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Openness strategies and the success of international entrepreneurship

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Abstract

Purpose: External knowledge is a key resource for the success and the survival of born global firms, however, existing models provide minimal evidence on how these firms should source this knowledge resource. Thus, the purpose of this research is to increase understanding on the impact of diverse knowledge search and knowledge formal protection in international new ventures (INVs).

Design/methodology/approach: The study uses a quantitative methodology based on a sample of start-ups from the Spanish CIS data. Using OLS regressions on a ten-year period panel data, this research tests the moderator role of a heterogeneous base of international partners and formal knowledge appropriation strategy on the relationship between start-ups and their export performance.

Findings: The results show that compared to non-born global start-ups, born global firms benefit more from establishing relationships with a set of heterogeneous international partners. By contrast, all start-ups benefit from an extensive appropriation strategy if they establish such alliances with diverse international partners.

Originality: The study extends current theory on international entrepreneurship by providing a new theoretical framework for international new ventures of both the extensive use of formal mechanisms of knowledge protection and the access to heterogeneous and distant knowledge. This study has also several implications for knowledge management domain.

Keywords: appropriability; entrepreneurship; international entrepreneurship; internationalization; open innovation; patents; start-ups.

Paper type: Research paper

1. Introduction

In the current globalized world, an increasing number of new firms, known as 'born global', are created with an international perspective from inception (Cavusgil and Knight, 2015; Del Sarto *et al*., 2021; Knight and Cavusgil, 2004; Oviatt and McDougall, 1994). Over the last decades, international entrepreneurship literature has tried to explain why born global succeed despite their smallness and newness liabilities and why the traditional sequential approach to internationalization does not work for them (Johanson and Vahlne, 1977).

Among the several factors that may explain successful international entrepreneurship (Kropp *et al*., 2008; Mills, 2011; Santos *et al*., 2021), current literature highlights the existence of two groups of factors, that are internal (Agarwal and Audretsch 2001) and external (Ebert *et al*., 2019) to the firm. Several studies have focused on the importance of internal resources of born global firms (see among others Del Sarto *et al*., 2021), while others have devoted some attention to the role of external technological knowledge in these firms (Zahra, 2005; Zahra *et al*., 2000). However, expanding knowledge frontiers in entrepreneurship is highly needed (e.g. Scazziota *et al*., 2020) whereas experiential learning processes take place differently (Mansoori, 2017), in particular in internationalization processes (Galdino *et al*., 2019). Despite the lack of knowledge resources and absorptive capacity of international new ventures (INVs), the theory of "learning advantages of newness" (Autio *et al*., 2000; Giménez-Fernández *et al*., 2020) suggests that these firms may have some advantages to exploit external technological knowledge. For instance, these young firms do not have rigid technological trajectories (Almirall and Casadesus-Masanell, 2010) and benefit from structures that allow the quick assimilation of external knowledge (Autio *et al*., 2000). Leveraging on these advantages, born-global firms may use external technological knowledge as a core competitive resource (Freeman *et al*., 2010). Despite the potential contribution of external technological knowledge to INVs success, the existing literature provides little guidance on what are the best strategies to acquire external knowledge in these firms. This limited knowledge on the topic represents a relevant research opportunity to broaden the current understanding of scholars and practitioners. Existing evidence focused more on multinational firms (e.g. Ferraris *et al*., 2017; 2020) while the few on SMEs supports the argument that knowledge and information diversity improves innovative performance and establishes the basis for robust organizational learning capabilities (Hull *et al*. 2020; Love *et al*., 2014). However, this argument has not been empirically proved yet to INVs, which typically operate in distant markets and international partners with few resources. By contrast, INVs entering international R&D partnerships may face serious appropriability hazards unless the necessary precautions are taken (Herstad *et al*., 2014). However, firms such as INVs that need to combine appropriability instruments and knowledge diversity may find difficulties in managing the opposite effects of both strategies (Capaldo and Petruzzelli, 2011). The main goal of this research is to extend current

theory to increase understanding on the real impact of diverse knowledge search and knowledge formal protection in INVs.

The research tests the moderator role of a heterogeneous base of international partners and formal knowledge appropriation strategy on the relationship between start-ups and their export performance. Our final sample consists of 344 start-ups and we used OLS regressions on a ten-year period panel data. The results show that compared to non-born global start-ups, born global firms benefit more from establishing relationships with a set of heterogeneous international partners. By contrast, all start-ups benefit from an extensive appropriation strategy if (when) they establish such alliances with diverse international partners.

Our study proceeds as follows. First, we discuss the theoretical background and provide the research hypotheses. Then, we introduce the methodology used and present the results of the analyses. After going through the discussion of the findings, we conclude the paper by discussing the main theoretical and managerial implications, followed by the concluding remarks, limitations, and future research.

2. Theoretical background and hypotheses development

2.1 External knowledge sources and international entrepreneurship

As summarized by the relatively recent knowledge spillover theory of entrepreneurship, knowledge lies at the heart of entrepreneurial activity (Acs *et al*., 2009). The positive relationship between knowledge and success has also been confirmed for international entrepreneurship literature (Oviatt and McDougall, 1994; Prashantam, 2005; Zahra *et al*., 2000). Recently, the study of Raza *et al*. (2020, p. 633) sought to solve the recurring dilemma "why do some new ventures thrive while others fail?" and the authors highlighted that new ventures with high level of external knowledge sourcing tend to be more innovative. In this vein, Guo *et al*. (2020) found that ambidexterity of knowledge sharing and knowledge protection enhances new product development. Similarly, Amankwah-Amoah and Adomako (2021) showed that knowledge integration is positively related to contextual ambidexterity, and human resource slack plays a key role in moderating this relationship.

International entrepreneurship decisions are highly dependent on both the market and technological knowledge of the founders and the subsequent learning process and information sources (i.e. De Clerq *et al*., 2012; Hull *et al*., 2020; Sharma and Blomstermo, 2003). To ignite this learning process, INVs founders, who typically lack the knowledge required to grasp the pool of market opportunities in international markets, try to build routines and processes that support the search for new and valuable knowledge from external sources (Gruber *et al*., 2013).

A significant stream of research on external knowledge search suggests that these external sources need to be heterogeneous independently of the governance of knowledge exchange (Gimenez-

Fernandez and Sandulli, 2017). In fact, there are a number of reasons that would explain why INVs will benefit more than other start-ups from a heterogeneous base of knowledge partners.

First, more diverse knowledge partners provide access to different skills and knowledge which will offer more opportunities for rapid learning (Pangarkar and Wu, 2013) which is basic in the international expansion strategy of born-globals. For instance, cooperation with suppliers, has been shown to help improve exploitation-related performance, cooperation with competitors can provide start-ups with access to industry-specific knowledge, while universities can lead to more radical innovations (de Leeuw *et al*., 2014). Despite some challenges that SMEs face (see Bertello *et al*., 2021), combining these different sources together will speed up the accumulation of knowledge required to early enter in international markets.

Second, INVs may also increase the speed of knowledge accumulation by exploiting the creative recombination, complementary alignment, and spillovers of heterogeneous knowledge (Hagedoorn *et al*., 2018) being more agile and better address multiple stakeholders' needs in several foreign markets (e.g. Ferraris *et al*., 2021; Shams *et al*., 2021). With this regard, Nemkova (2017, p. 257) clearly found that "agility is more likely to be positively related to international market performance" when managers possess experience and knowledge of the market as well as international one. Knowledge has not only value in absolute terms, but also in terms of compatibility with internal resources and capabilities (Roper *et al*., 2008). Therefore, with more diverse knowledge sources INVs may increase the likelihood of finding complementary knowledge. In this sense, diversity of knowledge sources will be an important factor favouring organizational learning in INVs, where the initial trial and error approach to external knowledge sourcing will be substituted over time by a more planned and accurate strategy (Love *et al*., 2014) that will be supported by new routines and improved managerial capabilities related not only to search and external knowledge integration but also to the management of heterogeneous knowledge itself. This view is in line with the theory of learning as a social process (Brown and Duguid, 2001), which is especially useful to understand how INVs explore and exploit new opportunities through the participation in knowledge exchanges within a community or a network of diverse actors (Colombo *et al*., 2006; Powell *et al*., 1996; Zahra *et al*., 2005).

Third, the outcome of entering international knowledge partnerships is highly uncertain because of the difficulties to define ex-ante both the actual value of the partner knowledge contribution (Hagedoorn *et al*., 2005). New international ventures may deal with this uncertainty by simply accessing an increasing variety of knowledge sources in order to have a higher likelihood of finding the right knowledge source (Leiponen and Helftat, 2010).

Recent literature suggests that not only knowledge heterogeneity but also partners' geographical distance may benefit external knowledge sourcing (Herstad *et al*., 2014; Rodriguez *et al*., 2018; Wang, 2015). First, in fact, recent evidence suggests that the primary requisite of successful INVs is the number and diversity of international partners, because the network of partners will

compensate for the lack of knowledge (Hughes *et al*., 2017). Moreover, the complexities of establishing early ties with international partners makes it a difficult to imitate strategy and therefore a source of competitive advantage (Karra *et al*., 2008). Second, a heterogeneous base of international knowledge partners may support rapid entry in multiple markets, since INVs will share risks and gain access to diverse resources of multiple partners (Freeman *et al*., 2010). Third, the heterogeneous network of international partners will also reduce the costs of knowledge access, since INVs do not need to create R&D facilities abroad to access local knowledge in international markets. Fourth, INVs participating in international knowledge exchanges are less affected by cultural differences because international partnerships focusing on knowledge exchange are more network-based than country-based, compared to other international partnerships with a different focus (Freeman *et al*., 2010). Fifth, a broader set of heterogeneous and international partners perform as a sign of quality that reinforce the legitimacy of INVs willing to enter international markets (Hoang and Antoncic, 2003).

Overall, it can be argued that:

Hypothesis 1*:* International new ventures will benefit more - in terms of international sales - from the heterogeneity of international knowledge sources than other start-ups.

2.2. Formal Appropriation Mechanisms in International Entrepreneurship

Since opportunistic behaviours are more likely to arise in international contexts (Oxley and Samson, 2004) – and several companies may behave opportunistically in their knowledge-gathering behaviors (Danik and Kowalik, 2020), INVs need to develop capabilities to explore and integrate knowledge from international partners as well as they also need to deploy suitable appropriation strategies in order to capture the rents from opportunities in international markets (Colombo *et al*., 2006; Gans and Stern 2003; Wang, 2015). The study of Guo et al., (2020) shows that knowledge protection, when applied simultaneously with knowledge sharing, has positive effects on the development of new products. Zhang and Groen (2021) recently found that firms adopt different modes of open innovation when they choose corresponding effective protection mechanisms and some relationships have been found also in SMEs (e.g. Freel and Robson, 2017). Besides, appropriability strategies in international technological knowledge exchanges can be expected to be even more important than in other international partnerships without knowledge exchange. This is especially true because in joint international R&D projects, there is always a higher risk of unanticipated knowledge leakage compared to joint national R&D projects (Hagedoorn *et al*., 2005). Secrecy, licensing and inimitability are conditions to succeed in foreign markets (Cannone and Ughetto, 2014; Oviatt and McDougall, 1994). INVs may use formal appropriation mechanisms that give the right to exclude others and are defensible in legal suits (Hall *et al*., 2014). Besides, INVs may use formal appropriation mechanisms such as patents to

improve terms of trade with international partners (Hsu and Ziedonis, 2013). Thus, formal Intellectual Property Rights (IPRs) are a safeguard in internationalization strategies that help INVs to capture the rents of new business opportunities in foreign markets. In fact, there is some evidence showing that the use of IPR protection increases the willingness of the firm to collaborate at a distance, with globally dispersed partners (Herstad *et al*., 2014).

Moreover, formal appropriation mechanisms are viewed as a codification of a technology or knowledge that can perform as a sign of firm's quality (Gick, 2008). Hence, the appropriation mechanism is itself a quality stamp (Shane, 2001). As already highlighted by Symeonidou *et al*. (2017), since INVs typically enter international markets without having a strong reputation or brand, they can also make use of appropriation mechanisms as a sign of quality of their products. INVs may use formal appropriability instruments also to attract better partners, since these instruments, such as patents, also serve as a proof of concept providing codified information about the nature of the patented invention, thereby reducing information asymmetries between INVs and potential partners about INVs R&D capabilities in contexts such as international cooperation where these asymmetries tend to be larger. Appropriability in INVs will be in this case a driver for internationalization (Kyläheiko *et al*., 2011), even more effective in case of policy support (Colombelli *et al*., 2020; Jafari-Sadeghi et al., 2020).

Moreover, formal appropriability strategies may help INVs to attract better complementary assets. For instance, INVs may use patents to attract financial investments and venture capital (i.e. Gambardella, 2013), that may help to speed up the internationalization process. According to the above arguments, the following hypothesis is proposed:

Hypothesis 2: International new ventures will benefit more - in terms of international sales - from formal appropriability instruments than other start-ups.

3. Methodology

To test our hypotheses, data from the Spanish Technological Innovation Panel database (PITEC) is used. The database is based on the annual Spanish responses to the Community Innovation Survey (CIS). The database includes yearly data on firms from all sectors of the Statistical Classification of Economic Activities in the European Community (NACE), being representative of the population of Spanish firms. The present paper considers the first year in the database with reliable data on start-ups, 2004 as the focal year. From the whole sample, a ten-year period is gathered to test our model on start-ups created in 2004. Due to some missing data, our initial sample consists of 344 start-ups and 2360 observations.

Since our goal is to analyse moderators on the relationship between born global firms and their international market performance, this study uses export performance as dependent variable following former research on international entrepreneurship (Cavusgil and Knight, 2015; Knight

and Cavusgil, 2004). Precisely, our dependent variable will measure the ratio exports/turnover, excluding trade within the European Community[1].

In this study, born global firms are considered as the start-ups that sold products or services to international markets the year they were created, in this case year 2004; while the international diversity of knowledge sources is defined as the cooperation agreements with a diversity of external agents from other countries than Spain. The survey asks whether the firm cooperated during the last three years with the following partners: suppliers, customers (private and public sector), competitors or other firms from the same activity field, consultants or commercial laboratories, universities or other higher education institutes, public or private research centres and technological centres; and by location. Following the methodology of Laursen and Salter (2006, 2014), the variable international cooperation breadth is constructed as the addition of those seven cooperation partners. Each of the seven cooperation partners is coded as a binary variable, 1 if the firm cooperated with that partner, and 0 being no use. Subsequently, the seven types of cooperation partners are added up so that each start-up gets a 0 when no cooperation agreements with any type of partner were taken in the last three years, and the start-up gets the value of 7 when it cooperated with all the different types of partners in the last three years. Since literature on innovation has largely discussed for an inversed-U shape (e.g. Laursen and Salter, 2006), it is included its square term. The interaction term between international cooperation breadth and INVs is created.

The addition of the different appropriation mechanisms that a firm uses generates its appropriation strategy (Cohen *et al*., 2000; Laursen and Salter, 2014). There are four main formal appropriation mechanisms that together consist of the formal appropriation strategy of a firm: patents, trademarks, copyright, and design rights. Adapting Laursen and Salter (2014) methodology, the formal appropriation strategy is measured by the addition of these four appropriation mechanisms. Each mechanism is codified as a binary variable, being 1 if the firm registered or applied it during the last three years, and 0 otherwise. Thus, the formal appropriation strategy gets the value of 4 when all the mechanisms were used by the start-up, and 0 if none has been used. The interaction term between the appropriation strategy and INVs is included.

Consistent with existing literature, the following control variables are included. First, as scholars consider internal R&D to be crucial for innovation, and a proxy for absorptive capacity (Cohen and Levinthal, 1990), firm's internal R&D efforts is included, measured as the proportion of its internal innovation expenses. Second, it is controlled for firm size as organizational size may benefit external learning in start-ups (Almeida *et al*., 2003). This variable is measured by the natural logarithm of the total number of employees. Third, a dummy variable is included to control

[1] The questionnaire excludes trade within the European Community as a consequence of the single internal market in the European Union.

if the firm belongs to a group because INVs belonging to a corporate may benefit from larger resources to enter international markets (Criscuolo *et al*., 2012). Fourth, the R&D intensity of the industry is considered by building a dummy variable to indicate whether the start-up belongs to a high-tech sector. Finally, controlling time-varying effects is necessary in a rapid changing environment such as international markets and therefore a dummy variables is created to control the observation year. A brief description of the variables used to test the model is included in Table I.

*** *Table I about here* ***

4. Results

The descriptive statistics and correlations between the variables of the whole sample are presented in Table II. Table III refers to the descriptive statistics distinguishing between INVs and non-INVs. Results show that INVs are 29 per cent of the start-ups sample and that half of the sample (54%) operates in high-tech industries. The results also show that exports are the main entry mode to foreign markets. After conducting a variance inflation factor (VIF) test, none of the correlations are sufficiently strong to suggest multicollinearity problems.

*** *Table II about here* ***

*** *Table III about here* ***

The condition of INVs is fixed and no time dependent and therefore the study uses OLS estimations of pooled data instead of panel-based estimations. To avoid any bias caused by heteroscedasticity, we have run robust estimators of the OLS regressions. The regression model to test our model is:

(#1) Export performance $= \beta_0 + \beta_1$*Born global firms* $+ \beta_2$*Int. Coop. Breadth* $+ \beta_3$*Int. Coop. Breadth^2* $+ \beta_4$*Formal App. Strat.* $+ \beta_5$*Int. Coop. Breadth x Born global firms* $+ \beta_6$*Int. Coop. Breadth^2 x Born global firms* $+ \beta_7$*Formal App. Strat. x Born global firms* $+ \beta_8$*InternalR&D* $+ \beta_9$*Size(ln)* $+ \beta_{10}$*Group*$+\beta_{11}$*High-Tech*$+ \beta_{12}$*YearDummies* $+ \varepsilon$

The results of the OLS regressions can be found in Table IV. Model I contains the control variables and Model II shows the direct effects of INVs, international cooperation breadth, and formal appropriation strategy on exports. The results of this model show that the larger the heterogeneity of international knowledge sources and the more extensive the appropriation

strategies the larger the exports of start-ups in our sample. Model III tests the first hypothesis. The main result of this model is that the interaction coefficient between heterogeneity of international knowledge sources and international entrepreneurship is significant and positive (β=6.011, $p<0.01$), confirming our first hypothesis. This means that INVs will benefit more in terms of international sales from the heterogeneity of international knowledge sources than other start-ups. Model IV tests the second hypothesis. The results show a significant and positive interaction between formal appropriation strategies and international entrepreneurship (β=2.667, $p<0.01$), confirming the second hypothesis. Hence, our findings show that INVs will benefit more in terms of international sales from formal appropriability instruments than other start-ups.

Regarding the control variables, the main result is that corporate group variable is significant and positive in all models, meaning that start-ups belonging to a corporate group have larger exports. The lack of significant results for the high-tech industry variable and R&D intensity does not allow to draw any significant conclusion.

**** Table IV about here ****

4.1 Robustness checks

To test the robustness of the findings several additional tests were performed (not reported for the sake of brevity). First, we run mean difference tests for the main variables of our model. We found that international cooperation breadth and export performance are significantly higher in INVs than in other start-ups. Regarding the formal appropriability strategy variable, the mean value is higher for INVs than for other start-ups, but the mean difference did not result significant.

Second, to improve the reliability of our findings, we checked an alternative measure of our independent variable. We measured the export performance in terms of the volume of exportations per employee and run the OLS regressions. The significance and sign of the coefficients in the OLS regressions do not change with the new measure of the variable, confirming our hypotheses.

Third, several OLS regressions were ran by adding other control variables. Start-ups identify multiple market opportunities before deciding the first market entry of their emerging firms (Gruber *et al*., 2008). Thus, a variable referred to market scope is included, measured by the addition of the involvement in different markets: local, national, European, and other international markets (Laursen and Salter, 2014). Results of the OLS regressions do not change after introducing that variable. Some scholars have highlighted the innovative nature of start-ups (Gruber *et al*., 2008), which might influence the export performance. A further control variable

is included to indicate whether the start-up has introduced product innovations to the market or not; and the results do not change after introducing that variable.

Finally, attrition may generate a bias that may distort the estimates (Colombo *et al*., 2006). Since the study is based on secondary data, an attempt was made to control for extent by introducing a dummy variable that measures whether the firm survived to the next year or not. Results of the OLS regressions do not change after introducing that variable. As an alternative way to control for attrition bias, the model with the firms that survive to the full period of analysis was performed. Results remain similar in magnitude and statistically significant.

5. Discussion

The aim of this study was shed light on how INVs may benefit from external knowledge sourcing. The results confirm the theoretical model which proposed that INVs should devote more efforts than other start-ups to create a heterogeneous set of international knowledge partners and to establish formal appropriation strategies because the marginal return to these strategies will be higher in INVs than in other start-ups. This work provides significant clues on why INVs are capable of succeeding while defying traditional management perspectives such as the perspective of gradual entry in international markets (Johanson and Vahlne, 1977) or the view that absorptive capacity is built through internal knowledge accumulation (Cohen and Levinthal, 1990). The significant contribution of this paper suggests that future research on international entrepreneurship should pay special attention to two core capabilities for international entrepreneurship underlying the results of this research: organizational learning and ambidexterity. Regarding organizational learning, in line with former research (Powell *et al*., 1996) our results suggest that heterogeneous international knowledge sources are not only complementary within the same time period, but also that INVs learn from some diverse links to develop new and even more diverse linkages. Collaborative work in one country or one knowledge field alerts INVs to the need to access ideas and information from a variety of countries and knowledge fields. From this experience gained from collaboration in one field or market, INVs can develop capabilities that can be used with other partners or in other markets, and learn to do this better through time. Moreover, since time is a critical variable in INVs´ competitive strategies, the results of our research complement existing research by showing that not only the size of the network of international knowledge partners (Freeman *et al*., 2010) but also the diversity of these networks may increase the learning speed in INVs. Overall, our results confirm Fernhaber *et al*. (2009) in that absorptive capacity arguments that suggest that pre-existing knowledge is an essential condition for maximum learning, cannot be applied to INVs and that the strong contribution of external knowledge sources to INVs strategies is better explained by the learning advantages of newness (Autio *et al*., 2000).

Nevertheless, the results of our research also show an inverted U-shaped relationship between heterogeneity of international knowledge partners. This result shows that there are limits to the value of diverse and distant linkages for innovation in INVs. INVs will have costs related to partner search, to appropriate contractual agreements for diverse formal linkages, and to maintain these linkages through time. Besides, INVs managerial teams have a limited span of attention and low capacity to pay attention to and cognitively process many sources of information. In this sense, this research shows for the first time in international entrepreneurship literature this U-shaped relationship between heterogeneity and performance, which has been already observed in other management research fields (Laursen and Salter, 2006). This result means that while the returns to additional international knowledge linkages may at first be positive, eventually INVs will reach a point at which an additional international linkage actually serves to diminish the innovation returns to external networking. Therefore, INVs should be cautious in defining the span of their knowledge alliance networks since there is a point where the benefits of fast learning may be offset by the costs of establishing these alliances.

The second relevant concept underlying the results of this research is that solving the challenging balance between openness and appropriability is especially relevant in INVs strategies. Our results show that INVs have strong incentives to enter cooperation agreements with diverse international partners. Obviously, in these knowledge exchanges there will be always some level of information disclosure. By contrast, in international markets with high transaction costs, our results show that INVs also have strong incentives to keep their knowledge secret in order to capture as much value as possible from it. The significant results for exploration and appropriability strategies may suggest that knowledge alliances for INVs may be more vehicles for accessing rather than acquiring capabilities according to the framework in Mowery *et al*. (1996). Thus, INVs may be entering knowledge exchanges that facilitate reciprocal specialization and will follow a divergent development (Nakamura *et al*., 1996) by searching for international knowledge partners with dissimilar but complementary capabilities.

Contrary to other start-ups, INVs are created with an international perspective from inception, breaking the gradual learning process to enter into foreign markets. An early international expansion would bring more opportunities to INVs to capture the international rents from their innovations, but they need from an appropriation strategy to assure the value capture. The results are also in line with previous literature on the called 'paradox of openness' (Arora *et al*., 2016) in that INVs want to protect their focal innovation produced through collaboration in international markets, their background knowledge and also want to send out precise signals about their value as innovators to customers and future partners.

6. Conclusion

6.1 Theoretical and managerial implications

This study analyses the impact of external knowledge sources and formal knowledge appropriation strategy on performance of international new ventures. The results show that both strategies have a positive effect on export performance. At the empirical level, this research contributes by comparing INVs with other start-ups, while previous literature tends to focus only on INVs. Our study advances on the integration of the internationalization theory with the entrepreneurship theory. In particular, our study increases knowledge on how INVs make use of a diversity of international partners. This study supports the relevance of organizational learning through external knowledge sourcing in the success of INVs. Our research confirms that INVs benefit more from the learning process based on heterogeneous technological knowledge from international knowledge partners. Even in a context with high transaction costs, wide cooperation strategies yield positive results to firm with scant resources, such as INVs. However, the results show a curvilinear relationship between partner heterogeneity and international sales in the context of INVs. Therefore, firms should be cautious in their trial and error learning process in not trying to create too wide networks. This study is also the first to confirm that the openness paradox is also relevant for INVs and that formal appropriation mechanisms contribute significantly to the exports performance of INVs. The lack of reputation, international knowledge and the risks of opportunistic behavior advise these firms to have an appropriation strategy. The research contributes to an improved understanding of how INVs may use IPRs to capture the value from their innovations when they interact in international markets.

For the open innovation literature, this paper is one of the first to investigate the connection between entrepreneurship and open innovation (Flamini *et al.*, 2021), and the first to apply the cooperation breadth in the context of international new venture. While most of open innovation literature has focused on large firms, and some scholars recently are researching on SMEs, the study of open innovation in start-ups in general and INVs in particular is an area much unexplored that needs more research.

From a managerial level, this study has several implications for policy and practice. First, INVs managers need to devote attention, time and resources to build early capabilities related to alliance management and IP protection since the study has evidenced the positive effect of these two strategies for born global firms' export performance. Second, the research explains how born global firms can make use of a diversity of international partners to enhance their export performance, but having too many cooperation partners could diminish the returns in their exports. Accordingly, managers of these firms should balance the number of different types of partners to maximise their international market performance. In this way, a medium level of cooperation breadth will allow to absorb the international knowledge required by these firms.

Third, INVs managers should be aware of the risks of operating in foreign markets from inception. A mechanism to protect their innovations and capture the value from them is to use formal appropriation mechanisms.

From a policy perspective, the design of programmes of firm internationalization should include a special consideration of born global firms due to the importance of these firms for economic growth and wealth creation. Although there are some programmes in Europe that help start-ups and entrepreneurs to connect with foreign markets and international partners, few firms access to them. An improved diffusion of the programmes and new instruments to support early international expansion of start-ups will improve the number of born global start-ups and their successes. In addition, the difficulties and costs of having IPRs keep start-ups away from applying for them. More information and incentive programs to favour INVs access to appropriation mechanisms would help these firms to be more competitive.

6.2 Limitations and future research

This study has some limitations that leave some questions unanswered, which in turn suggests future research opportunities. First, the use of secondary data limits the measurement of our variables. Due to the lack of information about informal appropriation mechanisms and the intensity in its use, this study only focused on formal appropriation mechanisms. However, as literature has found that the use of informal and formal appropriation mechanisms are highly positively correlated (Alcacer *et al*., 2017), it is not expected that if including also the informal mechanisms the results would change. Nevertheless, future studies could create a measure weighting by the degree of importance of the different mechanisms, as well as the country in which these IPRs are filled. Second, our dataset is based on Spanish firms and considers export performance as sales outside the European Union. It would be desirable to differentiate between national and European sales performance, as well as using other sampling frames to extend the validity of the findings (e.g. Radojevic *et al*., 2021). Third, our sample could suffer from some survivorship bias since our focal year is 2004 and the panel only provides information about start-ups that were alive during data collection for that year. Given that the study samples start-ups this is a limitation to any start-up study. Another potential area for future research would be extending the analysis carried in this research by considering the cultural and institutional distance between firms and countries to investigate the called liability of foreignness (Zaheer, 1995). Overall, our study calls for further research on the extremely relevant fields of organizational learning processes and ambidextrous capabilities in international new ventures, in addition to the consolidation of a knowledge-based theory of international entrepreneurship.

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Table I. Variable description

Variable	Description
Exports	Proportion relative to turnover of exports.
New international ventures	Dummy variable to indicate whether the start-up sold its products in foreign markets during 2004 or the two previous years.
Int. Coop. Breadth	Addition of seven cooperation partners: suppliers, customers (private and public sector), competitors or other firms from the same activity field, consultants or commercial laboratories, universities or other higher education institutes, public or private research centers and technological centers.
Formal Appr. Strategy	Addition of the use of the four appropriation mechanisms: patents, trademarks, copyright, and design rights.
Internal R&D	Proportion of firm's internal innovation expenses.
Size	Natural logarithm of the total number of employees.
Group	Dummy variable to indicate if the firm belongs to a firm group.
High-tech	Dummy variable to indicate whether the start-up belongs to a high-tech sector.
Year	A set of dummy variables for the observation year.

Table II. Correlations

Variable	Mean	Stand. dev.	1	2	3	4	5	6	7
Exports	6.38	17.68							
New international ventures	0.29	0.45	0.28***						
Int. Coop. Breadth	0.44	1.10	0.14***	0.09***					
Formal Appr. Strat.	0.62	0.87	0.15***	0.02	0.18***				
Internal R&D	63.80	38.60	0.06***	0.05**	0.15***	0.12***			
Size	38.62	89.85	0.04**	0.10***	0.05**	-0.01	-0.02		
Group	0.32	0.47	0.09***	0.08***	0.14***	0.01	-0.00	0.32***	
High-tech	0.54	0.50	-0.05**	-0.16***	0.16***	0.11***	0.26***	-0.07***	-0.07***

Note: * p < 0.10; ** p < 0.05; *** p < 0.01

Table III. Descriptive statistics

	Born global firms (n: 677)				Non-born global firms (n: 1683)			
Variable	Mean	Stand. dev.	Min.	Max.	Mean	Stand. dev.	Min.	Max.
Export perform.	14.19	22.66	0	100	3.25	14.05	0	100
Int. Coop. Breadth	0.60	1.23	0	6	0.38	1.03	0	7
Formal Appr. Strat.	0.65	0.88	0	4	0.61	0.87	0	4
Internal R&D	66.60	36.93	0	100	62.67	39.21	0	100
Size	52.33	77.94	1	610	33.10	93.67	1	1112
Group	0.37	0.48	0	1	0.30	0.46	0	1
High-tech	0.41	0.49	0	1	0.59	0.49	0	1

Table IV. OLS regressions (Robust Estimations)

	Model I	Model II	Model III	Model IV
Internal R&D	0.032***	0.011	0.012	0.012
	[0.009]	[0.009]	[0.009]	[0.009]
Size	0.980***	0.017	0.107	-0.013
	[0.279]	[0.263]	[0.265]	[0.264]
Group	1.932**	1.774**	1.536*	1.669**
	[0.917]	[0.861]	[0.878]	[0.869]
High-tech	-1.746**	-1.162	-1.261*	-1.202
	[0.788]	[0.800]	[0.795]	[0.797]
Year dummies	Yes	Yes	Yes	Yes
Born-gobalfirms		10.014***	9.435***	8.343***
		[0.984]	[1.025]	[0.956]
Int. Coop. Breadth		3.804***	1.780*	3.701***
		[1.134]	[1.320]	[1.133]
Int. Coop. Breadth^2		-0.590***	-0.054	-0.573***
		[0.250]	[0.322]	[0.250]
Formal Appr. Strategy		2.678***	2.649***	1.916***
		[0.502]	[0.501]	[0.530]
Int. Coop. Breadth x			6.011***	
New international ventures			[2.395]	
Int. Coop. Breadth^2 x			-1.600***	
New international ventures			[0.501]	
Formal Appr. Strategy x				2.667**
New international ventures				[1.268]
Constant	1.79	-0.383	-0.523	0.092
	[1.263]	[1.192]	[1.193]	[1.213]
R-squared	0.033	0.13	0.137	0.134
No of Obs	2360	2360	2360	2360
F test	5.67***	14.66***	16.49***	16.52***

Note: Robust standard errors in parenthesis. * p< 0.10; ** p < 0.05; *** p < 0.01

Table IVb. Volume of Exports per Employee as Dependent Variable

	Model I	Model II	Model III	Model IV
Internal R&D	28.446	-9.886	3.582	-12.486
	[34.192]	[33.849]	[33.604]	[33.837]
Size	3623.862***	1405.169	1696.4	1486.661
	[1057.709]	[1063.833]	[1057.362]	[1063.447]
Group	15413.41***	15039.03***	15056.99***	15323.66***
	[3074.256]	[3025.55]	[3015.916]	[3025.305]
High-tech	-5084.031*	-2847.607	-3869.683	-2738.91
	[2667.971]	[2692.126]	[2672.234]	[2690.073]
Yeardummies	No	No	No	No
Born-gobalfirms		25121.1***	16640.48***	29634.31***
		[2874.622]	[3201.992]	[3477.376]
Int. Coop. Breadth		15466.15 ***	410.5345	15744.06***
		[3116.864]	[3810.695]	[3116.346]
Int. Coop. Breadth^2		-2979.45***	-8.743369	-3026.421***
		[681.765]	[829.62]	[681.445]
Formal Appr. Strategy		-939.1755	-1076.569	1116.555
		[1476.492]	[1637.744]	[1724.392]
Int. Coop. Breadth x			42581.87***	
New international ventures			[6332.961]	
Int. Coop. Breadth^2 x			-8595.624***	
New international ventures			[1422.153]	
Formal Appr. Strategy x				-7204.325**
New international ventures				[3129.613]
Constant	-2306.969	-3759.628	-3480.615	-5040.483
	[4682.739]	[4701.128]	[4664.603]	[4729.663]
R-squared	0.035	0.078	0.096	0.080
Adj.R-squared	0.029	0.072	0.089	0.073
No of Obs	2360	2360	2360	2360
F test	6.46***	11.71***	13.06***	11.37***

Note: Robust standard errors in parenthesis. * p< 0.10; ** p < 0.05; *** p < 0.01