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Determinants of student entrepreneurship

An assessment on higher education institutions in Brazil

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Abstract

Purpose – The purpose of this paper is to analyze this phenomenon and identify its determinants using data from Brazilian higher education institutions.

Design/methodology/approach – Based on a data set comprehending 2,230 university students from 70 different institutions across the country, the authors develop five Probit models to assess impacts related to individual traits and systemic conditions on five dependent dimensions: entrepreneurial activity, potential entrepreneurs, high-impact entrepreneurship, serial entrepreneurship and innovation-driven entrepreneurship.

Findings – The lack of significance in many of the variables included in estimations suggests that student entrepreneurship seems to be a rather random phenomenon in Brazil.

Research limitations/implications – Findings pose challenges for student entrepreneurship, as targets for intervention are not clear.

Originality/value – Over the past decades, universities have been receiving an increasing demand to go beyond their role of producing science and technology to explore its knowledge potential to produce novel commercial applications. However, while there is a growing interest in ways to foster scientific academic entrepreneurship, universities also serve as a positive environment for student entrepreneurship training, knowledge sharing, testing ideas and learning. So far, the importance of student entrepreneurship has received far less attention than it likely deserves.

Keywords Brazil, Entrepreneurial university, Ecosystems of entrepreneurship

Paper type Research paper

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1. Introduction

Over the past decades, universities have come under increasing pressure to go beyond their role of producing science and technology to also explore the potential for novel commercial applications. Accordingly, academia has been expanding its role beyond research and education to become a driver of innovation (Etzkowitz *et al.*, 2000). These universities engage in entrepreneurial activities as they exploit scientific and technological advances through technology transfer activities (Mowery and Shane, 2002). Some of these efforts have been referred to and studied under the concept of "academic entrepreneurship" (Rothaermel *et al.*, 2007), a phenomenon that has been attached to processes of technological development and economic growth (Fini *et al.*, 2017).

While there is a growing interest in fostering academic entrepreneurship – usually done by faculty who establish spinoff companies based on their research (Hayter, 2016; Shane, 2004), universities also provide the environment for student entrepreneurship (Marchand and Hermens, 2015). Such perspective suggests a broader understanding of the "academic entrepreneurship" concept. In fact, recent literature has devoted efforts to expand this construct beyond the traditional, patent-based, view of universities' spinoffs (Abreu and Grinevich, 2013; Matt and Schaeffer, 2018). In this regard, student entrepreneurship can be addressed as a sub-group of academic entrepreneurship, not necessarily involving scientific research. Well-known examples of this phenomenon include Apple, Microsoft, Dell, Facebook and Snapchat. These ventures share one characteristic in common: they started while their founders were experimenting new knowledge and business opportunities within the academic environment.

Nonetheless, the entrepreneurial behavior in students involved in higher education has received far less attention from literature than it probably deserves (Grimaldi *et al.*, 2011), being treated as a marginal phenomenon compared to its relevance in the business domain (Politis *et al.*, 2010). Additionally, it is possible to observe a growing interest in an entrepreneurial career among students (Fayolle and Gailly, 2015; Zellweger *et al.*, 2011). Consequently, there is a need for further investigations on the nature and determinants of student entrepreneurial systems (Wright *et al.*, 2017).

This is key in a moment in which "entrepreneurial university" policies have their efficiency challenged (Matt and Schaeffer, 2018). Within this context, some issues deserve further attention for setting the appropriate conditions for student entrepreneurship to thrive. What are the specific features that allow the emergence of student entrepreneurship? What is the influence of the university environment and support institutions over the entrepreneurial behavior of students? The overarching issue herein is to understand the drivers of student entrepreneurship. In turn, this will allow a deeper comprehension of this area of research, generating insights for policies targeted at increasing entrepreneurship levels within academic contexts.

The purpose of this paper is to analyze this facet of academic entrepreneurship, the student entrepreneur and explore its determinants using data from Brazilian Higher-Education Institutions (HEIs). We build our analysis on a dataset developed by Endeavor[1] Brazil and Sebrae[2]. In total, 2,230 college and university students from 70 HEIs were interviewed between April and May 2016. This approach enables a novel evaluation of student entrepreneurship behavior in this country. Through the assessment of this data set – based on a probabilistic sample with national representativeness – we can draw insights that reach beyond the existing body of knowledge. Furthermore, Brazil is an interest case for analysis concerning entrepreneurship research: while it presents a strong total entrepreneurial activity, it is placed as a laggard nation in terms of job and innovation impacts arising from the establishment of new ventures (Global Entrepreneurship Monitor

[GEM], 2018). Delving deeper into student entrepreneurship and addressing its determinants is a way to further understand this situation.

Five Probit models were developed to identify impacts related to individual traits and systemic conditions on five dimensions of interest: entrepreneurial activity, prospective entrepreneurs, high-impact entrepreneurship, serial entrepreneurship and innovation-driven entrepreneurship. The lack of significance in many of the variables analyzed suggests that student entrepreneurship can be deemed as a random phenomenon in Brazil. On the other hand, some (weak) signs indicate that high-quality, research-oriented universities generate higher levels of innovative entrepreneurs.

This situation poses challenges for entrepreneurship policies in the country, as determinants of student entrepreneurship are not clearly defined. Lessons learned from developed economies might not be efficient for the Brazilian context – a reality that is probably valid for other developing countries as well. Consequently, our contribution calls for a rethink on the idea of the "entrepreneurial university" as a widespread phenomenon. It seems there is still a long way to go to embed the academic environment into productive systems through the promotion of student entrepreneurship.

After this introductory section, the article is structured as follows: Section 2 places the concept of student entrepreneurship within the discussion of academic entrepreneurship. This section also dedicates attention to the literature on the determinants of academic entrepreneurship. Section 3 presents the sample, variables of interest and analytical models. Empirical results are provided in Section 4. Section 5 discusses the empirical findings and its interpretations in the light of the entrepreneurial conditions and incentives in Brazil. Section 6 concludes with final remarks, implications and avenues for future research.

2. Academic entrepreneurship and the student: beyond technology transfer

Universities play a significant role in education and research. These have been referred to as the first and second missions of academia (Roper and Hirth, 2005). Over the past four decades, however, attention has been directed to universities' third mission, which stands for activities related to innovation, social change and industrial competitiveness (Siegel and Wright, 2015). This has given rise to conceptual notions such as "entrepreneurial university" (Etzkowitz *et al.*, 2000) and, incidentally, "academic entrepreneurship" (Rothaermel *et al.*, 2007).

The unit of analysis of academic entrepreneurial efforts has consistently been attached to scientific research, patenting and technological transfer activities (Abreu and Grinevich, 2013). While important, and often related to radical technological innovations, these contributions can be deemed as marginal when compared to the whole of new ventures that emerge from student entrepreneurs, as they are mostly not related to direct outcomes of scientific research and formal technology transfer activities (Politis *et al.*, 2010). For this reason, student start-ups have become part of the academic entrepreneurship debate (Matt and Schaeffer, 2018). Yet, student entrepreneurship has received far less attention than it deserves within this field of research (Grimaldi *et al.*, 2011; Marchand and Hermens, 2015).

While some universities have placed significant attention and energy in third mission activities, there has been an increasing demand to offer entrepreneurship education across all fields and programs (Jansen *et al.*, 2015). In this sense, entrepreneurial initiatives may go beyond universities' own scope of knowledge and technologies mastered by its faculty. Therefore, it is relevant to explore what are the key determinants for student entrepreneurship and the role of the university in this process.

According to Grimaldi *et al.* (2011, p. 1047), "*one of the least recognized and inadvertent roles of universities in 'encouraging' entrepreneurship is providing a protected environment*

where students can experiment with new ideas and follow their passions". Siegel and Wright (2015) argue that the study of academic entrepreneurship should go beyond direct technology and knowledge transfer to encompass indirect aspects such as education and research that lead to entrepreneurial activity, startups and spinoffs.

Examples of the influence of the university environment over entrepreneurial intentions and efforts of students include some high-profile cases: Michael Dell started his computer retailing business in a dormitory of the University of Texas. Yahoo! and Google started by the initiative of students at Stanford. Mark Zuckerberg launched Facebook as a social network for university students at Harvard facilities. Bill Gates, Steve Jobs and Steve Wozniak are also examples of students that experimented with new technologies and business opportunities while at the university in their undergraduate years. Although these examples stand for anecdotal evidence, it is also true that they provide reasons to expect student entrepreneurship to have the potential of supplying markets with new technologies – even without being connected to formal technology transfer activities and academic science.

2.1 Drivers of student entrepreneurship

According to Venkataraman (1997), entrepreneurial activity is a function of the nexus of two phenomena: the presence of lucrative opportunities and the presence of enterprising individuals. While entrepreneurship studies often place the individual at the center of the analysis, these same individuals are often influenced and shaped by the nature of opportunities (Radosevic and Yoruk, 2013). These aspects are now explored in further detail. By carrying out an extensive literature review, we aim at integrating theoretical and empirical propositions oriented toward identifying the key elements that explain the entrepreneurial activity of students.

2.1.1 Individual vectors. We begin our assessment by addressing theoretical and empirical evidence on five individual factors related to entrepreneurial propensity in students: age, family income, family culture, STEM (Science, Technology, Engineering and Math) profile, and level of enrollment (undergraduate vs graduate). Previous research has pinpointed the relevance of individual characteristics in promoting student entrepreneurship (Guerrero *et al.*, 2017; Wright *et al.*, 2017), and how they shape students' perceptions of opportunities (Shane, 2000). Individual factors involve the social and cultural conditions, as well as the previous experience with entrepreneurial activities, that influence the entrepreneurial potential of the students (Iizuka and Moraes, 2014). However, as the literature highlights in further depth, empirical findings are controversial, making it difficult to establish clear patterns that attach individual characteristics to entrepreneurial behavior.

As a first aspect of interest, students' *age* represents a relevant driver of entrepreneurial behavior. According to Lévesque and Minniti (2011), there are opportunity costs associated with different age groups. With fewer resources, younger individuals can absorb more easily the uncertainty that arises with new ventures. Conversely, older individuals have much more to lose by forgoing seniority wages in favor of risky returns. Also, the university environment can provide younger students with the necessary resources they lack to initiate their first entrepreneurial trials. Accordingly, empirical results indicate that university students between 25 and 34 years of age are those with the highest probability to engage in entrepreneurial activities (Liñán *et al.*, 2011; Reynolds *et al.*, 2002). Urbano *et al.* (2017) have also found a similar association between age and entrepreneurial propensity[3].

In its turn, aspects related to *family income* are also expected to be connected to the dynamics of entrepreneurial activity (Radosevic and Yoruk, 2013). Cuervo (2005) and Steier (2007) assert that the family is a source of information, complementary resources, funds,

managerial capabilities, networks and guarantees for the entrepreneur. Thus, it can be assumed that family income is likely to provide an easier access for initial venture funding for students to experiment with their entrepreneurial initiatives. Along these lines, studies indicate that, within some ethnic communities, families do provide a great deal of financial capital (Aldrich and Waldinger, 1990). Following Aldrich and Langton (1998) and Zellweger *et al.* (2011), families play an important role in the resource mobilization process during the startup stage. Also, family income helps to reduce transaction costs associated with the establishment of relationships and acquisition of investment (Cuervo, 2005). On the other hand, these assumptions do not go without empirical dispute (Aldrich *et al.*, 1998). For instance, entrepreneurial activity can be seen as a way out of low-income situations, as suggested by Urbano *et al.* (2017).

Family income, however, provides only a partial view on the potential impacts that close relatives may have upon the students' engagement regarding the establishment of new ventures. Moving beyond availability of financial resources, businesses are often embedded in family culture and relations (Aldrich and Cliff, 2003). Urbano *et al.* (2017) have identified a positive role of family culture in shaping the propensity of students to engage in launching new ventures, an aspect that had also been highlighted by Cramton (1993). In this sense, family background can be considered as a significant predictor for entrepreneurial behavior, given that students who have entrepreneurs among family members present a stronger inclination for self-employment (Scott and Twomey, 1988).

However, although students with a family business background are optimistic about their respective capabilities and resources, they also seem pessimistic about controlling their careers as entrepreneurs – a finding related to the obstacles and personal sacrifices experienced by their parents (Zellweger *et al.*, 2011). Beyond culture, family members may also share biological characteristics that drive attitudes toward entrepreneurship. According to Shane (2010), studies on adoption provide evidence of the effect of genes on work interests where "*biologically related members tend to have similar job preferences, while adopted family members do not*" (p. 53). This may influence the propensity of family members to take the entrepreneurial career path.

The nature and source of knowledge is also a factor of interest in this analysis, as it can allow entrepreneurs to recognize technological and market opportunities (Kor *et al.*, 2007). Radosevic and Yoruk (2013) state that knowledge-intensive entrepreneurship constitutes not only an ordinary activity of innovation systems but one of its core properties. A similar perspective is shared by Ács *et al.* (2014). Accordingly, individuals' knowledge intensity warrants the possibility of identifying and responding to technological opportunities. For these reasons, *STEM* areas are traditionally associated with high-impact entrepreneurship. Nonetheless, students from these fields of knowledge are highly demanded by incumbent firms. This creates a paradoxical situation in which knowledge-intensive individuals face a strong competition between the market for entrepreneurship and the market for jobs. This situation potentially harms new enterprises to emerge in both high- and low-tech sectors (Delmar and Wennberg, 2010).

Finally, students enrolled in graduate programs often take on entrepreneurial efforts through spinoffs related to academic research. Hayter *et al.* (2017), for instance, present the creation of Google as one academic spinoff of this kind. Hayter (2016) also finds that graduate students play a critical role in the early stages of the spinoff development. It is suggested, therefore, that the *level of academic enrollment* positively affects the entrepreneurial intention of students (Liñán *et al.*, 2011), even though these propositions do not go unchallenged: Uhlaner and Thurik (2005) found higher levels of education to be associated with lower rates of self-employment.

Next, we turn to systemic vectors of influence in student entrepreneurship behavior. By doing so, we investigate the institutional conditions that shape the environment in which individuals are embedded.

2.1.2 Systemic vectors. Entrepreneurial activity is a social phenomenon, dependent on structural features of the economic system and on social processes and mechanisms (Radosevic and Yoruk, 2013). These factors shape the "entrepreneurial orientation" of innovation systems, i.e. their capacity to generate and exploit opportunities. This systemic nature involves not only individuals, but also socioeconomic and institutional aspects, whereas the productivity of an entrepreneurial system is affected by the performance of any of its components (Ács *et al.*, 2014).

For instance, changes in legislation and regulatory frameworks at the national and university levels can enhance levels of entrepreneurial activity within academic contexts (Fini *et al.*, 2017). This evidence pinpoints the importance of supporting actors and structures for the generation of student entrepreneurs (Wright *et al.*, 2017). However, it is worth noting that causal ambiguity is strongly present in these dynamics, making it hard for practitioners to know in advance which initiatives will render the expected results. Ultimately, this leads to a lack of agreement on the role played by specific instruments in fostering student entrepreneurship. Some of these features of the academic environment are analyzed in this section.

First, characteristics of geographic regions have been associated with student entrepreneurship as they set the basic market conditions for the emergence of new ventures (Hayter *et al.*, 2017). Agglomeration economies provide entrepreneurial systems with larger pools of individuals that can engage in the generation of new ventures, as well as the supply of complementary productive inputs, resources and positive externalities (Glaeser and Kerr, 2009). A related aspect concerns the efficiency gap that exists in peripheral regions in comparison with central regions, indicating the existence of agglomeration economies for the entrepreneurial activity (Fritsch, 2002).

Accordingly, the location of universities within *urban agglomerations* represents an important analytical vector to understand the entrepreneurial activity of students. As universities operate in different local and regional contexts, there is a need to explore how they adopt different strategies for academic entrepreneurship (Fini *et al.*, 2011; Packham *et al.*, 2010). On the other hand, we must consider the differential aspects of the geography of entrepreneurship taking place in developing economies. Fischer *et al.* (2018a) find that highly dense urban agglomerations may hamper the potential of knowledge-intensive entrepreneurship, a function of the high levels of agglomeration diseconomies in these laggard nations.

Second, the quality of research undertaken by universities has demonstrated significant impacts on institutions' capabilities of generating student entrepreneurship (Wright *et al.*, 2017). Di Gregorio and Shane (2003) identify that the intellectual eminence of universities functions as a key predictor of startups. Thus, it is assumed that research-intensive universities can positively affect the generation of new businesses by students, with special emphasis on innovation-driven ventures (Rocha and Freitas, 2014). Hence, *University quality* is expected to exert a positive influence on the quality and rate of entrepreneurial activity, considering the relevance of the technological environment on the performance of young firms (Laursen Reichstein and Salter, 2011; Tischler, 2014). Analogous findings have been reported on the Brazilian environment by Fischer *et al.* (2018b).

In addition to research intensity and quality, universities also engage in more direct strategies targeted at fostering entrepreneurial activities. These *support initiatives* often involve internal policies, processes and infrastructure that seek to stimulate students to start

new businesses. Henrekson and Rosenberg (2001) find that such approaches contribute to the survival and growth of new ventures. Jansen *et al.* (2015) identify three major categories of initiatives: education (for awakening dormant entrepreneurs), stimulation (to support students in starting a business) and incubation (to drive young companies to independence). Along these lines, empirical evidence identifies positive impacts of entrepreneurship education programs and training activities (Bae *et al.*, 2014; Fayolle and Liñán, 2014; Liñán *et al.*, 2011; Liñán and Fayolle, 2015; Urbano *et al.*, 2017). The key role of educational programs is to increase student awareness and to highlight the entrepreneurial path as a viable career option (Donckels, 1991). Other contents such as entrepreneurship obstacles, skills, and the methods involved in the creation of a new startup are also addressed in entrepreneurship courses (Liñán *et al.*, 2011). However, when these activities are restricted to the preparation of business plans, for example, the effects are negative in fostering entrepreneurial intention (Carrier, 2005).

Besides the simple implementation of entrepreneurship courses, favorable impacts are also related to the coordination of entrepreneurship programs and other mechanisms at the university level, such as business competitions and outreach activities (Boh *et al.*, 2015). In this sense, the university environment can shape the conditions for student entrepreneurship to thrive through the promotion of events, workshops, junior companies and student organizations that cultivate entrepreneurial practices (Moraes *et al.*, 2018).

Complementarily, university-level structures for commercialization of research and business opportunities are defined as potential drivers of student entrepreneurship (Wright *et al.*, 2017). The relevance of incubators and science parks as supporting mechanisms for startups is highlighted by Fini *et al.* (2011), Feldman (2001) and Wright *et al.* (2017). In the Brazilian case, empirical findings show evidence in favor of such sort of academic provisions (Fischer *et al.*, 2018b). However, while there is a widespread belief that university support for student entrepreneurship generates desirable effects (Feola *et al.*, 2017), the evaluation of its impacts across the literature provides mixed outcomes (Guerrero *et al.*, 2017).

Within the university context, students can also benefit from the exchange of ideas with experienced faculty members and alumni (Wright *et al.*, 2017). Hence, the availability of *mentoring* programs is another important support activity for student entrepreneurs. Mentoring is defined as "*one-to-one learning relationship between an older person and a younger person that is based on modeling behavior and extended dialogue*" (Lester and Johnson, 1981, p. 50). According to Blackwell (1989), mentoring is a process by which people of superior rank, special achievements, and prestige, instruct, counsel, guide, and facilitate the career development of protégés. St-Jean and Audet (2012) find that mentoring benefits include an increase in management skills, improved vision for business ventures and ability to identify new opportunities. Beyond that, mentoring programs generate knowledge about what it means to be an entrepreneur and about what activities and processes this activity involves, also introducing students to business networks (Gibb, 1998).

Delving deeper into this rationale, entrepreneurial ventures are relational by nature, involving the formation of *networks* by the nascent entrepreneur and depending on existing levels of trust among agents (Stam, 2009). This is so because networks between academics and other agents of the entrepreneurial ecosystem increase the capacity of students to identify business opportunities, increasing students' chances for success in launching new ventures (Bienkowska *et al.*, 2016; Liñán and Santos, 2007; Liñán *et al.*, 2011). It follows that the very location of entrepreneurs is bounded by the availability of social networks that can grant access to a relevant knowledge base (Feldman, 2001). Consequently, some authors have put strong emphasis on what is called 'entrepreneurial support networks', i.e. agents

that offer complementary services to the activity of entrepreneurial ventures (Kenney and Patton, 2005). Ultimately, by connecting entrepreneurs to other agents, these linkages make for social connections that enhance growth potential of entrepreneurial ventures (Bruederl and Preisendoerfer, 1998). Accordingly, universities can spur entrepreneurship among its students by developing initiatives that aim at engaging students in external networks (Wright *et al.*, 2017).

However, although Hayter (2016) concludes that networking activities stand for a relevant factor for the creation of university spinoffs, Rocha and Freitas (2014) suggest that this is not a predictive variable of the entrepreneurial profile among university students. According to the latter, the level of sociability does not influence students' self-efficacy, as they are just beginning the process of forming their networks and still are not able to clearly identify their relationship possibilities.

Building upon these insights obtained from the literature, the next section explores the structure of data and other methodological aspects related to the empirical step of our assessment. We then derive econometric models targeted at identifying the relationship between potential determinants of entrepreneurial behavior and student entrepreneurship at different levels.

3. Methodological approach

This research addresses the issue of student entrepreneurship by using a data set developed by Endeavor Brazil and Sebrae and made available to the authors for the purposes of this research[4]. The research aimed at providing information to universities and policymakers in Brazil to help direct their strategies concerning entrepreneurship education in the country (Endeavor, 2016). 2,230 college and university students from 70 Higher Education Institutions (HEIs) across Brazil were interviewed between April and May 2016. Data were collected by the Instituto Data Popular with focus on achieving a sample with national representativeness. This was based on the 2015 Brazilian National Census of Superior Education developed by the National Institute of Education Studies and Research (INEP). Interviews were carried out using the intercept research methodology (randomly selected face-to-face interviews) between April 29 and May 13 2016, achieving a margin of error of 5 percentage points (Endeavor, 2016).

This information provides an adequate sample for the evaluation of the phenomenon under analysis, allowing a deeper understanding of the entrepreneurial dynamics in the Brazilian academic context from the perspective of students. This goes beyond existing assessments dealing with smaller, non-probabilistic samples of students enrolled in higher education institutions across the country. In addition, the case of Brazil can be considered as emblematic for other developing countries in terms of entrepreneurial activity. With considerable levels of new ventures, the country still lags behind when it comes to job and innovation impacts associated with these emerging companies (GEM, 2018), a reality that has been observed by many Latin American countries (Lederman *et al.*, 2014).

Drawing from this data set, we established a research agenda aiming at identifying the key factors that put student entrepreneurship in motion. We adapted propositions contained in Grimaldi *et al.* (2011), Hayter (2016), Radosevic and Yoruk (2013) and Siegel and Wright (2015) to establish an "entrepreneurial behavior function." The model structure relies on the assumptions that entrepreneurial activity, **E**, can be attributed to joint effects of individual traits, **I**, and systemic vectors, **S**, that offer support and incentives for new ventures. This can be formally stated by:

$$E_y = f\left(\left[\sum yI_y\right];\left[\sum zS_z\right]\right) \quad (1)$$

where the subscript "y" identifies each individual student and "z" reflects aspects of each system in which the individual is embedded (as per each individual's perception)[5]. To make this model operational, the set of variables to be included in empirical estimations is outlined in Table I.

This set of variables allows assessing five different indicators related to entrepreneurial activity. Besides entrepreneurship *per se*, we can identify the determinants behind prospective entrepreneurs, high-impact new ventures, serial entrepreneurs and innovation-driven entrepreneurship. While the variables related to entrepreneurship, high-impact entrepreneurs, serial entrepreneurs and innovation refer to actual entrepreneurial behavior, the prospective entrepreneurs variable measures entrepreneurial intent (Shapero, 1984). Entrepreneurial intent can be defined as "*state of mind that directs the attention and actions of an individual toward situations of self-employment*" (Fayolle and Gailly, 2015, p. 76). However, although the concept is widely used as a proxy for entrepreneurial behavior (Fayolle and Gailly, 2015; Liñán and Chen, 2009; Liñán *et al.*, 2011; Moraes *et al.*, 2018), it is only the precursor of a complex process of entrepreneurial behavior (Kolvereid, 1996; Lee and Wong, 2004). In this sense, addressing these aspects is desirable as it offers the possibility of drawing a complete picture of the underlying dynamics of student entrepreneurship. In its turn, predictors follow a long tradition of variables of interest addressed by dedicated research (Di Gregorio and Shane, 2003; Fini *et al.*, 2011; Glaeser, 2007; Radosevic and Yoruk, 2013; Stam, 2009).

We applied herein Probit models with quasi-maximum likelihood (QML) standard errors. Regressions[6] for the whole sample can only be assessed for "Entrepreneurs" and "Prospective Entrepreneurs" as dependent variables, as "High-Impact Entrepreneurs," "Serial Entrepreneurs" and "Innovation" are subgroups of "Entrepreneurs." Accordingly, "Mentors," "University Support" and "Networking" correspond to variables collected only for those students involved in an entrepreneurial activity. Hence, they cannot be included in the analysis for the complete sample.

As the variable "University Support" generates a considerable amount of missing values, estimations for entrepreneurial cohorts ("High-Impact Entrepreneurs," "Serial Entrepreneurs" and "Innovation") are applied both with and without this variable for robustness checks. As there are no observations for "Graduate Student" within the group of "High-Impact Entrepreneurs," this predictor was excluded from estimations for this dependent variable. We also included a squared term for "Age," aiming at identifying potential curvilinear patterns for this indicator. Applications of the general model described in equation (1) can be stated as follows:

$$\begin{aligned} P(Entrepreneurs = 1|x) = G\big(&\beta_0 + \beta_1 Age + \beta_2 Age^2 + \beta_3 Family\ Income \\ &+ \beta_4 Family\ Culture + \beta_5 STEM\ Student \\ &+ \beta_6 Graduate\ Student + \beta_7 Urban\ Agglomeration \\ &+ \beta_8 High - Quality\ University + \mu \end{aligned} \quad \text{(Model I)}$$

Dimension	Variable	Description
E	Entrepreneurs	Binary variable. It takes the value of 1 if the student is currently involved or has been involved in the past in an entrepreneurial venture; 0 otherwise
	Prospective entrepreneurs	Binary variable. It takes the value of 1 if the student foresees the possibility of becoming an entrepreneur in the future; 0 otherwise
	High-impact entrepreneurs	Binary variable. It takes the value of 1 if the entrepreneurial student expects his business to have over 25 employees within the next 5 years; 0 otherwise
	Serial entrepreneurs	Binary variable. It takes the value of 1 if the entrepreneurial student foresees the possibility of launching other ventures in the future (besides the current firm); 0 otherwise
	Innovation	Binary variable. It takes the value of 1 if entrepreneurial students were involved in launching a product that was new to the world, new to the national/regional market or an improvement of an existing product
I	Age	Age of students
	Family income	Family income group of students. Group 1: up to minimum wage; Group 2: between 1 and 2 minimum wage equivalents (MWE); Group 3: between 2 and 3 MWE; Group 4: between 3 and 5 MWE; Group 5: between 5 and 10 MWE; Group 6: between 10 and 20 MWE; Group 7: Above 20 MWE
	Family culture	Binary variable. It takes the value of 1 if members of the family have engaged in entrepreneurial activity; 0 otherwise
	STEM student	Binary variable. It takes the value of 1 if the student is enrolled in STEM programs (Science, Technology, Engineering or Math); 0 otherwise
	Graduate student	Binary variable. It takes the value of 1 if the student is enrolled in a graduate program; 0 otherwise
S	Urban agglomeration	Binary variable. It takes the value of 1 if the student is enrolled in a university located in a state capital or metropolitan area; 0 otherwise
	High-quality univ	Binary variable. It takes the value of 1 if the student is enrolled in a high-quality, research-oriented Higher Education Institution; 0 otherwise. We used the top 100 institutions in Brazil classified in the Scimago ranking[8] as a benchmark. The following institutions were defined as high-quality: Getúlio Vargas Foundation, Federal University of the ABC, University of Brasília, University of Campinas, Federal University of Ceará, State University of São Paulo, Federal University of Bahia, Federal University of Juiz de Fora, Federal University of Mato Grosso, Federal University of Pernambuco, Federal University of Santa Catarina, Federal University of Rio Grande do Sul and Institute of Military Engineering. Other preeminent institutions in the Brazilian academic scenery were not included in the sample
	University support	This variable was obtained through factor analysis comprehending categorical variables related to the satisfaction of entrepreneurs with support aspects offered by the university. These support items involved the quality of courses dedicated to entrepreneurship, availability of technological parks and incubators, access to investors and relationships with alumni. Extraction was obtained through Principal Components method with Varimax rotation and Bartlett Scores. The outcome variable explained 69.11% of the variance in original vectors

(*continued*)

Table I.
Variables of analysis

Dimension	Variable	Description
	Mentors	Binary variable. It takes the value of 1 if entrepreneurial students had support from a mentor; 0 otherwise
	Networking	This variable was obtained through factor analysis comprehending categorical variables related to the importance of networks for the entrepreneurial process. These networks involve relationships with professors, other entrepreneurs, executives and alumni. Extraction was obtained through Principal Components method with Varimax rotation and Bartlett Scores. The outcome variable explained 85.22% of the variance in original vectors

Table I.

$$P(ProspectiveEntrepreneurs = 1|x) = G(\beta_0 + \beta_1 Age + \beta_2 Age^2 + \beta_3 Family\ Income + \beta_4 Family\ Culture + \beta_5 STEM\ Student + \beta_6 Graduate\ Student + \beta_7 Urban\ Agglomeration + \beta_8 High - Quality\ University + \mu \quad \text{(Model II)}$$

$$P(High - Impact\ Entrepreneurs = 1|x) = G(\beta_0 + \beta_1 Age + \beta_2 Age^2 + \beta_3 Family\ Income + \beta_4 Family\ Culture + \beta_5 STEM\ Student + \beta_6 Urban\ Agglomeration + \beta_7 High - Quality\ University + \beta_8 Mentors + (\beta_9 University\ Support) + \beta_{10} Networking + \mu \quad \text{(Model III)}$$

$$P(Serial\ Entrepreneurs = 1|x) = G(\beta_0 + \beta_1 Age + \beta_2 Age^2 + \beta_3 Family\ Income + \beta_4 Family\ Culture + \beta_5 STEM\ Student + \beta_6 Graduate\ Student + \beta_7 Urban\ Agglomeration + \beta_8 High - Quality\ University + \beta_9 Mentors + (\beta_{10} University\ Support) + \beta_{11} Networking + \mu \quad \text{(Model IV)}$$

$$P(Innovation = 1|x) = G(\beta_0 + \beta_1 Age + \beta_2 Age^2 + \beta_3 Family\ Income + \beta_4 Family\ Culture + \beta_5 STEM\ Student + \beta_6 Graduate\ Student + \beta_7 Urban\ Agglomeration + \beta_8 High - Quality\ University + \beta_9 Mentors + (\beta_{10} University\ Support) + \beta_{11} Networking + \mu \quad \text{(Model V)}$$

where the probability, **P**, of each entrepreneurial phenomenon is a function of a set of predictors, **G**, ranging between 0 and 1 (Wooldridge, 2000). To each variable a parameter $\boldsymbol{\beta_k}$ is assigned and $\boldsymbol{\mu}$ is an error term. In Models III, IV and V, "University Support" is in between parentheses because of its exclusion for robustness checks as mentioned above. Next, we analyze the empirical outcomes of the models' estimations.

4. Results

Descriptive statistics are presented in Table II. Variables related to entrepreneurial activity indicate that entrepreneurs are relatively marginal in the sample – although values seem to be compatible with national-level evidence from the Global Entrepreneurship Monitor[7]. Interestingly, a high proportion of individuals come from families with previous entrepreneurial experience. Graduate students represent a small share of our sample, while STEM students have a significant weight. Most interviews were conducted with individuals located in state capitals and other metropolitan areas. The age range of the sample is broad, but central trends indicate that it mostly comprehends individuals in their 20s.

Results of the regression models' estimations are outlined in Table III. An initial assessment of empirical results allows verifying a low level of predictive power across models. This situation can also be attested by the non-significance of several variables. We now turn to discuss the main findings and possible explanations for these outcomes.

Variable	*N*	Mean	Min.	Max.	SD	Variance
Age	2230	25.40	17	68	7.197	51.796
Family income	2179	3.93	1	7	1.409	1.984
University support	90	−0.001	−1.807	1.985	1.000	1.000
Networking	270	1.48	−0.204	5.50	2.404	5.780
	N	Frequency (1)	Frequency (1) (%)	Frequency (0)		Frequency (0) (%)
Entrepreneurs	2230	270	12.1	1960		87.9
Prospective entrepreneurs	2230	468	21.0	1762		79.0
High-Impact entrepreneurs	127	12	9.4	115		90.6
Serial entrepreneurs	270	28	10.4	242		89.6
Innovation	270	17	6.3	253		93.7
Family culture	2230	1382	62.0	848		38.0
STEM student	2230	661	29.6	1569		70.4
Graduate student	2230	67	3.0	2163		97.0
Urban agglomeration	2230	1389	62.3	841		37.7
High-quality univ	2230	347	15.6	1883		84.4
Mentors	270	73	27.0	197		73.0

Table II.
Descriptive statistics

Table III.
Probit estimations

Variable	Model I Entrepreneurs	Model II Prospective entrepreneurs	Model III.a	Model III.b	Model IV.a	Model IV.b	Model V.a	Model V.b
			High-impact entrepreneurs		Serial entrepreneurs		Innovation	
const	−3.027*** [0.387]	−0.639* [0.346]	−5.042** [2.180]	−6.378** [2.971]	−3.117** [1.495]	−2.044 [2.105]	−1.011 [1.623]	0.953 [2.202]
Age	0.065*** [0.023]	−0.019 [0.021]	0.131 [0.111]	0.182 [0.161]	0.031 [0.075]	0.006 [0.116]	−0.049 [0.087]	−0.096 [0.126]
Age sq	−0.001 [0.001]	0.001 [0.001]	−0.002 [0.001]	−0.002 [0.002]	−0.001 [0.001]	−0.001 [0.001]	0.001 [0.001]	0.001 [0.001]
Family income	0.048* [0.027]	0.012 [0.021]	0.199* [0.108]	0.154 [0.143]	0.069 [0.093]	0.038 [0.127]	0.002 [0.111]	−0.152 [0.144]
Family culture	0.337*** [0.077]	0.220*** [0.064]	−0.172 [0.351]	0.180 [0.504]	0.087 [0.256]	0.330 [0.370]	−0.242 [0.318]	−0.341 [0.403]
STEM student	0.064 [0.082]	−0.099 [0.069]	−0.313 [0.347]	−5.525*** [0.296]	0.130 [0.283]	0.356 [0.393]	−0.344 [0.322]	−0.693 [0.432]
Graduate student	0.135 [0.195]	−0.304 [0.211]	–	–	0.179 [0.453]	0.180 [0.689]	0.252 [0.515]	0.887 [0.706]
Urban agglom	−0.144* [0.077]	−0.065 [0.066]	0.225 [0.342]	0.195 [0.424]	−0.089 [0.251]	0.196 [0.320]	−0.344 [0.304]	−0.631 [0.403]
High-quality univ	0.153 [0.103]	−0.017 [0.088]	0.219 [0.470]	0.399 [0.552]	0.988*** [0.303]	0.726* [0.399]	0.665* [0.342]	0.908** [0.430]
University support	–	–	–	−0.087 [0.211]	–	0.163 [0.173]	–	−0.091 [0.156]
Mentors	–	–	0.090 [0.351]	0.578 [0.525]	0.717* [0.389]	0.478 [0.443]	0.649 [0.447]	0.645 [0.493]
Networking	–	–	0.228*** [0.083]	0.235** [0.094]	0.193*** [0.066]	0.048 [0.083]	0.208*** [0.072]	0.121 [0.078]
Valid N	2179	2179	124	89	265	89	265	89
Rsq. (McFadden)	0.071	0.008	0.159	0.266	0.267	0.097	0.284	0.203

Notes: Std. errors in brackets: *sig. at 10%; **sig. at 5%; ***sig. at 1%

"Age" is a significant predictor of overall entrepreneurial activity with a positive sign. Older students are more likely to be involved (or to have been involved in the past) with firm creation. The lack of significance in "Age sq." suggests that this relationship is rather linear in form. Nonetheless, "Age" is not a matter of relevance in the remaining models. A similar situation is identified for "Family Income", although this variable has a weaker statistical significance, and it is also somewhat related to "High-Impact Entrepreneurs." This is a surprising result. One would expect that individuals coming from wealthier families would be more strongly associated with entrepreneurial ventures, considering their security against higher levels of risk (Cuervo, 2005; Zellweger *et al.*, 2011).

For the case of "Family Culture", this variable is positively related to entrepreneurial activity and entrepreneurial intention (Models I and II), indicating that previous experience with new ventures in the family can have an influential effect on the behavior of students. We can hypothesize that these students may learn from having close ties with entrepreneurs, as well as identifying potential career role models in their respective families as discussed in Shane (2010) and Zellweger *et al.* (2011).

STEM students are not positively related to any of the dependent variables included in the analysis. On the contrary: these students are less likely to be involved in high-impact entrepreneurship than individuals from other fields. This brings some evidence to what Delmar and Wennberg (2010) call a paradox of knowledge-intensive entrepreneurship, where high-skilled personal find more attractive work options in the industry to the detriment of self-employment. This situation can be attributed to the shortage of STEM professionals in Brazil, driving up wages in incumbent firms and reducing incentives for this group of students to become entrepreneurs. In its turn, the variable "Graduate Student" has no significance in the proposed models.

Thus far, we have addressed aspects related to individual traits of entrepreneurs. An overall assessment of this dimension suggests that non-observed factors – such as psychological features – may have a deeper connection with entrepreneurial activity than the variables contained in the analyzed dataset.

The appraisal of results from the systemic side of models also renders weak results in an aggregate perspective. A possible explanation for this situation can be traced to the hostile regulatory environment for entrepreneurial activity in Brazil. While we understand that the academic ecosystem might exert effects on entrepreneurial propensity, it lies on top of an institutional framework (Ács *et al.*, 2014). If institutions do not set incentives and support for individuals to engage in entrepreneurial endeavors, this might render other parts of systems of entrepreneurship (such as Universities) highly ineffective – despite initiatives to foster student entrepreneurship.

"Urban Agglomeration" is negatively related to overall entrepreneurial activity (Model I). While this is in contrast with evidence from developed nations (Glaeser, 2007), it is in accordance with findings in the Brazilian context (Fischer *et al.*, 2018a). A possible explanation resides on the strong agglomeration diseconomies found in large cities located in this country. "High-Quality Universities" do not seem to generate more entrepreneurial students, but these centers of excellence are significantly connected to the emergence of "Serial Entrepreneurs" and "Innovation." This outcome is in line with recent results obtained for Brazil (Fischer *et al.*, 2018b), suggesting that these institutions have a key role to play in promoting socioeconomic changes in the economic structure and its respective evolutionary trends.

A striking result concerns the lack of relevance identified in the variable "University Support." This vector is not associated with any of the entrepreneurial propensity functions to which it is assigned, an outcome which contrasts with earlier findings obtained by

Iizuka and Moraes (2014), Moraes *et al.* (2018) and Rocha and Freitas (2014). This suggests a lack of coordination and establishment of correct initiatives aiming at fostering entrepreneurial behavior in the Brazilian academia. The role of "Mentors" is of marginal relevance, and it is statistically significant only for "Serial Entrepreneurs," although this outcome is not robust across the two specifications for this dependent variable. Finally, the role of "Networking," a key aspect of successful academic entrepreneurship (Hayter, 2016) presents positive impacts for all of the three instances in which it is evaluated ("High-Impact Entrepreneurship," "Serial Entrepreneurs" and "Innovation"), although its significance is not robust in Models IV and V.

5. Discussion

As postulated by Ács *et al.* (2014), systemic effects related to the generation of entrepreneurial activity involve a series of connections among different dimensions of the socioeconomic environment. Flaws or inefficiencies in key components of these systems of entrepreneurship may hinder the overall production of new ventures. In this regard, what our findings suggest is that student entrepreneurship is a rather random phenomenon in Brazil, as there is a lack of significance and consistency in coefficients related to variables that are often understood as drivers of entrepreneurial activity.

A direct implication of this perspective concerns the incipient nature of the idea of entrepreneurial systems in this particular country. The expected connections among systemic vectors (Isenberg, 2010) are weak and the "pieces of the puzzle" do not seem to fit together. Consequently, Brazilian universities seem to have a very limited capacity of promoting higher levels of student entrepreneurship – a desirable phenomenon for socioeconomic and technological evolution of the national business environment. This situation presents striking challenges for entrepreneurship policies, since determinants of entrepreneurial activity are not clearly defined.

In fact, this situation seems to fit the existing criticisms toward the notion of "entrepreneurial universities." For instance, Watson and Hall (2015) identify a lack of adherence of universities with activities that go beyond research and teaching. In turn, Matt and Schaeffer (2018) pinpoint the low levels of efficiency in terms of academic entrepreneurial policies. In this regard, our assessment indicates the need for further empirical analyses concerning universities' actual engagement with academic entrepreneurship.

In this regard, we must complement the analysis by acknowledging that developing countries face idiosyncratic challenges in the promotion of academic entrepreneurship, so the pure imitation of strategies and mechanisms from developed economies can be an inefficient strategy (Davey *et al.*, 2016). Fundamental issues of the market environment can help understanding the apparent "randomness" of student entrepreneurship in Brazil. We must first consider that macroeconomic conditions set the stage for the existence or absence of appropriate incentives concerning the behavior of individuals toward entrepreneurship (Aidis *et al.*, 2008; Baumol, 1990, 1993; McMillan and Woodruff, 2002; North, 1990; Welter and Smallbone, 2011). Audretsch, Keilbach and Lehmann (2006) refer to "entrepreneurship capital," understood as local-level institutions that foster entrepreneurial activity. Even though talent and personalities of individuals are fundamental triggers of entrepreneurial activity, conducive environments and appropriate incentives are key to achieve sustained levels of student entrepreneurship (Boh *et al.*, 2015). If not tackled properly by the dedicated policies, the institutional context may actually hinder systemic dimensions to function effectively.

Accordingly, "characteristics of the formal or regulatory dimension would profess predominantly necessity-based and mostly low-growth, short-term oriented entrepreneurship in emerging economies" (Manolova *et al.*, 2007, p. 206). In the Brazilian case, it is well known that the inefficient regulatory environment stands for a structural challenge in terms of entrepreneurial activity. Data from the Doing Business Report from the World Bank underscore these barriers. Even compared to other Latin American countries, Brazil performs poorly in terms of starting a business (28th position among 32 nations), tax compliance (30th) and international trade (30th). It follows the challenge to shift a socioeconomic environment that has historically focused on support for incumbent firms.

This context may help explaining, for instance, the lack of engagement of STEM students in entrepreneurship, providing evidence for the paradoxical situation highlighted by Delmar and Wennberg (2010). When facing the decision of going entrepreneurial or joining the job market, these students face reduced incentives to engage in the former. This can also be explained by the fact that the returns on entrepreneurial careers are risky. In this regard, Åstebro and Chen (2014) have shown that, on average, self-employed individuals earn less than employees do. Unfortunately, this issue is often left out of policy arguments because of the anecdotal evidence that provides confirmation bias for weak assumptions related to successful cases. In this regard, the main contribution of our research seems to be highlighting weaknesses in the academic system that allows us to question the validity of the "entrepreneurial university" rationale. Understanding this issue in further depth is necessary for Brazil – and countries in similar conditions – to move up the technology ladder by finding the right ways to promote knowledge-intensive entrepreneurship.

6. Concluding remarks

This paper has addressed the issue of determinants of student entrepreneurship based on the context of Brazilian universities. A rather complete picture of the dynamics behind entrepreneurial activity, prospective entrepreneurship, high-impact entrepreneurship, serial entrepreneurship and innovation in small ventures has been drawn for a representative sample of institutions and students in this country.

While recent work has put emphasis on the university as the leading agent within the dynamics of systems of entrepreneurship (Miller and Ács, 2017), there is still a long way to go in terms of understanding the causal conditions that shape student entrepreneurship. This is especially relevant for the case of developing countries, where initiatives are strongly based on the replication of approaches undertaken in the developed world – even though surrounding contexts may differ. Accordingly, our assessment indicates that Brazilian universities fall short in stimulating the entrepreneurial behavior of students. As brought up in our discussion, this is likely to be related to a relatively hostile institutional environment.

However, it is important to highlight that our findings represent aggregate trends in the reality of higher education institutions in Brazil. We recognize the possibility of particular cases of success. In this regard, our analysis should be complemented by case studies that can derive functional mechanisms that can guide other universities into becoming entrepreneurial hotbeds. But this is not an easy task. As per our demonstrations, achieving the status of "entrepreneurial university" goes well beyond the simple setup of a bundle of generic conditions. Hence, the target herein appears to be too complex to be tackled by simple, short-term solutions, requiring a complete rethink on the way that the academic environment operates.

Such fundamental aspects of the entrepreneurial activity can render initiatives targeted at fostering systemic connections highly unfruitful. Building specific university programs to develop a stronger entrepreneurial orientation in students is unlikely to shift the overall propensity of students to engage in establishing new ventures, provided the institutional settings do not favor such endeavors. This unfriendly environment harms students' attitudes toward entrepreneurial intentions, a fundamental feature of entrepreneurial systems (Liñán *et al.*, 2011). We believe these conditions are not constrained to the Brazilian case, and they may represent the reality of other developing countries as well.

The assessment contained in our research deals with a very sensitive and strategic issue for the long term, evolutionary patterns that developing countries' innovation systems can reach. Understanding the systemic dynamics in which entrepreneurial activity takes place, particularly the often neglected case of student entrepreneurship, represents a fundamental step forward in generating knowledge that can guide future policymaking processes in these environments.

Finally, these conclusions do not go without limitations. Main caveats of our empirical analysis can be attributed to model specifications, i.e. the set of variables available for the identification of the determinants of student entrepreneurship. In this regard, a closer scrutiny of the current literature could be of help in designing more accurate instruments for data collection. Illustratively, the addition of students' attitudinal characteristics would represent an important step forward in future rounds of interviews (Moraes *et al.*, 2018). Also, the very nature of the indicators does not allow a thorough understanding of qualitative aspects behind individual and systemic vectors. More refined variables are needed to capture differences that were not detected in this article.

Notes

1. Endeavor is a non-profit organization that catalyzes long-term economic growth by selecting, mentoring, and accelerating the best high-impact entrepreneurs worldwide.
2. Sebrae is a Brazilian Micro and Small-Sized Business Support Service. Sebrae is a not-for-profit private entity with the mission of promoting the sustainable and competitive development of small businesses.
3. However, it is worth noticing that these expectations face some limitations, particularly since we are dealing with a limited age cohort.
4. Thus, the dataset consists of secondary data. Authors did not participate in the formulation of the questionnaire or their respective applications.
5. As questionnaires are applied to students, different students from the same institution can have distinct points of view on how the institutional environment at the university can promote entrepreneurial activity.
6. Regression analysis have the advantage of not being dependent on a particular theoretical model (Liñán *et al.*, 2011). Since the model used secondary data produced by third-party, this method allowed the authors to analyze different aspects collected in the questionnaires.
7. Data from GEM can be downloaded at < www.gemconsortium.org/data>.
8. This ranking corresponds to a classification of academic and research-related institutions according to a composite indicator based on research performance, innovation outputs and societal impact (www.scimagoir.com/methodology.php).

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