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KNOWLEDGE SPILLOVER AND CITY INTERCONNECTION: THE RELATIONSHIP BETWEEN STUDENTS' MOBILITY AND HIGH-TECH FIRMS IN ITALIAN CITIES

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ABSTRACT:

Across-region students' mobility in terms of university enrolment of students is crucial to study because the human capital of new generations is one of the most important areas for exploration and development in advanced economies. In this study, we aim to observe students' mobility in terms of knowledge flow and its influence on city performance in terms of innovation. Combining data on students' mobility at the city level refers to the 20 cities with the greatest number of resident students in Italy to determine the linkage between students' mobility and city innovation. Our database includes data on the students' mobility of more than 700.000 students enrolled in the bachelor's and master's degree programs in Italy for 10 years (2009-2019). Using Spatial panel-data model we find that city attractiveness in terms of students' mobility is affected by the capability of the cities to generate and promote innovation in terms of high-tech firms. Moreover, we also found that a greater presence of youth entrepreneurship in the city, in addition to a high number of high-tech firms, positively moderates the cities' attractiveness in terms of knowledge flow and students incoming.

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1. Introduction

Economics and economic geography have progressively focused on the role of spatial and network ties and relate them to innovation and economic growth (Glaeser, 2000; Boix and Trullén, 2007; Huber, 2012).

Within economic debates, explanations regarding the regional development highlight the role played by knowledge generation, knowledge inputs and knowledge spillovers in location processes (Faggian and McCann, 2009b; Qian *et al.*, 2019). However, these knowledge processes are usually viewed from two different perspectives depending on the strand of literature employed, the first one being the agglomeration and clustering literature, and the other in the urban systems literature.

On the other hand, the urban systems literature (Holmes *et al.*, 2000), which support central-place theory (Warnes and Daniels, 1979; Mulligan, Partridge and Carruthers, 2012), consider these knowledge processes to be primarily an inter-regional macro-phenomenon, in which the geographical mobility of physical capital in terms of firms (Knoben and Oerlemans, 2008) and human capital in terms of labor (Faggian and Mccann, 2006, 2009), determine the revealed patterns of economic geography. The agglomeration and clustering literature perceives the knowledge processes like a primarily local intra-regional micro-phenomenon in which the accent is on a large number of interactions between agents within a spatially constrained environment (Faggian and Mccann, 2009). These interactions affect the local development in terms of knowledge exchange (Caragliu and Nijkamp, 2016), industrial clusters (Iammarino and McCann, 2006), R&D investments (Abramovsky and Simpson, 2011) and innovation (Capello and Faggian, 2005).

Across-region students' mobility in terms of university enrolment of students is crucial to study because the human capital of new generations is one of the most important areas for exploration and development in advanced economies (Qian *et al.*, 2019). In fact, in this paper, we are observing the city performance in terms of innovation on students' migration in terms of knowledge flow and city attractiveness.

Previous studies looking at the impact of students' mobility on knowledge spillovers were conducted at a regional level. However, there are only a few studies on the impact of mobility and knowledge sharing in terms of city development and city attraction. Relying on the research by Goldstein and Drucker (2006) that underlines the need of studies that discuss knowledge spillovers are greater in small to medium-sized metropolitan areas, we base our research on city level.

Besides, to understand the impact on city attractiveness, we evaluate the relation between high-tech firms and students' mobility from other regions and other countries in the overall period in response to the following research question: RQ1 "*How the presences of high-tech firms helps the attraction of human capital in terms of university students?".* Moreover, another important aspect of the development of the territory is the ability to attract and train young entrepreneur (Chigunta, 2002). As a consequence, youth entrepreneurship impacts the city attraction in terms of new opportunities and job satisfaction, and we hypothesize the following: RQ2: "*How existence of a large number of youth entrepreneurs in the cities impact on the relationship between high-tech firms and students' mobility?"*

To test our conjunctures, we focus on the 20 cities with the greatest number of resident students in Italy to determine the linkage between students' mobility and city innovation. Our database includes data on the students' mobility of more than 700.000 students enrolled in the bachelor's and master's degree programs in Italy for 10 years (2009-2019). The unit of analysis is the city.

We estimate the impact of students' mobility on the development of high-tech firms in Italian cities. In this study, the Spatial panel-data model is used to verify the research framework and hypotheses. Hypotheses testing was conducted using a panel data regression analysis model. Moreover, we evaluate the moderating role of youth entrepreneurship in this relation. The result shows that city attractiveness in terms of students' mobility is affected by the capability of the cities to generate and promote innovation in terms of high-tech firms. Moreover, we also found that a greater presence of youth entrepreneurship in the city, in addition to a high number of high-tech firms, positively moderate this relation.

2. Theoretical background

University education has gained in importance over the recent years. Governments, organizations, and society in terms of public institutions have become increasingly aware of the crucial role of higher education in the performance of the economy. Although, education is the most easily determined form of human capital.

For understanding the role played by human capital in economic development is important to base on the new growth theories. One of the most important theories was made by Romer (1986, 1990, 1994)who first formally examined the role of knowledge in growth from the perception of the public good aspect knowledge spillovers, and this type of approach has been a started point in the agglomeration literature. Moreover, the role played by knowledge externalities linked with human capital was also supported by Lucas (1988).

To connect human capital and regional development an important role has played by the university. In fact, there is a large literature that examines the role of universities related to economic growth. As already specified, universities play a key role as producers of creative and high human capital that is embodied in their graduates and their staff and that impact on regional economic growth (Florida, 1995; Lee, Florida and Gates, 2010; Sedlacek, 2013). In addition, several researches have also argued that universities can be a contributor to growth as a source of knowledge spillovers (Coe *et al.*, 2004; Goldstein and Drucker, 2006; Faggian and McCann, 2009a). Universities are assumed to be important sources of localized knowledge spillovers due to their explicit focus on the generation and diffusion of knowledge.

The impact of knowledge spillover on regional development and the crucial role of the university in this phenomenon has assumed a great level of importance within the last years.

As long ago as 1890, Marshall argued that geographical proximity promotes knowledge spillovers that benefit firms' knowledge production— i.e., positive externalities in the form of ideas (Marshall, 1890). The production of knowledge in the local geographical environment affects the ability of firms to introduce innovations based on new ideas.

Across-region students' mobility in terms of university enrolment of national and international students is crucial to study because the human capital of new generations is one of the most important areas for exploration and development in advanced economies. King & Ruiz-Gelices (2003) pointed out that worldwide student migration is an increasingly important phenomenon that needs attention from both policy and research points of view. In addition to that, Dustmann & Glitz (2011) stated that education and migration are so closely linked that it is almost impossible to separate them from each other. This linkage represents an important prospect of growing in terms of knowledge and regional development.

In particular, from the student perspective, mobility can be considered as an opportunity. For instance, Faggian and McCann (2009a) studied the migration flows of students in Great Britain and outlines a positive and cumulative connection between the relative economic well-being of destination regions and the scale of human capital net inflows. Furthermore, these flows can generate significant inequality in different geographical areas within and across countries (Baryla and Dotterweich, 2001; Xiang and Shen, 2009). In other words, while student migration has a recognized positive effect in destination regions, it may also give rise to larger regional disparities(Krugman, 1991).

In many countries, it is often the case that the more developed regions attract students for several reasons such as adequate services and infrastructure (Camagni, 1992), a high level of amenities (Florida, 1995, 2002) and greater social well-being (Mak and Tran, 2001; Sage, Evandrou and Falkingham, 2013), but also because they provide appropriate labor market conditions that, in turn, ensure more employment opportunities after graduation (Iammarino *et al.*, 2011; Marinelli, 2013).

Therefore, an important consequence of this migration regarding the areas that suffer a constant outmigration of better and/or wealthier students must endure a substantial decline in their human capital, whereas attractive areas benefit from the in-migration. Moreover, outmigration can prevent the development of high-quality universities and other institutions in the areas that people tend to leave (Mchugh and Morgan,

1984; Gribble, 2008). We can assume that this link between the university and the local areas in terms of human capital represents a fundamental factor of economic growth.

Related to economic growth, several studies estimate the influence of knowledge spillover on regional development linked to innovation and new firms' development.

Relating o the connection between knowledge spillover and innovation, the majority of literature is based on patents and R&D as indicators of innovation. For instance, Jaffe et al. (1993; 2000) have analyzed the geographic location of patent citations in order to prove that knowledge spillovers are geographically localized. Moreover, Maurseth and Verspagen (2002) conducted similar research for knowledge spillovers between European regions and got to the same conclusion. By tracking patent citations these studies fixated on the exchange of explicit knowledge. Concerning R&D, Harabi(1997) investigated the effectiveness of different channels of R&D spillovers at the intra-industry level. The study observed R&D activities, reverse engineering, publications, technical meetings, interpersonal communication, and patent disclosures as possible channels for knowledge spillovers. The aforementioned study suggests that a firm's investment in R&D is the most important channel for spillovers.

Concerning new firms' development, Arselin (2000) observed that university spillover effects are significantly stronger when there is a critical mass of high technology firms. Furthermore, in terms of high-technology firms, Bania et al. (1993) found that university spillover facilitates only a specific type of start-up. Similarly, De Silva and McComb(2012) stated that proximity to a research university only somewhat increases the probability of high-technology start-up, however, this research has not taken into consideration the survival of new firms.

Moreover, Florida and Kenney (1988, 1992) used venture capital data to document the geographic patterns of high-tech entrepreneurship and the social structures of innovation fixed by a venture capitalist that supports such geographically organized social structures of innovation. In particular, Florida (2002) recognizes the crucial role of HEIs in attracting creative individuals, but this link is not fully developed and relies generically on the association between the creative class and the high level of human capital. In terms of public policy (Glaeser, 2000; Porter, 2003; Faggian, Comunian and Li, 2014) have simply pointed out that universities can play a role in knowledge transfer and development of the creative economy.

Several studies observe the impact of knowledge spillovers on high-tech firms and how they facilitate the creation of new firms. This paper aims to comprehend how much the attractiveness of the city, measured by the high-tech firms number, is capable of attracting human capital. Based on this relation we suggest that city attraction is related to the high-tech startups and we hypothesize the following.

HYPOTHESIS I: Cities with more high-tech firms are more likely to attract human capital in terms of university students.

Another important aspect of the development of the territory is the ability to attract and train young entrepreneurs (Chigunta, 2002). It is widely accepted that there are many good reasons to promote entrepreneurship among young people. While caution should be exercised so that entrepreneurship is not seen as a 'mass' or comprehensive solution which can cure all economic problems, as many experts such as Curtain (2000) warn, it has several potential benefits. An obvious, and perhaps a significant one, is that it creates employment for a young person who owns a business. Many experts believe that this could bring back the youth unemployed into the economic mainstream (Ginzberg, 1980; Richard, 2000; Schoof, 2006). There may also be a direct effect on employment if new young entrepreneurs employ more youth people and a new workforce. (Richard, 2000). Another perspective of entrepreneurship is from new and dynamic businesses(Drucker, 1985) that have great economic impacts. The approach to entrepreneurship in this research is based on new business formation by entrepreneurs, especially the creation of innovative and high-tech firms that contribute significantly to regional economic development. In sum, youth entrepreneurship impacts the city attraction in terms of new opportunities and job satisfaction, and we hypothesize the following:

HYPOTHESIS II: The existence of a large number of youth entrepreneurs in the cities influences the relationship between high-tech firms and students' mobility

A large part of scholars focused on the influence of knowledge spillover on regional growth and was looking for a linkage between university students' mobility and regional growth. However, there are only several studies regarding the impact of mobility and knowledge sharing in terms of city development.

Considering the following research by Goldstein and Drucker(2006) who argue that general university spillovers are greater in small to medium-sized metropolitan areas, we base our research on the city level, in particular, we focus on 20 cities with the greatest number of resident students in Italy to determine the linkage between students' mobility and city innovation.

Based on this fact, we focused on the impact of students' migration from the city that sends students to the city that receives them and the consequential influence on the city development in terms of innovation and city performance.

3. Methodology

3.1 Sample and Data collection

This research paper uses different databases such as *Indagine multiscopo sulle famiglie, Censimento Popolazione e Abitazioni*, *Anagrafe* (Registrations and cancellations at the registry office for transfer of residence) and *National Student Clearinghouse* (NSC) to explain the interaction between students' mobility and city innovation. Our database includes data on the students' mobility of more than 700.000 students enrolled in the bachelor's and master's degree programs in Italy for 10 years (2009-2019). The unit of analysis is the city.

Our research sample is based on 20 Italian cities with the highest number of university students for 10 years (2009-2019)3. The cities taken into consideration are Rome, Milan, Turin, Naples, Salerno, Bari, Catania, Palermo, Caserta, Verona, Foggia, Reggio Calabria, Messina, Genoa, Bologna, Florence, Lecce, Bergamo, Brescia, and Cosenza.

[Insert Tab 1 – Data e sample - here]

Regarding the characteristics of the population, the data were collected through the sample survey "Aspettidella vita quotidiana", which represents a part of an integrated system of social surveys conducted by ISTAT –Indagine multiscopo sulle famiglie, and it contains fundamental information related to the daily life of individuals and families. The survey was carried out on a sample of about 25,000 families distributed in about 800 Italian municipalities of different demographic size. The families were randomly extracted from the list of names involved in the 2018 census surveys, due to a sampling strategy aimed at building a statistically representative sample of the resident population in Italy.

This research paper also uses the CensimentoPopolazione ed Abitazioni (ISTAT, 2019) conducted by the ISTAT. The survey examines the characteristics of cities in terms of population, taking into consideration variables such as residence, age, sex and development of the city in terms of migration and immigration.

Concerning the mobility of the cities, both inbound and outbound, this research paper relies on the data from "Registrations and cancellations at the registry office for transfer of residence". The survey deals with data related to registrations and registry deletions for transfer of residence carried out by the municipalities. These data are obtained from the survey carried out by the model APR / 4: a copy is taken from the migratory file filled in by the municipality of registration for residence transfers from another municipality or from abroad and by the municipality of cancellation for transfers abroad. Specifically, the survey of the foreign municipal resident population, sorted by sex and year of birth, is calculated on 31 December each year and published on 1 January of the following year.

[3]The students that were taken into consideration are the ones born in these cities, not the ones moving to them.

For the interconnection between cities, the database of the National Student Clearinghouse has been used. NSC is an administrative archive in which all the students enrolled in the Italian university system are registered. The data within the NSC database are sent monthly by the Italian universities and all the students enrolled in a university during a given academic year are taken into consideration, regardless of the year of the course. From the moment the collection of data of NSC is limited to careers that started in 2003/2004 for Bachelor's Degrees and Single Cycle Degree Programmes and the careers that started in 2004/2005 for Master's Degrees, in the total number are counted only the students who have taken on a career from the years indicated by the various course typologies.

3.2 Operationalization of the variables

Our aim was to estimate the impact of students' mobility and knowledge spillover on the economic growth in terms of technological firms of Italian cities in the period 2008/09–2018/19. This study was conducted using spatial panel-data model to verify the research framework and hypotheses which aims to predict the extent of the strength of effects of an independent variable on a dependent variable.

[Insert Tab 2 – Description variables - here]

3.2.1 Dependent variable

Among the forms contributing to the dissemination of knowledge, we can refer to the number of students attending the Bachelor's and Master's Degree Programme. They represent an uninterrupted channel for the transfer of scientific and technical knowledge among countries. In the most advanced countries, the number of foreign students enrolled in higher education had a surprising growth rate over the last decade (González, Mesanza and Mariel, 2011; Guruz, 2011; Choudaha and Chang, 2012). We consider the variable of students' mobility in terms of non-resident students enrolled in a university course in the city taken into consideration (as) the dependent variable. Students' mobility is measured by comparing the relation between students from different cities to the total amount of population of the receiving city. This variable considers the students enrolled in the Bachelor's and Master's Degree Programme in an Italian university. The sample analyzed ranges from 18 to 35 years. A total of 842.552 students are analyzed to understand the linkage between students' mobility of the 20 biggest cities in terms of students in Italy.

3.2.2 Independent variables

Our independent variables are based on high-tech firms and youth entrepreneurship. The following indicators are based on the Business Register ASIA4. This database covers all enterprises carrying out economic activities contributing to the gross domestic product at market prices, in the fields of industry, trade, and services, and it provides identification (name and address) and stratification (main economic activity, size, legal form, date of creation and date of cessation, turnover) of variables. The Register is yearly updated through a process of integration of administrative and statistical sources. Its regular maintenance ensures the updating of the active units, providing an official source of data, harmonized at the European level, for statistical analysis of the business population and its demography. The variable based on high-tech firms considered a firm founded in the year taken into consideration "n" in the high technology sector in comparison to the total firms' activities over time in the same area. The data refer to 31 December of each year and consider the relation between high-tech firms and total firms for each city. The variable based on youth entrepreneurship regards the percentage of company owners with less than 30 years of age registered

[4]**Business Register ASIA**: The Business Register ASIA was set-up in 1996 according to the European Council Regulation No. 2186/93 on Community coordination in drawing up business registers for statistical purposes, then replaced by Regulation (EC) No 177/2008.

in the Chamber of Commerce. This variable is compared to the total number of company owners registered in the Chamber of Commerce.

3.2.3 Control variables

This research shows that students' migration is positively correlated to city attractiveness. The likelihood of migration depends on the relative economic attractiveness of the potential destination in comparison to the origin location (Faggian and Mccann, 2009). Other personal influences such as gender (Faggian, Mccann and Sheppard, 2007), ethnicity (Levie, 2007), and the institutional structure of the education system (Faggian, Comunian and Li, 2014) may also play a role. Our control variable is based on city attractiveness in terms of migration and economic growth. In particular, the variable based on *employments* considered the percentage of workers in the city. This percentage is based on the relationship between the worker and the total amount of population of the same age for each city taken into consideration. In this case, we considered a sample aged 15 to 64 years.

In terms of economic development, another control variable regards the new firms founded in the city and the *Gross Domestic Product* (GDO). The variable based on the new firms as pointed out by Rosenthal & Strange (2003), in a study that examines the decisions on locations of new firms in the US, location attributes are fixed at the time of the start-up. In this variable, we are taking into consideration the firms founded in the year "n" compared to the total firms' activities over time based on the registration in the Chamber of Commerce. The choice of is GDP based on the representative economic indicator of each Italian region, considering a Gross domestic product (GDP) of every region that represented the city taken into consideration. GDP is a monetary measure of the market value of all the final goods and services produced in a specific period.

In terms of population characteristics, our control variable is based on the *migration* from one city to the city taken into consideration based on the total population in the aforementioned city. The information about a new resident from another city relies on the data from "Registrations and cancellations at the registry office for transfer of residence", the survey deals with data related to registrations and registry deletions for transfer of residence carried out by the municipalities. This data considers the transfer of a resident from another city to the city taken into consideration to understand the attraction and the movement to each city. The last control variable regards the *total students* enrolled in the Bachelor's and Master's Degree Programme in every single city. This variable represents a ratio between the total number of students in a city and the total amount of population of each city.

[Insert Tab 3 – Descriptive statistics - here]

4. Results

The knowledge spillover interconnection between cities is tested by linking knowledge within the spatial context of the city, evaluated by students 'mobility, to the number of high-tech firms. Using tests for spatial correlation we find, as expected, that the rate of high-tech firm births in the cities is positively correlated with the city attractiveness in terms of students inbound. The empirical results are presented in Table 5. Tab 4 reports the correlation among variables and the descriptive statistics are presented in tab 2. No major collinearity issues are detectable. To assess potential multicollinearity, we computed the variance inflation factor (VIFs). For each model (Model I and II in Tab 5) the mean and maximum VIF are well below the thresholds of 3.4. We thus concluded that multicollinearity is not a threat to the validity of our results.

[Insert Tab 4 - Correlation Matrix - here]

[Insert Tab.5 – Regression model - here]

[Insert Fig.1 – U-Shaped effect - here]

First of all, the figure 1 show the U-Shaped relationship between students' mobility and the number of new high-tech firms in the city. The result is also confirmed in model I and model II og the Tab. 5.

Model I shows the effect of our independent variable, that is a high-tech firms, and provides support for HHI (*Cities with more high-tech firms are more likely to attract human capital in terms of university students*.) by showing a positive and statistically significant association between the high-tech firms, measured by the firm founded in the same year in the high-tech sector and the city attraction measured by non-resident students enrolled into a university course ($p = 0.004$, $t=2.89$). In other words, we find that cities with a high number of high-tech firms are more willing likely to attract new human capital in terms of students compared to other cities. We also control the effect of our second independent variable "Youth Entrepreneurship" on the students mobility inbound but we did not find evidence to support that youth entrepreneurship in the city affect students' mobility (Model I).

Interestingly, however, that when we interact youth entrepreneurship whit new high-tech firms. The result in Model II show the evidence of the effect on students'mobility and its moderation by new high-tech firms.

Besides, we find that youth entrepreneurship in the cities, measured by the percentage of company owners with less than 30 years of age, positively moderates the relation between students' mobility and high-tech firms in Italian cities. The moderator term City_TECH*City_YouthEntr in Model III tests our HH2 (*The existence of a large number of youth entrepreneurs in the cities influences the relationship between high-tech firms and students' mobility*). The result shows that the presence of many young entrepreneurs in the city positively affects the relation between students' mobility and high-tech firms ($p=0.041$, $t=2.04$). We find that the presence of many young entrepreneurs in the city, in addition to a great number of high-tech firms, increase the city attraction and regional development.

Finally, we also ceck if there are factor that may affect the students' mobility as a total number of students, GDP, number of empoyment and number of migrant from other cities to te city token into consideration.

The results confirm the hypothesis and shed a light on both factors associated with the economic geography of talent and its effects on regional development. According to Florida (1995, 2002), the economic geography of talent is highly concentrated. Furthermore, the economic geography of talent is strongly associated with high-technology industry locations (Knudsen *et al.*, 2007; Adler *et al.*, 2019).

5. Discussion and conclusions

This article has explored the linkages between high- tech firms and city attractiveness within Italian cities and our result confirms the relationship between city attractiveness in terms of students' mobility and high-tech firms. The results show that a high concentration of high-tech firms increases the attractiveness of the city itself. Our analysis suggests that city attractiveness is affected by the capability of the cities to generate and promote innovation in terms of high-tech firms. The number of companies can derive from an investment policy of the city in terms of innovation (Frenkel, Shefer and Roper, 2003; Grilli and Murtinu, 2014; Wu *et al.*, 2019) or from the creation of highly specialized human capital within the city which attracts other human capital (Faggian and McCann, 2009b; Eriksson and Rataj, 2019). Therefore, we assume that cities with a high level of high-tech firms are more attractive than the cities that invest less in this sector. Moreover, Florida and Kenney (1988, 1992a, 1992b) used venture capital data to document the geographic patterns of high-tech entrepreneurship and the social structures of innovation anchored by a venture capitalist

that underpin such geographically organized social structures of innovation. However, the data they used covered major US centres for venture capital, but the focus was on entrepreneurial patterns and not on city attractiveness.

Furthermore, a major part of researchers focus on a regional level (Iammarino *et al.*, 2011; Stephens, Partridge and Faggian, 2013; Boschma, Iammarino and Boschma, 2017; Faggian, Rajbhandari and Dotzel, 2017), but less literature evaluates student mobility and knowledge spillover at the city level.

However, our research also reveals an important suggestion: we also found that a greater presence of youth entrepreneurship in the city, in addition to a high number of high-tech firms, positively moderates the cities' attractiveness in terms of students' mobility.

Therefore, hight innovation in terms of high-tech firms makes inbound spillovers flow more easily, youth entrepreneurship encourages this relationship by moderating positively. Interestingly, in oppositions to these results there are several strands of literature. Despite the key role played by the youth in economic development (Llisterri *et al.*, 2006; Blokker and Dallago, 2017), it was found that during the start-up and ongoing stages of their businesses, the young entrepreneurs were confronted by a myriad of obstacles. The most critical of these were related to lack of access to finance (Chigunta, 2002; Dzisi, 2014), negative social and cultural attitude to entrepreneurship (Dionco-Adetayo, 2006; Athayde, 2012) and lack of management experience (Grilo and Irigoyen, 2006; Dzisi, 2014).

The presence of an increasing number of youth entrepreneurship and a large number of high-tech companies moderates the perception of student mobility and the attractiveness of the city itself.

5.1 Limitation

Our approach also has various limitations, which could be tackled by future research. The firs limitation regards the sample taken into consideration. We focus our research sample on 20 Italian cities with the highest number of university students during a 10-year period (2009-2019) which represents an important starting point of the Italian national fabric as it concerns the 20 Italian cities with the highest production of university students and knowledge. Future research could improve this sample and look for a connection with other important cities in the world. This extension would enable us to examine the connection between cities with different policies, different culture and also different development. Moreover, in this study, we have focused solely on students' mobility in terms of knowledge attraction. We aim to improve this sample in terms of knowledge flow with new variables such as graduate students, workers, and researchers. Another limitation concerns the years analyzed (2009–2019): even if we control time-specific effects, economic growth was influenced by the 2008 crisis and the continuous change in terms of innovation and technology over these years. The negative impact of our moderating variable and the relation between high-tech firms and students' mobility may be related to this. Ottaviano and Peri (2011) and Behrens and Sato(2011) find that time horizon could be crucial to whether immigration has a positive or a negative impact on the destination wage structure.

5.2 Practical and theoretical implications

The findings have several implications for city development. Whereas in regions with a high number of high-tech firms, this level of innovation positively affects the attraction of students from different cities, in cities with low levels of high-tech firms, the policy must invest more in the development.

First, a higher level of investment in the high-tech sector leads to a higher level of city attractiveness. Therefore, investing in innovation, R&D or knowledge creation may contribute to city development. Many empirical studies have provided evidence on this positive relationship between knowledge and new firm formation in regional economies. The second recommendation is for cities in terms of exploring the role that cities' attractiveness plays in supporting the cities development (Lee, Florida and Gates, 2010; Florida, 2012)

Following the previous literature by Jacobs (1961, 1969) and Lucas (1988) and the empirical findings of Glaeser (1999; 2000) and others (Florida, 2002; Lee, Florida and Gates, 2010; Curea and Ciora, 2013), we understand that talent or human capital is a driving factor in regional development. Moreover, we assume from the following literature that talent and knowledge, not just an endowment or stock that is in place in a given region, but that certain regional conditions are required to attract human capital and knowledge. In other words, knowledge and human capital do not simply show up in a region; rather, certain regional factors appear to play a role in creating an environment or habitat that can attract and retain knowledge or human capital. Paramount among these factors, the findings suggest, is to invest in innovation and city development to attract knowledge. This, in turn, suggests that a more efficacious approach to city development may be to emphasize policies and programs to attract human capital, as opposed to conventional approaches that focus on the attraction of firms and the formation of industrial clusters, in these terms, the cities may have much to gain by investing in a "people climate" as a complement to their more traditional "business climate" strategies (Florida, 2002).

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7. Tables and figure:

7.1 Tables

Tab 1: Data e Sample of analysis

City	Area Km²	Resident Population	Density of population	Enrolled	Graduate	Enr./Grad.
Roma	5.363,28	4.342.212,00	809,62	144.046,00	25.647,00	0,178%
Napoli	1.178,93	3.084.890,00	2.616,69	106.190,00	19.054,00	0,179%
Milano	1.575,65	3.250.315,00	2.062,84	78.894,00	14.774,00	0,187%
Torino	6.827,00	2.259.523,00	330,97	57.891,00	10.171,00	0,176%
Salerno	4.954,16	1.098.513,00	221,74	42.065,00	7.607,00	0,181%
Bari	3.862,88	1.251.994,00	324,11	41.057,00	7.496,00	0,183%
Catania	3.573,68	1.107.702,00	309,96	36.464,00	6.690,00	0,183%
Palermo	5.009,28	1.252.588,00	250,05	36.956,00	7.164,00	0,194%
Caserta	2.651,35	922.965,00	348,11	35.769,00	6.404,00	0,179%
Verona	3.096,39	926.497,00	299,22	22.587,00	4.598,00	0,204%
Foggia	7.007,54	622.183,00	88,79	20.937,00	3.628,00	0,173%
R. Calabria	3.210,37	548.009,00	170,70	21.429,00	3.648,00	0,170%
Messina	3.266,12	626.876,00	191,93	21.276,00	3.830,00	0,180%
Genova	1.833,79	841.180,00	458,71	23.286,00	4.353,00	0,187%
Bologna	3.702,32	1.014.619,00	274,05	24.605,00	4.919,00	0,200%
Firenze	3.513,69	1.011.349,00	287,83	26.110,00	4.455,00	0,171%
Lecce	2.799,07	813.556,00	290,65	26.835,00	4.892,00	0,182%
Bergamo	2.754,90	1.114.590,00	404,58	25.445,00	5.001,00	0,197%
Brescia	4.785,62	1.265.954,00	264,53	27.057,00	5.254,00	0,194%
Cosenza	6.709,75	705.753,00	105,18	23.653,00	3.815,00	0,161%

Fonte: ISTAT.

Tab 2: Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Students' Mobility (log)	200	-4,307	1,303	-6,17	-1,52
New High-Tech Firms (log)	200	-3,970	0,276	-4,77	-3,45
Youth Entrepreneurship (log)	200	-3,064	0,210	-3,57	-2,54
Total Students (log)	200	-1,065	0,285	-1,60	0,55
GDP (log)	200	11,575	0,674	10,37	12,89
Employment (log)	200	-0,531	0,173	0,89	-0,26
Migration (log)	200	-3,552	0,362	-4,35	-2.28

Tab.3: Description Variable

Variable	Description
Dependent Variable:	
Students' Mobility	Non-resident students enrolled into a university course in the city taken into consideration
Independent Variable	
New High-Tech Firms	The firm founded in the year taken into consideration in the high technology sector in comparison to the total firms' active over time in the same area.
Youth Entrepreneurship	The percentage of company owner's whit less than 30 years of age in regard to the total number of company owners registered in Chamber of Commerce.
Control Variable	
Employment	Percentage of people workers aged 15 – to 64 based on the relationship between the worker and the total amount of population of the same age for each city taken into consideration.
GDP	We considering a Gross domestic product (GDP) of every region that represented the city take into consideration. GDP is a monetary measure of the market value of all the final goods and services produced in a specific time period.
Migration	Transfers of residence from another city to the city takes into consideration. This data is related to registrations for transfer of residence carried out by the municipalities
Total Students	We considering the total number of students enrolled in the university course in the same or another city, residence in the city takes into consideration.

Tab 4: Correlation Matrix

	Variable	[1]	[2]	[3]	[4]	[5]	[6]	[7]
[1]	Students' Mobility (log)	1,00						
[2]	New High-Tech Firms (log)	0,69***	1					
[3]	Youth Entrepreneurship (log)	-0,56***	-0,70***	1				
[4]	Total Students (log)	-0,68***	0.49***	,0,49***	1			
[5]	GDP (log)	0,45***	0,58***	-0,34***	-0,72***	1		
[6]	Employment (log)	0,81***	0,55***	-0,54***	-0,92***	0,59***	1	
[7]	Migration (log)	0,61***	0,46***	-0,27***	0,61***	0,56***	0,58***	1

* p < 0,05, ** p < 0,01, p < 0,001

Tab 5: Regression Model

	Model I	Model II
Students' Mobility (log)		
New High-Tech Firms (log)	3,974***	21,392**
	[1,227]	[10,318]
New High-Tech Firms^2 (log)	0,554***	3,028**
	[0,145]	[1,328]
Youth Entrepreneurship (log)	-0,066	12,801*
	[0,113]	[7,070]
New High-Tech Firms (log)*Youth Entrepreneurship (log)		7,239**
		[3,681]
New High-Tech Firms^2 (log)*Youth Entrepreneurship (log)		1,005**
		[0,480]
Total Students (log)	1,736***	1,760***
	[0,284]	[2,278]
GDP (log)	0,521	0,795
	[0,727]	[0,762]
Employment (log)	1,039***	1,041***
	[0,335]	[0,329]
Migration (log)	0,016	0,042
	[0,075]	[0,074]
W3		
Students' Mobility	0,534***	0,517***
	[0,105]	[0,103]
e.Students' Mobility	0,719***	0,747***
	[0,084]	[0,075]
Sigma_e_cons	0,095***	0,092***
	[0,005]	[0,005]
N	200	200
Year Fixed	Yes	Yes

Standard errors in parentheses

Notes: Students' mobility, dependent variable. P < 0.100; *P < 0.050; ** P < 0.010; ***P < 0.001

7.2 Figure

Figure 1: U-Shaped