EXCHANGE OF KNOWLEDGE IN PROTECTED ENVIRONMENTS. THE CASE OF UNIVERSITY BUSINESS INCUBATORS

ABSTRACT

Purpose. University Business Incubators (UBIs) are born as tools of the academic world to market research results, for the transfer of technology and to promote entrepreneurial spirit. In these contexts, the exchange of knowledge among entrepreneurs can be a key variable for the development and success of their businesses. In this paper, we analyse the characteristics of entrepreneurs' resources and the institutional logic that prevails in the incubator as determinants of the exchange of knowledge, and we examine the results in terms of entrepreneurial commitment and the generation of innovations.

Design/methodology/approach. The empirical study carried out on a sample of 101 entrepreneurs in UBIs in Spain and the Netherlands.

Findings. Results reveals how complementarity, supplementarity and transferability of resources as well as incubator predisposition towards business are fundamental for the exchange of knowledge, the development of entrepreneurial spirit and the generation of innovation.

Originality/value. This research makes a contribution towards an understanding of how relationships between university entrepreneurs provide access to and help create useful knowledge for the parties, with this resource constituting one possible source of sustainable competitive advantage.

Keywords. Incubators; exchange of knowledge; incubator's business logic; entrepreneurial commitment; generation of innovation.

Article classification. Research paper.

1. INTRODUCTION

University Business Incubators (UBIs) are, by definition, environments in which innovation predominates. Their link with knowledge is clear: UBIs are created by universities who wish to disseminate scientific and technological progress (Radosevich, 1995; Jones-Evans and Klofsten, 1998) and, through this, to encourage the creation of new companies (Heydebreck et al., 2000; Grimaldi and Grandi, 2001). One key characteristic of the knowledge used by university spin-offs is that, in most cases, it is in an embryonic phase - proof of concept or initial prototype - of the development of a technology, regardless of whether it is intended for implementation in industry at an early or at a mature stage (Clarysse et al., 2011). Moreover, one key reason to create companies in the academic field is to incubate the technology for its development and commercialization (Jensen and Thursby, 2001; Feldman et al., 2002; Katila and Shane, 2005; Lowe and Ziedonis, 2006).

In addition, incubators are enabling environments for relationships between entrepreneurs. The closeness, the use of common spaces and the participation in the different activities organized in the incubator itself, lead to contacts. The higher the frequency of these contacts, the greater the likelihood that founders of the firms will interact and communicate. At the same time, in an environment where knowledge predominates, it seems likely that any communication will centre around the exchange of knowledge.

In the transfer of knowledge, and following Van den Hooff and de Leeuw van Weenen (2004), two processes can be identified: knowledge donation and knowledge collecting. The donation of knowledge involves sharing with others the intellectual capital an individual possesses, while the collection of knowledge allows one party to take advantage of the intellectual capital of others. In this line, in the present work, when speaking of knowledge exchange, we refer to processes in which the actors (entrepreneurs) donate and receive knowledge in a reciprocal

way (van Wijk et al., 2008). These transfer processes can be a source of competitive advantage (Powell et al., 1996) and unique business opportunities (Uzzi, 1997).

Although university spin-offs involve entrepreneurs from academia, having the available knowledge is necessary yet is not enough for an exchange to take place (Lahti and Beyerlein, 2000). Entrepreneurs in UBIs may be reluctant to exchange ideas and information for fear of opportunistic behaviour or plagiarism of ideas that have not yet been exploited in the marketplace. In addition, since their background is the university, they are likely to have similar experience and knowledge in some cases, which may lead them to disregard a relationship based on the exchange of knowledge.

Literature has explored the relationships in the university incubator environment (e.g. McAdam and Marlow, 2008; Ahmad and Ingle, 2011; Cooper et al., 2012; Ahmad, 2014; Redondo and Camarero, 2017, 2019, 2020; Öberg et al., 2020). However, few studies have focused on knowledge-based relationships. Specifically, Studdard (2006) explores how the entrepreneur company's acquisition of business process knowledge through interacting with incubator managers has a positive effect on the company's reputation. Warren et al. (2009) provide a two-step explanation for the knowledge acquisition process experienced by entrepreneurs in incubation: (a) knowledge gained through the incubator manager; and (b) via external networks.

There are no empirical studies that analyse relationships between academic entrepreneurs in incubation based on knowledge. In an effort to fill this gap, the current paper attempts to address the following research questions: (1) Are UBIs spaces for building relationships based on knowledge exchange between novel entrepreneurs? (2) What factors can contribute to the exchange of knowledge between entrepreneurs? and (3) Is the knowledge exchanged valuable for founders and their companies? To address these questions, the current study aims to provide insights into the characteristics of the entrepreneurs' resources (complementarity,

supplementarity, and transferability) and the incubator's business logic as triggers of knowledge exchange. Likewise, this exchange between founders can lead to increased entrepreneurial commitment with their incipient business and favours the generation of innovation.

The present research contributes to the literature in different ways. Firstly, it finds empirical evidence of the determinants of dyadic relationships between entrepreneurs based on knowledge in a specific context: academic incubators. Not only can the complementarity and transferability of knowledge shape the development of relationships, but having supplementary resources may also be a way to create relationships between entrepreneurs. Moreover, implementing the incubator's business logic within the academic world allows for the exchange of knowledge between spin-offs. Secondly, the knowledge exchanged is useful for the parties, with this resource constituting one possible source of sustainable competitive advantage in terms of entrepreneurial commitment and innovation.

This paper is structured as follows. In Section 2, we provide the theoretical background and a literature review of prior research on antecedents (entrepreneurs' resources and incubator business logic) together with the results of knowledge exchange (in terms of entrepreneurial commitment and generation of innovation). We also put forward the hypotheses that explain the relationships between the antecedents and the exchange of knowledge in UBIs, as well as the influence between this exchange and the results derived from it. In section 3, the method and data collection are introduced. In section 4, we explain the results of the empirical analysis. Finally, section 5 provides the main conclusions, as well as the theoretical and managerial implications, limitations and suggestions for further research.

2. ANTECEDENTS AND RESULTS OF THE EXCHANGE OF KNOWLEDGE

2.1. Resource-based view: entrepreneurs' resources

According to the resource-based approach, and as formulated by Barney (1991), resources (unique, valuable, rare, inimitable, and non-substitutable) are fundamental when developing any type of business activity. In the early stages of business, the difficulties involved in accessing resources are greater than at any other time, and this is precisely when entrepreneurs spend more time on this activity (Greve and Salaff, 2003). Through relationships, individuals can access, create and modify resources (Gulati, 1999).

In the present research, complementarity and supplementarity of resources are considered to be determining variables for the exchange of knowledge between entrepreneurs. As we are dealing with an intangible resource, the transferability of knowledge also proves key to the exchange, particularly when companies can protect their knowledge through different mechanisms that may hinder their transfer (Dyer and Singh, 1998).

Complementary resources. Complementary resources are those capacities, knowledge and resources that a company has and that enable it to sharpen up the performance of another company (Jap, 1999). These resources may differ and may derive from individuals' different experiences and backgrounds. In the literature on academic entrepreneurship, complementary capabilities in scientists are seen as those which are not inherent to the world of science, but which are, nevertheless, critical to the success of the companies they create. These capabilities include, to a greater extent, the following: access to social networks (Stuart and Ding, 2006), collaboration with industry and previous experience, access to financing (Shane and Stuart, 2002) and the ability to recruit staff who have market and operational knowledge (Vohora et al., 2004).

Faced with market opportunities, companies can choose to collaborate with other organizations that possess complementary resources (Hitt et al., 2000; Sarkar et al., 2001). Taking into account that entrepreneurs are just starting their businesses, the latent needs inherent to that moment are many and varied, and range from being part of a business network to gaining access

to finance. It thus seems likely that complementary resources can facilitate the exchange of knowledge across an array of different aspects. More specifically, if we consider the case of entrepreneurs who have complementary resources, and where each party can contribute with its know-how, for example, to providing a joint service, the dependence between the two parties will increase, as will the interactions and the exchange of knowledge. Thus,

H1. Entrepreneur perception of complementary resources with other entrepreneurs has a positive influence on the exchange of knowledge.

Supplementary resources. Supplementary resources are those which overlap and which are common to both parties. Although supplementary resources may be perceived as redundant and lacking in value for the parties, integrating them may allow more value to be created than could otherwise be obtained were those resources to be used separately (Das and Teng, 2000).

A priori, when one entrepreneur perceives that another entrepreneur in incubation has similar resources to theirs, they will think that it is their competence, because they can satisfy similar needs to the same potential and/or real clients. However, because the contact with that "competitor" takes place in the UBI environment and not in the market, it might change the entrepreneur's perception for two reasons. First, it must be remembered that people in UBIs come from an academic background, where they usually work in teams with colleagues from the same department, and that they have a keen interest in science and an aversion to using it as a source of personal enrichment (Birley, 2002; Etzkowitz, 2004; Vohora et al., 2004). However, these characteristics do not usually concur with those evidenced by entrepreneurs who are in the market, and who are outside the university environment. Secondly, entrepreneurs can participate in different activities in UBIs, from receiving training workshops to sharing the advisory services of the same coach in group meetings. In order to participate actively in these activities and to optimize their use, entrepreneurs who share similar resources

(e.g. working in the same activity area) will be able to draw on greater synergies than those who have no common resources or capabilities.

The existence of similar knowledge decreases the costs associated with the process of knowledge transfer (Reagans and McEvily, 2003). Regardless of the type of knowledge they possess, if they have skills or competencies that are supplemented, the understanding between them will be more fluid, since they will have a meeting point. When two entrepreneurs maintain a relationship and possess similar or related knowledge, they speak the same language. Contact between them will therefore prove to be more effective over time, since reaching an optimal understanding will require less effort than if they were working in different disciplines. Communication will thus be more fluid between the two parties. Understanding and good communication between entrepreneurs in UBIs will make them more likely to continue collaborating together in creating and exploiting new knowledge. It is thus proposed that,

H2. Entrepreneur perception of supplementary resources with other entrepeneurs has a positive influence on the exchange of knowledge.

Transferability of knowledge. The degree of knowledge transferability depends on its characteristics (Gorovaia and Windsperger, 2010), the first of which is the degree of specificity. Specific knowledge is derived from particular situations of space and time (Hayek, 1945). Its transfer and exchange is more difficult than in the case of general knowledge (Jensen and Meckling, 1992). Secondly, there is the issue of its codification, namely whether it is tacit or explicit. Tacit or procedural knowledge (Anderson, 2013) resides in the processes of companies and individuals. It is often described as the "hidden knowledge" that individuals possess, yet it cannot be easily explained (Byosiere et al., 2010). Referring to tacit knowledge, Polanyi (1966, p.4) states: "... we can know more than we can say". In contrast, explicit or declarative knowledge (Harvey and Anderson, 1996) is the simple knowledge of coding and content in

manuals, such that it can easily be articulated, acquired and transferred (Byosiere et al., 2010). The type of knowledge affects its acquisition and exploitation (Lane and Lubatkin, 1998). Tacit knowledge is more difficult to exchange because of its high level of causal ambiguity (eg. Nonaka, 1991; Zander and Kogut, 1995; Szulanski et al., 2004). In short, when the knowledge in question is easy to interpret and to absorb (Doz et al., 1989) and is unambiguous (Hedlund and Zander, 1993) transferring it between parties proves far less problematic. The characteristics of knowledge also affect the creation of competitive advantage. In this case, the greater the level of specificity, diversity, complexity and tactical nature of knowledge, the greater its potential to generate competitive advantage (Kogut and Zander, 1992; Grant, 1996).

Two other determining factors that will affect the exchange of knowledge are who owns it (depositary) and who receives it (receiver). In our case, the depositary and the receiver of knowledge are academics. Their internal knowledge is scientific, linked to a specific discipline, tacit and innovative in itself. Unilaterally evaluating the transferability of an academic entrepreneur's knowledge, we could state that, a priori, it is not transferable and does not favour exchange. However, from another perspective, an entrepreneur may perceive that their knowledge is easily transferable, since they have a thorough understanding of it and know how to convey transmit it, and may feel the same to be true of their colleagues in the incubator. This may be due to their belonging to the scientific community, which makes communication and understanding between them fluid. This will not happen when relating to other types of entrepreneurs. For example, one entrepreneur from the scientific world's perception of transferability to another entrepreneur who engages in a sector which requires a non-scientific qualification will be low, which will hinder the process of knowledge exchange as well as the utility thereof. Therefore,

H3. Transferability of knowledge has a positive influence on the exchange of knowledge between entrepreneurs in UBIs.

2.2. The incubator's business logic

Institutional logics are defined as "the socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality" (Thornton and Ocasio, 1999, p. 804).

The logic of a UBI can be defined through university logic and managerial logic. In turn, the logic of the incubator (and its management) affects the entrepreneurs. A priori, universities mainly have their own academic logic (focused on teaching and research). However, universities are increasingly displaying a positive and proactive disposition towards entrepreneurship and towards actively promoting it. The creation of UBIs is one example of this, and this specific type of incubator is a tool within the academic field. Nevertheless, UBIs foster entrepreneurial and business activities (business logic). This therefore involves implementing a business logic within the academic world. Some universities do, however, have a long-running tradition of business creation and of offering support for entrepreneurs. It comes as no surprise that the idea for business incubators first emerged in the university environment. In 1942, the Students Agencies Inc. was created in Ithaca (New York) to offer an appropriate physical space where companies created by students could commence their activity (Allen, 1985).

As regards the running of UBIs, they can managed by those who have either an academic or a business background. Managers who possess business logic know how the business world works and are more aware of the weaknesses of academic entrepreneurs. As a result, managers with business logic are more effective when it comes to vis-à-vis the services offered and promoted by incubators: in other words, business assistance, personal assistance and networking (Redondo and Camarero, 2017).

Inside UBIs, entrepreneurs enjoy a "protected" business environment compared to the market. This can help them develop their entrepreneurial abilities, "learning by doing", through the services from which they benefit. Networking activities, in particular, favour the development of social skills and the exchange of knowledge between entrepreneurs. Therefore, we hypothesize that,

H4. The incubator's business logic has a positive influence on the exchange of knowledge between entrepreneurs.

2.3. Results of the exchange of knowledge

The exchange of knowledge between entrepreneurs in incubation can lead to two positive results for the future of emerging businesses: increasing the entrepreneurial commitment and the generation of innovation.

Entrepreneurial commitment. Entrepreneurial commitment has been defined by Fayolle et al. (2011, p.161) as: "the moment in which the individual begins to devote most of his time, energy, and financial, intellectual, relational and emotional resources to his project." Entrepreneurial commitment is born and developed in certain individuals, and its advantages extend to the businesses in which they actively participate. Maintaining this commitment by individuals leads to the development of additional competence and capacity, which can provide new perspectives and the potential to pinpoint business opportunities (Erikson, 2002; Tasnim and Singh, 2016).

Academics obviously require entrepreneurial commitment if the company they have created and in which they are immersed is to move forward. Certain academics are stubborn and do not wish to relinquish control over their company (Vohora et al., 2004), a behaviour that demonstrates high entrepreneurial commitment. This, however, is not the dominant practice among academic entrepreneurs.

In relationships with other founders, entrepreneurs will share their concerns about the situation they find themselves in, their professional experiences, and their knowledge. Exchanging knowledge would allow them to have more resources to mitigate the lack of experience in the business world, and could strengthen their capacities to be able to continue with their business. People with a strong belief in their ability may be more persistent in their efforts (Boyd and Vozikis, 1994). In addition, the greater the level of business competition, the stronger the entrepreneurial commitment (Erikson, 2002).

Relationships between entrepreneurs that are based on a fluid exchange of knowledge and which are characterized by a commitment between the parties could therefore have a positive reinforcing effect on the individual's level of commitment to their business. In addition, when academics are in a UBI it means they are involved in a business network (even though they are all at the start-up stage) and will develop their social skills. These social interactions also help to strengthen entrepreneurial commitment (Erikson, 2002). Thus,

H5. Exchange of knowledge between entrepreneurs in UBIs has a positive influence on entrepreneurs' entrepreneurial commitment.

Generation of innovation. According to resource and knowledge-based views, having access to external knowledge is one of the key requirements for generating innovation (Ghoshal and Bartlett, 1988; Eisenhardt and Schoonhoven, 1996; Grant, 1996; Nonaka et al., 2006; Simonin and Özsomer, 2009). Innovation is not inherent to all entrepreneurs (Michael, 2007), yet does prove to be true in the case in hand, namely scientists, added to which they play a key role in innovation processes (Zucker et al., 2002). However, it is difficult for companies to have all the resources and capabilities required to innovate and to compete successfully in the many scientific and technological fields that are constantly emerging. Faced with this situation, companies are often involved in collaboration agreements (Rothaermel and Deeds, 2004).

The relationships between entrepreneurs in UBIs favour the generation of innovation for several reasons: (1) firms localised in incubators (incubatees) have the knowledge and capacity needed for innovation; and (2) the exchange of knowledge within the UBI can give the businesses a competitive advantage to innovate when they leave the incubator. All incubated companies (university spin-offs) are based on knowledge. Therefore, they have the capacity for innovation, a capacity that increases when they share their knowledge and access new resources. While they are in the UBI, entrepreneurs who maintain relationships with other entrepreneurs, based on the exchange of scientific knowledge and mutual commitment, develop a competitive advantage for the generators of innovation at the end of the incubation process. When academics "graduate" is when the time comes to sustain their business outside the incubator (Hackett and Dilts, 2004). It is in the "real" market where the relationships created in UBIs can bear fruit in terms of capacity for innovation. It is thus proposed that,

H6. Exchange of knowledge between entrepreneurs in UBIs has a positive influence on the generation of innovation of an incubatee.

Figure 1 presents the proposed model with the hypotheses.

Insert Figure 1 here

3. METHODOLOGY

3.1. Sample selection and data collection

Data were collected between September 2014 and March 2015 from UBIs in Spain and the Netherlands through an online questionnaire. The decision to opt for these two countries was based on the interest they aroused, with the Netherlands having a longer and more innovative tradition of incubators compared to Spain, added to which was the possibility they afforded of obtaining information concerning UBIs.

First, since there are no databases of the number of UBIs in Spain and the Netherlands, we consulted each university webpage or phoned to find out the number of incubators. The data collection process commenced in Spain and was conducted in two stages. During the first stage, all UBI managers were contacted by phone. The procedure followed was very much the same in each call; namely, giving an explanation of the framework and goal of the study, and requesting their cooperation. If we received a positive reply, an e-mail was immediately sent with the information and the link to the founders' questionnaire. The second stage commenced three weeks after the first had concluded. When no reply had been received from the manager and/or entrepreneurs, managers were again contacted to remind them and to re-send them the information.

While the first series of contacts was being completed with the managers of the Spanish incubators, collection of data from the Netherlands commenced. To do this, between November and December 2014, personal visits were made to two UBIs in the Netherlands. At the same time, the remaining managers and entrepreneurs were telephoned and e-mailed to request their participation in the research. When a further three weeks had elapsed without receiving any reply from managers and/or founders, the information and questionnaires were sent once again. The UBIs that form part of the sample account for 68.12% of the total population. Table I shows their features. Worth highlighting is the fact that 38.30% offer two (of the possible three) incubation programmes, 42.55% are supported by a university as well as by at least a further two other organisations, and 51.06% have no means of self-financing.

Insert Table I here

Managers were asked to fill in one questionnaire for each incubation programme they ran. Since we cannot know the exact number of tenants in the incubators (there are no databases of the number of UBIs and incubator tenants), we calculated an approximate sampling error. First, we calculated the approximate mean number of tenants in the UBIs in each country (from data

provided by the managers), and then multiplied this figure by the number of UBIs in Spain, 53, and in the Netherlands, 16. Population sizes, sample sizes, and sampling errors, for a confidence level of 95%, are shown in Table II. The same type of calculated data is also collected globally; that is, adding the populations and samples of Spanish and Dutch.

Insert Table II here

In addition to the collaboration of the UBI managers, we collected information from the founders of the incubatee firms. In fact, in the current study, the unit of analysis is the founder. We obtained 101 responses from them through questionnaires. In order to identify possible differences between entrepreneurs in UBIs in the two countries, a test was carried out to check for a different response pattern for the indicators used. This was done by conducting a homogeneity analysis of the samples employed through a *t* test for independent samples. The results affirmed that the samples (Spanish and Dutch entrepreneurs) display a high degree of homogeneity.

The founders who make up the sample are mainly Spaniards (65.35%), male (71.29%), aged between 25 and 35 (57.43%), are graduates (51.49%) from the field of engineering and architecture (49.50%), and have no prior entrepreneurial experience (77.22%). The full description of the sample is shown in Table III. We also present data of the incubatee firms in Table IV.

Insert Table III here

Insert Table IV here

3.2. Measurement variables

To measure the variables in the model, we used existing measures when possible, but adapted to the incubation context. We used five-point Likert scales. Variables were measured from the viewpoint of the respondent with regard to a specific entrepreneur they had been involved with.

Measuring the *supplementarity and complementarity of entrepreneurs' resources* was carried out using the scales proposed by Sarkar et al. (2001) and Lambe et al. (2002). In both cases, and as emerged from the first pre-test, it was necessary to modify the wording of the items in order to improve the understanding thereof and so ensure they would not be misinterpreted. The greatest changes were made to supplementarity of resources. Given the absence of a reliable and valid scale that could be used, a scale similar to the one employed for the complementarity of resources was drawn up. Four reflective indicators for complementarity and three for supplementarity were used. In order to measure *transferability of knowledge*, two reflective items taken from the empirical work carried out by Simonin (1999) were included; said model being one which has also been widely validated.

As for the *incubator's business logics*, we consider it as a second-order formative construct built on two aspects: the manager's and the university's business logics. The manager's logic was reflected in three items that indicate the extent to which the manager favours contacts and networking between entrepreneurs in incubation. The university's logic was measured by two formative items: positive attitude towards entrepreneurship and the creation of new ventures and the historical tradition in spin-offs.

Knowledge exchange was measured based on the items proposed by Yli-Renko et al. (2001) and by Simonin (1999). Three items refer to the knowledge acquired by the respondent entrepreneur, and three items refer to the knowledge transferred by the respondent entrepreneur to their partner. The six items were considered as reflective indicators of the magnitude of knowledge exchange.

As regards the results, *entrepreneurial commitment* was measured through a four-item reflective scale defined by Erikson (2002). Its content refers to the level of commitment, demands and the individual's business goals. *Generation of innovation* was reflected through a five-indicator reflective scale; three reflecting what the relationship has provided up to that

point and two dealing with future expectations in terms of what innovation might emerge from the cooperation. Finally, we included the country (0=Spain; 1=The Netherlands) as a control variable.

We followed the procedure proposed by Armstrong and Overton (1977) to test non-response bias. We compared the responses of entrepreneurs who had answered the survey during the first weeks with later respondents, in other words those answering in the final weeks. All the items in the study were compared through a t test for independent samples, and we found significant differences in five items belonging to different variables. Therefore, we concluded that there are no relevant differences in the measurement of the variables and that non-response bias is not an issue in the study.

Table V shows the descriptive statistics corresponding to the variables and measures used.

4. ANALYSIS AND RESULTS

Partial least squares (PLS) was used to perform the joint estimation of the measuring model and the structural model. Specifically, we used SmartPLS v3.2 (Ringle et al., 2015). To calculate the significance of the factor loadings and the estimated coefficients, bootstrapping was applied to 1000 sub-samples. This analytical technique allows for estimations with a modest sample size and complex structural equation models (i.e., with multiple dependent and independent variables measured with several indicators).

Table V provides information concerning the outcomes of the reliability and validity analysis of the measurement scales used. Cronbach's alpha (α), composite reliability (CR) and average extracted variance (AVE) values are given (all are well above the recommended thresholds: α>0.7, CR>0.7, and AVE>0.6). Consequently, the reliability of the measurement scales is confirmed. The factor loadings are above 0.7 for all the items, thus confirming the convergent validity of the measurement scales.

Insert Table V here

In order to evaluate discriminant validity, we first followed the criterion of Fornell and Larcker (1981). Table VI shows the correlation matrix between latent constructs. The main diagonal includes the square root values of the AVE for each construct. Comparing each square root with the correlations in the corresponding row and column indicates whether there is discriminant validity amongst the latent variables. This condition is met in all cases. A further indicator of discriminant validity is the heterotrait-monotrait (HTMT) ratio of correlations, proposed by Henseler et al. (2015). This ratio reflects the average of the correlations of indicators in constructs which measure different phenomena, compared to the average of the correlations of indicators within the same construct (Henseler et al., 2015). In order to evaluate discriminant validity through HTMT, correlations should not exceed 0.85 (Clark and Watson, 1995; Kline, 2011). The values corresponding to the ratio of HTMT correlations for each pair of constructs are included above the principal diagonal of the correlation matrix, and all of them are below the critical value.

Insert Table VI here

To estimate the proposed model and to analyse the mediation effect of knowledge exchange, we followed two steps. First, we estimated an alternative structural model where we introduced the proposed relationships as well as all the direct effects between the antecedents and the consequences of knowledge exchange (Table VII). In this model, we observe that the relationship between complementary resources and entrepreneurial commitment and the relationship between complementary resources and the generation of innovation proved to be significant. Second, we estimated the proposed model including these relationships. The estimation of the final structural model with the direct, indirect and total effects is shown in Table VIII. The coefficient of determination (R^2) was 0.541 for exchange of knowledge, 0.434 for entrepreneurial commitment, and 0.580 for generation of innovation.

The results obtained provide empirical support for hypotheses H1, H2 and H3. The positive effects of complementary resources (β_1=0.333; p<0.00), supplementary resources (β_2=0.311; p<0.00), and the transferability of knowledge (β_3=0.208; p<0.05) on the exchange of knowledge among incubates are supported. Hypothesis H4 is also verified. The orientation of the university of origin towards entrepreneurship and the work of the manager as a promoter of relationships between the entrepreneurs are key to the exchange of knowledge (β_4=0.161; p<0.05). As regards the effects of knowledge exchange, the results provide support for hypotheses H5 and H6. The exchange of knowledge predisposes entrepreneurial commitment (β_5=0.429; p<0.05) and fosters the generation of innovation (β_6=0.642; p<0.05).

These results confirm the mediating effect of knowledge exchange. As observed (1), the existence of complementary resources directly impacts entrepreneurial commitment and generation of innovation, and also has an indirect effect through the exchange of knowledge, with significant indirect effects, i.e., there is partial or complementary mediation; (2) supplementary resources, transferability, and the incubator's business logic affect entrepreneurial commitment and the generation of innovation only indirectly through the exchange of knowledge, i.e. total or indirect-only mediation.

Finally, and with regard to the control variable, the country in which the UBI is located is related to two variables that determine the exchange: supplementarity of resources and institutional logic. Specifically, in the Netherlands there are higher levels of relationships between entrepreneurs with supplementary resources, and on the part of the institutions (university and manager) there is greater promotion of entrepreneurial initiative.

Insert Table VII here

Insert Table VIII here

In addition to these results, we performed the importance-performance map analysis (IPMA) to determine the impact of entrepreneurs' resources and the incubator's business logics on knowledge exchange, entrepreneurial commitment, and generation of innovation. This analysis extends the results of PLS-SEM by taking both the importance and the performance of each construct into account (Hair et al., 2017). The IPMA contrasts the importance of the exogenous constructs (complementary and supplementary resources, transferability and incubator's business logic), i.e. the total effects on the endogenous constructs (knowledge exchange, entrepreneurial commitment and generation of innovation), with their performance, i.e. the average latent variable scores. Figure 2 shows the total effects and the latent variables scores rescaled on a range from 0 to 100.

Insert Figure 2 here

As can be seen, the highest level of performance is for complementarity of resources, which is consistent with its importance for knowledge exchange, entrepreneurial commitment and generation of information. However, the lowest level of performance is for supplementary resources, in spite of its importance for knowledge exchange and for the generation of information. Finally, the level of performance of the incubator's logic and transferability of knowledge is medium-high, even if they are not as important as resources.

5. DISCUSSION

5.1. Main findings

The results confirm that the exchange of knowledge in the relationships between entrepreneurs in UBIs drives entrepreneurs' commitment to their start-ups and emerging businesses and stimulates innovation and growth. Knowledge is mainly exchanged when entrepreneurs perceive that they share different and complementary resources. The resources of small businesses can be combined so as to be more innovative, to develop a better offer, or, in general,

to achieve satisfactory results. Indeed, far more than any other factor, it is the relationships supported on the complementarity of resources which are seen to foster founder commitment to their entrepreneurial goals and to enable innovation and development in incubatee' businesses.

The partner's resources are also valuable vis-à-vis exchanging knowledge when said resources are similar and supplementary. Supplementary resources allow entrepreneurs to reach a higher dimension in their businesses. It is important to point out that those entrepreneurs with similar resources will not be perceived as competitors within the UBI-environment. The reason for this is their common situation of being academic entrepreneurs, which differs from that of entrepreneurs who are in the non-protected (market) environment, since academic entrepreneurs have a keen interest in science and its development and which prevails over economic interest.

A priori, the knowledge of entrepreneurs whose businesses are capital intensive and innovative tends to be difficult to transfer. However, if a UBI tenant perceives their knowledge to be easily transferable, because they are familiar with it and know how to convey it, and if they also believe the same is true of the knowledge possessed by their incubation colleagues (perhaps due to their belonging to the scientific community), fluid communication and understanding between them will prove easier.

Finally, one antecedent of the process of knowledge exchange is the incubator's business logic. Incubators' business logic involves both the manager's involvement in promoting relationships between entrepreneurs and the university's background in entrepreneurship. When these conditions are met, the exchange of knowledge is easier, and the likelihood of entrepreneurial commitment and innovation is greater.

5.2. Theoretical implications

The main contribution of our study, in comparison with other studies in the same research area,

is that it provides a conceptual understanding of knowledge exchange among entrepreneurs in the scope of UBIs - through institutional logics and, basically, the resource-based view – and which is empirically supported. Specifically, we contribute to the literature by (1) characterizing UBIs as ideal spaces for exchanging knowledge between university spin-offs at an early stage; (2) linking incubator logic (and its management) to the content of networking activities among academic entrepreneurs; (3) enabling a better understanding of resources (with regard to complementarity and supplementarity, as well as transferability of knowledge) as determinants of knowledge-based exchanges; and (4) measuring the results of these exchanges in terms of entrepreneurial commitment and generation of innovation.

5.3. Managerial implications

From these results, certain managerial implications emerge. The first concerns the university incubator decision with regard to the right mix of entrepreneurs who share the incubator (incubator tenant selection). The recommendation is to strike a balance between entrepreneurs with complementary resources and entrepreneurs with supplementary resources. Diversity, in other words the coexistence of entrepreneurs with complementary resources (different academic backgrounds or different abilities in business areas such as engineering, design, production, marketing, etc.), allows them to share skills and to improve their capabilities before venturing out into the market. However, communalities, namely the coexistence of entrepreneurs with supplementary resources (similar academic backgrounds or similar core businesses), are also recommended in order to leverage business potential. Entrepreneurs can join forces to obtain results in specific research areas and, therefore, increase the scope of their business projects. A further implication of this study concerns the role of institutional logic: the business logic implicitly and explicitly displayed by management is an important factor, meaning that the recruitment of incubator management is of pivotal importance.

Finally, in order to increase the efficiency of the incubatee businesses, it is necessary to foster the relationships between founders. Incubation is an embryonic phase for businesses, yet all entrepreneurs possess one very valuable resource, both for themselves and for the other partners: knowledge. Promoting relationships based on knowledge exchange implies reinforcing the commitment as entrepreneurs. This is key, since we are talking about academics who are in a transition process towards becoming academic entrepreneurs. In addition, the exchange of knowledge between these entrepreneurs favours the generation of new ideas which, together with the business project being developed, will allow innovation and the reliability of the final products or services to be enhanced. In turn, this will result in potential business viability in the market.

5.4. Limitations and further research

The research carried out evidences certain limitations and posits some future lines of inquiry. The sample size is small, although the size of the population of entrepreneurs in Spanish and Dutch UBIs is also limited. In addition, the study focuses on a specific type of incubators, university incubators, which limits their generalization to other incubation contexts. As future lines of research, we propose contrasting the model proposed in other types of incubators, analysing whether the exchange of knowledge occurs in any incubation context among knowledge-intensive companies and, if so, whether the resources (especially, supplementary ones) are determinants of the exchange, and whether the results are specified in the same terms. Expanding the geographical scope of the study will also help to understand and evaluate whether the results are only specific to European countries or whether they also hold for other regions.

Herein, only the factors that favour the exchange of knowledge have been analysed, yet it would prove interesting to study which factors or events lead to the failure of the relationships. In particular, cases in which attempts have been made to exchange knowledge, but which have

ultimately failed to do so, should be explored as should cases where the exchange does indeed occur but in which the consequences have proven to be negative for either of the parties involved.

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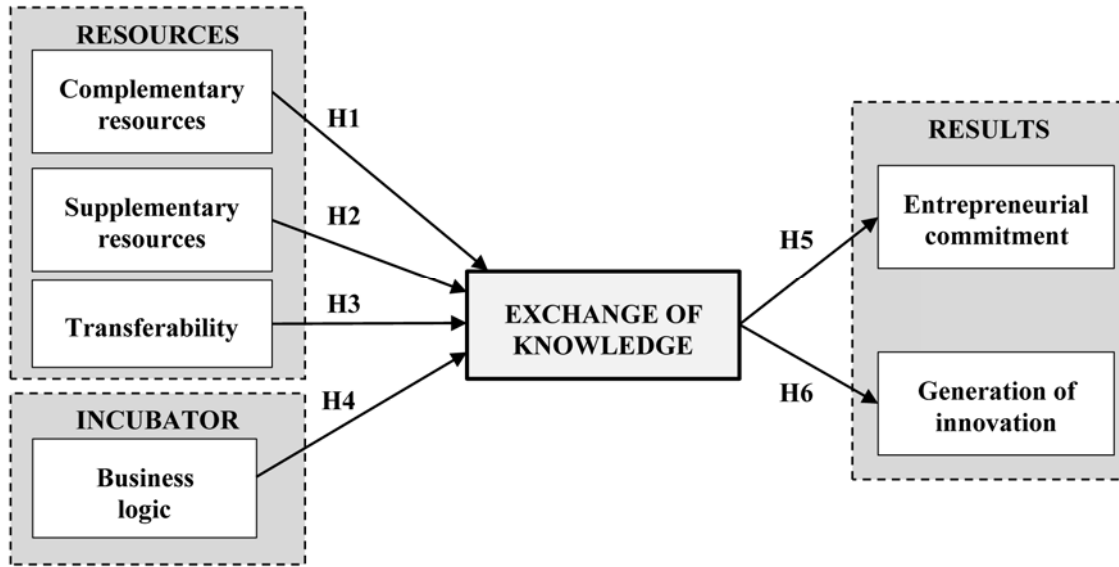
Figure 1.
Proposed model

Figure 2.
Importance-performance maps
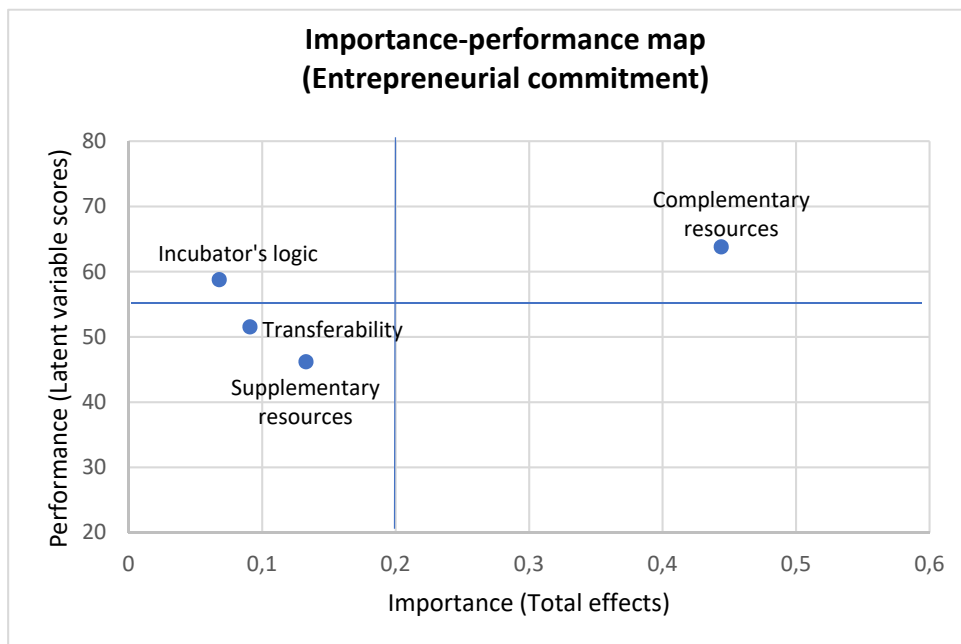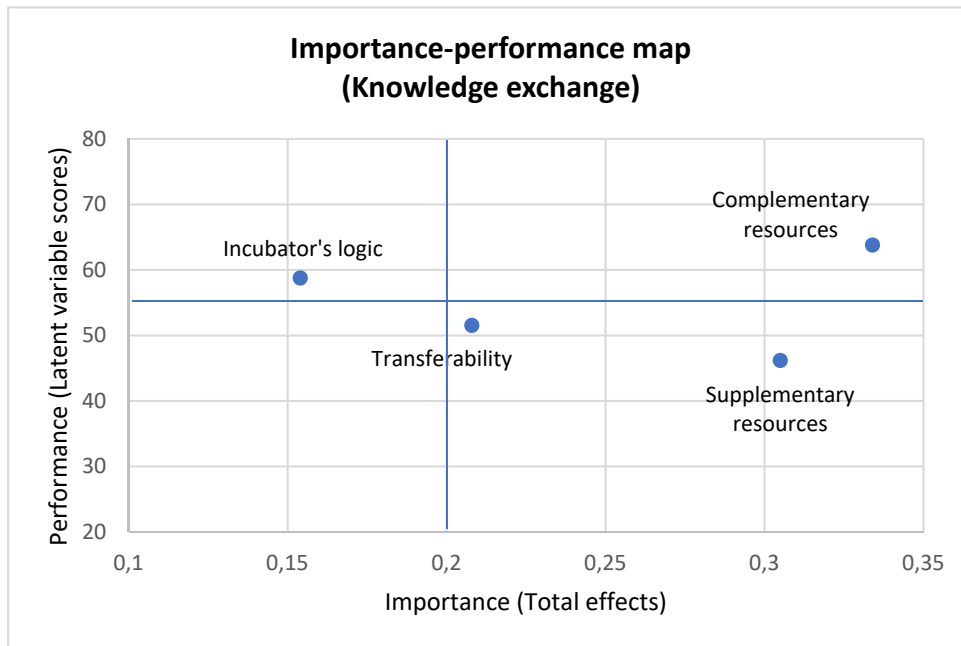
**Importance-performance map
(Generation of innovation)**

Performance (Latent variable scores)

Importance (Total effects)

Incubator's logic

Transferability

Supplementary
resources

Complementary
resources
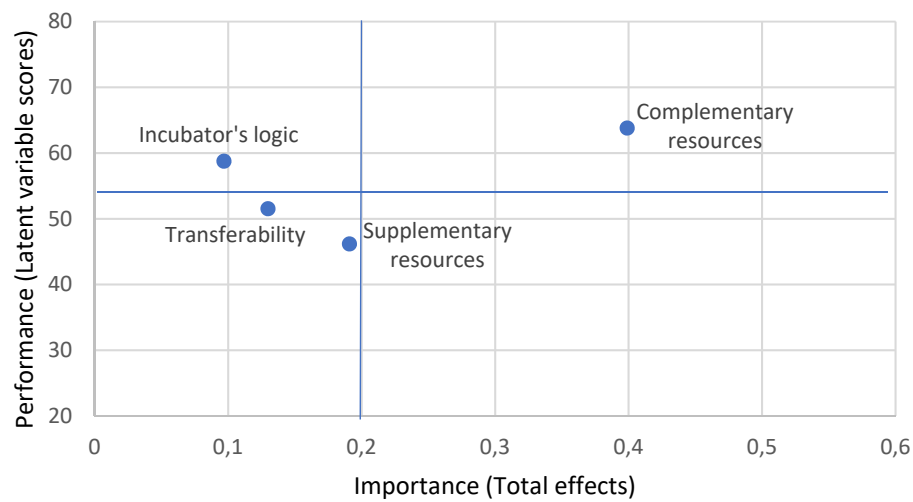
Table I.
Description of the sample of incubators

	No.	%
Location of incubator		
Spain	39	82.98
The Netherlands	8	17.02
Years incubator has been in operation		
Up to 2 years	8	17.02
Between 3 and 5 years	14	29.79
Between 6 and 8 years	12	25.53
More than 8 years	13	27.66
Incubation programmes/services		
Pre-incubation	6	12.77
Incubation	9	19.15
Pre-incubation and incubation	12	25.53
Incubation and post-incubation	6	12.77
Pre-incubation, incubation and post-incubation	14	29.79
Organizations that support and are involved with the incubator		
University	15	31.91
2 organizations	12	25.53
More than 2 organizations	20	42.55
Self-financed incubator		
0%	24	51.06
Between 1% and 25%	3	6.38
Between 26% and 50%	6	12.77
Between 51% and 75%	2	4.26
Between 76% and 100%	12	25.53

Table II.
Population and sample sizes, and sampling errors of entrepreneurs in UBIs

Location of incubator	Estimated population	Sample	Sampling error
Spain	1,855 (*)	66	11.85 %
The Netherlands	544 (**)	35	16.04%
Total	2,399	101	9.55%

(*) 53 · 35; population of Spanish UBIs · average number of entrepreneurs in Spanish UBIs
(**) 16 · 34; population of Dutch UBIs · average number of entrepreneurs in Dutch UBIs

Table III.
Characteristics of the sample (101 entrepreneurs)

	No.	%
Location of incubator		
Spain	66	65.35
The Netherlands	35	34.65
Age of entrepreneur		
Less than 25	15	14.85
Between 25 and 35	58	57.43
Between 36 and 45	20	19.80
Between 46 and 55	7	6.93
Between 56 and 65	1	0.99
Gender		
Male	72	71.29
Female	29	28.71
Highest qualification		
PhD	14	14.29
Master	34	34.69
Bachelor	50	51.02
Status		
Professor	5	4.95
Researcher	16	15.84
Student	28	27.72
Graduate	52	51.49
Area of knowledge		
Sciences	23	22.77
Health sciences	6	5.94
Social sciences	18	17.82
Engineering & architecture	50	49.50
Arts & humanities	4	3.96
Experience as an employee in a company		
No experience	35	34.65
Up to 3 years	29	28.71
Between 4 and 5 years	7	6.93
Between 6 and 10 years	15	14.85
More than 10 years	15	14.85
Previous entrepreneurial experience		
No experience	78	77.22
Up to 3 years	15	14.85
Between 4 and 5 years	4	3.96
Between 6 and 10 years	2	1.98
More than 10 years	2	1.98
Academic/scientific experience at a university/research centre		
No experience	79	78.22
Up to 3 years	14	13.86
Between 4 and 5 years	1	0.99
Between 6 and 10 years	2	1.98
More than 10 years	5	4.95

Table IV.
Characteristics of the sample of firms

	No.	%
Location of incubator		
Spain	66	65.35
The Netherlands	35	34.65
Number of months in incubation		
Less than 6 months	19	18.81
Between 6 and 12 months	38	37.62
Between 13 and 24 months	27	26.73
More than 24 months	17	16.83
Partners of the firm		
1 partner	29	28.71
2 partners	24	23.76
3 partners	27	26.73
4 or more partners	21	20.79
Participation in pre-incubation		
Yes	43	42.57
No	58	57.43

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Table V.
Measurement of variables and descriptive statistics

</div>

	Mean	S.D.	Outer loadings	Outer weights
Complementary resources *(α=.866; CR=.904; AVE=.703)*				
This entrepreneur:				
Has different resources to mine that are very precious to me	3.50	1.119	0.829***	
His/her resources are necessary to achieve my goals	3.11	1.240	0.823***	
Has different and complementary resources to mine	3.66	1.023	0.861***	
His/her resources, combined with mine, enable me to achieve more satisfactory results	3.89	1.048	0.845***	
Supplementary resources *(α=.887; CR=.929; AVE=.814)*				
This entrepreneur:				
Has similar resources to mine, but nevertheless they are very precious to me	2.68	1.166	0.927***	
Has similar resources to mine, but supplementary to mine	2.92	1.181	0.871***	
His/her resources are similar to mine, but when combined, allow me to achieve more satisfactory results	2.98	1.304	0.908***	
Transferability				
Regarding my knowledge or training applied to the business I have started:				
The knowledge (technical-scientific) held by me is easily transferable	3.05	1.135		0.504**
Evaluate the following statements about this entrepreneur:				
The knowledge (technical-scientific) held by him/her is easily transferable	3.07	1.032		0.629***
Incubator's business logic				
Manager's logic *(α=.950; CR=.968; AVE=.908) The incubator manager…*				[2]0.227
Encourages contacts between entrepreneurs	3.81	1.093	[1]0.957***	
Tries to establish links between entrepreneurs who can collaborate	3.63	1.155	[1]0.951***	
Facilitates networking between all entrepreneurs	3.77	1.085	[1]0.952***	
University logic. *In my home university …*				[2]0.868***
There is a tradition of creating spin-offs	2.78	1.254		[1]0.788***
There is a positive attitude within my university towards entrepreneurship	3.78	1.035		[1]0.411*
Knowledge exchange *(α=.928; CR=.944; AVE=.737)*				
Knowledge transferred				
I acquire technical knowledge and a tremendous amount of know-how	3.39	1.104	0.870***	
I learn from his/her knowledge	3.61	0.959	0.900***	
I assimilate the knowledge that he/she gives me and it contributes to the development of my start-up	3.57	0.973	0.854***	
Through me, the other entrepreneur:				
Acquires technical knowledge and a tremendous amount of know-how	3.62	1.028	0.790***	
Learns from my knowledge	3.67	0.850	0.867***	
Assimilates the knowledge that I give him/her and contributes to the development of his/her start-up	3.51	1.006	0.864***	
Entrepreneurial commitment. *The relationship with this entrepreneur has allowed me: (α=.940; CR=.961; AVE=.892)*				
To be more committed to my entrepreneurial goals	3.35	1.170	0.951***	
To be more demanding about my entrepreneurial goals	3.38	1.148	0.939***	
To be more ambitious about my entrepreneurial goals	3.59	1.106	0.944***	
Generation of innovation. *The relationship with this entrepreneur has enabled my business: (α=.936; CR=.954; AVE=.839)*				
To be more innovative in terms of product or service	3.56	1.117	0.928***	
To be more feasible in its development	3.68	1.174	0.910***	
In the future, I think the relationship with this entrepreneur will stimulate:				
Generation of innovation	3.81	1.046	0.926***	
New products/services	3.81	1.093	0.900***	

(***) p < 0.001; (**) p < 0.01; (*) p < 0.05
([1]) First order level; ([2]) Second order level

Table VI.
Correlation matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Complementary resources	**0.839**	0.389	n.a.	n.a.	0.619	0.587	0.596	0.149
(2) Supplementary resources	0.385	**0.902**	n.a.	n.a.	0.591	0.295	0.357	0.300
(3) Transferability	0.435	0.220	**n.a.**	n.a.	n.a.	n.a.	n.a.	n.a.
(4) Incubator's business logic	0.291	0.443	0.474	**n.a.**	n.a.	n.a.	n.a.	n.a.
(5) Knowledge exchange	0.589	0.546	0.493	0.485	**0.858**	0.651	0.785	0.156
(6) Entrepreneurial commitment	0.558	0.279	0.355	0.387	0.612	**0.945**	0.705	0.120
(7) Generation of innovation	0.558	0.334	0.323	0.382	0.737	0.663	**0.916**	0.044
(8) Country	0.083	0.285	0.133	0.250	0.145	0.116	-0.000	**1.000**

n.a. Not applicable

Table VII.
Estimation of direct and indirect effects

Hip.	Relationships	Path coefficients
H1	**Complementary resources → Knowledge exchange**	0.332***
	Complementary resources → Entrepreneurial commitment	0.321**
	Complementary resources → Generation of innovation	0.231**
H2	**Supplementary resources → Knowledge exchange**	0.315***
	Supplementary resources → Entrepreneurial commitment	-0.161
	Supplementary resources → Generation of innovation	-0.134
H3	**Transferability → Knowledge exchange**	0.209**
	Transferability → Entrepreneurial commitment	-0.042
	Transferability → Generation of innovation	-0.136
H4	**Incubator's business logic → Knowledge exchange**	0.160*
	Incubator's business logic → Entrepreneurial commitment	0.155
	Incubator's business logic → Generation of innovation	0.126
H5	**Knowledge exchange → Entrepreneurial commitment**	0.451***
H6	**Knowledge exchange → Generation of innovation**	0.694***
Control	Country[a] → Complementary resources	0.081
	Country → Supplementary resources	0.285**
	Country → Transferability	0.135
	Country → Incubator's business logic	0.245**
	Country → Knowledge exchange	-0.039
	Country → Entrepreneurial commitment	0.038
	Country → Generation of innovation	-0.094

([a]) 0=Spain; 1=The Netherlands
([b]) This relationship has not been included in the proposed hypotheses.
(*) $p < 0.05$; (**) $p < 0.010$; (***) $p < 0.001$

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Table VIII.
Final model. Direct, indirect and total effects

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Hip.	Relationships	Direct effects	Indirect effects	Total effects
H1	**Complementary resources → Knowledge exchange**	0.333***		0.333***
	Complementary resources → Entrepreneurial commitment	0.299[b]**	0.144**	0.443***
	Complementary resources → Generation of innovation	0.190[b]*	0.214***	0.404***
H2	**Supplementary resources → Knowledge exchange**	0.313***		0.311***
	Supplementary resources → Entrepreneurial commitment		0.136***	0.134***
	Supplementary resources → Generation of innovation		0.201***	0.235***
H3	**Transferability → Knowledge exchange**	0.208*		0.208*
	Transferability → Entrepreneurial commitment		0.090*	0.090*
	Transferability → Generation of innovation		0.133*	0.133*
H4	**Incubator's business logic → Knowledge exchange**	0.161*		0.161*
	Incubator's business logic → Entrepreneurial commitment		0.069[+]	0.069[+]
	Incubator's business logic → Generation of innovation		0.103*	0.103*
H5	**Knowledge exchange → Entrepreneurial commitment**	0.432***		0.429***
H6	**Knowledge exchange → Generation of innovation**	0.642***		0.642***
Control	Country[a] → Complementary resources	0.081		0.089
	Country → Supplementary resources	0.285**		0.285**
	Country → Transferability	0.133		0.133
	Country → Incubator's business logic	0.250**		0.250**
	Country → Knowledge exchange	-0.039	0.184*	0.145
	Country → Entrepreneurial commitment	0.029	0.087	0.116
	Country → Generation of innovation	-0.109*	0.109	0.000

([a]) 0=Spain; 1=The Netherlands
([b]) This relationship has not been included in the proposed hypotheses.
([+]) p < 0.10; (*) p < 0.05; (**) p< 0.010; (***) p < 0.001