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UNIVERSITIES AND THE LOCATIONAL DYNAMICS OF ACADEMIC ENTREPRENEURSHIP: AN APPROACH FOR THE STATE OF SÃO PAULO, BRAZIL

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Purpose - This research aims to investigate the dynamics of location of academic entrepreneurs in the State of São Paulo, Brazil, and its association with the respective universities of origin.

Method - A total of 1,082 PIPE/FAPESP projects were analyzed between 1998 and 2017, allowing the construction of heatmaps that demonstrate consistent patterns of geographic distribution of knowledge-intensive academic entrepreneurship in the State of São Paulo.

Main results - While research-intensive public universities play a leading role in the generation and retention of entrepreneurs at the local level, the distance from developed markets significantly reduces the concentration of spin offs in regions.

Theoretical/methodological contributions – Findings have implications for the notion that universities' campuses can trigger levels of regional development, since the causal relationships in this process seem to be linked to both endogenous factors and processes exogenous to the university.

Relevance/originality - Issues involved in this analysis include topics of central interest in the search for a deeper understanding of the evolutionary dynamics of entrepreneurship ecosystems in the Brazilian context.

Keywords: Academic Entrepreneurship; Geography of Entrepreneurship; Regional Development; Universities.

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1 INTRODUCTION

The role of Universities in the 21st century reaches beyond teaching. Universities are currently recognized not only as institutions that create and disseminate knowledge, but which are related to corporate activity, promoting regional development (Poods, Oort & Frenken, 2010). Thus, the ideal of a third mission suggests precisely the translation of scientific knowledge into commercial applications that incorporate and capture regional value, boosting local company's capacities and improving their respective competitive capacities (Benneworth , Coenen, Moodysoon, & Asheim, 2009).

Research activities in these institutions have been transformed into significant innovation sources, where academic entrepreneurship is one of its primary representations (Collini, 2012). In this sense, universities are frequently seen as the central actors of entrepreneurship and innovation (Asheim, Smith, & Oughton, 2011; Jiao, Zhou, Gao, & Liu, 2016). These connections play a strategic role within the dynamics of productive systems. Academic entrepreneurship, having intensive knowledge, has the capacity of affecting significantly the paths of economic growth and development (Beckman, Eisenhardt, Kotha, Meyer, & Rajagopalan, 2012; Fritsch, 2008).

Notwithstanding, academic entrepreneurship is heterogeneously distributed across territories, which occurs due to the different levels of resource and knowledge availability, besides non-homogeneous structures in terms of institutions and markets (Stam, 2009). These processes create high spatial concentration levels in entrepreneurship activities Florida, Adler, & Mellander, 2016; Feldman, 2001), even though there are knowledge gaps regarding the aspects affecting localization patterns for new companies (Audretsch, 2012).

In this scope, one of the main attention points concerns the role of universities as structuring axis of local entrepreneurship systems, given that areas close to these institutions are the ones with higher rates of high-tech entrepreneurship (Rothaermel, & Ku, 2008; Schaeffer, Fischer, & Queiroz, 2018). This observation is related to the

fact that entrepreneurship activities' locations can be understood as a strategic decision, considering the possibility of accessing the knowledge spillovers from the academic environment (Audretsch, Lehman, & Warning, 2005; Kolympiris, Kalaitzandonakes, & Miller, 2015).

For the Brazilian context, issues related to the proximity of academic spin offs and universities remain an unexplored field of study, which is set as an obstacle for a deeper understanding of the dynamics of economic activity distribution and its respective impacts regarding regional development policies. Therefore, aiming to contribute to this debate, this study was based on the following research question: ***Do academic entrepreneurs establish new companies close to the institutions which they have developed their academic activities in?*** Considering this introductory context, it is expected that the results of the analysis carried out can offer relevant input regarding the behavior of entrepreneurship ecosystems, also contributing for the knowledge regarding respective policies fomenting such productive configurations.

In methodological terms, academic entrepreneurship was approached, in this article, through data from the Program Innovative Research in Small-Sized Companies (*Programa Pesquisa Inovativa em Pequenas Empresas*) promoted by the São Paulo Research Foundation (*Fundação de Amparo à Pesquisa do Estado de São Paulo* - PIPE/FAPESP). 1,082 projects were analyzed covering the period from 1998 to 2017. The data allow for the construction of heatmaps that evince consistent patterns of academic entrepreneurship's geographical distribution in the studied State. Based on this input, it was possible to observe the pattern of local academic entrepreneurship, the dynamics of attracting entrepreneurs from other localities, and the micro-geography of academic entrepreneurship in the context of the main ecosystems in the State of São Paulo. To complement the analysis, four companies participating in PIPE/FAPESP were interviewed, aiming to validate and detail quantitative perspectives, observing their relations with universities and characteristics related to their localization strategies.

The main result of the research suggests that, while public research-intensive universities have a prevailing role on entrepreneur creation and retention, the distance to developed markets significantly reduces the concentration of spin offs in their respective regions. Such finding has implications for the understanding that universities' campuses can, on their own, boost regional development levels, since the causal relations in this process seem to be related not only to aspects endogenous to universities, but also to processes that are exogenous to these institutions.

After the introduction, the rest of this article is organized as follows: Section 2 draws a conceptual and theoretical explanation on the evolution of the role of universities on the socio-economic context, emphasizing issues involving the entrepreneurial university, the phenomenon of academic entrepreneurship, and its location patterns. Section 3 presents the methodological procedures used in the research. The results are presented and discussed in section 4. Section 5 concludes the article with the research's contributions and implications, as well as suggestions for future approaches.

2 ENTREPRENEURIAL UNIVERSITIES

Studies on the role of university on economic development represent a constantly expanding literature, with emphasis on the growing significance of these institutions for the knowledge-based economy (e.g. Poods et al., 2010; Siegel, & Wright, 2015; Jiao et al., 2016). Along with this perspective, besides traditional research and teaching activities, universities have been stablishing strategies for integration to markets through many technology transfer mechanisms.

The first studies to recognize the importance of universities for regional innovation have granted to these institutions the role of scientific knowledge producers (knowledge factories) (Uyarra, 2010; Youtie, & Shapira, 2008). Later on, researches started to confer universities a more relational or collaborative characteristic, emphasizing interactions with firms, which are characterized by a bi-

directional flow of knowledge between both actors (Cohen, Nelson, & Walsh, 2002; Mowery, & Sampat, 2005).

Within this same context, entrepreneurial universities have emerged as a theoretical approach. This view results from the analytical landmark proposed by the *Triple Helix*, in which the interaction dynamics among university, industry, and the government compose the fundamental pillars of innovation processes present in productive structures (Etzkowitz, & Leydesdorff, 1998). Along these lines, innovation occurs when the knowledge created by universities is directed in the intent of meeting companies' demands, supported by public policies that aim to coordinate the development of regions and to foster partnerships (Etzkowitz, & Zhou, 2017). According to the literature on the theme, such interactions have been demonstrating positive results in many contexts (Bramwell, & Wolfe, 2008; Lazzeretti, & Tavoletti, 2005; Mok, 2005; Gonçalves, & Cóser, 2014).

Thus, universities have taken on a primary position on the knowledge economy (Jiao et al., 2016). In addition, such proposals have conceptually evolved by including not only the establishment of relations with the productive segment, but also the creation of companies, technology transfer offices, and scientific parks (Audretsch, 2014; Etzkowitz, 2004; Siegel & Wright, 2015). In this perspective, Collini (2012) explains that the connections between the academic environment and the entrepreneurial context not only benefits existing businesses – through university-industry interactions –, but also the dynamic of creation of new business coming from the activities performed within the university environment: the academic spin offs.

Therefore, universities incorporate the mission of supporting the evolution of entrepreneurship ecosystems, be it through the provision of human resources and technologies for existing companies or through the creation of entrepreneurs. As an example, literature indicates universities as central actors of these ecosystems (Charles, 2006). Notwithstanding, it must be considered that, besides noteworthy successful cases, the capacity of universities in creating new intensive-knowledge companies is highly heterogeneous (Di Gregorio, & Shane, 2003). Such note emphasizes, additionally, the relevance of the analysis and evaluation of public and

institutional policies for the involvement of academic units in the productive structure (Gonçalves, & Cóser, 2014).

In addition, the role given to universities is even more relevant when some sectors are specifically analyzed, such as technology-intensive or science-based ones, or when the context of developing countries is considered – given the systemic frailties in terms of the innovative capacity of the business structure (Azagra-Caro, Pardo, & Rama, 2014; Cowan, & Zinovyeva, 2013). The following section aims to analyze these propositions within the Brazilian context.

2.1 Entrepreneurial Universities in Brazil

Up to the 1960s, the Brazilian model for industrial policy was widely guided by a behavior of importing technology. National institutions used to play the role of assisting new imported technologies, making it easier for them to be absorbed through extension programs. After that period, the country started to engage more actively in Science and Technology (S&T) activities, which, in its turn, resulted on the acceleration of technology transfer processes and on the valorization of the universities' role in the socio-economic context (Ipiranga, Freitas, & Paiva, 2010).

Notwithstanding, public resources destined to universities remained restricted, a context that was changed after the beginning of the 2000s, with the expansion of government expenditure on the academic segment (Porto, Kannebley Jr., Selan, & Baroni, 2011).In the beginning of the second decade of the 21st century, the Brazilian government had a participation of around 60% in the total national expenditures on Research and Development (R&D), most of them being executed by public universities with intensive research (Castro, & Souza, 2012).

However, according to the international experience, such approach, based on a linear thinking, is insufficient to boost the capacities of the National Innovation System. As explained by Ryan (2010), decision-makers in the bodies responsible for Brazilian Science and Technology policies have observed, since the 90s, that Brazilian science was not being translated into technological innovation, a fact that

Albuquerque (1999) has interpreted as a sign of immaturity in the Brazilian Innovation System. As an attempt to create a more adequate environment, increasing company's participation on the development of innovative projects, the Innovation Law (Federal Law no. 10.973/2004) was enacted, an important milestone for encouraging the innovation process (Fischer et al., 2018c). Since then, and being fomented by the Industrial, Technological and Commercial Policy (PITCE 2004-2008), the approximation between universities and companies remains a central axis of national strategies for science, technology, and innovation.

The positive effects of the 2004 Innovation Law, in terms of patents created in academia and of the university-industry collaboration, were connected to higher levels of innovative capacity in firms (Dewes, Dalmarco, & Padula, 2015; Santos, & Mello, 2009). However, institutional frailties in making agreements with companies have remained, especially due to the inexperienced governance of technological innovation centers and to existing bureaucratic barriers in public universities and research institutes (Alves, Fischer, Vonortas, & Queiroz, 2015; Freitas, Marques, & Silva, 2013).

Further discussions among government, the academic segment, and industry have led to updates in the 2004 Innovation Law, through a new institutional structure in 2016 (Law 13243/2016, also known as New Legal Framework for Science, Technology and Innovation), which aims to strengthen the bonds between the academy and industry. Among the changes, some can affect public universities, such as the availability of public university professors in exclusive service to perform paid activities in private institutions and shared labs between universities and companies. The impacts of this new institutional environment will be perceived in the following years, but it is noteworthy the approximation between universities and companies in Brazil during the last two decades (Fischer et al., 2018c).

2.2 Academic Entrepreneurship

One of the main expressions of entrepreneurial universities and their respective integrative role between higher education institutions and productive

structures concerns the practices of academic entrepreneurship Krabel, & Mueller, 2009; Landry, Amara, & Rherrad, 2006). This concept may be defined as the creation of new companies coming from the university context and emphasizing the exploitation of scientific research results, representing a technology transfer vehicle (Guerrero, & Urbano, 2012). Foment to such practices is growing, just as the interest on the theme by researchers (Abreu, & Grinevich, 2013; Shane, 2004; Siegel, & Wright, 2015).

The increase in the significance of academic entrepreneurship is related to the perception that new science-based companies have an important potential to contribute to the commercialization of knowledge (Siegel, Wright, & Lockett, 2007). In their turn, these spin offs are connected to high levels of innovative capacity, promoting substantial socio-economic impacts (Ferreira, Fayolle, Fernandes, & Raposo, 2017).

Besides, under a systemic view, these companies positively affect the growth and economic development levels of the regions where they are embedded ((Audretsch, Keilbach, & Lehmann, 2006; Ferreira et al., 2017; Landry et al., 2006). According to this perspective, universities can be seen as producers of entrepreneurial capital within the perspective of innovation and entrepreneur ecosystems (Audretsch, 2014; Galán-Muros & Davey, 2017). Well-known examples include the Silicon Valley and Route 128, two environments where research-intensive universities have been set as central actors and suppliers of academic entrepreneurs (Feldman, 2001; Hsu, Roberts, & Eesley, 2007). However, as indicated by literature, the impacts related to academic entrepreneurship are strongly connected to the local environment, which justifies the interest for a deeper understanding of these new companies' location dynamics.

2.2.1 Location of academic entrepreneurship

Universities have been playing a decisive role in the process of locational decision for academic spin offs, given that these institutions act as shapers for entrepreneurial ecosystems (Fischer et al., 2018b). Audretsch et al. (2006) have

approached this matter by referring to the “entrepreneurial capital”, a concept that may be understood as local institutions that promote the creation of new ventures. Within this context, geographical proximity is essential for the transmission of knowledge, thus presenting a significant impact on the emergence of knowledge-intensive entrepreneurial activities (Gilbert, Audretsch, & McDougall, 2004). According to the propositions by Egeln, Gottschalk e Rammer (2004), the main factors that determine geographic proximity processes through academic entrepreneur retention and attraction are related to:

(i) Easy access to collaboration in research and knowledge flows;
(ii) Reduction of costs related to these transactions;
(iii) Depending on additional R&D activities promoted by the university;
(iv) Ease at overcoming issues that new ventures face (high costs, lack of equipment, etc.);
(v) Existence of possible social relations between the entrepreneur and the university.

In fact, many empirical studies corroborate to these localization vectors. Boschma and Martin (2010) establish the notion that knowledge-intensive entrepreneurship tends to be located in places where entrepreneurs establish social networks and where they can access a relevant knowledge source. This results from the fact that entrepreneur processes are essentially relational, involving the formation of networks by the emerging entrepreneur and depending on existing trust levels among the agents (Heblich & Slavtchev, 2014; Stam, 2009).

Therefore, the argument supporting the proposition that universities attract and create new enterprises consists on the fact that they are incorporated in social relations and are prone to cluster spatially (Alvedalen & Boschma, 2017; Audretsch & Belitski, 2017; Feldman, 2001). Miller and Ács (2017) go beyond this perspective and suggest that the university campus itself can be seen as the prime *locus* of the notion of entrepreneurial ecosystems.

In addition, Stam (2009) proposes that knowledge-intensive entrepreneurial activity is connected to research activities carried out in universities and the provision

of qualified individuals offered by these institutions. Likewise, Berggren and Dahlstand (2009) identify that new intensive-technology enterprises are usually located where the entrepreneur has previously studied, results that were confirmed by Baltzopoulos and Broström (2013). When analyzing the case of Sweden, these authors have verified that entrepreneurs are very likely to start a new business in the same region where they have studied. The same pattern was observed in Italy, where universities are identified as centers of attraction for innovative entrepreneurs (Calcagnini, Favaretto, Giombini, Perugini, & Rombaldoni, 2016).

Other factors that also affect this decision refer to the levels of regional development, given that students graduated in less developed regions tend to present higher geographical mobility (Faggian & McCann, 2009). Places with denser productive structures tend, thus, to exert higher attraction levels on new companies and entrepreneurs (Li, Goetz, Partridge, & Fleming, 2016).

In this sense, the location of academic entrepreneurs is mediated by the socio-economic context, since areas that comprise more developed markets foment the retention and attraction of these new ventures ((Polonyová, Ondos, & Ely, 2015). Larsson, Wennberg, Wiklund e Wright (2017), when observing the Swedish case, have also identified the entrepreneurs' tendency in clustering close to their original universities, even though this factor may be controlled by the existence of great urban centers in these regions. The mediation exerted by market conditions on the process and academic entrepreneurs attraction and retention performed by universities is also recognized by other authors (Egeln et al., 2004; Guerrero Urbano, Fayolle, Klofsten, & Mian, 2016; Kolympiris et al., 2015). This is a matter with serious implications for the formulation of public policies and for understanding universities as potential vectors of regional development. Focusing on academic entrepreneurship, its clustering processes seem to be connected to factors related to the economic development structure, so that a university campus established in an economically peripheral region will hardly be capable of creating by itself the dynamics needed for the formation of an entrepreneurial ecosystem (Schaeffer et al., 2018).

3 METHODOLOGY

The methodology employed in this researched had two phases. The first stage of the empirical exercise was essentially quantitative and consisted on the geographical mapping of companies originated from academic entrepreneurship. For that, data from projects of the Program Innovative Research in Small-Sized Companies promoted by the São Paulo Research Foundation (PIPE/FAPESP) were used. PIPE was created in 1997, inspired by the US program Small Business Innovation Research (Salles-Filho, Bonacelli, Carneiro, Castro, & Santos, 2011).

Even though this dataset provides a restricted view of the universe of academic entrepreneurs in the State of São Paulo, it allows to approach the studied phenomenon with consistent parameters about the contents of entrepreneurial activities (Fischer et al., 2018b). This is because projects are evaluated in terms of technical merit, allowing for the association between entrepreneurial activities and the innovative content of the proposals.

However, PIPE is a program not only destined to academic entrepreneurship. Therefore, as the focus of this research consists on analyzing the proximity between new entrepreneurs and the universities they have carried out their last education, the information was filtered according to the profile of the individuals that had curriculums in the Lattes Platform. It is understood that this approach allows for a coherent view on entrepreneurs with research bonds – as students, employees, and professors – to higher education institutions. The extraction was manually done, and it enabled the compilation of a list of 1,259 individuals of a total of 1,418 entrepreneurs listed on the PIPE/FAPESP dataset.

After that, the identification data of the companies these individuals had connected their PIPE projects to were found, including the city where they were located. With these data, the Google Maps geolocation tool, a free platform for the visualization of maps and satellite images on the web, was used to obtain the location coordinates of these companies. After this process, the sample was reduced to 1,082 companies due to missing data – a possible effect of a share of the

enterprises having closed. The data cover projects developed between 1998 and 2017.

Based on this information, it was possible to crosscheck and define, by using the binary system, if the companies matched with the municipality in which the entrepreneurs had their last education. The research was not restricted to any kind of academic area, considering those who had graduated, master's or PhD degrees. Due to the timeframe, it was considered the last previous formation to the development of the PIPE project. Based on this refined dataset, heatmaps were constructed on Google Fusion Tables to verify the enterprises' concentration patterns, just as the characteristics regarding (i) retention close to origin universities, and (ii) mobility tendencies of academic entrepreneurs graduated in other regions.

Aiming to deepen the understanding on questions related to the geographical proximity between entrepreneurs and universities of origin, the second stage of the research was directed to a qualitative approach focused on interviews with companies that were funded by PIPE and that fit into the definition of academic entrepreneurship used in the empirical approach. Four companies indicated by the assistant coordinating body of the PIPE/FAPESP Program took part in the qualitative phase of the research between September and November 2018. The criteria for indications were as it follows:

i. PIPE companies with academic entrepreneurship characteristics, that is, having entrepreneurs coming from the academic research environment (such as graduate students or researchers)
ii. That represented company success cases in the scope of the PIPE/FAPESP program, thus excluding ventures in initial activity phases or that had closed their operations.
iii. That were located in any of the main entrepreneur ecosystems of the State (São Paulo, Campinas, São José dos Campos, São Carlos or Ribeirão Preto), mapped in Fischer et al. (2018a), so to restrict the geographical scope to ecosystems with more advanced maturity levels.

These criteria allowed for the qualitative analysis, complementing the quantitative view, to provide deep input to support propositions from the approach based on mapping the entrepreneur activity in the State of São Paulo. Table 1 presents data referring to the place, originating academic institution, job position of the interviewee, and segment of the interviewed companies.

The interview script was oriented towards issues referring to the intensity of interaction between companies and the universities, as well as to the role of higher education institutions in fomenting the creation of these companies[4]. The interviews were recorded and dully transcribed for the content analysis.

Name code	Locality	Academic Institution of Origin	Interviewee Position	Segment (CNAE)
CompanyPIPE_1	Campinas	UNICAMP	Founding member and R&D Director	Information Technology Consultancy
CompanyPIPE_2*	São Carlos	USP – São Carlos	Founder (1) CEO (2)	Support to Health Management
CompanyPIPE_3	São José dos Campos	ITA	Product Director	Aircraft Manufacturing
CompanyPIPE_4	São Paulo	USP	Founding member and Co-CEO	Development and Licensing of Customizable Computer Programs

Table 1. Summary of interviewed companies.
* We chose to perform two interviews in Company_PIPE_2. The first with the company's founder, who was responsible for technology development, and the second with the current CEO, given that the founder withdrew from the company's management.
Source: The authors.

4 ANALYSIS AND RESULTS

Firstly, it was analyzed the distribution of PIPE projects related to the academic entrepreneurship activity and to their respective university of origin (Table 2). The main institutions, in terms of percentage, comprise the following universities: *Universidade de São Paulo* (USP), *Universidade Estadual de Campinas* (UNICAMP), *Universidade Federal de São Carlos* (UFSCAR), *Universidade Estadual Paulista*

[4] The research's qualitative phase was previously validated by the Research Ethics Committee of the authors' institution, registered under the process no. 89010418.2.0000.8142.

(UNESP), and *Instituto Tecnológico de Aeronáutica* (ITA). These universities are responsible for around 80% of the total verified projects. Such characteristics agree with the propositions by Di Gregorio and Shane (2003), who identify that knowledge-intensive entrepreneurial activity is related to research-intensive universities.

With the exception of ITA, the other universities have wide geographical coverage due to their "multi-campuses" nature. This is specially evident in the case of UNESP, with 24 units placed in different municipalities of the State of São Paulo. The remaining projects are distributed in 152 different universities that correspond to the last institution of the entrepreneurs – all having marginal individual participation, including many institutions located outside the country.

University	Number of PIPE projects	Distribution of PIPE projects
USP	450	41.59%
UNICAMP	198	18.30%
UFSCAR	83	7.67%
UNESP	72	6.65%
ITA	53	4.90%
Other Universities	226	20.89%
Total	**1082**	**100%**

Table 2. Total distribution of PIPE projects.
Source: The authors

A second aspect refers to the analysis of the distribution of PIPE projects per knowledge areas (Table 3). It was thus observed a prevalence of areas considered as hard sciences and with technological orientation to the detriment of projects in the areas of Human, Social, Applied, and Interdisciplinary Sciences. This fact shows the connection between the projects performed and the nature of the fomenting tool, focused on innovative research guided towards technological development (knowledge fields related to "STEM" activities[5]).

Additionally, it is possible to analyze the number of remaining projects and its percentage, that is, projects by academic entrepreneurs who develop activities in the same municipality of their last graduation, covered by the PIPE Program. The

[5] STEM is the acronym traditionally used to identify Science, Technology, Engineering and Math areas. More recently, the acronym has started to also cover areas related to Health Sciences and Medicine.

percentage of projects in agrarian, biological, and social applied sciences that remained close to the universities was, in average, 50%. While for health, exact and land sciences, besides engineering and interdisciplinary ones, this percentage grows to 60%.

In the interviews with the companies, it was possible to verify that Engineering areas have a substantial dependence relation to the university environment, once the companies – especially in their first operation years – widely depend on the use of labs shared with research institutions, as is the case of CompanyPIPE_2 and CompanyPIPE_4, located in the cities of São Carlos and São Paulo, respectively. Both companies, in the beginning of their operations, have actively used the university structure for performing research and tests, with emphasis to available labs and equipment. Such evidences corroborate to the perception of previous studies (e.g. Gilbert et al., 2004; Egeln et al., 2004).

Wide Knowledge Areas	PIPE Projects	Remaining ones	% of Remaining ones
Agrarian Sciences	134	66	49.25%
Biological Sciences	112	53	47.32%
Health Sciences	74	47	63.51%
Exact and Land Sciences	204	125	61.27%
Human Sciences	7	2	28.57%
Social Applied Sciences	22	11	50.00%
Engineering	495	300	60.61%
Interdisciplinary	34	21	61.76%

Table 3. PIPE projects characterized according to Wide Knowledge Areas.
Source: The authors

Based on the data extracted form the entrepreneurs' Lattes curriculums, it was possible to deepen the discussion regarding the level of formation of the individuals responsible for PIPE projects (Table 4). It was verified the prevalence of academic entrepreneurs holding PhD degrees.

It is also highlighted that entrepreneurs with higher formation levels (masters and PhD) have significantly higher levels of permanence in the place of their last formation, as evinced in the example above. This finding provides further subsidy to assess the matter of strengthening relationship networks and how they evolve throughout the individuals' academic path, making them less prone to geographical

mobility. Other possible explanation for this finding concerns the age of entrepreneurs, given that younger individuals would be associated to a lesser tendency in remaining at the locality.

Formation Level	PIPE Projects	Remaining ones	% of Remaining ones
Graduated	171	77	45.03%
Masters	243	150	61.73%
PhD	668	395	59.13%

Table 4. PIPE project according to the level of academic formation.
Source: The authors

Next, PIPE/FAPESP projects are mapped according to their geographic distribution in the State of São Paulo. Initially, the total number of PIPE projects was analyzed (Figure 1). The heatmap supports previous findings regarding the tendency of concentration of knowledge-intensive entrepreneurship in this region (Fischer et al., 2018a), identifying five central ecosystems: São Paulo, Campinas, São Carlos, Ribeirão Preto, and São José dos Campos. With a contiguity characteristic, these municipalities seem to create a single axis of entrepreneurial activity, even though recent research has demonstrated the existence of relatively independent ecosystems in this area (Alves et al., 2018). These municipalities receive special attention in further stages on our investigation.

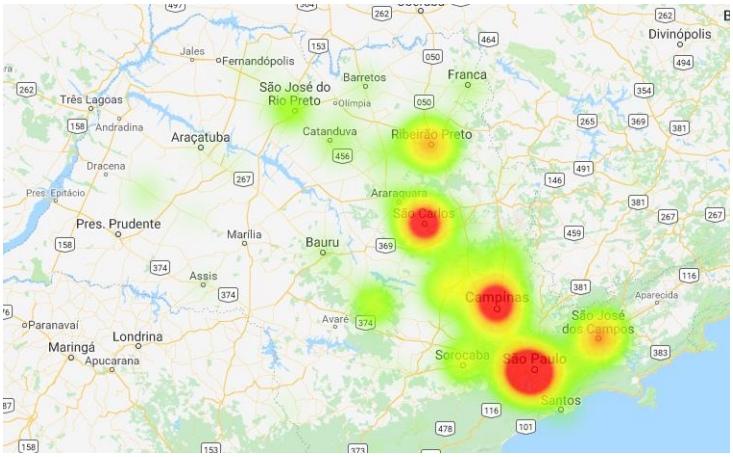

Figure 1. Heatmap of PIPE projects in the state of São Paulo.
Source: PIPE (2018)

The second phase of the exploration regarding the geographical distribution of academic entrepreneurship in the studied State corresponds to deepening the map outlined in Figure 1, decomposing it into two groups: remaining entrepreneurs (Figure

2 – A), and moving entrepreneurs (Figure 2 – B). As pointed out in the methodology, remaining entrepreneurs are seen as those with the last formal bond to institutions located in the same city where the company related to the PIPE project is, while moving entrepreneurs are those with businesses located in municipalities different from the last formation bond.

Some interesting patterns emerge when verifying the maps. While remaining entrepreneurs (57.7% of the total) present a geographical distribution that clearly outlines the five main ecosystems mentioned, moving entrepreneurs (42.3% of the total) have a wider spatial coverage, with a tendency for high concentration on the Campinas-São Paulo axis. This difference between both maps supports the literature that identifies how factors related to the development level of local markets affect the localization decision for the entrepreneur activity, feeding ecosystems with more advanced development levels (Faggian & McCann, 2009; Li et al., 2016; Polonyová et al., 2015; Larsson et al., 2017; Egeln et al., 2004; Guerrero et al., 2016; Kolympiris et al., 2015). Among the vectors shaping these tendencies, it can be mentioned support structures, access to credit, higher entrepreneur culture, and business infrastructure (Isenberg, 2010).

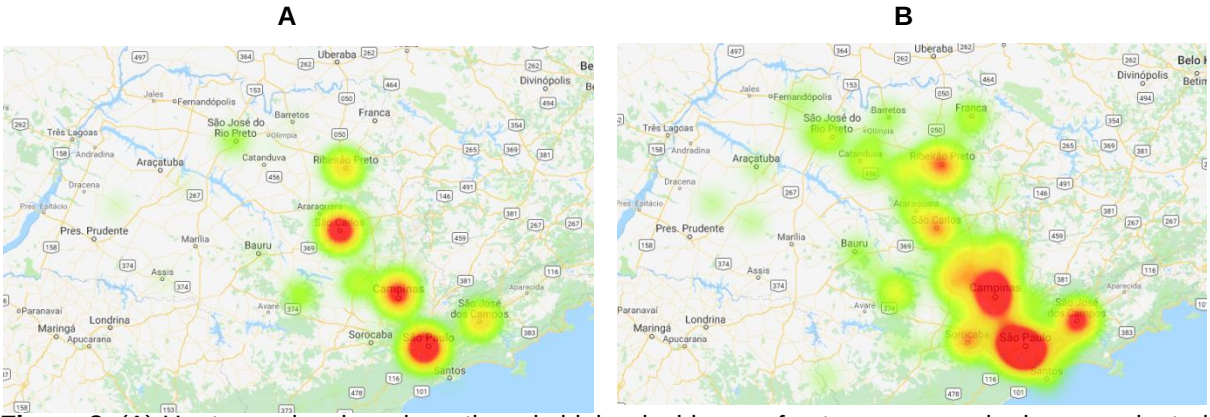

Figure 2. (A) Heatmap showing where there is higher incidence of entrepreneurs who have graduated and stablished business in the same city (n=625); and (B) Heatmap showing where there is higher incidence of entrepreneurs who have established business outside the place of their last formation (n=457).
Source: PIPE (2018)

Aiming to explore these findings in more detail, Table 5 identifies the data of related PIPE projects and the permanence rate by institution. As aforementioned, with the exception of the *Instituto Tecnológico de Aeronáutica* (ITA), all other

institutions establish their activities in “multi-campuses” structures. Notwithstanding, the *Universidade de São Paulo* (USP), *Universidade Federal de São Carlos* (UFSCAR), and *Universidade Estadual de Campinas* (UNICAMP) have a strong centralization around their respective head-units, all located within an axis with high economic development levels in the State of São Paulo (Fischer et al., 2018a).

Whereas for the case of the *Universidade Estadual Paulista* (UNESP), its institutional structure is highly decentralized, covering 24 municipalities in areas presenting high levels of socio-economic heterogeneity among themselves; Thus, the data also point out to a complementarity between the retention role of the entrepreneur’s last academic bond and the level of development of the local economic system.

University	PIPE Projects	Remaining ones	% of Remaining ones
USP	450	324	72.00%
ITA	53	37	69.81%
UFSCAR	83	56	67.47%
UNICAMP	198	116	58.59%
UNESP	72	25	34.72%

Table 5. Number of PIPE projects, of the ones remaining in the city and its percentage per university. Source: the authors

The next step of the analysis is verifying the micro-geography of academic entrepreneurship in the five main ecosystems of the State of São Paulo: São Paulo, Campinas, São Carlos, São José dos Campos, and Ribeirão Preto. Using this procedure allows for deeply qualifying the argument on the role of universities as agents structuring these entrepreneurial ecosystems, according to the proposal by Schaeffer et al. (2018).

Figure 3 explores the case of São Paulo and Campinas, cities that host, respectively, the central campuses of USP and UNICAMP. In São Paulo, it is observed a high concentration in the area of Cidade Universitária (University City), in the western region of the city, strengthening the proposition of the significance of geographical proximity between academic entrepreneurs and the university environment.

CompanyPIPE_4 is an example of the importance of USP for entrepreneur creation and retention. Founded in CIETEC, USP's technology-based incubator, the company was originated in the Polytechnic School of USP, given that the idea supporting the developed technology was the theme of the graduation thesis of one of the company's founding members. Along with graduated colleagues, the freshly graduated individuals decided to create the company based on the knowledge obtained in the university. CIETEC was the one that helped the company to take part in the PIPE Program, who has as the responsible researcher the professor that had supervised one of the founding members at USP.

This partnership, besides allowing for the performance of joint research activities and the use of labs, has also created a co-patent between the company and the professor. Currently, the company aims to capture and train human resources specially at USP, besides keeping informal contact with professors and acting on the mentorship of new companies based on the incubator, a factor that feeds the São Paulo entrepreneurial ecosystem back. Therefore, the university has not only eased the creation of the company and helped it to obtain PIPE resources, but it has also integrated the company's innovative dynamics with the scientific environment since the beginning of its operations.

In the case of Campinas, a higher dispersion prevails, even though the district of Barão Geraldo – in the northern region of the city – and its surrounding areas represent the main pole of entrepreneur concentration. Also in this case, this is the region where UNICAMP is located, besides the Campus I of the *Pontíficia Universidade Católica* of Campinas.

Regarding CompanyPIPE_1, located in the city of Campinas, but outside the district of Barão Geraldo, it is important to highlight that the University, more specifically the undergraduate course in Computer Engineering at UNICAMP, promoted the meeting place for three different entrepreneurs that would later on found the company. Besides, it was at UNICAMP that the entrepreneurs acquired the knowledge basis necessary for developing the product sold by the company. However, despite the university having played an important role in the beginning of

the company's operations, its relevance is currently focused on teaching activities, that is, on the formation of qualified human resources and on informal relations with the institution's professors who are interested in common themes.

It is precisely UNICAMP's capacity in promoting qualified human capital that encourages the company to remain in the same respective city. Moreover, this company does not keep joint research projects with universities, given that the efforts required by these projects are beyond the company's internal capacity. Currently, it only grants the use of its software for teaching purposes at UNICAMP, which ends up resulting on punctual development suggestions by the students.

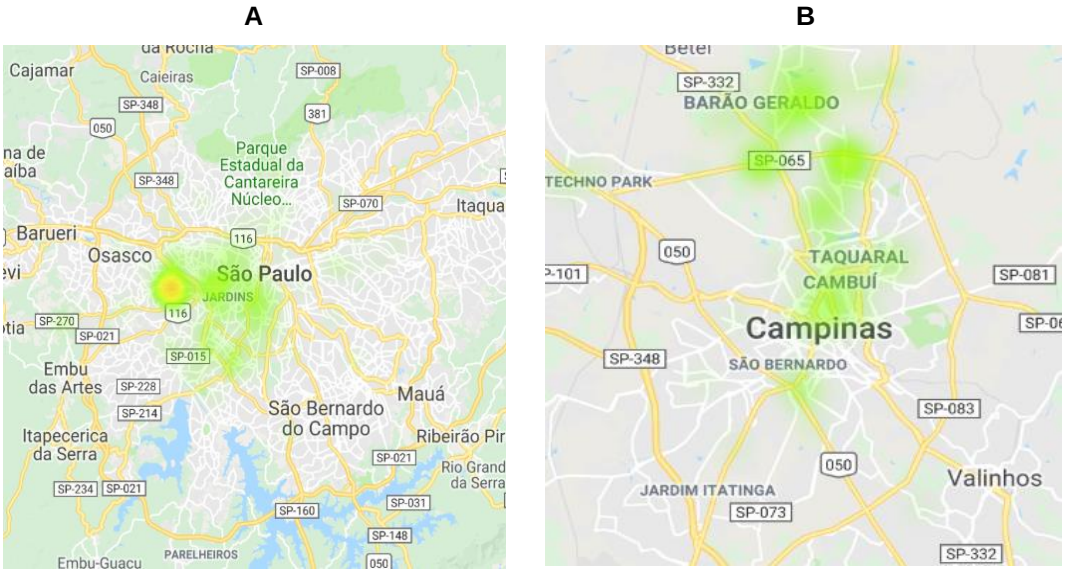

Figure 3. Distribution of academic entrepreneurship in the city of São Paulo (A) and Campinas (B).
Source: The authors

Whereas for the case of the cities of São Carlos, São José dos Campos and Ribeirão Preto (Figure 4), there is a slightly different pattern. Despite these municipalities having large universities, the main axis for entrepreneurial activity concentration are dislocated to the areas where the main technological parks of these cities are: Parqtec, in the center of São Carlos, Technological Park of São José dos Campos, at Via Dutra, and Supera Park, in the western region of Ribeirão Preto.

Both in the cases of São Paulo and Campinas, the presence of parks and incubators associated to USP and UNICAMP have also played a central role on the

location of academic spin offs. However, their geographical integration to university campuses seem to change the entrepreneurs' spatial location tendencies, even if in other cities these support structures are not placed far from the main higher education institutions.

Therefore, the micro-geographical analysis carried out offers interesting subsidy to identify the relevance of different agents on the formation of entrepreneurial ecosystems locally, including not only universities, but also incubators and technological parks.

Figure 4. Distribution of academic entrepreneurship in the cities of São Carlos (A), São José dos Campos (B), and Ribeirão Preto (C).
Source: The authors

Additionally, one of the factors that might explain this different behavior among cities is the relative distance. In the case of great urban centers, such as São Paulo and Campinas, there are significant costs to be considered when moving within the city, which cross the discussion of diseconomies of agglomeration (Chauvin et al., 2016). While for the case of medium-sized cities, such as São José dos Campos, São Carlos and Ribeirão Preto, urban mobility is eased, which may affect the allocation pattern for the studied ventures.

The case of CompanyPIPE_3 corroborates to these findings. Currently located in the Technological Park of São José dos Campos, the aircraft manufacturing

company was initially installed within the incubator of the Department of Aerospace Science and Technology (DCTA). Founded by two former ITA students, it was the university that enabled the entrepreneurs to take part in exchange programs during the undergraduate course, in which they had contact with the technology and product that would be later on improved and developed by them in Brazil. Besides, the interviewee emphasized the relevance of ITA's teaching and research activities. In the teaching spectrum, ITA, as well as three other higher education and research institutions, the National Space Research Institute (INPE), FATEC, and the Federal Institute, all located in São José dos Campos, contribute to the formation of qualified human resources and with projects for graduation works, and master's and PhD thesis that fit to the company's demands. It is important to highlight the Industrial Academic Master Degree and the Industrial Academic PhD, CNPq programs that were developed by the company along with ITA and INPE. Regarding the research scope, the company has developed research projects and a PIPE project in partnership with ITA, besides having co-patents and co-publications with said institution.

In this sense, in the cases of CompanyPIPE_3 and CompanyPIPE_4, it was observed that the university incubator was a key element for the creation of these companies, since it was responsible for putting them in contact to angel investors and to public funding sources, besides enabling the establishment of informal contact with professors. Currently, despite the companies not being located in the DCTA and CIETEC, respectively, anymore, the research projects established with external institutions, as well as knowledge and information flows, are still subjected to the effects of geographical proximity.

5 CONCLUDING REMARKS

This article has approached the location patterns of academic entrepreneurship in the State of São Paulo based on data of the PIPE/FAPESP Program. For that, it aimed to empirically connect entrepreneurs and their universities of origin, based on a hypothesis grounded in literature. The questions involved in this

analysis cover themes of central interest in the search for a deeper understanding of the evolutive dynamics of entrepreneurial ecosystems in Brazil.

Firstly, it is understood that new companies in technology-intensive segments – such as the ones included in this research – have a high dependence level to collaborative arrangements in order to achieve technological and competitive maturity (Malecki, 2009). In this sense, universities to which entrepreneurs have previous relations may be seen as attraction poles for these new enterprises. In fact, the analyzed data suggest relatively high levels of local retention of entrepreneurs based on their academic affiliations.

The interviews evince not only the importance new companies give to teaching activities in universities, such as the formation of qualified human resources, but also to research activities and the shared use of structures, especially labs and equipment for performing tests.

A first interest result concerns the formation of an entrepreneur axis involving five focal localities: São Paulo, Campinas, São Carlos, São José dos Campos, and Ribeirão Preto. These cities host the main university poles of the State of São Paulo, with research-leader institutions. Notwithstanding, these institutions are also responsible for an intense entrepreneurial activity, with main emphasis on PhD individuals, an observation that goes against the widely spread perception of the distance of research institutions – and their qualified researchers – from the market's reality and dynamics.

On the other hand, entrepreneurial ecosystems are complex structures that are connected to dimensions going beyond the scope focused only on university campuses. Despite being considered anchor-institutions for innovation ecosystems, the universities cannot meet the market needs of these companies, thus evincing the importance of the productive segment in the region (Hayter, 2016). Therefore, the presence of these institutions is set as a necessary condition, but not enough for the regional economic development (Feldman, & Kogler, 2010).

Such notions have a strong correspondence to geographic distribution patterns of academic entrepreneurship in the State of São Paulo, in which the São Paulo-Campinas axis has a high entrepreneur attraction rate, while students from institutions located in economically peripheral regions present higher mobility rates.

These findings agree to the results observed by Calcagnini et al. (2016) but are in conflict to the ones by Baltzopoulos and Broström (2013), and Heblich and Slavtchev (2014), who had more positive results regarding the role of universities in the promotion of regional development.

The differences in the dynamics of entrepreneurial activity localization add complexity to the understanding of the operation of entrepreneur ecosystems, presenting implications for the formulation of policies fomenting these structures. This happens since strategies for the creation of university units in less developed markets may not have the desired effects in terms of boosting local economies. Due to that, policies for promoting entrepreneur ecosystems have been adopting a systemic and relational character, considering effective interactions among different elements as triggers for success (Mason, & Brown, 2013).

According to this view, some challenges remain for the creation of convergence among different regions, which may be seen as the function of two central mechanisms. Firstly, university contributions for the ecosystems have strong localization characteristics, specially at the municipal level (Calcagnini et al., 2016; Schaeffer et al., 2018). Secondly, based on the relation between knowledge-intensive entrepreneurship and endogenous economic growth, localities with lesser entrepreneur attraction or retention tend to reach lower development rates, which creates a negative feedback cycle for the structuring of entrepreneurial ecosystems.

Another interesting result concerns the role of innovation habitats in the process of localization for academic entrepreneurs, such as incubators and scientific parks. Along with the proximity of state-of-the-art academic institutions and of urban centers with high development levels, such initiatives tend to concentrate a high percentage of new potentially innovative companies, thus strengthening the

entrepreneurial environment and promoting the creation of a critical mass of new ventures.

It is essential to highlight that the results and orientation of this research have limitations regarding the scope of data and the inferential capacity of the considerations exposed here. First, the sample of academic entrepreneurship projects is limited to the evaluation of PIPE/FAPESP projects, which represent a biased perspective in relation to the universe of new companies created from universities in the State of São Paulo. However, this methodological choice is justified by the researchers' interest in working with company units of academic origin and intensive in knowledge. The selection process carried out by PIPE/FAPESP, in this sense, offers a desirable parameterization on these companies' productive and innovative activity. However, the analysis also face limitations regarding timing issues, in which the studied enterprises are in different evolutive stages in their paths.

Further researches, both quantitative and qualitative ones, must consider such obstacles in order to address the proposed questions, aiming to deepen the understanding on the relations among different components of entrepreneurial ecosystems and their causal attributions. Such approaches are a central theme of interest to encourage the success of entrepreneurial agglomerations locally and regionally.

6 REFERENCES

Abreu, M., & Grinevich, V. (2013). The nature of academic entrepreneurship in the UK: Widening the focus on entrepreneurial activities. *Research Policy*, v. 42(2), pp. 408-422.

Albuquerque, E. (1999). National systems of innovation and non-OECD countries: notes about a rudimentary and tentative typology. *Brazilian Journal of Political Economy*, v. 19(4), p. 35-52.

Alvedalen, J., & Boschma, R. (2017). A critical review of entrepreneurial ecosystems research: towards a future research agenda. *European Planning Studies*, v. 25(6), pp. 887-903.

Alves, A., Quelhas, O., Silva, M., & Lameira, V. (2015). On the role of university in the promotion of innovation: exploratory evidences from a university-industry cooperation experience in Brazil. *International Journal of Innovation and Learning*, v. 17(1), pp. 1-18.

Alves, A., Fischer, B., Vonortas, N., & Queiroz, S. (2018). Configurations of knowledge-intensive entrepreneurial ecosystems: An assessment of the State of São Paulo, Brazil. Anais do *X Encontro de Estudos em Empreendedorismo e Gestão de Pequenas Empresas*, São Paulo, 10.

Asheim, B., Smith, H., & Oughton, C. (2011). Regional Innovation Systems: theory, empirics and policy. *Regional Studies*, v. 45(7), pp. 875-891.

Audretsch, D. (2014). From the Entrepreneurial University to the University for the Entrepreneurial Society. *The Journal of Technology Transfer*, v. 39(3), pp. 313-321.

Audretsch, D. (2012). Determinants of high-growth entrepreneurship. Relatório apresentado no *OECD/DBA International Workshop on "High-Growth Firms: local policies and local determinants*, Copenhagen.

Audretsch, D., & Belitski, M. (2017). Entrepreneurial ecosystems in cities: establishing the framework conditions. *Journal of Technology Transfer*, v. 42(5), pp. 1030-1051.

Audretsch, D., Keilbach, M., & Lehmann, E. (2006). *Entrepreneurship and Economic Growth*. New York: Oxford University Press.

Audretsch, D. B., Lehman, E. E., & Warning, S. (2005). University spillover and new firm location. *Research Policy*, v. 34(7), pp. 1113-1122.

Azagra-Caro, J., Pardo, R., & Rama, R. (2014). Not searching, but finding: how innovation issues shapes perceptions about universities and public research organisations. *Journal of Technology Transfer*, v. 39(3), pp. 454-471.

Baltzopoulos, A., & Broström, A. (2013). Attractors of Entrepreneurial Activity: universities, regions and alumni entrepreneurs. *Regional Studies*, v. 47(6), pp. 934-949.

Beckman, C., Eisenhardt, K., Kotha, S., Meyer, A., & Rajagopalan, N. (2012). Technology entrepreneurship. *Strategic Entrepreneurship Journal*, v. 6(2), pp. 89-93.

Benneworth, P., Coenen, L., Moodysoon, J., & Asheim, B. (2009). Exploring the Multiple Roles of Lund University in Strengthening Scania's Regional Innovation System: towards institutional learning? *European Planning Studies*, v. 17(11), pp. 1645-1664.

Berggren, E., & Dahlstand, A. (2009). Creating an Entrepreneurial Region: two waves of academic spin-offs from Halmstad University. *European Planning Studies*, v. 17(8), pp. 1171-1189.

Boschma, R., & Martin, R. (2010). The aims and scope of evolutionary economic geography. [Papers in Evolutionary Economic Geography #10.01]. *Utrecht University - Urban & Regional Research Centre*.

Bramwell, A., & Wolfe, D. A. (2008). Universities and regional economic development: The entrepreneurial University of Waterloo. *Research Policy*, v. 37(8), pp. 1175-1187.

Calcagnini, G., Favaretto, I., Giombini, G., Perugini, F., & Rombaldoni, R. (2016). The role of universities in the location of innovative start-ups. *The Journal of Technology Transfer*, v. 41(4), pp. 670-693.

Castro, B., & Souza, G. (2012). O papel dos Núcleos de Inovação Tecnológica (NITs) nas universidades brasileiras. *Liinc em Revista*, v. 8(21), pp. 125-140.

Charles, D. (2006). Universities and key knowledge infrastructures in regional innovation systems. *The European Journal of Social Science Research*, v. 19(1), pp. 117-130.

Chauvin, J., Glaeser, E., Ma, Y., & Tobio, K. (2016). What is Different About Urbanization in Rich and Poor Countries? Cities in Brazil, China, India and the United States. *Journal of Urban Economics*, v. 98, pp. 17-49.

Cohen, W., Nelson, R., & Walsh, J. (2002). Links and Impacts: the influence of public research on industrial R&D. *Management Science*, v. 48(1), pp. 1-23.

Collini S. (2012). *What Are Universities for?* London: Penguin.

Cowan, R., & Zinovyeva, N. (2013). University effects on regional innovation. *Research Policy*, v. 42(3), pp. 788-800.

Dewes, M., Dalmarco, G., & Padula, A. (2015). Innovation policies in Brazilian and Dutch aerospace industries: How sectors driven by national procurement are influenced by its S&T environment. *Space Policy*, v. 34, pp. 32-38.

Di Gregorio, D., & Shane, S. (2003). Why do some universities generate more start-ups than others? *Research Policy*, v. 32(2), pp. 209-227.

Egeln, J., Gottschalk, S., & Rammer, C. (2004). Location Decision of Spin-offs from Public Research Institutions. *Industry and Innovation*, v. 11(3), pp. 207-223.

Etzkowitz, H. (2004). The evolution of the entrepreneurial university. *International Journal of Technology and Globalization*, v. 1(1), pp. 64-77.

Etzkowitz, H., & Leydesdorff, L. (1998). The Endless Transition: A "Triple Helix" of University-Industry-Government Relations. *Minerva: A Review of Science, Learning & Policy*, v. 36(3), pp. 271-288.

Etzkowitz, H., & Zhou, C. (2017). Hélice Tríplice: inovação e empreendedorismo universidade-indústria-governo. *Estudos Avançados*, v. 31(90), pp. 23-48.

Faggian, A., & McCann, P. (2009). Human capital, graduate migration and innovation in British regions. *Cambridge Journal of Economics*, v. 33(2), pp. 317-333.

Feldman, M. (2001). The entrepreneurial event revisited: firm formation in a regional context. *Industrial and Corporate Change*, v. 10(4), pp. 861-881.

Feldman, M., Kogler, D. (2010). Stylized facts in the geography of innovation. In: Hall, B., & Rosenberg, N. (eds). *Handbook of the Economics of Innovation*, v. 1, North Holland: Amsterdam, pp. 381-410.

Ferreira, J., Fayolle, A., Fernandes, C., & Raposo, M. (2017). Effects of Schumpeterian and Kirznerian entrepreneurship on economic growth: panel data evidence. *Entrepreneurship and Regional Development*, v. 29(1-2), pp. 27-50.

Fischer, B., Queiroz, S., & Vonortas, N. (2018a). On the location of knowledge-intensive entrepreneurship in developing countries: lessons from São Paulo, Brazil. *Entrepreneurship and Regional Development*, v. 30(5-6), pp. 612-638.

Fischer, B. B., Schaeffer, P. R., Vonortas, N. S., & Queiroz, S. (2018b). Quality comes first: university-industry collaboration as a source of academic entrepreneurship in a developing country. *Journal of Technology Transfer*, v. 43(2), pp. 263-284.

Fischer, B., Schaeffer, P., & Vonortas, N. (2018c). Evolution of University-Industry Collaboration in Brazil from a Technology Upgrading Perspective. *Technological Forecasting and Social Change*. Forthcoming.

Florida, R., Adler, P., & Mellander, C. (2016). The city as innovation machine. *Regional Studies*, v. 51(1), pp. 86-96.

Freitas, I., Marques, R., & Silva, E. (2013) University-industry collaboration and innovation in emergent and mature industries in new industrialized countries. *Research Policy*, v. 42(2), pp. 443-453.

Fritsch, M. (2008). How does new business formation affect regional development? Introduction to the special issue. *Small Business Economics*, v. 30(1), pp. 1-14.

Galán-Muros, V., & Davey, T. (2017). The UBC ecosystem: putting together a comprehensive framework for university-business cooperation. *Journal of Technology Transfer.* Forthcoming.

Gilbert, B., Audretsch, D., & McDougall, P. (2004). The emergence of entrepreneurship policy. *Small Business Economics*, v. 22(3-4), pp. 313-323.

Gonçalves, E., & Cóser, I. (2014). O programa de incentivo à inovação como mecanismo de fomento ao empreendedorismo acadêmico: A experiência da UFJF. *Nova Economia*, v. 24(3), pp. 555-585.

Guerrero, M., & Urbano, D. (2012). The development of an entrepreneurial university. *Journal of Technology Transfer*, v. 37(1), pp. 43-74.

Guerrero, M., Urbano, D., Fayolle, A., Klofsten, M., & Mian, S. (2016). Entrepreneurial universities: emerging models in the new social and economic landscape. *Small Business Economics*, v. 47(3), pp. 551-563.

Hayter, C. (2016). A trajectory of early-stage spinoff success: the role of knowledge intermediaries within an entrepreneurial university ecosystem. *Small Business Economics*, v. 47(3), pp. 633-656.

Heblich, S., & Slavtchev, V. (2014). Parent universities and the location of academic startups. *Small Business Economics*, v. 42(1), pp. 1-15.

Hsu, D., Roberts, E., & Eesley, C. (2007). Entrepreneurs from technology-based universities: Evidence from MIT. *Research Policy*, v. 36(5), pp. 768-788.

Ipiranga, A., Freitas, A., & Paiva, T. (2010). O empreendedorismo acadêmico no contexto da interação Universidade - Empresa - Governo. *Cadernos EBAPE*, v. 8(4), pp. 676-693.

Isenberg, D (2010). How to start an entrepreneurial revolution. *Harvard Business Review*, v. 88(6), pp. 40-51.

Jiao, H., Zhou, J., Gao, T., & Liu, X. (2016). The more interactions the better? The moderating effect of the interaction between local producers and users of

knowledge on the relationship between R&D investment and regional innovation systems. *Technological Forecasting and Social Change*, v. 110, pp. 13-20.

Kolympiris, C., Kalaitzandonakes, N., & Miller, D. (2015). Location choice of academic entrepreneurs: Evidence from the US biotechnology industry. *Journal of Business Venturing*, v. 30(2), pp. 227-254.

Krabel, S., & Mueller, P. (2009). What drives scientists to start their own company? An empirical investigation of Max Planck Society scientists. *Research Policy*, v. 38(6), pp. 947-956.

Landry, R., Amara, N., & Rherrad, I. (2006). Why are some university researchers more likely to create spin-offs than others? Evidence from Canadian universities. *Research Policy*, v. 35(10), pp. 1599-1615.

Larsson, J., Wennberg, K., Wiklund, J., & Wright, M. (2017). Location choices of graduate entrepreneurs. *Research Policy,* v. 46(8), pp. 1490-1504.

Lazzeretti, L., & Tavoletti, E. (2005). Higher education excellence and local economic development: The case of the entrepreneurial University of Twente. *European Planning Studies*, v. 13(3), pp. 475-493.

Li, M., Goetz, S., Partridge, M., Fleming, D. (2016). Location determinants of high-growth firms. *Entrepreneurship and Regional Development*, v. 28(1-2), pp. 97-125.

Malecki, E. (2009). Geographical environments for entrepreneurship. *International Journal of Entrepreneurship and Small Business*, v. 7(2), pp. 175-190.

Mason, C., & Brown, R. (2013). Entrepreneurial ecosystems and growth oriented entrepreneurship. Artigo apresentado no Workshop Entrepreneurial Ecosystems and Growth Oriented Entrepreneurship, *OECD LEED Programme*, The Hague.

Miller, D., & Ács, Z. (2017). The campus as entrepreneurial ecosystem: the University of Chicago. *Small Business Economics*, v. 49(1), pp. 75-95.

Mok, K. (2005). Fostering entrepreneurship: Changing role of government and higher education governance in Hong Kong. *Research Policy*, v. 34(4), pp. 537-554.

Mowery, D., & Sampat, B. (2005). Universities in national systems. In J. Fagerberg, D. Mowery, & R. Nelson (Ed.), *The Oxford Handbook of Innovation* (pp. 209-239). Oxford: Oxford University Press.

Polonyová, E., Ondos, S., & Ely, P. (2015). The location choice of graduate entrepreneurs in the United Kingdom. *Miscellanea Geographica*, v. 19(4), pp. 34-43.

Poods, R., Oort, F., & Frenken, K. (2010). Innovation, spillovers and university-industry collaboration: an extended knowledge production function approach. *Journal of Economic Geography*, v. 10(2), pp. 231-255.

Porto, G., Kannebley Jr., S., Selan, B., & Baroni, J. (2011). Rede de interações universidade-empresa no Brasil: uma análise de redes sociais. *Revista de Economia*, v. 37(n. especial), pp. 51-84.

Rothaermel, F., & Ku, D. (2008). Intercluster innovation differentials: The role of research universities. *IEEE Transactions on Engineering Management*, v. 55(1), pp. 9-22.

Ryan, M. (2010). Patent Incentives, Technology Markets, and Public–Private Bio-Medical Innovation Networks in Brazil. *World Development*, v. 38(8), pp. 1082-1093.

Salles-Filho, S., Bonacelli, M., Carneiro, A., Castro, P., & Santos, F. (2011). Evaluation of ST&I programs: a methodological approach to the Brazilian Small Business Program and some comparisons with the SBIR program. *Research Evaluation*, v. 20(2), pp. 159-171.

Santos, M. & Mello, J. (2009). IPR Policy and Management of University Technology Transfer Offices in Brazil. Proceedings of the *7th Biennial International Conference on University, Industry and Government Linkages, Triple Helix Association*, Glasgow, 7.

Schaeffer, P., Fischer, B., & Queiroz, S. (2018). Beyond education: the role of research universities in innovation ecosystems. *Foresight and STI Governance*, v. 12(2), pp. 50-61.

Shane, S. (2004). Encouraging university entrepreneurship? The effect of the Bayh-Dole Act on university patenting in the United States. *Journal of Business Venturing*, v. 19(1), pp. 127-151.

Siegel, D., & Wright, M. (2015). Academic Entrepreneurship: Time for a Rethink? *British Journal of Management*, v. 26(4), pp. 582-595.

Siegel, D., Wright, M., & Lockett, A. (2007). The rise of entrepreneurial activity at universities: organizational and societal implications. *Industrial and Corporate Change*, v. 16(4), pp. 489-504.

Stam, E. (2009). Entrepreneurship, Evolution and Geography. [Papers in Evolutionary Economic Geography #09.13]. *Utrecht University - Urban & Regional Research Centre*.

Uyarra, E. (2010). What is evolutionary about 'regional systems of innovation'? Implications for regional policy. *Journal of Evolutionary Economics*, v. 20, pp. 115-137.

Youtie, J., & Shapira, P. (2008). Building an innovation hub: a case study of the transformation of university roles in regional technological and economic development. *Research Policy*, v. 37(8), pp. 1188-1204.