establishing long-term relationship with their customers, i.e., by adopting relational lending approaches³ (Berger and Udell, 2002). Banks adopting relational lending approaches reduce the information asymmetries they face (Usai and Vannini, 2005), through the acquisition of soft information such as on borrowers' personality or reliability (Berger and Udell, 2002). In particular, banks acquire soft information benefiting from continually face-to-face interactions between their managers and the entrepreneurs (Howorth and Moro, 2006). Furthermore, such frequent and continuous interactions allow cooperative banks to build and reinforce trust in the entrepreneur–bank relationship, which is a crucial element of decision maker under conditions of complexity, high risk and scarce information as in the case of university-based entrepreneurship. In this view, trust can reduce the cost of monitoring and control that banks have to deal with (Howorth and Moro, 2006). Third, due to the difficulties related to the transmission of soft information even within the same organizations, banks adopting such

³ Differently from what happens for relationship lending, transactional lending approaches base their lending decisions on hard information of the firm requiring loans and its business. In this view, transactional lending approaches usually articulates in three different technologies. First, financial statement lending, in which is crucial the evaluation of customers' balance sheet and financial reports. Second, asset-based lending, where the lending decisions mirror the availability and the quality of collateral capital. Third, credit scoring, in which the banks' decisions are influenced by the financial situation of the firm and track record of the entrepreneur (Berger and Udell, 2002; 2006). As such, these technologies using mostly standardized procedures are rather formal and impersonal. It is acknowledged that large stakeholders banks are the most suitable in adopting transactional lending approaches, due to their superior ability in elaborating hard information on the customers and reducing the related costs, by reaching scale economies (Berger and Udell, 2002).

approach are normally led by managers who reside in the area (Ayadi et al., 2010). Therefore, when deciding whether or not financing a new venture, banks also have close connections with local stakeholders. Thus, they can collect information also via indirect contacts (e.g., the bank manager does not know directly the perspective entrepreneur, but she knows local entrepreneurs who knows her). Connections with local stakeholders, in turn, reinforces the trust mechanism resulting from relationship lending approaches. Indeed, entrepreneurs who adopt opportunistic behaviors will be labelled as unreliable, not only by the bank, but also by other members of the local community (e.g., managers and local entrepreneurs) who have connections with this bank. Such a widespread bad reputation would make it difficult to obtain future funding (Howorth and Moro, 2006). Thus, entrepreneurs who act opportunistically run the risk to be excluded from the local credit market. In sum, relational lending approaches are strongly reliant on interpersonal relationship between individuals. Consequently, we expect a positive moderating effect to the university-based entrepreneurship, due to the superior ability of local cooperative banks in overcoming information asymmetries issues by establishing and reinforcing trust with the borrowers (hereafter: trust-building effect). Therefore, we posit:

H1a: In a geographical area, the local presence of cooperative banks fosters university-based entrepreneurship.

Nevertheless, we are aware of the fact that there are several articles in the literature investigating the characteristics of the banking institutions, reporting how cooperative banks are less risky compared to other banks, and this might influence the degree to which they are willing to invest in the university-based entrepreneurship. First, differently from other banking institutions (i.e., commercial banks), the aim of cooperative banks is the value maximization of the long-term relationship with the borrower (Ferri et al., 2010; Ayadi et al., 2010 among others). In so doing, cooperative banks do not have incentives in taking excessive risks in order to maximize profits in the short term. On the contrary, the evidence suggests that cooperative banks have a superior ability in

granting loans for safer investments (Rasmusen, 1988), generating lower loan losses (Cesarini et al., 1996; Fonteyne, 2007). This ultimately results in cooperative banks experiencing superior allocative efficiency (Cesarini et al., 1996). Second, recent articles have studied the extent to which cooperative banks differ from other banking institutions in affecting the financial stability of the banking system. Cihak and Hesse (2007) provide empirical evidence of a higher financial stability of cooperative banks. In particular, using a well-known indicator of individual bank risk, the Z - score, they investigate the probability of insolvency risk of banks in 29 OECD countries, showing that cooperative banks experience lower risk of default than commercial banks. Their findings suggest that such evidence is driven by the lower volatility of cooperative banks' returns. Coherently, by investigating the risk and stability of German banks, Beck et al. (2009) find that private banks are less stable than cooperative banks in terms of Z-score, the proportion of non-performing loans, and distress probabilities. Such findings potentially reflect the tendency of cooperative banks to invest in less risky business prospects, which ultimately results in lower attitude in financing university-based entrepreneurship. Coherently, it appears coherent to expect university-based entrepreneurship hindered by a higher local presence of cooperative banks (hereafter: risk-aversion effect). Thus, we posit:

H1b: In a geographical area, the local presence of cooperative banks hinders university-based entrepreneurship.

Since the trust-building effect strongly rests on the superior ability of cooperative banks in reducing opportunistic behaviors of their customers by establishing and reinforcing trust with them, we contend that such positive effect differently affects the university-based entrepreneurship, depending on the extent to which local population behave opportunistically.

Financial contracts (e.g., bank loans) are nothing than an exchange of a sum today for a promise to future economic returns. In this perspective, lending decisions depend on the extent to which the financier expect the financee behaving opportunistically (Guiso et al., 2004). More specifically, in local environments with high (low) expectation on others' behaving opportunistically, local banks' face higher (lower) costs of monitoring. As such, it seems coherent to expect that the superior ability of local cooperative banks to deal with information asymmetries issues, differently affects the university-based entrepreneurship depending on the tendency of local population to behave opportunistically. In this vein, several articles relate the tendency of individuals belonging to a community to behave opportunistically, with lower level of compliance to social norms (Knack and Keefer, 1997). Conversely, it is more likely that local communities overcome problems of credible commitment when the fraction of people sharing social norms increases. In other words, economic agents (e.g., banks) embedded in local communities experiencing high compliance to social norms can spend less to protect themselves through monitoring activities. We thus expect that in geographical areas where the compliance to social norms is high, the positive effect of the local presence of cooperative banks to university-based entrepreneurship is negligible. From a different perspective, we expect that the positive influence of the local presence of cooperative banks is especially important in areas where the local population tend not to comply to social norms. Thus, we posit:

H2. The positive effect of the local presence of cooperative banks on university-based entrepreneurship is more important in geographical areas where local population tend not to comply with social norms.

3. Data and methodology

To ascertain the extent to which the local presence of cooperative banks moderates the university-based entrepreneurship, we resort to various negative binomial models with the following general form:

$$N_KIFS_{i,j} = f(UNIKNOW_{i,j}, COOPERATIVE_j, SOCIAL_NORMS_j, CONTROLS_{i,j}) \quad (I)$$

3.1 Dependent variable

The dependent variable $N_KIFS_{i,j}$ is the number of new firms created in industry i and province j in the period 2012-2014 in the high-tech knowledge-intensive industries as defined by the Eurostat⁴. In so doing, we consider 792 industry/province pairs⁵ (8 industries * 99 provinces), accounting for 3,774 new knowledge-intensive firms. The Italian firm registry (Registro Imprese) records the total population of Italian firms⁶, providing data on their geographical location and industry of operation (NACE rev. 2). Table 1 reports the distribution of new knowledge-intensive firms established in the period 2012-2014 in Italy.

[Table 1 about here]

3.2 Main explanatory variables

The variable $UNIKNOW_{i,j}$ refers to university knowledge available in the province j that constitutes the knowledge base of knowledge intensive firms' industry i . More precisely, $LOCAL_UNIKNOW_{i,j}$ is the ratio between the average size of academic staff (i.e. full, associate and assistant professors) of the top-quality universities located in province j in the period 2009-2011, specialized in the scientific fields that constitutes the knowledge base of the industry i (see Bonaccorsi

⁴ Specifically, we consider the knowledge-intensive services ([http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Knowledge-intensive_services_\(KIS\)](http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Knowledge-intensive_services_(KIS))) and the high-tech manufacturing.

⁵ In this study, we use the classification at 107 provinces (valid from 2001 to 2011). In 2001, the existing provinces of Sardinia (4 provinces) were reorganized in 8 new provinces. However, in some cases statistical sources of data that provide information at the province level use the old classification. Because of these data constraints, we have therefore excluded the provinces located in Sardinia.

⁶ <http://www.infocamere.it/movimprese> .

et al. 2013 for a similar approach), and the population of the province j as in 2011. Moreover, in order to consider the decaying effect of university knowledge as the geographical distance from the university generating it increases, we measure the effect of knowledge created by universities located outside the province j in province j by using a spatially weighted measure:

$$EXT_UNIKNOW_{i,j} = \sum_{k \neq j} \frac{LOCAL_UNIKNOW_{i,k}}{d_{j,k}^{\alpha}} \quad (1)$$

where $d_{j,k}$ is the geographical distance between province j and province k , $LOCAL_UNIKNOW_{i,k}$ refers to specialized university knowledge that constitutes the knowledge base for the industry i generated from universities located in province k , (with $k \neq j$), and α is a distance decay parameter set to 2.5, as this is the value that maximizes the log-likelihood of the econometric model. We calculate distances by considering the centroid of each province (with 1 km as the unit of distance). In so doing, $UNIKNOW_{i,j}$ is calculated as follows:

$$UNIKNOW_{i,j} = LOCAL_UNIKNOW_{i,j} + EXT_UNIKNOW_{i,j} \quad (2)$$

To build our measure of university knowledge, we use data obtained from the Italian Ministry of Education and Research (Ministero dell'Istruzione, dell'Università e della Ricerca, MIUR), which provides information on the academic staff enrolled in all Italian universities. For each university, the MIUR provides data on the academic staff operating in 14 academic scientific fields (for details see Appendix A.2), ranking the quality of universities' research activities in each fields. We consider only the Italian research active universities⁷, thus focusing on 80 universities. Then, for each knowledge fields, we compute the average of the academic staff enrolled in the period 2009-2011 of the universities ranked in the first quantile of the distribution in terms of research quality, for each

⁷ Following the definition provided by the EUMIDA database, “research active” if research is considered as constitutive part of institutional activities and it is organized with a durable perspective. See <http://ec.europa.eu/research/era/docs/en/eumida-final-report.pdf> for further information.

university/scientific field. We build on the findings of Scharfetter et al. (2002) to link the university's scientific field with the industry classification of the focal knowledge-intensive firm⁸. In this way, we identify the relevant knowledge base for each industry in which the knowledge intensive-firms of our samples operate.

Data on the characteristics of Italian banking industry at the local level come from the Bank of Italy statistical office⁹, which provides information on the banking industries across Italian provinces. In particular, the variable *COOPERATIVE_j* measures the relative presence of cooperative banks in the focal province *j*, accounting for the share of bank branches in a province held by cooperative banks (Alessandrini et al., 2010; De Loof and La Rocca 2014).

3.3 Controls

As to control variables (*CONTROLS_{i,j}*), we take into account several dimensions of the local context that, according to the extant literature, are likely to influence new firm creation at the local level. First, *SOCIAL NORMS_j* measures the average percentage of inhabitants of province *j* voting at the three most recent referenda (2005, 2009, 2011) (see Guiso et al., 2004). Since voting to referenda is not mandatory, the participation to these voting activities mirrors the extent to which people comply to social norms. Second, following prior empirical works (de Guevara and Maudos, 2009; Alessandrini et al., 2009; Alessandrini et al., 2010; Rogers, 2012), we resort to the Herfindahl–Hirschman concentration index (*CONCENTRATION_j*) to control for bank market concentration. *CONCENTRATION_j* is defined as the sum of the square of the shares of branches held by banks operating in the focal province *j* (Alessandrini et al., 2009; Alessandrini et al., 2010). Third, we control for the local availability of financial capital from banks in a province *j* through the variable *DEPOSIT_j*, which measures the amount of bank deposit¹⁰ held by the private sector in bank branches

⁸ See the Appendix for Table A2 that shows the link between the knowledge-intensive industries and the 14 university disciplinary areas.

⁹ <https://infostat.bancaditalia.it/inquiry/>.

¹⁰ Thousands of euro.

located in province j over its population as in 2011. Fourth, $TECH_j$ measures the effect of technological spillovers from the productive system by measuring the number of non-academic patent applications held by inventors residing in the province j , in the period 2008-2010 per million inhabitants. (Qian et al., 2013). Fourth, to control for the diversity of the local industrial system, we define $IND_DIVERSITY_{i,j}$ as:

$$IND_DIVERSITY_j = 1 - \sum_{i=1}^I (s_{j,i})^2 \quad (3)$$

where $s_{j,i}$ is the share of firms in province j operating in the industry i . The index varies between zero and one, with higher value corresponding to higher diversity (see Gao 2004 for a similar approach). Fifth, $RESIDENTS_j$ controls for the number of individuals residing in province j as in 2011. Sixth, the variable $INCUMBENT_{i,j}$ allows us to control for the effect of incumbent firms in influencing the local creation of new firms, by considering the number of firms registered in the industry i in the province j per inhabitants of the province. Seventh, with $EDUCATION_j$ we measure the share of local population with university degree or higher academic title (Qian and Acs, 2013). Eight, we account for the local presence of facilities supporting entrepreneurial activity by controlling for the local presence of incubators in the province ($INCUBATORS_j$). Ninth, $UNEMPLOYMENT_j$ measures the unemployment rate in the province j as in 2011 to control for the extent to which the creation of new knowledge-intensive firms is a necessity-driven phenomenon. Finally, we include GDP_j which measures the gross domestic product per capita for the province j as in 2011. We also include industry and macro-area regional (NUTS1) dummies. Table 2 reports a detailed description of all the variables included in the regressions

To build the aforementioned control variables, we resort to multiple sources. They include the Movimprese database¹¹ (e.g., number of new and incumbent firms operating in each province, disaggregated by industry of operation); the ISTAT database¹² (e.g., local resident population; gross

¹¹ <http://www.infocamere.it/movimprese>.

¹² <http://dati.istat.it/>.

domestic product); the Bank of Italy¹³ (data on the private sector's bank deposit); the Italian Minister of the Interior¹⁴ (voting turnout); the PATSTAT database (data on patent applications).

Table 2 reports a detailed description of all the variables included in the models, while Table 3 reports their summary statistics and the correlation matrix.

[Table 2 about here]

[Table 3 about here]

4. Results

Table 4 shows the results of the econometric estimates obtained using a negative binomial specification.

[Table 4 about here]

Column (I) refers to the model with only the direct effects of the main explanatory variables included in the analysis, i.e., $UNIKNOW_{i,j}$ and $COOPERATIVE_j$. To test the moderating effect of the relative presence of cooperative banks we compute the interaction terms $UNIKNOW_{i,j} * COOPERATIVE_j$ (Column II). Columns (IIa) and (IIb) refer to the models when the local level of compliance to social norms is low ($SOCIAL\ NORMS_j$ lower than its median value) and high ($SOCIAL\ NORMS_j$ higher than its median value), respectively.

Let us briefly discuss the results concerning control variables before analysing our main explanatory variables. As regards the variables capturing the characteristics of the local banking system, only $CONCENTRATION_j$ has a statistically significant coefficient, whose sign is negative in all the regressions. The availability of banking capital, measured through the amount of deposit per resident population ($DEPOSIT_j$) seems not to affect the local creation of new knowledge-intensive firms. Regarding the other control variables, $RESIDENTS_j$ has a positive and statistically significant

¹³ <https://infostat.bancaditalia.it/inquiry/>.

¹⁴ <http://elezionistorico.interno.it/>.

coefficient along the models, suggesting that demand factors are crucial for the local creation of new knowledge-intensive firms. Also the coefficient of other controls measuring further characteristics of the industrial systems are statistically significant, although with a lower explanatory power. The coefficient of *DIVERSITY_j* is positive and significant in three out of four models. As widely documented by prior studies (Qian and Acs, 2013; Qian et al., 2013), we find that the local creation of knowledge-intensive firms benefits from the local patenting activity (the variable *TECH_j* is positive and statistically significant in all the models). *INCUBATORS_j* is positive and statistically significant (p-value < 0.1) in three out of four models. The coefficients of *UNEMPLOYMENT_j*, while maintaining the same signs in all the specifications, reaches the statistical significance only in the model (I) and (II). Quite surprisingly, coefficients of *EDUCATION_j*, *SOCIAL NORMS_j* and *GDP_j* never reach the statistical significance.

We now turn attention to the main variables of interest. Coherently with the literature on the KSTE having assessed the fundamental role of university knowledge in fostering the creation of knowledge-intensive firms, we found a positive and significant effect of *UNIKNOW_{i,j}* on the dependent variable (p-value < 0.1). The evidence is robust since both the coefficient's sign and its statistical significance are persistent all over the specifications, except for the model in Column IIa. Interestingly, the coefficient of *COOPERATIVE_j* is negative in three specifications, while never reaching the statistical significance. Thus, a higher presence of cooperative banks at the local level does not directly affect the local creation of knowledge-intensive firms¹⁵.

Let us now focus on the results regarding the testing of our hypotheses. The positive and statistically significant coefficient of the interaction term *UNIKNOW_{i,j} * COOPERATIVE_j* in Column (II) seems to suggest that the trust-building effect of local cooperative banks overcomes their risk-aversion effect.

¹⁵ Table A1 reports further econometric evidence. In particular, we perform a robustness check analysis by adding a control for the venture capital investments.

Nevertheless, given the nonlinear specification of the zero-inflated negative binomial model, looking at the interaction term's estimated coefficients is not sufficient to assess the statistical significance and the magnitude of the moderating effects. To determine whether *COOPERATIVE_j* moderates the effect of *UNIKNOW_{i,j}* on the creation of knowledge-intensive firms, we therefore report the average marginal effects (MEs) of *UNIKNOW_{i,j}* as *COOPERATIVE_j* varies (the solid lines in Figure 1¹⁶).

[Figure 1 about here]

Figure 1 shows a positive trend of the ME of *UNIKNOW_{i,j}* as *COOPERATIVE_j* increases. The increase in the number of knowledge-intensive firms in each industry/province due to a one standard deviation increase of *UNIKNOW_{i,j}* is 0.72 (p-value<0.05) when (the standardized value of) *COOPERATIVE_j* is -0.5. When (the standardized value of) *COOPERATIVE_j* is 1.5, one standard deviation increase of *UNIKNOW_{i,j}* leads to an average 1.45 (p-value<0.001) increase in the number of knowledge-intensive firms in each industry/province. Thus, we do find support for H1a and we reject the competing hypothesis H1b.

[Table 5 about here]

Table 5 shows the ME of *UNIKNOW_{i,j}* on the dependent variable *N_KIFS_{i,j}* as *COOPERATIVE_j* increases in geographical areas with low (Column a) and high (Column b) compliance to social norms. The results are coherent with H2 and confirm that the relative presence of cooperative banks is crucial for the local creation of knowledge-intensive firms in geographical areas where banks have higher expectations of local individuals behaving opportunistically (i.e. with low compliance to social norms). Specifically, Column (a) evidences that the ME of *UNIKNOW_{i,j}* turns to be statistically significant only for high values of *COOPERATIVE_j*. In particular, when (the standardized value of) *COOPERATIVE_j* is -0.5, one standard deviation increase

¹⁶ The Figure reports the the marginal effect of university knowledge as *CONCENTRATION_j* varies between the 10th and the 90th percentiles of their distribution.

in $UNIKNOW_{i,j}$ do not lead to an increase in the number of knowledge-intensive firms. When (the standardized value of) $COOPERATIVE_j$ is 0.5, the average increase in the number of knowledge-intensive firms in each industry/province due to a one standard deviation increase of $UNIKNOW_{i,j}$ is 0.92. Finally, the average increase of $N_KIFS_{i,j}$ due to a one standard deviation increase of $UNIKNOW_{i,j}$ is 2.47 when (the standardized value of) $COOPERATIVE_j$ is 1.5. Conversely, Column (b) evidences that the ME of $UNIKNOW_{i,j}$ does not vary as $COOPERATIVE_j$ increases.

5. Conclusion

Prior works within the research strand of the KSTE have mainly focused on the direct impact of various knowledge spillover mechanisms from universities (e.g., scientific publications, academic patents, graduates, Acosta et al. 2011, Bonaccorsi et al., 2013; Bonaccorsi et al., 2014) and incumbent firms (Lasch et al., 2013) on local entrepreneurship. Conversely, scholars have given comparatively less attention to how the characteristics of the local context moderate the effect of these knowledge spillovers. Recent exceptions are the contributions by Qian and Acs (2013) and Qian et al. (2013), which have investigated the moderating role of the local human capital on the exploitation of industrial knowledge spillovers embedded in patents. The present paper makes a further step in this direction by focusing on the role of a crucial aspect of the local context, i.e., the local banking system. In particular, we demonstrate that a higher presence of cooperative banks in local banking industry, which is a key element of the local ecosystem nurturing entrepreneurship (Feld, 2012), can amplify the effects of university knowledge spillovers on creation of knowledge-intensive firms. More specifically, notwithstanding their lower propensity to finance risky business prospects, we find that the local presence of cooperative banks fosters the university-based entrepreneurship. In this view, their ability to deal with information asymmetries issues by establishing trust with the borrowers, thus lowering potential opportunistic behaviours (i.e., the trust-building effect) overcome the risk-aversion effect. Even more interesting, we find that such positive effect is more important in geographical areas

where local individuals tend to behave opportunistically. In this vein, when individuals do not share social norms and economic agents experience higher costs of monitoring and control, the establishment of trust-based relationship between the local cooperative banks and the borrowers is crucial.

The paper has several limitations that open up avenues for future research. First, in this paper we focus on the typology of the institutions composing the local banking system, disregarding their dimension. In this perspective, there are several works providing evidence to the fact that the dimension of banks is a crucial determinant of their business model and, therefore, of the extent to which they might invest in the university-based entrepreneurship. Accordingly, we encourage works that identify both the typology of the institution and its dimension to disentangle their effects. Second, the paper focuses on the Italian context. Despite we think that this research setting is particularly appropriate for our study, we acknowledge that such a focus may hamper the generalizability of our results. Therefore, it would be of interest to repeat our analysis in other countries. For instance, do our results change in contexts where the VC market is better developed? Are the characteristics of the banking industry still salient in these contexts? Finally, we argue that knowledge-intensive firms created out of university knowledge suffer from information asymmetries and that the characteristics of the banking industry affect banks' ability to cope with these information asymmetries. However, both information asymmetries and banks' ability to cope with them may vary depending on entrepreneurs' and banks' characteristics. Further research having entrepreneurs and banks as levels of analyses may improve our understanding of the phenomenon under investigation.

Despite these limitations, the paper has relevant policy implications for what concerns the banking industry. Our results show that the local creation of knowledge-intensive firms from university knowledge benefits from a higher presence of cooperative banks in the local banking system. Suitable policy interventions can favor the development of cooperative banks and thus amplify this positive influence. Indeed, these banks are usually small and with limited resources, especially in comparison with nationwide banks (Usai and Vannini, 2005; Ferri et al. 2014). In this

regards, policy interventions favouring alliances of cooperative banks with local stakeholders with strong technological expertise, such as incubators, technology transfer offices and universities, may help these to close their resource gap making their role in financing new knowledge-intensive firms even more effective. Indeed, hard, technological skills obtained through these alliances would ideally complement the natural bent of cooperative banks to an efficient acquisition of soft information, making them even better able to assess the value of highly innovative projects. Finally, our work suggests that when the contextual conditions hinder the entrepreneurs' chances to access institutional finance (e.g., in geographical areas where people tend to behave opportunistically), supporting the creation of a local environment able to deal with IA issues is crucial to foster university-based entrepreneurship.

Table and Figures

Table 1 - Distribution of new knowledge-intensive firms established in the period 2012-2014 by industry and macro-regions.

Industry by NACE rev. 2	N. of knowledge-intensive firms	Frequency (%)
C 21 - Manufacture of basic pharmaceutical products and pharmaceutical preparations	11	0.29
C 26 - Manufacture of computer, electronics and optics products; medical equipment, measuring instruments, watches and clocks	94	4.91
J 59 - Motion picture, video and television programme production, sound recording and music publishing activities	156	4.13
J 60 - Programming and broadcasting activities (14	0.37
J 61 - Telecommunications	166	4.40
J 62 - Production of software and IT consulting activities	1,777	47.09
J 63 - Information service activities	1,089	28.86
M 72 - Scientific research and development	346	9.17
Total	3,774	100.00
Macro-regions		
North Est	949	25.15
North West	1,421	37.65
Center	820	21.73
South	584	15.47
Total	3,774	100.00

Note: "South" includes the Sicilia region.

Table 2 – Variable description

Variable	Definition	Source
Dependent variable		
$N_KIF_{i,j}$	Number of new firms created in the knowledge-intensive industry i in the province j in the period 2012-2014.	Movimprese /Eurostat
Main independent variables:		
$UNIKNOW_{i,j}$	Average academic staff (average of the period 2009-2011) of universities located in the province j specialized in scientific fields that constitute the knowledge base of the KIF's industry i per million inhabitants of the province j .	Italian Ministry of Education and Research (MIUR)
$COOPERATIVE_j$	Share of bank branches owned by cooperative banks in the province j .	Bank of Italy
Control variables:		
$SOCIAL_NORMS_j$	Average percentage of inhabitants of province j voting at the referenda of 2005, 2009 and 2011.	Ministry of Interior
$CONCENTRATION_j$	Herfindahl–Hirschman index (HHI) defined as the sum of the square of the share of branches held by banks operating in the province j .	Bank of Italy
$DEPOSIT_j$	Deposits held by the <i>private sector</i> (k€) in bank branches located in the province j over its population	Bank of Italy; Italian Statistical Office (ISTAT)
$TECH_j$	Number of non-academic patent held by inventors residing in the province j in the period 2008-2010 per million inhabitants.	PATSTAT
$DIVERSITY_IND_j$	Herfindhal index measuring the degree of industrial diversity of the province j .	Movimprese
$RESIDENTS_j$	Number of inhabitants of the province j .	ISTAT
$INCUMBENT_{i,j}$	Number of incumbent firms in the industry i in the province j .	Movimprese
$EDUCATION_j$	Percentage of population of province j with bachelor degree or higher.	ISTAT
$INCUBATORS_j$	Number of incubators in the province j .	Movimprese
$UNEMPLOYMENT_j$	Unemployment rate in the province j .	ISTAT
GDP_j	GDP per capita in the province j .	ISTAT

Table 3 – Summary statistics and correlation matrix of regression variables

	Mean	Std. deviation	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	
$N_KIF_{s_{i,j}}$	(1) 4.765	17.938	0	380	1.000														
UNIKNOW_{i,j}	(2) 244.950	420.136	0.003	3053.906	0.077	1.000													
COOPERATIVE_j	(3) 0.136	0.100	0	0.601	-0.037	-0.029	1.000												
CONCENTRATION_j	(4) 0.113	0.040	0.029	0.313	-0.076	-0.106	-0.444	1.000											
INCUMBENT_{i,j}	(5) 158.090	453.228	0	6554	0.870	0.046	-0.078	-0.101	1.000										
DIVERSITY_IND_j	(6) 0.904	0.0312	0.808	0.941	0.154	0.166	-0.069	-0.125	0.156	1.000									
DEPOSIT_j	(7) 18.033	5.850	8.143	42.280	0.261	0.231	0.063	-0.142	0.284	0.495	1.000								
TECH_j	(8) 244.432	235.890	0	1001.800	0.201	0.254	-0.000	-0.132	0.157	0.548	0.659	1.000							
EDUCATION_j	(9) 0.175	.0283	0.131	0.263	0.210	0.580	-0.092	-0.224	0.272	0.125	0.354	0.191	1.000						
SOCIAL_NORMS_j	(10) 0.358	0.068	0.226	0.515	0.041	0.038	0.086	-0.072	0.003	0.267	0.151	0.255	0.067	1.000					
INCUBATORS_j	(11) 0.263	0.676	0	5	0.466	0.197	-0.015	-0.139	0.438	0.258	0.445	0.381	0.259	0.027	1.000				
UNEMPLOYMENT_j	(12) 8.314	3.719	3.343	17.841	-0.077	-0.085	-0.154	0.076	-0.001	-0.614	-0.627	-0.580	0.008	-0.342	-0.216	1.000			
GDP_j	(13) 24611.110	6118.620	13100	38550	0.217	0.167	0.183	-0.124	0.188	0.667	0.772	0.709	0.126	0.343	0.413	-0.838	1.000		
RESIDENTS_j	(14) 581448.100	641277.200	87241	3997465	0.456	0.225	-0.154	-0.179	0.598	0.188	0.312	0.211	0.358	-0.053	0.630	0.114	0.178	1.000	

Table 4 - Results of the econometric estimates: the moderating effect of the local presence of cooperative banks on the university-based entrepreneurship

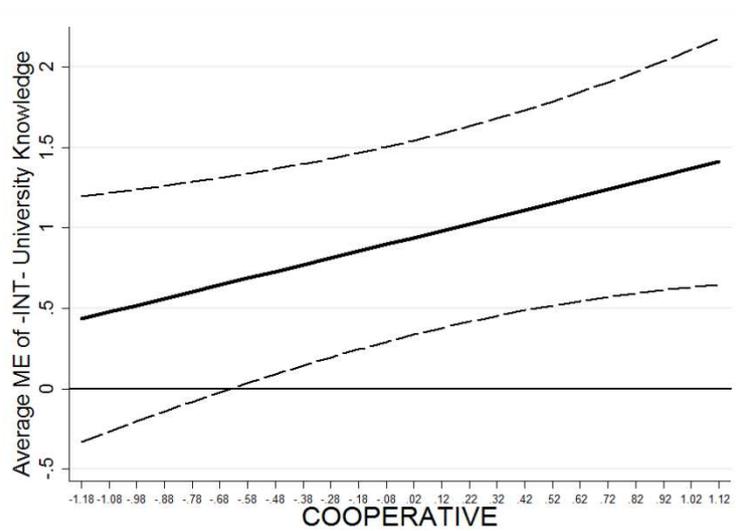
	(I)	(II)	(IIIa)	(IIIb)
UNIKNOW_{i,j}	0.179*** (0.064)	0.181*** (0.059)	0.119 (0.096)	0.204*** (0.071)
UNIKNOW_{i,j}*COOPERATIVE_j		0.082** (0.036)	0.341*** (0.089)	0.066 (0.042)
COOPERATIVE_j	-0.013 (0.059)	-0.034 (0.055)	0.091 (0.087)	-0.011 (0.062)
CONCENTRATION_j	-0.306*** (0.063)	-0.313*** (0.066)	-0.295*** (0.090)	-0.245*** (0.091)
INCUMBENT_{i,j}	0.026 (0.033)	0.023 (0.033)	0.380*** (0.145)	0.004 (0.032)
DIVERSITY_IND_j	0.151** (0.063)	0.148** (0.063)	0.157* (0.095)	0.205 (0.170)
DEPOSIT_j	-0.058 (0.067)	-0.060 (0.066)	0.169* (0.101)	-0.107 (0.094)
TECH_j	0.210*** (0.074)	0.201*** (0.073)	0.238** (0.103)	0.145* (0.087)
EDUCATION_j	-0.036 (0.075)	-0.042 (0.080)	-0.155 (0.136)	-0.019 (0.089)
SOCIAL_NORMS_j	0.042 (0.073)	0.049 (0.073)	0.046 (0.175)	0.127 (0.094)
INCUBATORS_j	0.087* (0.050)	0.089* (0.049)	0.113 (0.075)	0.100* (0.053)
UNEMPLOYMENT_j	-0.162* (0.093)	-0.155* (0.091)	-0.193 (0.124)	-0.118 (0.104)
GDP_j	-0.067 (0.109)	-0.049 (0.109)	0.005 (0.140)	0.040 (0.154)
RESIDENTS_j	0.496*** (0.081)	0.502*** (0.078)	0.412*** (0.091)	0.496*** (0.084)
Constant	0.654*** (0.195)	0.626*** (0.196)	1.496*** (0.355)	0.391* (0.228)
Industry dummies	Yes	Yes	Yes	Yes
NUTS2 dummies	Yes	Yes	Yes	Yes
N. of observations	792	792	392	400
Log likelihood	-1250.509	-1247.595	-540.098	-673.893

Standard errors are in brackets. The asterisks *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively. Standard errors clustered by region (NUTS3).

Table 5 - Results of the econometric estimates: the impact of local compliance to social norms

	(a)	(b)
COOPERATIVE_j = -0.5	Not statistically significant	(+) **
COOPERATIVE_j = 0	Not statistically significant	(+) **
COOPERATIVE_j = 0.5	(+) **	(+) ***
COOPERATIVE_j = 1	(+) **	(+) ***
COOPERATIVE_j = 1.5	(+) **	(+) ***

Figure 1 – Marginal effect of university knowledge, as COOPERATIVE_j varies



Appendix

A 1 – Further econometric evidence

	(I)	(II)	(IIIa)	(IIIb)
UNIKNOW_{i,j}	0.181*** (0.063)	0.183*** (0.058)	0.092 (0.093)	0.205*** (0.070)
COOPERATIVE_j	-0.016 (0.060)	-0.037 (0.058)	0.050 (0.081)	-0.013 (0.063)
UNIKNOW_{i,j} * COOPERATIVE_j		0.082** (0.036)	0.219** (0.090)	0.066 (0.042)
CONCENTRATION_j	-0.311*** (0.066)	-0.318*** (0.069)	-0.322*** (0.084)	-0.246*** (0.093)
INCUMBENT_{i,j}	0.027 (0.035)	0.024 (0.034)	0.379*** (0.129)	0.004 (0.033)
DIVERSITY_IND_j	0.151** (0.063)	0.148** (0.064)	0.176* (0.100)	0.203 (0.169)
DEPOSIT_j	-0.058 (0.065)	-0.059 (0.065)	0.401*** (0.120)	-0.106 (0.095)
TECH_j	0.206*** (0.072)	0.197*** (0.071)	0.237*** (0.090)	0.144* (0.088)
EDUCATION_j	-0.038 (0.076)	-0.044 (0.082)	-0.246* (0.138)	-0.019 (0.089)
SOCIAL_NORMS_j	0.036 (0.079)	0.042 (0.078)	0.207 (0.161)	0.126 (0.093)
INCUBATORS_j	0.072 (0.066)	0.073 (0.063)	0.241*** (0.091)	0.098 (0.071)
UNEMPLOYMENT_j	-0.163* (0.093)	-0.156* (0.091)	-0.132 (0.130)	-0.117 (0.106)
GDP_j	-0.071 (0.110)	-0.053 (0.109)	-0.136 (0.137)	0.039 (0.158)
RESIDENTS_j	0.486*** (0.094)	0.492*** (0.092)	0.530*** (0.095)	0.495*** (0.086)
VENTURE_CAPITAL_j	0.024 (0.079)	0.026 (0.077)	-0.581*** (0.178)	0.004 (0.070)
Constant	0.658*** (0.194)	0.631*** (0.195)	1.540*** (0.336)	0.395* (0.225)
Industry dummies	Yes	Yes	Yes	Yes
NUTS2 dummies	Yes	Yes	Yes	Yes
N. of observations	792	792	392	400
Log likelihood	-1250.509	-1247.595	-540.098	-673.893

The variable $VENTURE_CAPITAL_j$ accounts for the number of first investments made by venture capital firms in companies located in province j , in the period 2006-2013 (see Samila and Sorenson, 2011). Data on venture capital activity derives from Venture Capital Monitor and VentureXpert database.

A 2 - Link between the knowledge-intensive industries and university disciplinary areas, based on the studies of Schartinger et al. (2002)

Start-up's industry	Industry (Schartinger et al. 2002)	Scientific fields (Schartinger et al. 2002)	University disciplinary areas (MIUR)
C 21 - Manufacture of basic pharmaceutical products and pharmaceutical preparations	Manufacture of chemicals	Mining, metallurgy; Other, interdisciplinary technical sciences; Chemistry; Electrical engineering; Agriculture; Other interdisciplinary natural sciences; Biology, Botanic; Veterinary medicine; Medical chemistry; Clinical Medicine.	1) Mathematics and computer sciences; 2) Physics; 3) Chemistry; 4) Earth sciences; 5) Biology; 6) Medical sciences; 7) Agricultural and veterinary sciences; 8) Civil engineering and architecture; 9) Industrial and information engineering.
C 26 - Manufacture of computer, electronics and optics products; medical equipment, measuring instruments, watches and clocks	Manufacturing of computers, office machinery.	Electrical engineering; Physics, mechanics and astronomy.	1) Mathematics and computer sciences; 2) Physics; 9) Industrial and information engineering.
J 59 - Motion picture, video and television programme production, sound recording and music publishing activities	NA	NA	1) Mathematics and computer sciences; 9) Industrial and information engineering; 10) Antiquities, philological-literary and historical-artistic sciences; 11) History, philosophy, psychology and pedagogy; 14) Political and social sciences.
J 60 - Programming and broadcasting activities; J 61 - Telecommunications	NA	NA	1) Mathematics and computer sciences; 3) Chemistry; 8) Civil engineering and architecture; 9) Industrial and information engineering; 13) Economics and statistics
J 62 - Production of software and IT consulting activities	Software and related activities	Mathematics, informatics; Chemistry; Traffic and transport science; Other, interdisciplinary technical sciences; Economics Economic science; Spatial planning; Applied statistics, social statistics.	1) Mathematics and computer sciences; 3) Chemistry; 8) Civil engineering and architecture; 9) Industrial and information engineering; 13) Economics and statistics.
J 63 - Information service activities	NA	NA	9) Industrial and information engineering.
M 72 - Scientific research and development	Research and development	Mining, metallurgy; Engineering; Construction techniques; Architecture; Electrical engineering; Economics; Geodesy; Traffic and transport science; Other, interdisciplinary technical sciences; Spatial planning; Other, interdisciplinary social sciences; Political science; Jurisprudence; Animal production; Political science; Mathematics, informatics; Physics, mechanics and astronomy; Sociology; Hydrology, hydrography; Biology, Botanic and zoology; Psychology; Educational science.	1) Mathematics and computer sciences; 2) Physics; 4) Earth sciences; 5) Biology; 7) Agricultural and veterinary sciences; 8) Civil engineering and architecture; 9) Industrial and information engineering; 11) History, philosophy, psychology and pedagogy; 12) Law; 13) Economics and statistics; 14) Political and social sciences.

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