

The Dynamics of Innovation Networks: The Role of HEIs in Venture Creation

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Abstract

This research aims to understand the factors that contribute to venture creation within a specific pool of higher education institutions (HEIs) in Portugal – state-owned HEIs – through innovation networks. The paper reviews the literature on current approaches on firm creation through models of innovation networks and analyses data collected through a questionnaire completed by 255 nascent entrepreneurs who, in one form or another, had attended HEIs with the specific purpose of developing their entrepreneurial capacity. The data was submitted to factor analysis and logistic regression model and results show that cooperation and development of relationships with other agents in the innovation network emerge as the main form through which HEIs stimulate firm creation.

Keywords: Creation of Firms, Innovation Networks, Higher Education Institutions.

1. Introduction

Within the framework of intense globalization and increasing competition of all economic activity, new venture creation contributes to the introduction in the business sector of new technologies, new products/services and new forms of organization, and has been found to be one of the fundamental factors of economic growth, job creation, market efficiency, renewal of economic structure and spread of innovation, as well as one cause for improved global competitiveness (Birch, 1981, 1987; Phillips and Kirchoff 1989; Acs and Audretsch, 1990; Hamermesh, 1993; Reynolds et al., 1995; Wennekers and Thurik, 1999; Bednarzik, 2000; Keister, 2000). In parallel, innovation networks have been recognized as an important enabler and catalyser of firm creation since, besides allowing the reduction of uncertainty through cooperation among agents, they also facilitate the production and sharing of knowledge and of other scarce resources, of costs and risks, and, among other benefits, allow efficiency gains due to different forms of work allocation (Camagni, 1991; Yeung, 1994; Cassiman and

Veugelers, 2002; Felman et al., 2006; Braunerhjelm, 2008; Weber and Khademian, 2008). In advancing and energizing innovation networks, higher education institutions (HEI) play an important role since they act as hubs where the various contributions offered by the network are ignited and disseminated, not only locally and regionally but also nationally and globally through different means as, for instance, the production of this humble paper (Felman et al., 2006; Audretsch and Phillips, 2007; Braunerhjelm, 2008).

Currently, in the European Union, with escalating unemployment rates and lethargic economic growth, to stimulate a certain kind of entrepreneurship that may lead to venture creation is a measure favored by many governments as a possible contributor to the minimization of economic and social problems. This is also the case in the Portuguese context where these problems are particularly serious. Considering the recognized importance of innovation networks in firm creation and of the role HEI play in stimulating these innovation networks; considering also that this phenomenon has been little studied in Portugal, this research intends to analyse a specific set of factors that the literature has established as contributing to venture creation and answer the following broad question: Considering the role that Higher Education Institutions play within innovation networks in promoting venture creation, which variables are most likely to influence nascent entrepreneurs to start a company?

The paper is structured as follows: the first section reviews the literature on venture creation associated with innovation networks. Next, we present the research design and the method that led to the construction of the conceptual model guiding the research. The following section describes the model and hypotheses. In section five, the results are presented and discussed. Finally, the sixth section presents the final conclusions and offers suggestions for future research on the topic.

2. Literature Review

Innovation networks are systems composed by diverse subjects/entities whose interactions, dynamism, trust and relationships enable knowledge and innovation transfer. For the last two decades, the phenomenon of entrepreneurship has emerged in connection with network research (Hoang and Antoncic, 2003; Woollard et al., 2007) as its very significance – interpersonal and inter-organizational relationships – is seen as the means by which actors gain access to a variety of resources (including knowledge) helped by other actors (Hoang and Antoncic, 2003; Wu et al., 2008). HEIs are, by nature, an important source of knowledge. When competitiveness was based on routine tasks, HEIs played an important social, political and cultural role, but their role in economic terms was less evident and mainly consisted in the training of future venture collaborators (Audretsch and Phillips, 2007). As competitiveness befell dependent on knowledge, ideas and creativity, HEIs became crucial for economic development, the concept of entrepreneurial universities emerged (Clark, 1998, 2004; Van Vught, 1999; Etzkowitz and Leydersdorf, 2000; Bercovitz and Feldman, 2006; Audretsch and Phillips, 2007) and they gradually became central actors in a knowledge-based economy. The expectation is for universities to be active in promoting innovation and technological change (Bramwell and Wolfe, 2008).

In this context, entrepreneurial universities are themselves actors in an innovation network made up of diverse actors where government and public policies also have a relevant role. If, to be able to more effectively disseminate their knowledge to other actors, HEIs would better be inserted in innovation networks, how can they stimulate the proliferation of knowledge and venture creation within them? Venture creation relates to any newly and legally set up company that is at a launching or initial stage and is less than 12 months old from the date of the declaration of beginning of activity.

The process of developing an innovation network is related to the very characteristics of the entrepreneurs at the initial stage of creation. When, for example, an entrepreneur develops his business plan within an innovation network, it is expected this will be of higher quality since he will be able to incorporate the benefits of the network in the plan: the closer the contacts

between the various network actors, the higher the quality of information (Hoang and Antoncic, 2003).

The entrepreneurial process, according to Shane and Venkataraman (2000), consists of distinctive activities, such as identification of opportunities, mobilization of resources and creation of an organization. It follows that HEIs will be understood as actors par excellence to integrate an innovation network, since they possess teaching staff and various units of research that can help venture start-ups and young entrepreneurs to identify opportunities, mobilize resources and create an organization (Smith, 2003; Eiriz, 2005; Felman et al., 2006; Braunerhjelm, 2008; Huang and Chang, 2008; Weber and Khademian, 2008; Sanz-Velasco and Saemundsson, 2008). In fact, they make key contributions by generating new ideas and knowledge and embedding them not only in the basic disciplines that are their traditional core, but in new programs as well. With the increase of demand for knowledge and practical applications these new programs tend to be more applied in nature and adapted to the world of work. A crucial distinction between applied programs and basic disciplines is their orientation towards making a contribution to society beyond the walls of the HEI. To be sustainable over time, applied programs require a demand and interest outside the HEI. On the one hand, their development and evolution are typically formed by society's needs and interests; on the other, the evolution and development of basic disciplines tend to be molded and influenced by the disciplines themselves (evolution of knowledge) (Audretsch and Phillips, 2007; Woollard et al., 2007).

However, not even the addition of applied research and professional education generates sufficient spillovers from the source of knowledge – the HEI – to commercialize the increased generation of innovations in regional and national economies: to invest in traditional subjects and applied programs is not enough. In an effort to penetrate the knowledge filter and ease the spillover of generated knowledge and ideas from the HEI into the society, a third area has been developed representing the necessary means for transferring knowledge and technology created in the HEI, namely: technology units, incubators and research centers. These units have mechanisms that aim to facilitate the spillover of internal knowledge to the outside (Woollard et al., 2007; Ullah et al., 2007; Veciana, 2006, 2008).

As referred above, knowledge spillovers are the way of transferring knowledge directly or indirectly from one party to another (Malecki, 1985; Deeds et al., 1997; Gilbert et al., 2008). They are generated by institutions that have innovative activities and are valid because these activities provide knowledge that is new and relevant to the receiving institutions (Malecki, 1985; Deeds et al., 1997; Gilbert et al., 2008). Therefore, HEIs will transfer the knowledge they create through an innovation network, but will also receive knowledge and innovation generated by the various actors making up that network.

3. Research Design

To answer the broad question articulated in section 1, we started by reviewing the literature on current approaches on firm creation through models of innovation networks to support the basic idea of the importance of such networks in the process of firm creation since they allow weaknesses to be overcome and positive aspects to be strengthened, and consequently influence the process of firm creation. Our main intention with this paper is to study a specific set of factors within HEI and their contribution to firm creation within innovation networks, and therefore we will not join the debate on whether or not innovation networks do support this process by consequently exposing their possible flaws: we assume that they do play a positive role and that this positive role by far exceeds any negative facet.

The literature review enabled to design a questionnaire sent to 834 participants in entrepreneurship events promoted by state-owned HEIs in Portugal. The questionnaire results were submitted to factor analysis and the ensuing factors enabled the construction of a conceptual model (Figure 1), which was then subjected to logistic regression. Next we present and discuss these results.

3.1 Sample and Data Collection

The data used were gathered from a questionnaire administered to nascent entrepreneurs linked to HEIs in the state-owned sector in Portugal. The questionnaire contemplated potential entrepreneurs, i.e. people who were interested in starting a new business, who hoped to be the owners of a new business or of part of it, and/or who had been active in trying to start up a new business in the last 12 months (Wagner, 2004).

In this study, the population is made of all potential entrepreneurs from universities and polytechnics in the state-owned sector, that is, of individuals who participated, of their own free will, in events aiming at venture creation and/or at the development of entrepreneurial initiatives, namely: (i) entrepreneurship competitions (Empreenda'09, PoliEmpreende 6th Edition and START 2009) and (ii) technologically-based entrepreneurship courses (CEBT and CEBCT).

The questionnaire was sent to 834 participants and successfully completed by 255, which represents a return rate of 31% and produces a sample error of 5,2% according to the calculation method suggested by Hair *et al.* (1998).

3.2. Factor Analysis

The majorities of respondents are male, belong to the sub-system of polytechnic education and are part of the age group between 20 and 30. In the case of the university education, the age-group of the the majority of the respondents is between 20 and 35. According to Wagner (2004), the age of nascent entrepreneurs is related to expectations of return on investment, together with their academic qualifications, aversion to risk and the characteristics of the region where they live.

It can be summarized that the respondents, whatever the sub-system of higher education they belong to, have in most cases a first undergraduate degree, mostly Economics/Business or Engineering (around 91% of respondents). Most of them do not have either previous experience of venture creation or of the sector of activity and have not held management functions. Another finding within the general aspects of the research is that respondents stated to be willing to pay for specific entrepreneurship training but, in their opinion, this should be included free of charge in their academic studies.

The data obtained from the questionnaire were subjected to factor analysis in order for us to reduce observed variables and get a potentially lower number of unobserved variables called factors. Considering our aim to identify the practices developed by HEI to stimulate venture creation we used factor analysis with principal component analysis and varimax rotation with the Kaiser– Meyer – Olkin KMO (0,80) method Bartlett Test of sphericity =631,879 and significance < 0,001 providing support for convergent validity. From the data analysis three factors emerged (Table 1):

Table 1: The practices developed by HEIs to stimulate venture creation

Variable	Factor 1 Cooperation and development	Factor 2 Scientific research	Factor 3 Training
Partnerships with HEIs	0,781		
Post-graduate courses	0,743		
Masters	0,663		
Organizations	0,628		
Partnerships with businesses	0,601		

Variable	Factor 1 Cooperation and development	Factor 2 Scientific research	Factor 3 Training
Conferences and seminars		0,775	
Dissemination through articles		0,737	
Publication of pedagogical material		0,714	
Entrepreneurship courses			0,833
Entrepreneurship competitions			0,735
Subjects included in degree courses			0,572

The principal component analysis produced the following three factors: “cooperation and development”; “scientific research”; and “training”. We find that cooperation and development, which cover various forms of cooperation with other organizations and consultancy, are believed to be the best practices developed by HEIs, as they reach a wide public and are an excellent way for HEIs to encourage entrepreneurial activities.

Concerning the objective of identifying what facilitates venture creation, the data obtained from the factor analysis allowed the identification of two factors (Table 2). Principal component analysis and varimax rotation with the Kaiser– Meyer – Olkin KMO (0,54) method were used, Bartlett Test of Sphericity = 93,994 and significance < 0,001, providing support for convergent validity. The variables were grouped as follows:

Table 2: Reasons for choosing the importance of factors that facilitate venture creation

Variable	Factor 1 Network actors	Factor 2 Organizational resources
Training provided by professionals in the business sector	0,772	
Participation/proximity of the school to organizations related to entrepreneurship	0,656	
Services provided to the community		0,718
Information, orientation and accompaniment provided by bodies existing in the school (OTIC, GAPI; among others)		0,667
Training given by teaching staff		0,586

Based on these results and on the literature review, we propose a conceptual model and a set of hypotheses as described in the chapter that follows.

4. Model and Hypotheses

The proposed model is presented in Figure 1. It considers that the dependent variable – the propensity for new venture creation – is explained by a set of explanatory (independent) variables under the above mentioned two groups of factors: (i) “practices developed by HEIs” include: cooperation and development, scientific research, training supply; and (ii) “factors that facilitate venture creation” include: network actors and organizational resources.

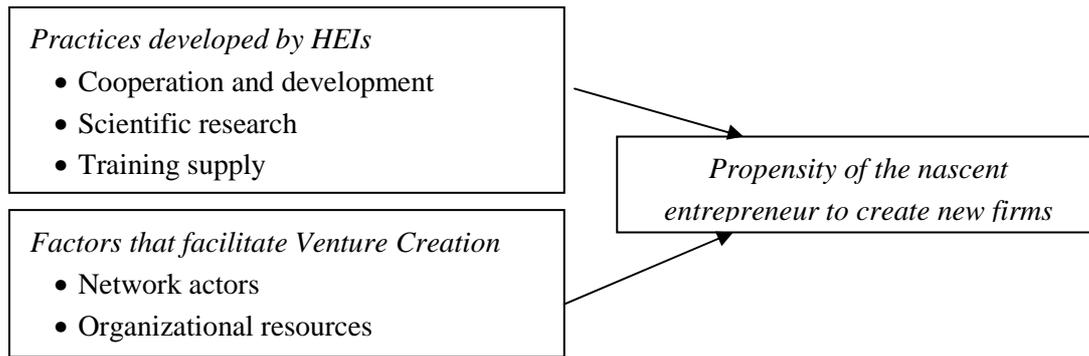


Figure 1: Proposed Model

From the literature review and the conceptual model proposed, a set of hypotheses has been formed and will be tested empirically.

Concerning the practices developed by HEIs that influence venture creation, the present research considers three factors:

- (1) The cooperation and practices developed by HEI in terms of partnerships with agents and business and courses that involve the participation of these partners;
- (2) Scientific research comprising conferences, seminars, publications and other forms of dissemination; and
- (3) Training supply provided by HEIs. Therefore, the following hypotheses are presented:

Hypothesis 1: The capacity the HEI has to cooperate and build relationships with other agents is positively related with the propensity of the nascent entrepreneur to create new firms.

Hypothesis 2: The capacity the HEI has to develop scientific research is positively related with the propensity of the nascent entrepreneur to create new firms.

Hypothesis 3: The training supply provided by HEIs is positively related with the propensity of the nascent entrepreneur to create new firms.

It should be noted however that, in a knowledge and information society, the people best prepared to create and grow ventures based on new technology, and therefore with high added value, able to compete internationally and create well-paid employment, are those who are technically better prepared and motivated (Cristóbal, 2006; Braunerhjelm, 2008). Both factors will contribute to increased entrepreneurial capacity and this, in turn, will influence future economic development (Cox and Taylor, 2006; Bramwell and Wolfe, 2008). Our aim is then to identify and analyze the organizational resources of the HEIs and networks used by HEIs to encourage venture creation. The following hypotheses are intended to investigate whether the second groups of factors in the model influence the propensity of a nascent entrepreneur to create firms are presented:

Hypothesis 4: HEI networks with other agents influence positively the propensity of the nascent entrepreneur to create new firms.

Hypothesis 5: The organizational resources of the HEIs influence positively the propensity of the nascent entrepreneur to create new firms.

5. Logistic Regression Model

From the theoretical literature review and the proposed conceptual model it is clear that new venture creation is a complex phenomenon influenced by a wide range of factors. Being essential to our research to explore the relationships between these factors and the propensity for new venture creation, specifically the statistical relationship between one dependent variable and more than one explanatory variables, we decided to use the Logistic Regression Model (Logit Model). This model has been one of the most frequently used in empirical studies (Hair et al. 1998) thus constituting an appropriate analytical technique in terms of the proposed conceptual model since this includes one categorical dependent variable (binary or dichotomic), several independent variables, also categorical, and control variables, as follows:

$$NVC = \beta_0 + \beta_1 F_1 + \beta_2 F_2 + \beta_3 F_3 + \beta_4 F_4 + \beta_5 F_5 + \beta_6 F_6 + \beta_7 F_7 + \beta_8 F_8 + \beta_9 LE_1 + \beta_{10} LE_2 + \beta_{11} LE_3 + \beta_{12} LE_4 + \beta_{13} LE_5 + \beta_{14} AE_8 + \beta_{15} AE_1 + \beta_{16} AE_2 + \epsilon_i$$

Where: NVC = New venture creation; ϵ_i = error term β = Coefficients F_1 = cooperation and develop; F_2 = Scientific Research; F_3 = Training supply; F_4 = Network actors; F_5 = Organizational resources; F_6 = Prior entrepreneurial experience; F_7 = Prior experience in sector; F_8 = type of HEIs; LE_i = Level of education; AE_i = Area of education.

1) Dependent and Independent Variables: In this study the propensity to create new ventures is measured from the information gathered about potential entrepreneurs' intentions to create a new venture or to develop a new project within an existing venture. Thus the propensity of the potential entrepreneur to create a new venture is considered as the dependent variable (CNV). This dimension is a dichotomic variable based on binary data. It takes the value 0 for potential entrepreneurs who do not have the intention to create a new venture and the value 1 for those who have the intention to do so.

Concerning independent variables, these are represented by the factors that stimulate venture creation (F_i). This research only took into account whether the factor functioned as a driver for new venture creation. The independent variables were subjected to factor analysis and are represented by the best practices that stimulate venture creation (Table 1) and by the factors within HEIs that facilitate venture creation (Table 2).

2) Control Variables: We included the following controls for the potential entrepreneur: (i) prior experience; (ii) the type of HEI attended; and (iii) the subject level and area of education. "Prior experience" represents both experiences as an entrepreneur and sector experience. Previous professional experience can provide useful skills that will be extremely important in the process of creating a business (Simões, 2009; Simões et al., 2010, 2011, 2012, 2013) and the survival and success of new organizations largely depend on their founders' previous experience (Carroll et al., 1996; Klepper, 2002; Helfat and Lieberman, 2002; Dahl and Reichstein, 2007; Fiet and Patel, 2008; and Lévesque et al. 2009). The control variables prior entrepreneurial experience and prior experience in the sector are also dichotomic variables based on binary data: they take the value 1 if the respondent has prior experience and value 0 if he does not.

Shane (2000) claims that the knowledge and skills entrepreneurs possess are not only the result of their previous professional experiences but of education too. Therefore the type of HEI attended is also considered a critical control variable and we distinguish it according to whether the subject attended a university or a polytechnic institute. The variable type of HEIs is again dichotomic based on binary data: it takes the value 1 for university and value 0 for polytechnic institute. Other critical control variables are directly linked to the level and area of education of the nascent entrepreneur. In order to measure levels of education, five variables were created: (1) primary; (2) secondary; (3) undergraduate; (4) master and (5) doctoral level. As to area of education three variables were created: (1) economics and management; (2) engineering and (3) other areas of education.

The estimates of the final model are presented in Table 3. According to the Wald statistics we detect that all the estimates of the regression parameters are statistically significant up to 5%, except for the relationships established with competitors.

Table 3: Logit Regression Model Results for New Venture Creation

Model	Initial Model		Final Model				EXP (B)
	Parameter Estimator	Sig.	Parameter Estimator	S.E.	Wald	Sig.	
Practices developed by higher education institutions:							
Cooperation and development	0,439	0,039**	0,531	0,228	5,432	0,020**	1,701
Scientific research	0,314	0,116*	0,397	0,217	3,362	0,067*	0,672
Training	0,046	0,801	0,032	0,196	0,027	0,870	1,033
Factors that facilitate venture creation:							
Network actors	0,368	0,054*	0,375	0,197	3,636	0,057*	0,687
Organizational resources	0,019	0,933	0,008	0,239	0,001	0,972	1,008
Prior entrepreneurial experience in creation of firm	1,397	0,000** *	1,575	0,438	12,939	0,000** *	4,833
Prior experience in sector	1,623	0,000** *	1,683	0,422	15,920	0,000** *	5,381
Type of higher education institution	1,140	0,004**	1,515	0,458	10,925	0,001** *	4,549
Levels of education:							
Primary/Doctoral			-2,442	1,274	3,673	0,055*	0,087
Secondary/Doctoral			-3,540	1,681	4,434	0,035**	0,029
Graduation/Doctoral			-1,776	0,967	3,372	0,066*	0,029
Master/Doctoral			-0,982	0,992	0,980	0,322	0,169
Area of Education Universities and OHEI							
Economics and management/Other			0,027	0,805	0,001	0,974	1,027
Engineering/Other			0,154	0,772	0,040	0,842	1,167
Constant	0,602	0,392	-0,377	1,052	0,128	0,720	0,686
<i>Model summary</i>							
Correct Predict (%)	80,7%		82,7%				
Chi-square	66,920	0,000** *	77,281			0,000** *	
Log likelihood	208,232		191,797				
Number of cases (n)	218		214				

Significance level: *** p-value<0, 001; ** p-value<0, 05; * p-value<0, 07

The logistic regression results for the model (table 3) show that not all regression parameter estimates are statistically significant at a level of 5%. Regarding adjustment quality of the model, the results show that the predictive capability of the model is 82,7%, which is a consequence from the comparison between the values of the variable “response values” predicted by the model and those observed. The Chi-square statistic test has a value of 77,281 with proof value less than the significance level of 0,001. The log-likelihood statistics, with a value of 191,797, corroborates the global significance of the model.

Hypothesis 1 relates the propensity of the nascent entrepreneur to create new firms with the capacity of the HEI to cooperate and build relationships with other agents and to develop courses that involve the participation of these partners. This hypothesis is presented as being significant at a level below 0, 05 and with a positive effect. In this way, the nascent entrepreneurs linked to HEIs that have cooperation and develop these practices are more prone to create a new venture than others. This finding is corroborated by results obtained by Sanz-Velasco and Saemundsson (2008), Wu et al. (2008), Lévesque et al. (2009) and Lim et al. (2010).

Hypothesis 2 associates the capacity of the HEI to develop scientific research with the propensity of the nascent entrepreneurs to create new firms. Results show that this capacity does have a positive and significant effect in the propensity of the nascent entrepreneurs to create new firms (0,672) thus strengthening the conclusions of studies carried out by Ullah et al. (2007), Franken et al. (2008), Wu et al. (2008) and Sanz-Velasco and Saemundsson (2008).

Hypothesis 3 is aimed at studying empirically if the training provided by HEIs relates positively with the propensity of nascent entrepreneurs to create new firms. However, results show that the training supply provided by HEIs does not have statistical significance in the model, so there is no conclusion to be drawn from the effect of this factor.

Hypothesis 4 associates the capacity of the HEI to develop contacts between the various network actors with the propensity of the nascent entrepreneurs to create new firms. Results show that this capacity has a positive and significant effect in the propensity of nascent entrepreneurs to create new ventures (0,687), which support the conclusions of studies carried out by Hoang and Antoncic (2003), Huang and Chang (2008) and Wu et al. (2008).

Concerning **Hypothesis 5**, the results do not have statistical significance in the model. Therefore nothing can be concluded as to the influence of organizational resources of the HEI on the propensity of nascent entrepreneurs to create new firms.

By adding the control variables we intended to test the robustness and consistency of the explanatory variables of the final model compared to the initial model. With this inclusion and analyzing the explanatory variables of the final model compared to those of the initial model, we found they have the same behavior, concerning both the exact estimate of parameters and the level of significance. It is therefore possible to confirm the consistency of the variables and the robustness of the model.

6. Conclusions

This study is a guide to allow higher education institutions to identify and analyze the possible relationships between the nature of HEI actions and new venture creation within innovation networks. As the literature demonstrates, venture creation is influenced by a vast and complex number of factors, which only partially are dealt with in this study as per the model in Figure 1. However, a set of internal and external factors of HEIs stood out as being able to influence venture creation within innovation networks. By analyzing the contribution of each one of these factors to the phenomenon of venture creation triggered by HEIs, it was found that the variables associated with HEIs and innovation networks are connected to the relationships HEIs form with existing organizations, with the knowledge they have available, with the training they provide, and with the forms and activities that stimulate venture creation and which they use.

As to identifying the practices developed by HEIs to stimulate new venture creation, according to the literature, cooperation and development are considered the best ways for HEIs to encourage entrepreneurial activities. However the respondents in our study also favor scientific research, a situation that will probably have to do with the demands of the market to guarantee the creation and development of new businesses by nascent entrepreneurs.

Regarding the objective of identifying what facilitates venture creation the nascent entrepreneurs surveyed selected as the most important the factor "network actors". As the very name indicates, this factor covers whatever incentivizes and dynamizes the diverse elements integrating the innovation network, promoting knowledge sharing and support to nascent entrepreneurs at the various stages of venture creation.

Concerning prior experience, we can conclude that a prior entrepreneurial experience influences positively the propensity of the nascent entrepreneur to create new firms. From the answers given by the respondents, we can verify that the nascent entrepreneurs with previous

entrepreneurial experience have an advantage in developing activities related to creating new firms compared to other entrepreneurs. We can also verify that a prior sector experience influences positively the propensity of the nascent entrepreneur to create new firms because they have an advantage in developing projects and in creating firms, compared to others. Therefore we can conclude that previous experience in the sector has a significant and positive effect on nascent entrepreneurs' propensity to create firms.

This study is not, of course, without limitations. The main limitation is certainly that the subjects are only drawn from participants in selected competitions and training courses. Considering how important it is for Portugal to get broader and deeper understanding of the factors that HEI can improve in order to increase venture creation, future research could broaden this scope and could also study the various ventures formed identifying which institutions stimulated their creation and possible reasons for success and failure.

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