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Higher Education Entrepreneurial Ecosystems: Exploring the Role of Business Incubators in an Emerging Economy

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Abstract. Entrepreneurship ecosystems involve a set of individual, organizational, industry and environmental elements such as leadership, dynamic capabilities, culture, capital markets, networks, and open-minded customers that combine in complex ways. One of the main pillars in any ecosystem is the university because it may generate an adequate environment to support the university community's exploration and exploitation of entrepreneurial activities. Previous studies have shown that universities also create their own entrepreneurial ecosystems, in which business incubators play a crucial role. The purpose of this study is to provide a better understanding of the role of an entrepreneurial university's business incubators within the entrepreneurial process, in both the pre-incubation and incubation stages. Adopting the entrepreneurial intention and entrepreneurial action approaches, a conceptual model is proposed and tested with data obtained from the Monterrey Institute of Technology and Higher Education (Mexico), as one of the most important multi-campus entrepreneurial universities in Latin America. Our results show a positive impact of entrepreneurial university business incubators on their students' start-up intentions (pre-incubation) as well as on their supported technology-based enterprises (incubation). We discuss implications of our results for various entrepreneurial university stakeholders.

Keywords: entrepreneurial process; entrepreneurial university; incubation mechanisms; Mexico

JEL codes: L26; I23; A23

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1. Introduction

Entrepreneurship ecosystems involve a set of individual, organizational, industry and environmental elements such as leadership, dynamic capabilities, culture, capital markets, networks, and open-minded customers that combine in complex ways (Isenberg, 2010, p. 42). Mason and Brown (2014, p. 5) argue that the entrepreneurial ecosystem is an interconnected set of entrepreneurial actors and organisations that are part of any entrepreneurial process and that together determine the entrepreneurial environment of their localities or territories. On the other hand, ecosystems are focused on the complex relationships of cooperation, communication, and feedback among organisations (Carlsson et al., 2002; Autio et al., 2014). In this regards, a current academic debate is oriented to understand how different agents of an ecosystem operate, collaborate, make decisions, identify benefits, or transform their roles (Cunningham and Link, 2015). Interestingly, one of the main pillars in any ecosystem is the university because it may generate an adequate environment to support the university community's exploration and exploitation of entrepreneurial activities (Guerrero and Urbano, 2012). Previous studies have shown that universities also create their own entrepreneurial ecosystems. In this regards, we understand an entrepreneurial university ecosystem as a composition of educational programmes, infrastructures (incubators, research parks, technology transfer offices, business creation offices, employment offices, etc.), regulations (business creation normative, property rights, etc.), culture (role models, attitudes towards entrepreneurship, etc.) as well as relationships with government, investors, industry, and other socio-economic agents (Guerrero and Urbano, 2012). This ecosystem supports the university community (students, alumni, academics, staff, etc.) in the identification, development and commercialization of innovative and entrepreneurial initiatives (Guerrero et al., 2016). The analysis of this phenomenon is relevant because the entrepreneurial university ecosystem may regulate the nature and the quality of entrepreneurial activity by shaping rewards linked to opportunity identification/generation and pursuit of organizational forms/strategies (Wright et al., 2017). Following this point of view, it is important to explore the configuration of higher education entrepreneurial ecosystems across economies, particularly in transitional economies which comprise countries with a rapid pace of development and government policies oriented to become more entrepreneurial/innovative societies (Audretsch, 2014; Calá et al., 2017; Hoskisson et al., 2000).

Another academic debate in entrepreneurship research is oriented to understand why some people and not others discover opportunities in diverse environments (Busenitz et al., 2014). To understand the entrepreneurial phenomenon as a process at the university level, studies have provided evidence about why some universities generate more technological start-ups than others (Di Gregorio and Shane, 2003; O'Shea et al., 2007, 2008) or why university-

based start-ups are more productive than independent start-ups (Ensley and Hmieleski, 2005). These studies have identified that the main differences were explained by the level of entrepreneurial orientation of each university, which was measured in terms of the internal/external factors involved in the development of the core activities that influence entrepreneurial innovation actions (Guerrero et al., 2015) and by the individual factors linked to the university community's experiences, attitudes, and skills that motivate the entrepreneurial decision. In this sense, the influence of environmental factors (e.g., new technologies, regulatory and economic adjustments, and incubation patterns) on the emergence (Busenitz et al., 2014) or on the generation (Wiklund et al., 2011) of new entrepreneurial opportunities remains an important area of research in the entrepreneurship literature. Applying these arguments to entrepreneurial universities, it is relevant to analyze the interface between individuals and environments in the entrepreneurial process via support mechanisms such as entrepreneurial university incubators (Autio et al., 2014; Busenitz et al., 2014; Wiklund et al., 2011). Extant studies on university incubators have provided several insights about the types of enterprises located in the incubators, the evolution, the regional influence on their facilities/services, the diversity of incubation mechanisms, among others (Aernoudt, 2004; Barbero et al., 2014; Phan et al., 2005). However, only a few studies have provided a better understanding of the role of incubators within the entrepreneurial process, specifically how incubation mechanisms influence the behaviors and decisions of potential entrepreneurs within entrepreneurial universities (Al-Dajani et al., 2014; Guerrero et al., 2016).

The purpose of this study is to provide a better understanding of the role of an entrepreneurial university's mechanisms within the entrepreneurial process. Adopting the entrepreneurial intention and entrepreneurial action approaches, a more comprehensive model to explain how incubators affect the entrepreneurial process is proposed and tested with data obtained from the Monterrey Institute of Technology and Higher Education (Mexico), as one of the most important multi-campus entrepreneurial universities in Latin America. In addition, this paper adopts a broad definition of incubation mechanisms that includes a mix of infrastructures, resources, business support services, and networking (Phan et al., 2005) provided by the entrepreneurial university oriented to support entrepreneurship (Grimaldi and Grandi, 2005). This study will provide a deeper understanding how entrepreneurial university's incubators can add much value in entrepreneurial processes/ecosystems, and relevant implications for university managers, practitioners, and policy makers will emerge from this study.

The paper is organized as follows. Section 2 introduces the theoretical framework, in particular, addressing the role of an entrepreneurial university's incubation mechanisms in the entrepreneurial process. Section 3 describes the analyzed Higher Education Entrepreneurial Ecosystem. Section 4 provides the methodology used in the study. Two methodological steps are described to

analyze each stage of the entrepreneurial process: pre-incubation (intentions) and incubation (actions). Section 5 describes and discusses the main findings obtained in this study and also introduces the discussion. Finally, Section 6 presents the conclusions and implications.

2. Higher Education Entrepreneurial Ecosystems and Entrepreneurial Behaviors

2.1. The Entrepreneurial Process Within an Entrepreneurial University Ecosystem

In contrast with a traditional university, an entrepreneurial university is an organization characterized by its ability to adapt to environmental changes (Clark, 1998), a flexible managerial and governance distinctiveness (Subotzky, 1999), new activities oriented to foster the entrepreneurial culture across all university levels (Kirby, 2004), a strong vision focused on contributing to economic development through the creation of technology-based enterprises (Chrisman et al., 1995), and the commercialization/transfer of knowledge (Jacob et al., 2003). In the 21st century, the entrepreneurial university's role is considerably broader than simply facilitating technology transfer (Audretsch, 2014). The entrepreneurial university community (students and academics) exists inside an entrepreneurial ecosystem oriented to reinforce the community's ability to innovate, recognize, and create opportunities; work in teams; take risks; and respond to challenges (Kirby et al., 2011; Wright et al., 2017). Adopting the ideas of Phan et al. (2005) and Mian (2011), the entrepreneurial university provides a mix of incubation mechanisms including infrastructures (centers of small-university businesses, research facilities, research groups or quasi enterprises, liaison offices, technology transfer offices, and incubators), resources (physical, financial, commercial, technical, etc.), business support services (mentoring, seed funding, etc.), and networking (workshops, business angels platforms, business plan contests, etc.).

The entrepreneurial university's incubation mechanisms are oriented to support the university community within all stages of the entrepreneurial innovation process (Cooper et al., 2012; Guerrero et al., 2014). Both entrepreneurship and innovation are multidimensional processes (Ludvall et al., 2002; Gartner, 1990; Shane and Venkataraman, 2000; Shane, 2004) in which several components play relevant roles (Gartner, 1985; McMullen and Dimov, 2013). Gartner (1990) explained that entrepreneurial behavior is evidenced through five activities: (i) finding and refining the opportunity; (ii) acquiring resources and support; (iii) operating the business; (iv) identifying and selling to customers; and (v) focusing on marketing outside of the business. In this regards,

this paper focused on three core components in all types of entrepreneurship: (i) the motivation (the need or desire); (ii) the act (an action to enhance the reality); and (iii) the entrepreneur (the person who undertakes actions). Similarly, Renko et al. (2012) argued that an entrepreneurial process starts with the existence of opportunity followed by the decision to exploit it, including resources, strategy, and performance. Table 1 summarizes the main stages involved in the entrepreneurial process and the role of the entrepreneurial university ecosystem.

Table 1. The entrepreneurial process and the role of the entrepreneurial university ecosystem.

	Exploration	**Exploitation**	**Consolidation**	**Previous studies**
	Finding and refining the opportunity	Acquiring resources and support	Operating the business, identifying and selling to customers	Gartner (1990).
Entrepreneurial process	Discovery Exploration	Exploitation / Execution		Shane and Venkataraman (2000); Shane (2004); Van de Vrande et al. (2009); O'Connor and De Martino (2006).
	Motivations	Actions		McMullen and Shepherd (2006a, 2006b).
	Existence of opportunity	Decision to act	Consolidation	Renko et al. (2012).
Entrepreneurial university ecosystem: Incubation mechanisms	Research & Development	Incubation and technology transfer	Commercialization and acceleration to growth	Guerrero et al. (2016); Wright et al. (2017).

Source: Authors.

In order to understand the role of an entrepreneurial university entrepreneurial ecosystem, we focus on the role of incubation mechanisms within the entrepreneurial process. In this regard, it is necessary to create a distinction among the services, achievements, beneficiaries, and expected results (Aernoudt, 2004; Barbero et al., 2014; Mian, 2011). Adopting Gartner's (1985) ideas, entrepreneurship within a university is influenced by the university environment (incubation mechanisms); the profile of the individual (students, academics, and staff); the profile of the potential firm (high-tech, medium-tech, non-tech); and the stage within the entrepreneurial process (exploration, exploitation, consolidation). There is general recognition of the effective support of the incubation mechanisms during the creation and survival of enterprises based on the provision of facilities such as offices, administrative staff, and access to university research and external grant support (McAdam and McAdam, 2008; McAdam et al., 2012). In addition, other studies have shown that incubation mechanisms reinforce the entrepreneurial culture at all university levels (Guerrero et al., 2015) and operate as a tool created to support the entrepreneurial process (Autio et al., 2014).

2.2. The Role of Entrepreneurial University's Incubation on Entrepreneurial Behaviours

Table 2 shows the main focus how incubation mechanisms support entrepreneurial behaviours during the pre-incubation (entrepreneurial intentions) stage and the incubation (entrepreneurial actions) stage. Although those mechanisms are oriented to support all members of the university community, in this paper, the pre-incubation stage is analyzed via the entrepreneurial intentions of undergraduate students (which represent the largest population inside a university), and the incubation stage is explored via the entrepreneurial actions of some university community members (students and academics).

Table 2. The role of entrepreneurial university's incubators on entrepreneurial behaviours

	Pre-incubation Stage	**Incubation Stage**
Entrepreneurial behaviors	Intentions	Actions
University community	Undergraduate students	Students & academics
Entrepreneurial university's incubators	Research facilities/groups, small business units, university support	Incubators, technology transfer offices, university support
Role of entrepreneurial university's incubators	Provide services oriented to finding and refining the opportunity. Reinforce individual skills, attitudes, role models, etc.	Provide resources and support during the exploitation and execution of the entrepreneurial opportunity

Source: Authors.

2.2.1 The Role of Incubation Mechanisms Within the Pre-Incubation Stage

The entrepreneurship process begins with a desire to interact with new information about motive, means, and/or opportunities to form an idea. If an individual has the motive, means, and opportunity to act, then this idea can, but does not have to, become an innovative product, which in turn may or may not generate positive cash flows for the firm and/or economy (McMullen and Dimov, 2013). Therefore, whether or not an opportunity will turn into an enterprise will depend on the nature of the opportunity, on the individual who discovers this opportunity, and on the environment within which the idea will be explored (Shane and Venkataraman, 2000). Therefore, motivations depend on individual intentions and environmental characteristics (McMullen and Shepherd, 2006a, 2006b). Adopting the planned behavior theory, start-up intentions must trigger an individual's behavior to take action, which gives rise to innovation and entrepreneurship because intentions without actions will not generate new innovative enterprises or economic value (Ajzen, 2002; Bird and Schjoedt, 2009).

In knowledge contexts (e.g., entrepreneurial universities), the influence of incubation mechanisms on start-up intentions could be identified via motivational factors (attitudes toward behavior and self-efficacy) (Guerrero and Urbano, 2012). In the pre-incubation stage, a mix of incubation mechanisms provided by

the entrepreneurial university to undergraduate students are explored, including mentoring, and coaching programs; workshops/networking with experienced entrepreneurs and researchers; contests; among others (Souitaris et al., 2007). For potential entrepreneurs, incubation mechanisms provide more advanced services such as contact platforms with potential investors/researchers, and seed funding/ financial support from university and external funds (Alsos and Kolvereid, 1998; Scillitoe and Chakrabarti, 2010). Based on those mechanisms, an entrepreneurial university provides a wide variety of real situations and knowledge/skills/abilities (Kirby, 2004) and reinforces attributes/behaviors to help develop creative/critical thinking and to make individual career choices (Lee and Wong, 2004).

As a result, an undergraduate student can benefit from a pool of resources that can help him or her to evaluate ideas and develop them into new enterprises (Souitaris et al., 2007). For instance, an undergraduate student can get advice from researchers and technology transfer officers to test their ideas. Additionally, an undergraduate student can use networking events to access practitioners for recruitment or advice. A few studies have shown the positive effect of those incubation mechanisms on the attitudes toward entrepreneurship (the desire or attractiveness of the proposed behavior or the degree to which the individual holds a positive or negative personal valuation about being an entrepreneur) and the self-efficacy (the feasibility or the perceived ease/difficulty or individual's own capacity to carry out a specific behavior) (Ajzen, 2002; Autio et al., 2014; Kolvereid, 1996; Degroof and Roberts, 2004). Following this standpoint, the perception, identification, and assessment of entrepreneurial opportunities represent the chance for an individual to offer some new value to society, often by introducing innovative and novel products or services (Lee and Venkataraman, 2006). Therefore, we propose that incubation mechanisms increase the probability of a student becoming an entrepreneur because those mechanisms help to reinforce entrepreneurial motivation, to identify business opportunities, and to exploit opportunities in the short-term.

H1: In the pre-incubation stage, entrepreneurial university's incubation mechanisms increase the probability that an undergraduate student explores opportunities to become an entrepreneur in a short time.

2.2.2. The Role of Incubation Mechanisms Within the Incubation Stage

Entrepreneurship is a phenomenon to pursue and exploit opportunities (Autio et al., 2014). In this context, actions refer to the behavior in response to a decision to create an enterprise, always with the possibility for economic gain or financial loss (Hastie, 2001). An entrepreneur bears the responsibility for making decisions that affect the localization, moment, form, and use of goods or scarce resources to launch a new business (Shane and Venkataraman, 2000). McMullen and

Shepherd (2006a, 2006b) argued that any entrepreneurial action demands feasibility (what can be achieved in the way that is envisioned) and desirability (whether its attainment will fulfill the motive for which it is being sought). Therefore, an entrepreneurial action depends on how individuals combine: (a) their motivations, which vary in how they perceive the risk of expending resources before knowing the distribution of outcomes (Shane et al., 2003), (b) their human capital (i.e., individual education, experiences, and skills), which constitutes a firm-unique intangible asset (Davidsson and Honig, 2003), and (c) their access to the resources required to create an enterprise (Adner, 2006; Chang et al., 2011). Regarding the last point and adopting a resource-based view perspective, the entrepeneurial university's incubation mechanims are a unique set of valuable, rare, and imperfectly imitable resources and capabilities (Amit and Schoemaker 1993; Katz and Gartner, 1988). These resources and capabilities can be viewed as bundles of tangible and intangible assets controlled by an entrepreneurial university to generate sustained, competitive advantages through the creation of technology-based enterprises (Clarysse et al. 2005; DiGregorio and Shane, 2003; Kirby et al., 2011). In the incubation stage, a mix of incubation mechanisms provided by the entrepreneurial university to some members of the university community (students and academics) includes the access to financial resources, physical resources, and human capital (Guerrero and Urbano, 2012).

Several authors emphasize the importance of *financial resources* applied to the business incubation mechanisms to support entrepreneurship within the university (Aaboen, 2009). The variation of start-up activity within an entrepreneurial university depends on the availability of financial capital in the area because its quality decreases with geographical distance. In fact, incubation mechanisms require different financial sources (venture capital, grants, and government programs) to develop their activities as well as to fund the university community's start-ups (Di Gregorio and Shane, 2003; O'Shea et al., 2008). In this respect, Powers and McDougall (2005) found a positive and statistically significant relationship between business incubators' financial resources and the university's spin-off activity. Undoubtedly, funding is the first barrier for any entrepreneur within the entire entrepreneurial process; therefore, the support provided by the university's incubation mechanisms is extremelly important to exploit any entrepreneurial idea (Aernoudt, 2004). In addition, several studies have identified that a university's *physical infrastructure* is a key factor for the success of entrepreneurial activities (Benneworth and Charles, 2005; Bøllingtoft, 2012; O'Shea et al., 2005). Indeed, appropriate infrastructure is crucial to effectively incubate and provide services to the university community (Lazzeretti and Tavoletti, 2005). In this regard, a university's incubation mechanisms often include flexible rental spaces associated with innovation, research, and operational or commerial activities (Peters et al., 2004).

However, talented *human capital* is the most critical resource for the development of incubation mechanisms and the university's knowledge transfer

(Scillitoe and Chakrabarti, 2010). Entrepreneurial universities try to create innovative enterprises to capture the rents generated by their intellectual capital because it is difficult to imitate for other universities (O'Shea et al., 2007). It also includes access to networks of business and technical advisors capable of providing guidance and assistance in finance, business planning, legal consulting, manufacturing, etc. (Peters et al., 2004). Therefore, the role of human capital resources for university technology transfer and technology-based enterprises is crucial.

All in all, university incubation mechanisms provide an environment for fostering entrepreneurial actions of a university community, and contribute to an innovative region (Aaboen, 2009). We propose that incubation mechanisms increase an entrepreneurial university community's start-up creation because they help the university community to access and mobilize resources required during the execution of their entrepreneurial actions.

H2: In the incubation stage, entrepreneurial university's incubation mechanisms increase the number of students/academics who exploit opportunities to create new enterprises.

3. The Entrepreneurial Ecosystem of a Multi-campus Entrepreneurial University

Given the nature of this research field, it is not surprising that much of the literature is explored by cases (Hackett and Dilts, 2004). Based on the objective of this study and adopting the theoretical criteria to identify entrepreneurial universities[2], the Monterrey Institute of Technology and Higher Education (Instituto Tecnológico y de Estudios Superiores de Monterrey, ITESM) was identified as one of the most entrepreneurial universities in Mexico (Guerrero et al., 2014). Since its foundation by a group of businessmen in 1943, ITESM has lived a continuous evolutionary process to respond to the educational demands that emerge from social, economic, scientific, labor and technological changes, and to the challenges that the country development faces. The main purpose of ITESM is "to offer education that transforms lives through educative experiences, we develop persons who become change makers, willing to be even more competitive on everybody's benefit". As a result, ITESM's vision is oriented to develop entrepreneurial leaders, with human sense and internationally

2. The criteria used in extant studies (Clark, 1998; Di Gregorio and Shane, 2003; Guerrero and Urbano, 2012; Guerrero et al., 2015; Shane, 2004; Wright et al., 2017) to identify entrepreneurial universities consider: the promotion of an entrepreneurial culture across the university community; (ii) making self-instituting efforts to develop an entrepreneurial ecosystem and fostering innovative/entrepreneurial initiatives; (iii) the socioeconomic impact on the regions/countries; (iv) a continued and sustained transformation process, and (v) the involvement of several socioeconomic actors in the decisions, activities and objectives.

competitive. ITESM's Directive Board is integrated by twenty members that represent civil society and business sector with the CEOs of well-recognized Mexican enterprises. Interestingly, ITESM has adopted an organizational structure of a multi-campus university distributed by 31 campuses located in different cities[3] across Mexico. Therefore, ITESM has a presence in each Mexican region. In other words, regional characteristics (economic, social, political, and geographical) influence the activities of each campus, but the activity of each campus impacts on the socio-economic development of each region as well.

Based on this multi-campus system, ITESM promotes teaching, research and entrepreneurial activities. Concerning teaching activities, ITESM has implemented a novel educational system with transversal entrepreneurship training. Nowadays, ITESM has a strong mandatory curricular of entrepreneurship courses/programs across disciplines/campuses. Regarding research activities, ITESM's researchers are organized in over 41 research groups that conduct basic/applied research in strategical national areas.[4] Concerning entrepreneurial activities, ITESM has created the Eugenio Garza Lagüera Entrepreneurship Institute that enhances students' entrepreneurial spirit in order to propose/implement solutions for social, economic and environmental development. With this aim ITESM has celebrated strategic alliances with other universities such as Babson College, Stanford, UC Berkeley, etc. Based on these experiences, ITESM has implemented a business incubator model integrated by platform that comprise three subnetworks: (i) a technology-based incubator network that drives the transformation of ideas and innovative projects in advanced sectors into high value-added businesses; (ii) an intermediate technology-based incubator network that supports the creation, development, and consolidation of new businesses that incorporates some elements of innovation; and (iii) a social incubator network that promotes the creation and strengthening of micro-enterprises. All the entrepreneurship initiatives contribute to the generation of jobs and to strengthening the national economy by means of knowledge transfer to create, develop and grow companies. As a result, we believe that this type of entrepreneurial organizations reinforces the link between innovation and entrepreneurship that is required to facilitate economic growth via entrepreneurship (Autio et al., 2014, p. 1097).

3. Aguascalientes, Central de Veracruz, Chiapas, Chihuahua, Ciudad de México, Ciudad Juárez, Ciudad Obregón, Cuernavaca, Estado de México, Guadalajara, Hidalgo, Irapuato, Laguna, León, Mazatlán, Monterrey, Morelia, Puebla, Querétaro, Saltillo, San Luis Potosí, Santa Fe, Sinaloa, Sonora Norte, Tampico, Toluca, Zacatecas
4. Biotechnology and food, social sciences, regional development, social development, sustainable development, education, entrepreneurship, government, humanities, manufacturing and design, mechatronics, nanotechnology, business, health, and information and communications technologies.

4. Methodology

In order to provide a better understanding of the role of entrepreneurial university's incubators on entrepreneurial behaviours (see Table 2), we designed a mixed methodology composed of two steps: pre-incubation associated with entrepreneurial intentions; and incubation associated with entrepreneurial actions. The analysis was developed in one of the most important multi-campus entrepreneurial universities in Latin America: the Monterrey Institute of Technology and Higher Education (ITESM) described in Section 3.

4.1. Data Collection and Analysis

Data was collected using ITESM's two main databases. Table 3 shows a brief description of data sources adopted in each stage.

Table 3. Methodology and data sources.

Step	Entrepreneurial Process	Incubation Mechanisms	Level of Analysis	Data Source
Pre-incubation	Entrepreurship intentions (identification of opportunities)	Entrepreneurial university's services: workshops/networking, contact platforms/points, mentoring and coaching programs, seed financial support.	Undergratuate students' intentions	2011 ITESM's GUESSS database
Incubation	Entrepreurship action (creation of technology based enterprises)	Entrepreneurial university's resources: financial, physical and human	Technology-based enterprises created by university community (students/ academics)	2011 ITESM's incubators database

Source: Authors.

4.1.1. Pre-Incubation Stage: Analyzing Entrepreneurial Intentions

We use the 2011 ITESM's GUESSS database to explore the role of ITESM's incubation mechanisms on students' intentions (identification of opportunities). GUESSS is an international research project using a geographical and temporal comparison to investigate the entrepreneurial intention and activity of students. According to their average annual student population, this database provides a representative sample of 531 undergraduate students interviewed.

Concerning the dependent variable, the GUESSS methodology allows us to identify students' start-up intentions. In this regards, the variable *students' start-up intentions* was measured by a dichotomous variable that takes value 1 when the undergraduate student has the intention to create an enterprise in short time; and 0 otherwise. It is a proxy of potential entrepreneurs who evidenced the identification of opportunities and the initial intention to create a start-up during their studies (Allen and Meyer, 1990). Concerning the main explanatory variable,

(students' perceptions of) incubation mechanisms offered by the university, GUESSS adopted the scale of Souitaris et al. (2007). In this regards, we create this variable based on a factorial analysis[5] that included several items/services described in Appendix A (in particular, items BIS01 to BIS06). Regarding control variables, based on previous studies we included four sets of variables: (i) motivational factors toward entrepreneurship (i.e., attitudes toward behaviors, entrepreneurial self-efficacy) (Chen et al., 1998; Liñán and Chen, 2009), (ii) subjective norms as the influence of society via reference people (Liñán and Chen, 2009), (iii) students' perception about the existence of entrepreneurial education courses (Souitaris et al., 2007); and (iv) demographic characteristics (age, gender, entrepreneurial family background (Tognazzo et al., 2016), number of years that each student has been involved in the university). See Appendix A for the items underlying the first three sets of control variables.

Concerning data analysis, since the dependent variable is dichotomous, a binominal logistic regression method was used. The binominal logistic regression estimates the probability of an event happening; in this case, an individual intending to create an enterprise. The predicted proportion follows the logistic model of $Ln\ P_i/(1 - P_i) = \beta X_i$, where P_i is the probability of being a university student who has the intention of creating a new business (Hosmer and Lemeshow, 1989). The logarithmic odds of these events are held to be linearly affected by a vector of covariates X_i with coefficient vector β. Maximum likelihood estimations were used to calculate the logit coecients, which denote changes in *the log odds* of the dependent variable (Greene, 2003). We assessed the goodness of t of the models using the Pearson Chi-square test, the rate of correct classification, and the *pseudo R-square*. The signicance of each individual independent variable was tested using Wald statistics. Table 4 summarizes the descriptive analysis by the main variables that define the profile of students interviewed in this sample. Correlations can be found in Appendix A.

5. We corroborate the validity and correlations among the constructs shown in Appendix A (Shook et al., 2004). In particular, the study adopted three measures: (i) the confirmatory factor analysis, which helps ensure the measurement properties of the constructs and the test-reported values of 0.70 or higher; (ii) the Cronbach's alpha (α), used to calculate a measure of internal reliability based on the average covariance among items in a scale and the test-reported values of 0.70 or higher; and (iii) the item to total correlations, a test to check whether any item in the set of tests is inconsistent with the averaged behavior of the others, and thus can be discarded, and the test-reported values of 0.50 or higher. The obtained result in each factorial analysis was saved and introduced in our analysis.

Table 4. Students' entrepreneurial intentions, 2011.

	Description	**ITESM**
Sample	Annual period	2011
	Population	55,455 students
	Number of responses	531 students
Students' profile in the sample (averages)	Gender (% male)	56.0%
	Age (years)	23.63 years
	Years involved in the university (years)	3.69 years
	Parents (% self-employed)	81.50%
	Start-up intentions (binary)	75.9%
	Academic field	33.0% Management 20.0% Engineering 7.5% Economics 3.4% Medicine 36.1% Others

Source: ITESM's websites, GUESSS database.

4.1.2. Incubation Stage: Analyzing Entrepreneurial Actions

We use an ITESM's incubator database to explore the role of ITESM's incubation mechanisms on innovative entrepreneurship actions. This database provides a representative sample of entrepreneurial activity linked to ITESM's technology-base incubator network, which contains 50 observations across the main 25 university campuses in which those incubators operated during the annual periods 2009–2010 and 2010–2011. This database was built and provided by the Vicerrectoría Asociada de Emprendimiento, a centralized entity in charge of monitoring the university's entrepreneurial efforts occurring in all 25 campuses enrolled in this program. Based on previous studies (Aaboen, 2009; Scillitoe and Chakrabarti, 2010), Table 5 summarizes the main variables used to analyze the innovative entrepreneurship actions within the ITESM.

Table 5. University community's entrepreneurship actions

	Description	ITESM
Sample	Annual periods	2009–2010 and 2010–2011
	Population	25 university campuses
	Sample	50 observations
Dependent	Innovative entrepreneurship activity (LnEA)	Natural logarithm of the number of technology-based enterprises created
Independent (incubation mechanism)	Financial	
	Financial resources (LnFR)	Natural logarithm of funds obtained from government programs for incubation
	Physical	
	Incubation offices (LnIO)	Natural logarithm of number of available offices for incubation
	Staff offices (LnSO)	Natural logarithm of number of available offices for staff in the incubator.
	Meeting rooms (LnMR)	Natural logarithm of number of rooms for meetings and office services
	Human	
	Human resources (LnHU)	Natural logarithm of number of instructors and specialized consultants to support incubation.
	Business ownership experience (LnBOE)	Natural logarithm of average experience instructors
Control variables	Campus size (LnSize)	Natural logarithm of number of students and academics per campus
	Age	Age of each incubator
	GDP per region	Natural logarithm of GDP *per capita* of the region where the incubator is located.

Source: ITESM's database.

In this regards, the dependent variable *entrepreneurial activity (LnEA*) is measured by the natural logarithm of the number of technology-based enterprises created by each campus where the incubator infrastructure is located.[6] Concerning the independent variables associated with ITESM's incubation mechanisms, we use *financial resources,* defined by the natural logarithm of the amount of funds obtained from federal government programs for business incubators during the year *(LnFR)*; *physical resources,* measured by the natural logarithm of the number of available infrastructures for entrepreneurs per business incubator *(LnIO),* the number of offices for staff (*LnSO),* and the number of meeting rooms *(LnMR); human resources,* defined by the natural logarithm of the number of entrepreneurship instructors and specialized consultants *(LnHU);* and *business ownership experience (LnBOE*), measured by the natural logarithm of the average experience as business owners of instructors and consultants (in years). The control variables are campus size (log of number of students and

6. Although we do not have access to confidential information about the incubated enterprises (e.g., industry, age, investment, etc.), we may assume that the new ventures are technology based ventures since ITESM's incubators only support the creation and development of technology-based enterprises.

academics), the natural logarithm of the *per capita* GDP of the region where the incubation infrastructures are located (Economic Information Bank of *INEGI,* 2009) and the age of each incubator.

A pooled OLS regression model was used to test the proposed model, where standard errors were clustered by university campus. The Durbin-Watson test was used to detect the presence of autocorrelation in the residuals and the results indicated good values, i.e. in the statistical range from 0 to 4 (Greene, 2003). Correlations are included in Appendix B.

5. Evidence on the Effect of a Multi-campus Entrepreneurial University Ecosystem on Entrepreneurial Behaviours in Mexico

In this section, we explore the results obtained on the effect of a multi-campus entrepreneurial university ecosystem on the pre-incubation (students' start-up intention) and incubation (entrepreneurial activity) stages.

5.1. Students' Start-Up Intentions

Table 6 shows the logistic regression analysis of the influence of incubation mechanisms on the students' start-up intentions (first dependent variable). Our results show a positive and statistically significant relationship between business incubation services and start-up intentions. More concretely, the perception of business incubator services offered by ITESM increases more than 2.0 times the probability that an undergraduate student has the intention to create an innovative enterprise in a short time (coefficient 0.733; $p \leq 0.05$). The results suggest that the services offered (i.e., workshops/networking with experienced entrepreneurs, contact points for entrepreneurial issues, mentoring and coaching programs for entrepreneurs, business plan contests, contact platforms with potential investors, etc.) by ITESM's incubation mechanisms during the pre-incubation stage increase the probability that undergraduate students will explore opportunities to become potential entrepreneurs in a short-time (supporting H1). Possibly, ITESM's incubaton model allows students access to successful ways to test their creative/critical thinking and ideas to carry out business-planning activities as well as to increase their networks for recruitment or advice (Bøllingtoft, 2012; Souitaris et al., 2007). Analyzing the interaction between entrepreneurial university business incubation services and the main determinants of entrepreneurial intentions (attitudes and self-efficacy; see Model I), Model II shows that business incubation services provided by the university reinforce the effect of their students' attitudes towards entrepreneurship on start-up intentions (0.551; $p \leq 0.10$), but do not reinforce the effect of self-efficacy (-0.912; $p \leq 0.05$). Although mentors may positively influence entrepreneurial orientation of

students (Kirby et al., 2016), the negative interaction effect for self-efficacy perhaps means that among individuals with high self-efficacy, contact with business incubators raises awareness about the act of entrepreneurship. In other words, business incubator services may prevent *overconfident* students from starting their own businesses. Regarding the subjective norms, similar to previous studies, we did not find significant influence on students' start-up intentions (Liñán et al., 2011). Also, the results show that the probability that an ITESM' student becomes entrepreneur increases 1.9 times when the student is male. Another relevant result is that entrepreneurial education courses offered by ITESM (i.e., family enterprises, financing entrepreneurial ventures, technology entrepreneurship, innovation and idea generation) do not show a significant influence on their students' start-up intentions. This result is surprising as most studies on entrepreneurial education and start-up intentions find a positive influence (Souitaris et al., 2007; Athayde and Hart, 2012). A plausible explanation could be linked with the measure used in this study. This means that, in contrast with previous studies that measured it with a dichotomous or continuous variable, in this study the measure was built using a construct based on the students' perception about the existence of several courses associated with entrepreneurship. In other words, we are not capturing their real involvement or enrollment in entrepreneurial education.

Table 6. Logistic regression explaining students' start-up intentions.

Students' start-up intentions	**Model I**		**Model II**	
	Coefficient (SE)	Odds	Coefficient (SE)	Odds
Incubation Mechanisms				
Business incubator services offered	0.733 (0.335) **	2.082	0.949 (0.347) **	2.583
Attitudes toward entrepreneurship* Business incubator services			0.551 (0.229) †	1.735
Self-efficacy* Business incubator services			- 0.912 (0.387) **	0.402
Control variables				
Attitudes toward entrepreneurship	0.984 (0.154) ***	2.674	1.068 (0.160) ***	2.910
Self-efficacy	0.541 (0.181) **	1.718	0.451 (0.182) **	1.571
Social norms	- 0.031 (0.143)	0.969	- 0.023 (0.143)	0.977
Entrepreneurship education courses	- 0.207 (0.273)	0.813	- 0.262 (0.280)	0.770
Age	- 0.033 (0.205)	0.967	- 0.042 (0.207)	0.958
Age2	0.001 (0.003)	1.000	0.001 (0.003)	1.001
Gender (male)	0.651 (0.244) **	1.917	0.662 (0.246) **	1.939
Entrepreneur parents	0.649 (0.284) †	1.913	0.715 (0.288) †	2.045
Years at university	0.061 (0.073)	1.063	0.056 (0.073)	1.058
Constant	1.121(0.825)	3.067	1.197 (0.858)	3.310
N	531		531	
-2 Log Likelihood	452.095		446.924	
Cox & Snell R square	0.224		0.231	
Nagelkerke R square	0.335		0.346	
LR chi2	134.440		139.610	
Prob > chi2	0.000		0.000	

Note: *** $p \leq 0.01$, ** $p \leq 0.05$, † $p \leq 0.10$.

5.2. Entrepreneurial Activity

Table 7 shows the pooled OLS regression analysis of the influence of the availability of business incubator resources across ITESM campuses on the university community's entrepreneurship activity (second dependent variable). Model I exhibits the control variables used in this regression. During the incubation stage, Model II shows how the availability of ITESM's business incubator resources influences the creation of technology-based enteprises. Similar to DiGregorio and Shane (2003) and O'Shea et al. (2008), the results show a positive effect from the funds obtained through government programs oriented to the incubation/funding of the creation of innovative enterprises (0.353; $p \leq 0.05$). Specifically, a one percent increase in a campus's government funding is associated with a 0.353 percent increase in the number of new technology-based enterprises. In this emerging economy, an incubaton model is

a good promoter of entrepreneurial innovation activity because it reduces the most common barrier for any innovative entrepreneur: a lack of *financial resources* during the initial stages. Regarding *physical resources,* we also found a significant effect of some proxies used to measure the availability of physical offices and meeting rooms at an individual campus. Specifically, the number of available infrastructures for incubated enteprises (0.113; $p \leq 0.10$) and the number of meeting rooms and office services (0.156; $p \leq 0.001$) have a positive effect on the number of technology-based enterprises created at an ITESM's university campus. These results show the relevance of appropriate incubation infrastructure for the effectiveness and the success of entrepreneurial innovation activities (Autio et al., 2014; Bøllingtoft, 2012; O'Shea et al., 2005). Regarding human resources, we only obtained a positive impact of experienced instructors and consultants of incubator infrastructures on the number of technology-based enteprises created (0.149; $p \leq 0.10$). This also suggests that it is the quality (experience as business owner) rather than the quantity (number) of instructors working for incubators that matter for achieving actual entrepreneurial actions in the incubator (i.e. technology start-ups). In this respect, Scillitoe and Chakrabarti (2010) argue that experienced/talented human capital is the most critical/ inimitable resource during the identification and development of new enterprises based on the innovations/knowledge generated within the university. All in all, we found evidence for the majority of proxies proposed to test the influence of incubation infrastructure resources on entrepreneurial innovation activity created within the university; largely supporting H2.

Table 7. Pooled OLS regression explaining entrepreneurial activity.

LnEntrepreneurial Activity	**Model I**		**Model II**	
	Coefficient (SE)	Beta	Coefficient (SE)	Beta
Incubation Mechanisms				
Financial				
LnFR- Financial resources			0.353 (0.094) **	0.450
Physical				
LnIO - Incubation offices			0.113 (0.037) †	0.097
LnSO - Staff offices			-0.045 (0.141)	-0.038
LnMR – Meeting rooms			0.156 (0.044) ***	0.400
Human				
LnHU - Human resources			0.045 (0.114)	0.047
LnBOE – Business ownership experience			0.148 (0.087) †	0.161
Control variables				
Incubators' age	-0.374 (0.105)**	-0.281	-0.424 (0.156)**	-0.319
LnSize – Campus size	0.280 (0.101) **	0.445	0.118 (0.049) †	0.188
LnGDP per region	0.009(0.087)	0.016	0.052 (0.070)	0.089
Constant	0.973 (0.279)***		0.324 (0.306)	
N	50		50	
R	0.437		0.766	
R square	0.191		0.586	
Durbin-Watson	1.750		2.231	

Note: *** $p \leq 0.01$, ** $p \leq 0.05$, † $p \leq 0.10$. Standard errors are clustered by campus.

6. Conclusions and Implications

Adopting Feldman's (2014) ideas, as the agents who recognize opportunities, mobilize resources, and create value, innovative entrepreneurs are the key to the creation of organizations and the building of capacity that will sustain regional economic development. Innovative entrepreneurs benefit from location, but they are also agents of change who can transform local communities. Therefore, knowledge-intensive scenarios are a good example to help understand these issues. In this respect, the purpose of this study was to provide a better understanding of the role of entrepreneurial university ecosystems on entrepreneurial behaviour; in particular the role of incubation mechanisms across the entrepreneurial process. We explored the case of a multi-campus university located in an emerging economy (ITESM) where their incubation mechanisms form a unique set of valuable, rare, and imperfectly imitable resources and capabilities controlled by the entrepreneurial university to generate sustained competitive advantages through the creation of technology-based enterprises.

Specifically, ITESM's incubation mechanisms were explored during the first two entrepreneurial stages: the pre-incubation stage via the students' intentions and the incubation stage via the university community's actions.

Mexico is a country in transition from an efficiency-driven economy towards an innovation-driven economy. For this reason, during the last years, public policies started to be oriented towards supporting innovation and entrepreneurship. In this scenario, entrepreneurial universities take a relevant role transforming their environments by promoting entrepreneurship and innovation (Guerrero and Urbano, 2012). ITESM's incubation model is an interesting example that not only helps reinforce students' attitudes to become innovative entrepreneurs but also assigns strategic resources to support the creation of technology-based enterprises among the university community. In this regards, the results of this study offer valuable new insights regarding the positive role of incubation mechanisms for the identification and exploitation of entrepreneurial opportunities inside an entrepreneurial university.

Based on our analysis, this paper has two relevant conclusions per incubation stage. In the pre-incubation stage, the probability of students' start-up intentions increases when they perceive the existence of incubation services in their university campus. Also, in our sample, we did not find evidence for the effect of entrepreneurial education on start-up intentions. In the incubation stage, the main determinant of the number of technology-based entrepreneurs incubated in university business incubators is financial resources obtained from government programs. The second relevant determinant is the availability of infrastructures for incubated enterprises. The third relevant determinant is the quality (experience) rather than the quantity (number) of instructors that support the technology start-ups.

This paper contributes to several ongoing academic debates. First, the debate about the configuration of higher education entrepreneurial ecosystems (Wright et al., 2017; Guerrero et al., 2016) and their influence on individual entrepreneurial behaviours (Bird, 2015; Busenitz et al., 2014; Wiklund et al., 2011) in emerging countries (Calá et al., 2017). Second, our paper contributes to the business incubator literature by exploring the role of an entrepreneurial university's incubator mechanisms within the different stages of the entrepreneurial process (Peters et al., 2004). This study has several limitations that provide good opportunities for future researchers. The first limitation is the use of two different cross-sectional databases to analyze the role of incubators throughout the entrepreneurial process. Future research requires a longitudinal analysis that allows for a follow-up of those students who expressed their intention to become an innovative entrepreneur and an understanding of the backgound of the university members who have created technology-based enterprises. The second limitation is the number of observations obtained that do not allow for the analysis of each individual campus and the proxies used to test the models. Therefore, we need to improve the measures (e.g., measure of entrepreneurial education) and include other relevant variables associated with

the incubation (e.g., networking) and regional perspective to explore the main differences of incubation models in each type of economy (e.g., developed vs. developing). This allow us to adopt other theoretical perspectives such as the knowledge spillover theory, which could be used to understand the steps and barriers throughout the creation of technology-based enterprises. Third, regarding the first (pre-incubation) analysis, we cannot completely rule out the possibility of endogeneity in the sense that students with a prior start-up intention may be more aware of business incubation services offered at their campus.

From our results emerge some implications for different stakeholders. For university managers, this study exhibits a key problem within universities: the integration of different databases of a university communtiy. This integration would allow access to the history of each member of the university community during his or her stay within the university as well as all the activities/resources that were involved to fully understand the effectiveness of all of a university's mechanisms/strategies. Also, as perception of business incubator services was found to positively influence start-up intentions, it may be advised to optimise visibility of available services at all campuses. For incubator managers, this study offers some insights about the role of university incubation services that provides support to its university community throughout the entrepreneurial process. Incubator managers may have their own expertise in designing what the services offer and how to manage the available resources. Therefore, incubator managers should recognize their limited resources and the best way to use them effectively. Moreover, as our analysis at the incubation stage revealed that obtaining government funds is the most effective incubation mechanism, incubator managers may be advised to focus on specialising in writing applications for government funds.

Finally, for decision makers involved in emerging economies, ITESM's incubation model is a good example of best practices across the regions of a country and within the stages of the entrepreneurial process. Similar to the report developed by the European Commission (2002), it could be a benchmarking reference to develop similar strategies, taking into account that incubation mechanisms are key actors and drivers of regional innovation and entrepreneurial ecosystems (e.g., exploring the reinforcement of favourable entrepreneurial culture, partnerships, open innovation, and generating well-being). Also taking into account the suggestions of Peters et al. (2004), further business incubation research should be carried out to see whether learning practices are different for different types of incubators in order to reach their objectives.

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Appendix A. Reliability, convergence, and correlation analysis.

Factor/ Variable	Description	Original Measure	Factorial Analysis	Internal Reliability Analysis	
				Cronbach's α	Item to Total Correlation
Attitudes toward entrepreneurial behavior (Liñán and Chen, 2009)	ATT01. Being an entrepreneur implies more advantages than disadvantages to me.	Likert scale: 1 (strongly disagree) to 7 (strongly agree)	KMO 0.840 χ^2 1521.41 Sig. 0.000	0.912	0.842
	ATT02. A career as an entrepreneur is attractive for me.				0.917
	ATT03. If I had the opportunity and resources, I would become an entrepreneur.				0.876
	ATT04. Being an entrepreneur would entail great satisfaction for me.				0.924
Entrepreneurial self-efficacy (Chen et al., 1998)	SE01. Establish and achieve goals and objectives	Likert scale: 1 (strongly disagree) to 7 (strongly agree)	KMO 0.840 χ^2 2315.41 Sig. 0.000	0.865	0.629
	SE02. Generate new ideas				0.656
	SE03. Develop new products and services				0.673
	SE04. Performing financial analysis				0.661
	SE05. Reduce risk and uncertainty				0.748
	SE07. Make decisions under uncertainty and risk				0.678
	SE08. Manage time by setting goals				0.647
	SE09. Take responsibility for ideas and decisions				0.593
	SE10. Start my own firm				0.730
	SE11. Lead my own firm to success				0.702
Subjective norms (Liñán and Chen, 2009)	SN01. Care about the opinion of parents/family	Likert scale: 1 (strongly disagree) to 7 (strongly agree)	KMO 0.738 χ^2 1094.16 Sig. 0.000	0.907	0.905
	SN02. Care about the opinion of friends				0.917
	SN03. Care about the opinion of important people				0.937
Incubation mechanisms offered by the university (Souitaris et al., 2007)	BIS01. Workshops/networking with experienced entrepreneurs	1 (yes) and 0 (no)	KMO 0.826 χ^2 310.81 Sig. 0.000	0.806	0.762
	BIS02. Contact platforms with potential investors				0.787
	BIS03. Business plan contests				0.673
	BIS04. Mentoring and coaching programs for entrepreneurs				0.709
	BIS05. Contact point for entrepreneurial issues				0.783
	BIS06. Seed funding/financial support from the university				0.591
Entre_education offered at the university (Souitaris et al., 2007)	EE01. Family firms	1 (yes) and 0 (no)	KMO 0.717 χ^2 257.418 Sig. 0.000	0.762	0.576
	EE02. Financing entrepreneurial ventures				0.789
	EE03. Technology entrepreneurship				0.609
	EE04. Entrepreneurial marketing				0.780
	EE05. Innovation and idea generation				0.691

Correlation analysis	**Mean**	**S. D.**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
(1) Students' entrepreneurial innovation intentions	0.759	0.428	1									
(2) Incubation mechanisms	- 0.000	0.561	.047	1								
(3) Attitudes toward entrepreneurship	0.220	0.940	.459 ***	-.069	1							
(4) Self-efficacy	0.152	0.767	.350***	-.054	.506***	1						
(5) Social norms	0.185	0.884	.174***	-.068	.365***	.334***	1					
(6) Age	23.637	4.339	.051	.109 *	.036	.065	-.002	1				
(7) Gender	0.556	0.497	.152***	.014	.078 †	.140***	.030	.151***	1			
(8) Entrepreneur parents	0.815	0.388	.140***	-.032	.085 †	.092 *	.046	.002	-.004	1		
(9) Years at university	3.694	1.846	.013	.000	-.055	.000	-.033	.206***	-.009	.035	1	
(10) Entrepreneurship education courses	-0.293	0.478	-0.022	0.340***	-0.042	-0.110 †	-0.099 †	0.101 †	-0.068	-0.055	0.010	1

Note: Level of statistical significance: *** $p \leq 0.01$, ** $p \leq 0.05$, † $p \leq 0.10$.

Appendix B. Correlation analysis.

Correlations	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) LnEA – Entrepreneurial activity	1.662	0.312	1									
(2) LnFR - Financial resource	2.891	0.397	0.540***	1								
(3) LnIO- Incubation offices	0.908	0.266	0.186	0.404**	1							
(4) LnSO- Staff offices	0.375	0.293	0.467***	0.346**	0.190	1						
(5) LnMR– Meeting rooms	0.092	0.687	0.487***	0.205	0.093	0.277**	1					
(6) LnHR- Human resources	1.163	0.329	0.354**	0.303**	0.063	0.308**	0.182	1				
(7) LnBOE– Business ownership experience	0.722	0.412	0.121	-0.089	-0.356**	-0.163	0.046	-0.108	1			
(8) Incubators' age	29.06	12.16	0.113	0.294**	0.323**	0.201	0.176	0.168	0.028	1		
(9) LnSize per campus	3.068	0.494	0.347*	0.318*	0.412**	0.060	0.108	0.397**	0.005	0.370**	1	
(10) LnGDP per region	2.469	0.531	0.207	0.078	0.151	0.236**	0.107	0.270**	-0.196	-0.006	0.395**	1

Note: Level of statistical significance: *** $p \leq 0.01$, ** $p \leq 0.05$, † $p \leq 0.10$.