

Do they matter? The role of non-academics in the internationalisation of academic spin-offs

Abstract

Internationalisation and academic entrepreneurship have been receiving a lot of attention not only in academic research but also in policy practice. While academic spin-offs suffer from limited resources and lack of entrepreneurial skills, they often penetrate international market through their innovative products and technology since the very early years of their establishment. In the literature, little attention has been paid to explicitly examine the internationalisation process of academic spin-offs as well as the role of non-academics. In order to investigate the impact of non-academics on the performance of spin-offs, we carried out an empirical analysis of 126 Spanish spin-offs which were divided into two market categories, international and domestic market. With regards to the percentage of non-academics in founding team, we found that their impact was more relevant to performance goals than to innovativeness. On the other hand, the size of non-academic network contributed significantly not only to the performance goals but also to innovation. However, we did not find a significant relationship between strength of non-academic networks and performance goals and innovativeness of international spin-offs. Overall, we concluded that the role of non-academics was crucial for supporting internationalisation of spin-offs.

Keywords: academic spin-offs, internationalisation, network, founding team, innovation, performance.

1. Introduction

Internationalisation and academic entrepreneurship are arguably of growing interest not only in academic research but also in policy practice (Oviatt and McDougall 2005; Mathews and Zander 2007). As the economic impact of technology developed at universities becomes a main concern of current innovation policies (Bercivitz and Feldman 2006; Gilsing et al. 2010), fostering technology entrepreneurship has been increasingly popular in many governmental policies (Wright et al. 2004; Tamasy 2007). This results in a significant growth of academic spin-offs in the past decades (Wright et al. 2004; Clarysse et al. 2007). Studies on academic spin-offs have also increased over the years, most of the issues they address mainly focus on the characteristics of academic entrepreneurs and of the role of university with which they have been working (Steffensen et al. 2000), and on the complexity of external influences, including the availability of venture capital, the economic climate, market, technology and industrial relationships (Chiesa and Piccaluga 2000; Walter et al. 2006; Fini et al. 2011).

As academic spin-offs suffer from limited resources and experience, their overly reliance on support from university may inhibit their capability to grow (Soetanto and Geenhuizen, 2015). They often target small but specialised international niche through their innovative products and advanced technology (Franklin et al. 2001; Bell et al. 2003; Kiederich and Kraus 2009). Despite their limitation, they often seek to internationalise their activities at an unusually early stage of their establishment (Bjørnåli and Aspelund 2012). Recent studies on the internationalisation of small firms have found evidence of determinant factors such as founding team (Bjørnåli and Aspelund 2012) and networks (Pettersen and Tobiassen). However, there is still a gap in the literature related to the impact of individuals with non-academic backgrounds on supporting spin-offs with international market orientation. Considering the increasing attention devoted to support the growth of academic spin-offs, we believe that a more systematic assessment of the process of internationalisation of academic spin-offs is required (Teixera and Coimbra 2014).

Based on academic entrepreneurship literature and international entrepreneurship literature, this study aims to investigate the impact of the percentage non-academics in founding team and support non-academic networks on the performance of academic spin-offs including spin-offs targeting international market. Our argument is based on the fact that academic spin-offs need complementary knowledge, skills and resources from non-academics in starting a new venture especially in targeting international market (Bonaccorsi 1992; Oviatt and MacDougall 2005). We defined non-academics as individuals with professional and business background who are involved in the development of academic spin-offs. To achieve the objective of this study, an empirical analysis was carried out on a sample of 126 Spanish spin-offs, which were classified into two market categories, international and domestic markets.

This study provides a better understanding on the entrepreneurial process, which would provide an important contribution to the academic entrepreneurship literature, and the internationalisation literature. Firstly, although some recent studies focused in the study of international spin-off, this line of research is still incipient (Bjørnåli and Aspelund 2012; Pettersen and Tobiassen 2014; Texeira and Coimbra 2014). Supporting this argument, some studies state that little is known about the antecedents and consequences of internationalization of academic spin-offs (Cumming et al. 2009; Bjørnåli and Aspelund 2012; Texeira and Coimbra 2014). While the current literature on internationalisation and

academic spin-offs seems to be separated, the increasing number of born global spin-offs shows that internationalisation and academic spin-offs should be looked in the same context. In this study, we are responding to the call of research about the internationalisation process of academic spin-offs (Cumming et al. 2009; Pettersen and Tobiassen 2014). Our study represents one of the first attempts to analyse empirically the role of founding team and networks during the internationalisation process. More importantly, this study reveals some interesting insights on the role of non-academics founders and two structural elements of the network (size and strength of ties) on the performance goals and innovativeness of international spin-offs.

Secondly, although previous studies examined some antecedents and consequences of internationalization of technology firms, an analysis focused on the internationalisation of academic spin-offs is still relevant. This is because recent studies stated that academic spin-offs have inherit characteristics that differ from other technology firms (Zahra et al. 2007; Ensley and Hmieleski 2005; Colombo and Piva 2012; Rasmussen and Wriqth 2015). Rasmussen and Wright (2015) argue that academic spin-offs face cultural differences between the academic context and the market context. This means that international spin-offs face a more limited access to the competencies compared to other technology firms. Finally, as we used a control sample of the academic spin-offs targeting domestic markets and variables related to the percentage of academic founders and the size and strength of academic networks, the result of this study provides a comprehensive finding, which is rarely found in other similar studies in the international entrepreneurship literature and academic entrepreneurship literature.

2. Academic spin-offs and internationalisation

Recent studies in academic entrepreneurship literature consider that academic spin-offs, that are the product of research commercialisation of knowledge developed within university, have potential competitive advantages in international market due to their technological capability and the nature of their innovativeness (Pettersen and Tobiassen 2012; Texeira and Coimbra 2014). Aiming international market since the very early years, academic spin-offs may be categorised as born-global firms, that start their international activities from their early stages of development (Oviatt and McDougall 1994; 2005; Gabrielsson et al. 2008). In the literature, born global firms are defined as "...business organizations that, from or near their founding, seek superior international business performance from the application of knowledge-based resources to the sale of outputs in multiple countries" (Knight and Cavusgil 2004:124).

In this sense, prior research has stressed that academic spin-offs have advanced technologies which are attractive in global niche markets and are therefore natural born global candidates (Kiederich and Kraus 2009). Supporting these arguments, some authors have stated that the intensity of knowledge possessed by firms has positive impact on the growth of international market (Autio et al. 2000; Etemad 2004; Aspelund et al. 2007; Osarenkhoe 2009). Li et al. (2012) found that high R&D intensity foster internal innovative capabilities which drive the firms' early internationalization. However, literature has also highlighted the lack of resources and time as factors that might characterize most business that operate internationally from their birth (Knight and Cavusgil 2004; Sapienza et al. 2006; Kumar 2012).

2.1 The role of non-academics in coping with obstacles of internationalisation

In the case of academic spin-offs, there is an increasing amount of evidence that despite being small or in an early stage of their development and possessing limited resources, they have the opportunity to penetrate international market (Oviatt and McDougal 2005). These young and resource-constrained start-ups are relatively small in size and lack international-based resources but are heavily involved in international activities from the very early years of their establishment (Oviatt and McDougall 1994; Moen 2002; Andersson and Wictor 2003).

Despite the fact that academic spin-offs have an opportunity to exploit first mover advantages even in international market, the failure rate among academic spin-offs is still relatively high (Sapienza et al. 2006). Due to a high uncertainty in overseas market acceptance and some institutional barriers such as foreign bureaucracy and regulations, spin-offs targeting international market face riskier and more problematic obstacles than spin-offs targeting domestic market. A first obstacle is related to the deficiencies of the founding team in managerial competences. According to Pettersen and Tobiassen (2012), academic founders lack the global vision and international managerial capabilities to enter the global market from their birth. In this sense, academic founders need learn how to handle a variety of issues when conducting business in foreign markets. Specifically, Kumar (2012) considers that entrepreneurial knowledge and international vision are necessary to rapidly to seek out international opportunities (Kumar 2012). Supporting these arguments, Cumming et al (2009: 11) point out “the heterogeneity of international markets requires heterogeneity of approaches to opportunity recognition” (Cummings et al. 2009: 11).

The second obstacle is related to the commercialization process, which is more difficult for academic spin-offs targeting international markets. This is because commercialization process in international markets requires knowledge of international markets, buyers, sellers, products, prices, demand and distributors, and also know how to do business in that foreign market (Kumar 2012; Teixeira and Coimbra 2014). On the other hand, although academic spin-offs have technological capabilities, academic entrepreneurs might lack the necessary knowledge and technology for scientific discoveries to convert their basic technology into products and services, which can be commercially accepted in international markets. In this sense, international spin-offs might need complementary technological resources by means of the assessment of the technical feasibility of the research results, advice on identifying potential applications and functionality, and participation in the design of new products in order to commercialize their technology internationally.

The third obstacle is the difficulty in obtaining financing from investors for two three reasons (Shane and Stuart 2002; Lockett et al. 2002; Vohora et al. 2004). Firstly, their founders often lack the competences required to design an attractive international business plan for investors (Munari and Toschi 2011; Wright et al. 2006). Secondly, academic spin-offs usually lack credibility in international markets which makes potential investors see them as not very attractive businesses, given their lack of trustworthiness, expertise and reliability. Finally, when academic spin-offs are created, the development of the prototype product is usually in an incipient phase. Therefore, as investors face difficulties to evaluate the commercial potential of the technology, they often are dissuaded from backing the academic spin-offs financially. These obstacles make international spin-offs vulnerable as they face a high risk of failure in the early stage of new venture establishment (Sapienza et al. 2006; Knight and Cavusgil 2004; Evers 2010; Kumar 2012).

In the case of internationalisation, academic spin-offs experience another critical obstacle which includes limited network and lack of international experience (Bjørnåli and Aspelund 2012). The fact that spin-offs have emerged from a non-commercial environment where they have been rarely engage in profit seeking activities, building a network by communicating in commercial narrative is considered to be a challenge for many spin-offs. Aspelund et al. (2007) suggest that international entrepreneurs seek to overcome these limitations through relationships with different actors and strategic alliances (Johanson and Vahlne 2003; Evers and O’Gorman 2011). Unlike other technology-based start-ups, academic spin-offs rely heavily on the support provided by university. While the relation between the university and the spin-offs may be of a formal or an informal nature, the presence of university as their source of technology, innovation and support is important especially in the early stage of commercialisation (Johansson et al. 2005).

However, in exploring and exploiting opportunity, academic spin-offs should also receive help from non-academic contacts. Some studies found that non-academic actors tend to be better at this task than academics. The study from Franklin, Wright and Lockett (2001) reported that the involvement of ‘experienced’ entrepreneurs raises the probability that the academic spin-offs will succeed commercially. Those individuals who possess complementary skills, experience and network access are able to provide access to resources, knowledge and information regarding international market (Vanaelst et al. 2006; Filatotchev et al. 2006). It is expected that these non-academics present an important ability to recognize opportunities in these markets (Colombo and Grilli 2005), as well as high levels of entrepreneurial self-efficacy (Markman et al. 2005; Bandura 1992) as a result of the knowledge and abilities acquired through experiences and networks in international markets (Wilson et al. 2007). Individuals with business experiences may help spin-offs in defining the patterns and pace of internationalization, and deciding to take risks in entering new markets (Politis et al. 2012; Chetty and Campbell-Hunt 2004; Hutchinson et al. 2006; Texeira and Coimbra 2014).

With very little understanding on the process of internationalisation of academic spin-offs, this study aims to examine the impact of non-academics and the performance of international spin-offs. In the following section, propositions on the role of non-academics in founding team and support network will be discussed.

2.2 Non-academics in founding team

There are many cases in academic spin-offs in which founding teams have developed from friendship or work-related ties. Academics or researchers often collaborate with colleagues or students in founding spin-offs which results in a high degree of homogeneity in founding team (Ensley and Hmieleski 2005). This tendency of forming a homogenous team could be explained by the common academic origins of academic founders, as they are more likely to select team members from their academic circle and knowledge areas (Williamson and Cable 2003; Ensley and Hmieleski 2005). Studies on academic spin-offs have revealed that the composition of management team is a key factor in determining firms’ strategic orientation and performance (Clarysse and Moray 2004; Ensley and Hmieleski 2005; Diáñez-González and Camelo-Ordaz 2015). Founders of academic spin-offs usually have few contacts with non-academic managers and entrepreneurs when they establish the spin-offs (Cooper and Daily 1996), as they may not belong to appropriate business and financial networks (Visintin and Pittino 2014). For many spin-offs, their management experiences are usually limited and their managerial skills for leading a venture (which are different from those needed to lead a

research group) are mostly underdeveloped (De Cleyn and Braet 2009). Consequently, academic founders may not possess the skills or knowledge required to recognize and exploit market opportunities (Franklin et al. 2001).

Despite the tendency to compose homogeneous team, we argue that spin-offs should focus on building a balanced management teams in terms of scientific and business orientation (Visintin and Pittino 2014). The individuals with professional background, as well as members with different academic backgrounds could be particularly critical for academic spin-offs in pursuing international markets. This increased heterogeneity could affect the entrepreneurial orientation of academic spin-offs and international market search. In this respect, as the number of non-academic in the founder team increases, the range of the strategic options and the novelty of their options will also increase (Kellermans et al. 2008; Bjørnåli and Aspelund 2012).

Moreover, in the context of international academic spin-offs, the shortage of founders with business experience may hinder their growth potential. The obstacle that is linked to the deficiencies of the founding team in business competences is more pronounced as Pettersen and Tobiassen (2012:121) point out ‘founders coming from university milieus lack the global vision and international management skills to enter the global market from inception’. Conducting activity in an international market requires the development of more complex business competences than doing business in a domestic market. This is due to the fact that international academic spin-offs have to learn how to handle a variety of issues when conducting business in foreign markets.

In the case of international spin-offs, founders’ innovative, proactive risk-taking behaviour (Ardichvili et al. 2003) is often influenced by prior international encounters such as birth abroad, overseas study or works, access to global networks or foreign language skills (Coviello and Munro 1997; Ojala 2009). Thus, a high percentage of non-academics with international experience in founding teams will help to shape the ideas and opportunities that are eventually pursued. More importantly, non-academics will endorse the internationalisation process, as they possess a shared language, culture and narratives with business. A shared language suggests a common perspective and trustworthiness (Tsai and Ghoshal 1998). In this sense, as the percentage of non-academic in founding team increases, international spin-offs will experience accelerate learning and have access to more diverse resources. Overall, we argue that the percentage of non-academics in the founding teams is likely to become a major contributor of success (Cavusgil 1984; Loane et al. 2007; Fernandez-Ortiz and Lombardo 2009) and play an important role for international spin-offs. Based on the discussion, we propose the following proposition.

Proposition 1: The percentage of non-academics in founding team has a positive impact on the performance of international spin-offs.

2.3 Non-academics in support network

Another role of non-academics in supporting spin-offs is through networks. Studies describe and explain networks in various ways but they agree upon the fact that networks encompass a set of relationships, both horizontal and vertical including those with non-academics. The network literature suggests that, as entrepreneurs are embedded in a social network, they gain access to needed resources through interactions with other people facilitating the attainment of the actors’ goals (Lechner et al. 2006). McAdam and Marlow (2008) state that networks

contribute to the achievement of the objective of company growth because they provide resources that support the commercial activities, gain credibility in the market through the formation of alliances with established and reputable partners, and promote the exchange of valuable knowledge. This is especially important in the context of academic spin-offs where the relationships with a variety of agents, such as customers, suppliers or intermediary agents, are essential due to the lack of internal resources. These contacts that do not affiliate with nor have they any university background are likely to be an important source of resources that are not available for spin-offs (Adler and Kwon 2002).

Although academic networks might be relevant in early stages of development, some authors propose that relationships with non-academic actors are more critical for the development of academic spin-offs, principally because they offer resources that are difficult to obtain within the university context (Bjørnåli and Gulbrandsen 2010; Mosey and Wright 2007; Rasmussen and Borch 2010; Soetanto and Van Geenhuizen 2010; Vohora et al. 2004). In this sense, those entrepreneurs who develop strong links with non-academic networks have access to knowledge related to the identification of markets, the recognition of the opportunity, product/service improvements and user information regarding how their innovations may be used (Vohora et al. 2004; Walter et al. 2006; Rasmussen 2011). By interacting with non-academics, spin-offs receive benefits such as acquiring new insights and knowledge that allow them to meet the needs of market and customers. Moreover, non-academics encourage deeper discussions about products and services and can result in the emergence of new innovation, stimulation of creativity and ground-breaking advancement (Beckman and Haunschild 2002; Perry-Smith and Shalley 2003).

In the context of internationalisation, there is a relatively huge collection of studies that show that networks are an important part in the process because they enable firms to link activities and tie resources together (Andersson and Wictor 2003; Coviello and Munro 1997; Evers and O’Gorman 2011). International entrepreneurship has stressed the importance of establishing a wide range of contacts with networks and strategic alliances for companies (Bjørnåli and Aspelund 2012; Aspelund et al., 2007; Johanson and Bahlne 2003; Coviello and Munro 1997; Etemad 2004; Boojihawon 2004; Evers, 2010). Start-ups and small firms need to invite individuals with complementary skills, experience and network access (Vanaelst et al. 2006; Filatotchev et al. 2006). The network approach to internationalization is widely adopted in international entrepreneurship literature (Pettersen and Tobiassen 2012). Coviello (2006) found that networks would open doors for entrepreneurial firms by providing international market access, financing and distribution channels. Moen et al. (2004) identified the role of industry networks in the market entry forms and market selection of small software firms. While scholars such as Coviello and Munro (1997), Ritter and Gemünden (2003), and Andersson and Wictor (2003) investigated the role of individual entrepreneurs in developing network relationships, Harris and Wheeler (2005) highlighted that the origin of networks which are often outside entrepreneurs’ context have a positive impact on strategy and market. In specific reference to academic spin-offs, Pettersen and Tobiassen (2012) found that networks and resources acquired in pre-founding periods had great implications for growth and internationalization. As most of the studies have argued that networks with non-academics contribute to the success of internationalisation (Coviello and Munro 1995; Madsen and Servais 1997), we also predict that the non-academics contacts is more prevalent for international spin-offs than domestic spin-offs. Thus, we propose the following proposition.

Proposition 2: Non-academic networks have a positive impact on the performance of international spin-offs.

3. Research Method

This study aims to investigate the impact of non-academics on spin-offs' performance. The data of this study was collected from Spanish academic spin-offs founded in Spain during 2003–2011. To identify the academic spin-offs included in the population, we sent a formal request for collaboration addressed to managers of Technology Transfer Offices (TTOs) of all Spanish universities, which provided us with information about 555 academic spin-offs. Moreover, in order to complete the information provided by the TTOs about the academic spin-offs, we used some secondary sources such as annual reports developed by the chairs of entrepreneurship, university incubators, science parks, and the SABI database (Sistema de Análisis de Balances Ibéricos). From this information, we developed a database consisting of the following information on 555 academic spin-offs: address, phone number, email address, website, company name, founder name, year of constitution, and activity sector.

To collect accurate information, we designed two questionnaires based on a review of the previous literature that included different questions and sent them to the different people in order to avoid problems of common method biases. The questionnaires were pretested by conducting pilot interviews with twelve founders or managers of seven academic spin-offs. Their suggestions were incorporated in the final version of the two questionnaires. One of the questionnaires was sent to the main academic founder. The other questionnaire was sent to another member of the founding team who was directly involved with the management of the academic spin-offs and who was also an academic, if possible. We received valid responses from 167 academic spin-offs, a valid response rate of 30%. From the total sample, we selected those spin-offs that focus in a niche market (126 spin-offs) aiming for an unbiased comparison between international and domestic spin-offs as they both were considered to possess strong competitive advantages in their respective markets. In this study, we defined a niche market as a small and specific group of customers which offers a potential new opportunities and market. Spin-offs targeting a niche market do not have many competitors due to the innovativeness of their products or services. As a result, the sample consists of 61 spin-offs targeting international market and 65 spin-offs targeting domestic market.

In our sample, regarding the international spin-offs, the average age was 4.3 years and they employed an average of 7.9 people. Moreover, 67% of international spin-offs of those surveyed stated that they were still in the creation and initial development phase, while the remaining 33% defined themselves as consolidated companies. In addition, about 16 to 22 months elapsed since the emergence of the idea of commercializing the technology or knowledge until the official creation of the academic spin-offs and until the launching of the first product or service, respectively. Furthermore, the international spin-offs had an average 4 products or services under development. With respect to previous experience of the members of the team, 37.7% of international spin-offs stated that they had members in their team with previous experience in the foundation of a firm, about 67% of these spin-offs had work experience in other firms, more than 47% had previous management experience in other firms, about 38% had previous work experience in other firms, belonging to the same industry and more than 47% had members of boards or scientific advisor boards in other firms. Finally, about 33% of international spin-offs had women in their teams and 18 international spin-offs had both academic and non-academic members (Table 1).

With respect to the domestic spin-offs, the average age was 4.1 and they employed an average of 6 employees. In addition, 75.4% of the domestic spin-offs were in the creation and initial development phase and 18.5% of these spin-offs were in the consolidation stage. Moreover, about 18 to 21 months elapsed since the emergence of the idea of commercializing the technology or knowledge until the official creation of the domestic spin-offs, and until the launching of the first product or service, respectively. Furthermore, international spin-offs had an average of 2.6 products or services under development. Regarding previous experience of the team of the domestic spin-offs, 40% stated that they had members in their team with previous experience in the foundation of a firm, about 74% of these spin-offs had work experience in other firms, more than 32% had previous management experience in other firms, more than 52% had previous work experience in other firms, belonging to the same industry and about 28% had members of boards or scientific advisor boards in other firms. Finally, more than 35% of domestic spin-offs had women in their teams and 23 domestic spin-offs had both academic and non-academic members (Table 1).

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To check the possibility of nonresponse bias, we compared the characteristics of the responding academic spin-offs to those of the nonresponding academic spin-offs. This analysis indicated that the respondents did not differ significantly from the non-respondents with respect to age and size (number of employees). Therefore, we concluded there was no nonresponse bias in our data by age and size of academic spin-offs.

Our propositions aim to test the role of non-academics in the context of international spin-offs. However, we considered using a control sample of the academic spin-offs targeting domestic markets in our analysis. The reason for this inclusion was to build a comprehensive finding in assessing the role of non-academics in different types of spin-offs. Moreover, we also used a control variable in the form of the percentage of academics in both founding team and the size and strength of support networks. We defined the academics as individuals who still keep their position at university while being involving with or supporting academic spin-offs. In our sample, we found that those individuals include: academic staffs, researchers, PhD students, and technology transfer/knowledge exchange officers. By assessing the role of academics in either international or domestic spin-offs, our study offers a deeper insight into factors that contribute to the growth of academic spin-offs. The model is presented in figure 1.

INSERT FIGURE 1 ABOUT HERE

3.1 Variables used in the study

Although the main aim of this study was examining the impact of non-academics in founding teams and networks, the variables representing academics in the founding teams and networks were included. For that reason, the independent variables in this study covered both academics and non-academics. In the following section, the variables used in the study will be described.

Internationalisation. We asked a member of a founding team directly involved in the management of the spin-offs to indicate the local, national or international focus of their spin-off. All respondents select only one of the three options. From this information, we divided the sample into two parts, domestic spin-offs operating at national or local level and

international spin-offs that operate internationally (Clarysse et al. 2007; Vithessonthi and Tongurai 2015).

Performance. To measure the performance of the spin-offs, we developed two variables, *level of innovativeness* and *performance goals*. In measuring *innovativeness*, we based our approach on Kishida (2005). We asked the academic founders to indicate a situation of their academic spin-offs in comparison with their main competitors regarding the following aspects: the development of a new range of products/services (INN1); extension of the range of the existing products and services (INN2); improvement of the existing products/services (INN3); and innovation in products or services (INN4) (Table 2). The responses were obtained using a five-point Likert scale (*1 = much worse than competitors; 5 = much better than competitors*). To measure *performance goals*, we based on Walter et al. (2006). We measured the achievement of performance goals of the spin-offs in subjective terms by asking a member of the founding teams directly involved in the management of the spin-offs about the extent to which the following four types of objectives had been achieved: profit attainment (PG1), perceived customer relationships quality (PG2), realized competitive advantages (PG3), and securing long-term survival (PG4). The responses were obtained using a five-point Likert scale (*1 = not achieved at all; 5 = achieved to a large extent*) (Table 2).

Academic and non-academic founders. Based on Visintin and Pittino (2010; 2014), we asked a member of a founding team directly involved in the management of the spin-offs to indicate the size of the founder team and the specific number of non-academic members in the team. From this information, we calculated the percentage of the non-academic members in the team of the spin-offs (Table 2). We specifically questioned the member of founding team to indicate the backgrounds of the non-academic founders, finding that all of them either came directly from business contexts or had been imposed by outside investors. On the other hand, we asked a member of founding team that indicate the specific number of academic members in the team, such as academics, researchers, PhD students, TTOs and other support institutions' staff. From information about the total size of the founder team and the specific number of academic members in the team, we calculated the percentage of the academic members in the team of the spin-offs (Table 2).

Academic and non-academic network. For academic and non-academic networks, we developed two network indicators, network size and the strength of ties. Academic networks involve relationships with agents from academic context such as TTOs, university incubators and research colleagues. *Non-academic networks* are defined as a set of agents from non-academic context, such as customers and suppliers, business advisors, governmental and regional development agencies, intellectual property agencies, competitors, professional and business associations, and technological parks.

Based on previous studies, network size is measured as the number of links between a focal actor and other actors (Smith et al. 2005; Thorgren et al. 2005; Lechner et al. 2006). To measure the size of the network of the ASO, we requested the academic founder to specify the number of each of the actors included in the networks with whom their firm maintains relationships. From this information, we calculated the total number of relationships that ASOs maintain with these non-academic actors and academic actors (Table 2). On the other hand, the strength of academic and non-academic ties was measured by asking the principal academic founders to indicate on a five-point Likert scale the frequency of contacts with each of the academic and non-academic actors (1: less than one contact per month; 5: multiple

daily contacts) (Mitchell 1982; Smith et al. 2005). From this information, we calculated the mean value for each type of network (Table 2).

Control variables. We used the following two variables: age and industry type. The age of the ASO was measured by taking the number of years from the founding of the academic spin-offs up to the year 2012 (Table 2). Regarding industry type, we used a binary variable. Based on previous studies, this variable takes the value 1 when the industry type is biotechnology, chemical or R&D, and, 0 in otherwise (Vohora et al. 2004; Vendrell-Herrero and Ortín-Ángel 2010) (Table 2). This variable is consistent with the classification created for the Spanish Center for Industrial and Technological Development (CITD).

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4. Findings

To test our propositions we have employed Partial Least Squares (PLS), a variance-based structural equation modelling (Reinartz et al. 2009). As PLS is primarily useful when prior theoretical knowledge is still scarce, it is an appropriate technique to use in a theory development situation such as in this study (Reinartz et al. 2009; Chin 2010; Castro and Roldan 2013). PLS simultaneously allows an assessment of the validity and reliability of the measures of theoretical constructs (measurement model) and an estimation of the relationships between these constructs (structural model) (Barroso et al. 2010).

Regarding the measurement model, in order to study innovativeness and performance goals as reflective constructs, we analysed individual item reliability, construct reliability, convergent validity, and discriminant validity (Hair et al. 2012). Firstly, regarding individual item reliability, although some reflective indicators had loadings below 0.707, we did not eliminate them because the AVE was greater than 0.5 in these cases. Thus, we could state that all of the indicators were reliable (bold figures in table 3). Secondly, construct reliability evaluation allows the assessment of the extent to which a variable is consistent in what it measures (Straub et al. 2004). Both innovativeness and performance goals had a greater value than the value of 0.7 required in the early stages of a research, and the stricter value of 0.8 for a basic research (Nunnally 1978).

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To analyse the convergent validity we studied the average variance extracted (AVE) that quantifies the variance that a construct has from its indicators relative to the amount due to measurement error (Chin 1998). AVE values should be greater than 0.50. But in our study, AVE measures for innovativeness and performance goals exceeded this condition. Finally, for discriminant validity, we compared the square root of the AVE with the correlations among innovativeness and performance goals. On average, both innovativeness and performance goals was related more strongly to its own measures than to the others as shown in tables 4, 5 and 6. On the other hand, we assessed that no item loaded more highly on another construct than it did on the construct it measured (Hair et al. 2011). In addition, both innovativeness and performance goals should load higher with its assigned indicators than other items. In our study, we did the cross-loading analysis by calculating the correlations between the construct scores, innovativeness and performance goals (Gefen et al. 2011).

INSERT TABLE 4, 5 AND 6 ABOUT HERE

In table 7, we provided the descriptive statistic of all the variables used in the analysis.

INSERT TABLE 7 ABOUT HERE

With respect to structural models, following Hair et al. (2011), bootstrapping (5000 resamples) was used to obtain standard errors and t-statistics. This enabled us to assess the statistical significance of the path coefficients. Table 8 shows the results of the structural models. Regarding international spin-offs, on the one hand, the analysis of the outcomes show that the size of non-academic networks ($\beta=0.33$ $p<0.05$) positively influenced the innovativeness. On the other hand, the results showed that the non-academic founders ($\beta=0.46$; $p<0.01$) and the size of non-academic networks ($\beta=0.33$, $p<0.05$) and positively affected the performance goals. With respect to domestic spin-offs, the path coefficients of the strength of non-academic ties ($\beta=0.27$; $p<0.05$) and the strength of academic ties ($\beta=0.30$; $p<0.05$) had a positive and significant influence on innovativeness. On the other hand, the non-academic founders ($\beta=0.26$; $p<0.05$), strength of non-academic ties ($\beta=0.24$; $p<0.05$) and the strength of academic ties ($\beta=0.31$; $p<0.05$), positively affected the performance goals. In addition, the results also showed that the size of academic networks had a negative and significant influence on the performance goals ($\beta= -0.28$; $p<0.05$). Finally, we found a negative and significant relationships between the age and innovativeness ($\beta= -0.23$; $p<0.05$) and performance goals ($\beta= -0.24$; $p<0.05$) of domestic spin-offs. However, the type of industry was not significant.

INSERT TABLE 8 ABOUT HERE

Once we had tested the structural models, we studied the moderating effects of market category (international or domestic market). We analysed the moderating effects by means of applying a multi-group comparison approach because the moderator variable is categorical (Henseler and Fassot 2010). As we have indicated previously, the responses were divided into two groups, depending on market category. Then, we estimated the path coefficients for each sample and we analysed the differences between the paths (Sarstedt et al. 2011). Table 9 shows the results of the multi-group analysis. On the one hand, the market category (international or domestic) moderated the relationship between the size of non-academics network and innovativeness (t-test=-1.5522), and the relationship between the strength of academic ties and innovativeness (t-test=2.0902). On the other hand, the market category (international or domestic market) moderated the relationship between the relationship between the strength of non-academic ties and the performance goals (t-test=1.3692) and the strength of academic ties and the performance goals (t-test=1.3292).

INSERT TABLE 9 ABOUT HERE

In sum, firstly, non-academic founders positively affected to performance goals of international spin-offs. In addition, we did not found any significant relationship between non-academic founders and innovativeness of international spin-offs. Based on these results, the proposition 1 is partially supported (Table 10). Secondly, we found that the size of non-academic networks had a significant and positive relationship with innovativeness and performance goals of international spin-offs. The results of multigrup analysis did not evidence a significant difference between the path coefficients of the size of non-academic networks for each simple. Nevertheless, the individual groups results in the table 6 confirmed a positive and significant relationships between the size of non-academic networks and

performance goals of international spin-offs. On the other hand, contrary to expectations, we did not find that the strength of non-academic networks influenced on innovativeness and performance goals of international spin-offs. Therefore, the proposition 2 is partially supported (Table 10).

INSERT TABLE 10 ABOUT HERE

The results of the model are presented in Figure 2

INSERT FIGURE 2 ABOUT HERE

Overall, the finding show that the percentage of non-academic in the founder team positively influenced on performance goals of international spin-offs. In addition, the size of non-academic networks positively impacted on performance goals and innovativeness of international spin-offs. However, we did not find a significant relationship between strength of non-academic networks and, performance goals and innovativeness of international spin-offs.

5. Discussion

5.1 The role of non-academics in founding team and the internationalisation of academic spin-offs

Regarding proposition 1, we expected that the percentage of non-academics in founding team has a positive impact on the performance goals and innovativeness of international spin-offs. However, the result shows that the percentage of non-academics positively affected only the performance of international spin-offs in achieving their goal. This means that the finding revealed that there was no relationship between the percentage of non-academics in the founding teams and innovativeness. This result indicates that the role of non-academics in founding team seems to be excluded from the development of innovation as they were more involved in adding commercial values or dealing with the marketing and managerial sides of business. This may be due to that in small entrepreneurial firms, academics or scientists are the ones that develop the products. Therefore, there may well be a threshold level of academics required in order to insure product development. Likewise, the analysis using a control sample of academic spin-offs targeting domestic market confirmed a similar finding.

Overall, the finding is interesting as it became obvious for the academic spin-offs in our sample that having heterogeneous team members did not create conflicts as predicted by previous studies (Hambrick et al. 2001; Li and Hambrick 2005; Lau and Murnighan 1998). While the emergence of conflicts can lead to interpersonal incompatibilities and mistrust among members (Pelled et al. 1999) and to an impoverishment of performance (Harrison and Klein 2007; Visintin and Pittino 2014), our finding here shows that the percentage of non-academics in founding team actually contributed that the spin-offs achieved their performance goals. An interpretation of this result is that as the percentage of non-academics in founding team increases, international spin-offs will access more new insights, alternative approaches, new opportunities and probably different contacts that might be important for them. In this sense, non-academic founders may possess skills or knowledge required to recognize and exploit market opportunities (Franklin et al. 2001).

The recognition of new opportunities allows international spin-offs to adopt technology to new commercial uses in order to respond quickly to changing demands (Zaheer and Bell

2005; Sullivan and Marvel 2011). Therefore, as the percentage of non-academic in founding team increases, international spin-offs will have a better chance to consolidate their position and hold onto their initial market or enter new markets, and consequently to increase a long-term survival. On the other hand, the percentage of non-academics in founding team might positively influence the access to funding. Academic spin-offs often face difficulties to access private financial resources (Shane and Stuart 2002; Lockett et al. 2002; Vohora et al. 2004). As we have previously stated, academic founders often lack the competences to design an attractive business plan for investors and they usually lack credibility in international markets. Therefore, given their lack of trustworthiness and expertise, potential investors often are dissuaded to finance these companies. In this situation, academic spin-offs need to change their board, including non-academics with industry and managerial experience in order to increase the likelihood of getting private financial resources.

Therefore, as the percentage of non-academics in founding team increases, academic spin-offs might increase their likelihood of accessing funding. The acquisition of funding from venture capital firms allows academic spin-offs to obtain credibility in the market, which facilitates both the achievement of performance goals and access to new rounds of financing in later phases of development (Lockett et al. 2002; Munari and Toschi 2011; Vohora et al. 2004). In this respect, credibility acts as a signal of quality for suppliers, customers, and other investors, and increases the likelihood of obtaining additional rounds of funding as well as collaboration with market partners (Hsu 2007; Lechner et al. 2006). This access to a second round of funding in later stages of development allows academic spin-offs to expand the commercialization of their products in international markets, which should result in improved performance goals of these startups.

5.2 The role of non-academics in networks and the internationalisation of academic spin-offs

With respect to proposition 2, we expected that non-academic networks positively influence on the performance goals and innovativeness of international spin-offs. This study employed two indicators, namely the size of network and the strength of ties to examine the effect of non-academic networks on the internationalisation of academic spin-offs. Based on the size of network, the results showed that the size of non-academic networks had a positive impact on the performance of the international spin-offs in either achieving performance goals or innovativeness. Compared to the other type of spin-offs, spin-offs targeting international market face more obstacles and need more variety of resources in order to compete and maintain in the markets (Pettersen and Tobiassen 2012). In order to get access to a growing quantity of resources and faster access to resources, international spin-offs should have access to large non-academic networks. In this sense, the network literature proposes that the large networks allow the access to a high quantity of new resources and knowledge (McFadyen and Chanella 2004). This finding supported previous study that has emphasised the role of network as a means for building identity and pursuing international opportunities (Baroncheli and Cassia 2011; Söderqvist and Kamala 2013). These networks allow spin-offs to gain to local market knowledge and increase the initial credibility of firms that enter in the markets. Apparently, the involvement of non-academics in the spin-offs' networks offered support in achieving the spin-offs' goal or improving innovation in terms of customizing the need of foreign market. This stresses the facilitating role of non-academics actors as infrastructural networks which acting as vehicles for information, communication and influence from foreign market (Kuivalainen et al. 2010).

Regarding the strength of non-academic networks, we did not find that the strong ties with non-academics were relevant for the achievement of performance goals and innovativeness of international spin-offs. This might be because the strong ties increase the number of shared experiences among actors involved in the network and, therefore, might result in an overlap between their knowledge bases (Lane and Lubatkin 1998; Phelps et al. 2012). In this respect, although this overlap might facilitate mutual understanding among parties, the knowledge possessed by the actors in the network becomes similar. Therefore, strong ties might not have a significant influence on performance goals and innovativeness of international spin-offs.

Moreover, the analysis on the control sample of the spin-offs targeting domestic market found that the relationships between the size of non-academic networks and the achievement of performance goals or innovativeness were not significant. This might be due to that, in general academic spin-offs need critical resources for their successful development (Vohora et al. 2004; Mosey and Wright 2007); this need is even more accentuated in the case of international academic spin-offs. However, strong relationships will give a positive impact on the performance of achieving goals and innovation of domestic spin-offs. The strength of ties is a different network characteristic compared to size. The more contacts developed by spin-offs, the less resources have to be devoted to maintain the ties. Interestingly the finding shows that the domestic spin-offs had fewer non-academics contacts but the strong ties developed with them had positively influenced the performance goals and innovativeness. For domestic spin-offs, these ties may offer a channel for funding, ideas for improvement, or a new technology related to increasing innovativeness and achievement their performance goals.

5.3 The role of academics and the internationalisation of academic spin-offs

Our study also provides an insight into the role of academics. As illustrated in figure 2, the impact of non-academics (in the networks and as founders) was more visible than the impact of academics on the performance of spin-offs in general, whether or not they are internationalized. Apparently, the non-academics help the spin-offs in the process of commercialisation of their knowledge. However, the influence of academic networks for the international spin-offs had not been confirmed. The results might be indicating that in the Spanish context, academic networks might not have the capacity to help the spin-offs which try to access to international markets because these networks might not have the knowledge or other resources necessary to do so. However, we found an interesting finding that having strong ties with academics enhanced the performance goal and innovativeness of the domestic spin-offs. Despite the commercial limitations of academic networks, they might provide certain resources with respect to national or local markets. Therefore, increasing the frequency of interaction with these contacts might be useful for domestic spin-offs in order to access to these resources. On the contrary, a higher number of academics in network show a negative impact on the achievement of performance goals. The situation where spin-offs have lock-in in their relationships with academics may hamper the growth as most of the contacts have less business experience and commercial perspective.

The above finding resonances previously studies (e.g. Gübeli and Doloreux 2005; Vohora et al. 2004) which argue that by staying in the original academic environment, academic spin-offs will have difficulties in developing and growing their ventures. It is because the relationships with academic actors do not facilitate the creation of a distinctive corporate identity of their own in the eyes of customers, suppliers and investors. For this reason, for the successful development of academic spin-offs they should distance themselves from the

academic environment and act with more self-sufficiency to access resources from market actors (Gübeli and Doloreux 2005; Pérez and Martínez 2003; Vohora et al. 2004).

6. Conclusion

The paper sought to explore the role of non-academics in the internationalisation process of academic spin-offs. Our research addressed the following research question: what is the impact of having non-academics in founding team and in support networks on the performance of international spin-offs? Using a sample of 126 spin-offs from Spanish universities, we constructed two propositions. The overall finding shows that the non-academics played a key and crucial role in the development of the academic spin-offs. Specifically, the percentage of non-academics in the founder team and the size of non-academic networks positively had relevant influence. Overall, our results indicate that although spin-offs emerge from university setting and grew with university culture, conditions that may hinder the commercial ability, the percentage of non-academics founders and large non-academic networks compensates the lack of these resources and reduces the effect of excessive attachment to university.

We suggest that our findings have important implications for theory and practice. Cumming et al. (2009) note 'little of this research has investigated the antecedents and consequences of internationalization of academic spin-offs even though internationalization remains the preferred growth strategy for many of them' (Bjørnåli and Aspelund 2012: 351). This study aims to respond to that call. The implication for theory is related to the understanding of the internationalisation process of academic spin-offs. While the current literature on internationalisation and academic spin-offs seems to be separated, the increasing number of born global spin-offs shows that internationalisation and academic spin-offs should be looked in the same context. More specifically, this study examined the role of founding team and networks during the internationalisation process. More importantly, this study reveals some interesting insights on the role of non-academics in supporting the internationalisation process.

As far as policy practice is concerned, this study suggests an improvement on the way support should be delivered to academic spin-offs. Apparently, for academic spin-offs aiming at international markets, the non-academics cannot be underestimated. If academic spin-offs receive support from incubators, then they should be provided with different types of networking activities that will enable them to broaden their networks. Inviting non-academics in different role during spin-offs' development will help them overcome resources deficiency. Moreover, support should be designed to help spin-offs strengthen their networking capability during the internationalisation process. In the case of domestic spin-offs, the role academics seems to be important but the balance by introducing non-academics may enhance spin-offs' ability to grow.

Like most other empirical studies, this study has some limitations. Firstly, this study should consider the variety in the stage of internationalisation. In this case, the role of non-academics can be different as spin-offs progress from one stage to another. The next limitation is the way of collecting network data. As networks are dynamics and change over time, the collected data may suffer from memory bias. Scholars have found that the effect of networks can be temporal and influenced by external environment. Further analysis is necessary to accommodate how the impact of non-academics in founding teams and networks can be observed longitudinally. Another limitation is related to the measurement of performance of

the academic spin-offs in this study. Following Visintin and Pittino (2014), growth can be considered as an appropriate dimension of performance in new ventures. Therefore, future research could test our propositions using objective aspects of performance. Finally, this study use single indicators for the constructs and certainly this problem may weaken the results of the model.

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