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**Does age matter? The impact of SMEs age on the relationship between knowledge sourcing strategy and internationalization**

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(Article begins on next page)

## **Does age matter? The impact of SMEs age on the relationship between knowledge sourcing strategy and internationalization**

### **Abstract**

The use of external knowledge has received substantial attention in the literature of innovation management and open innovation alike. However, despite the interest in understanding the impact of knowledge sourcing strategy on financial and innovative performance, there is still a lack of studies assessing the impact on internationalization. Drawing on the inbound open innovation perspective, we theorize that searching widely and deeply is related to internationalization performance and that firm age contributes to enhance this relationship. Based on data gathered from 135 small and medium enterprises (SMEs), we found support for the positive relationship between knowledge sourcing strategy and internationalization, but not for the moderating role of firm age. These findings offer several implications to managers and scholars alike.

***Keywords:* SMEs; knowledge sourcing strategy; internationalization; age.**

### **Introduction**

Innovation has been long considered the key to sustain firms' competitive advantage, especially for the current dynamic environment, and to the shortening of product lifecycles in most industries (Lengnick-Hall, 1992; Taghizadeh, Rahman & Hossain,

2018). Accordingly, scholars have suggested that firms must expand ties with external stakeholders to reduce the development and commercialization phase of new products and services, ultimately reducing the time to market and anticipating technological trends (Chesbrough, 2006). This phenomenon, which has been called “open innovation” in the literature, has achieved increasing interest among practitioners and scholars alike. Specifically, open innovation has been defined as “a distributed innovation process that involves purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model” (Chesbrough & Bogers, 2014, p. 12).

In the current socioeconomic scenario, firms that aim to gain and maintain competitive advantage need to embrace co-creation initiatives leveraging stakeholders’ resources and competences (Schack, 2004; Del Giudice & Maggioni, 2014; Ferraris, Santoro & Dezi, 2017). This “open” process can be described as an active, dynamic, and social paradigm based on interactions and relationships between firms and external stakeholders (Ritala, Husted, Olander, & Michailova, 2018; Segarra-Ciprés & Bou-Llusar, 2018). Accordingly, many scholars have argued that firms need to involve several types of external stakeholders in the process in order to create substantial value and strive in the competitive landscape (Swan, Newell, Scarbrough & Hislop, 1999; Laursen & Salter, 2006; Del Giudice, Carayannis & Maggioni, 2017). By embracing co-creation with various types of external stakeholders, firms can achieve several advantages such as risk and time to market reduction and increased innovation performance (Laursen & Salter, 2006; Ferraris, Santoro & Scuotto, 2018; Thrassou, A., Orfanos, & Tsoukatos, 2018).

Despite these benefits, there has been a scarcity of studies assessing the relationship between open innovation and internationalization processes so far, which can be considered vital for small and medium enterprises (SMEs), for at least two reasons. First, internationalization can be viewed as an entrepreneurial opportunity-seeking behavior for smaller firms, whereas SMEs managers seek to explore how current and new products and services can be sold abroad. Therefore, internationalization can be considered part of the innovation strategy (Kafouros, Buckley, Sharp & Wang, 2008). Second, SMEs typically lack the resources and competences to organize the whole innovation process and therefore they need to be open to external sources not only to innovate (Ferraris, Santoro & Papa, 2018; Soto-Acosta, Popa, & Martinez-Conesa, 2018) but also to pursue internationalization strategies (Villar, Alegre & Pla-Barber, 2014). Internationalization processes are extremely important for firms which have encountered maturity in internal markets where sales are stagnating (Ardito, Ferraris, Petruzzelli, Bresciani, & Del Giudice, 2018; Rua, França, & Fernández Ortiz, 2018). Nevertheless, Battisti, Gallego, Rubalcaba, & Windrum. (2015) did not find positive synergistic effects between the intensity of knowledge sourcing and international sales. However, the authors focused on just the service industry and therefore more insights are needed in this regard, especially in the context of SMEs. In addition, they focused on the potential complementary effect of internationalization and search depth on innovation performance, thus neglecting the linear effect of both search breadth and depth on internationalization which, to the best of our knowledge, hasn't been tested so far. Search breadth concerns how broadly a firm should search for external knowledge, while the search depth regards the intensity of the relationship with each external source (Laursen & Salter, 2006).

Further, in this research we hypothesize that there is a moderating role of firm age on the relationship between knowledge sourcing strategy and internationalization. Given that the accumulation of prior knowledge is conducive to a firm's acquisition, assimilation, and application of external technologies for innovation effort (Cohen & Levinthal, 1990), we posit that older firms are capable of accumulating knowledge for internationalization processes. Prior research has argued that the production of a firm improves with a firm's age because the firm is likely to establish well-embedded and robust routines from previous operating experiences (Nelson & Winter, 1982; Carayannis, Grigoroudis, Del Giudice, Della Peruta, & Sindakis, 2017; Peruffo, Marchegiani, & Vicentini, 2018).

As a consequence, in this paper we aim at answering the following research questions: what is the relationship between open innovation and internationalization, and what is the impact of firm age on the relationship between knowledge search strategy and internationalization? In answering these questions, this research posits that searching for knowledge, both widely and deeply, is linearly related to internationalization as involving different stakeholders in the innovation process can help in a) developing products/services that are appreciated globally, b) acquiring knowledge on how to grow internationally, and c) developing competences to sell products/services abroad successfully. These three points are more emphasized in the context of SMEs as smaller firms typically have fewer competences and resources for both innovation and internationalization processes (Del Brìo & Junquera, 2003; Larsen & Lewis, 2007; Van de Vrande, De Jong, Vanhaverbeke & De Rochemont, 2009).

To answer these research questions, this study employs a quantitative approach involving SMEs operating in different sectors, both within the service and the manufacturing industry. Specifically, the study uses data gathered from 135 SMEs, and implements OLS regression analysis to test several research hypotheses. We found support for the relationship between knowledge search strategy and internationalization, but not for the moderating role of firm's age.

This study adds to the body of knowledge regarding open innovation, suggesting that search breadth and depth of knowledge provide SMEs with resources and competences for developing innovative products that can be accepted by international markets. This finding provides literature with an empirical demonstration that open innovation has an impact on internationalization performance, while previous studies focused on innovation and financial performance (Laursen & Salter, 2006). A second theoretical implication regards the insights concerning the moderating effect of the age on the relationship between knowledge sourcing and internationalization, which is not supported by our data. In this regard, while it is true that previous studies have suggested that firm age is arguably an essential proxy for organizational processes (Thornhill & Amit, 2003; Petruzzelli, Ardito & Savino, 2018), and that age and experience affect innovation (Arora, Gambardella, Magazzini, & Pammolli, 2009), we did not find support for the effect on internationalization. Indeed, according to our research model, firm age seems to have a negative effect on the relationship between open innovation (specifically knowledge search depth) and internationalization performance.

The remainder of the paper is organized as follows. The next section offers a review of the literature on open innovation in SMEs and on knowledge sourcing strategies. In the third section, we develop hypotheses about the positive effect of search breadth and search depth on internationalization and the moderating role exerted by firm age. Then, we present the data, methodology, and variables used in our study. Finally, we highlight the results of the analysis, proposing a novel discussion in the light of existing literature as well as recommendations to academics, managers, and practitioners.

## **Literature**

### *Open innovation in SMEs*

Open innovation is a model that describes how organizations can innovate by soliciting ideas from outside the organization or how they can benefit from their innovation activities through sharing internal intellectual property with external partners (Chesbrough, 2006). There are three categories of open innovation: inbound, outbound, and coupled. In inbound open innovation, ideas flow into the organization from partners such as customers, suppliers, competitors, universities, or governments and are used with ideas developed inside with the ultimate goal of innovating (Laursen & Salter, 2006; Martinez-Conesa, Soto-Acosta & Carayannis, 2017).

By contrast, outbound open innovation is the process of leveraging internally developed ideas and intellectual property to external partners through licensing, selling intellectual property, spinning off parts of an organization, alliances, and joint ventures (Bellantuono, Pontrandolfo & Scozzi, 2013). Finally, coupled open

innovation refers to organizations engaging in both inbound and outbound open innovation simultaneously. The majority of open innovation research to date has focused on large and multinational organizations (Brunswicker & van de Vrande, 2014) or particular industries, such as high-tech, while SMEs engaging in open innovation are still rather unexplored (Brunswicker & van de Vrande, 2014). Nevertheless, open innovation in SMEs has attracted growing interest lately (Santoro, 2017; Scuotto, Santoro, Bresciani, & Del Giudice, 2017; Gama, Frishammar, & Parida, 2018). While there is ample evidence that SMEs do engage in open innovation, how open innovation takes place in SMEs and how SMEs open innovation differs from large organizations remains unclear (Brunswicker & van de Vrande, 2014; Scuotto, Del Giudice, Bresciani, & Meissner, 2017).

Given that SMEs are at a disadvantage in innovation due to their size and level of resource availability (Thrassou & Vrontis, 2008; Festa, Ciasullo, Vrontis, & Thrassou, 2017), they are more likely to have an external and boundary-spanning component in their managerial approaches (Brunswicker & Vanhaverbeke, 2015), thus exploiting knowledge sourcing strategies. In fact, despite a novel field of inquiry, recent articles suggest that SMEs are able to pursue different open innovation strategies at the same time (Spithoven, Vanhaverbeke, & Roijakkers, 2013) and that they benefit in leveraging stakeholders' resources and competences (Scuotto et al., 2017; Tardivo, Santoro, & Ferraris, 2017; Santoro, Bertoldi, Giachino, & Candelo, 2018).

### Knowledge sourcing strategy

Knowledge search strategies are a fundamental part of the open innovation strategy (Giampaoli, Ciambotti, & Bontis, 2017; Santoro, Vrontis, Thrassou, & Dezi, 2018). In this regard, it is possible to understand the impact of knowledge acquisition from the knowledge-based view (KBV) of the firm, which rests on the assumption that firm resources are the main sources leading to competitive advantage (Teece 1984; Wernerfelt 1984; Barney 1991). Knowledge is proposed to be the core resource for obtaining competitive advantage (Conner and Prahalad 1996; Grant 1996; Kogut & Zander 1992), and thus it impacts the extent to which firms collaborate with others (Dyer & Singh 1998; Brusoni, Prencipe, & Pavitt, 2001). Access to specialized, complementary assets is argued to be the main reason firms engage in innovation through open processes (Wu & Chen, 2014; Natalicchio, Ardito, Savino, & Albino, 2017). The knowledge-based view has however expanded much further than viewing knowledge as a mere, but important, asset. Building on Penrose's (1959) notion of knowledge as the skilled process of leveraging resources, knowledge is perceived as the component that enables a firm to use resources to create competitive advantage (Oliva, Couto, Santos, & Bresciani, 2018).

Understanding the communication, coordination, and combination of knowledge as the core of the firm has enabled the explanation of many aspects of the existence, structure, and strategy of organizations (Conner & Prahalad 1996; Kogut & Zander 1996). In this regard, firms find it increasingly difficult to achieve successful innovation on their own (Santoro, 2017; Papa, Dezi, Gregori, Mueller, & Miglietta, 2018; Santoro, Bresciani, & Papa, 2018). Knowledge sourcing strategy has been suggested as an effective method for addressing the increasing complexity and uncertainty of the competitive landscape and business processes (Díaz-Díaz & de Saá

Pérez, 2014; Ortiz, Donate, & Guadamillas, 2018). To improve the flexibility and adaptability to environmental changes, it is suggested that firms broaden their knowledge base by acquiring external knowledge from diverse sources (Katila & Ahuja, 2002; Mu, Peng & Love, 2008; Santoro, Ferraris & Vrontis, 2018).

In this regard, the concepts of search breadth and search depth have been proposed (Laursen & Salter, 2006). The first concerns how broadly a firm should search for external knowledge, while the second regards the intensity of the relationship with each external source.

These contributions advocate that knowledge search plays a key role in helping firms generate solutions for emerging problems (Felin & Zenger, 2014). However, knowledge searching is not an easy job as it is arguably quite complex and difficult, involving sophisticated characteristics such as the tacitness, competitiveness, and indivisibility of firm knowledge (Lopez-Vega et al., 2016; Manfredi Latilla, Frattini, Messeni Petruzzelli, & Berner, 2018). The question of how the breadth and depth of knowledge search activity is beneficial for organizational innovation development has attracted substantial academic interest. For example, Laursen & Salter (2006) found that searching widely and deeply (search breadth and depth) is curvilinearly (taking an inverted U-shape) related to performance. By considering the dynamism of the external environment, Chiang & Hung (2010) suggested that search breadth is positively related to perceived firm performance in less technologically dynamic environments, while this positive effect turns into a negative in highly technologically dynamic settings. Overall, by embracing co-creation with various types of external stakeholders, firms can achieve several advantages such as risk reduction, reduced

time to market, and increased innovation performance (Lin, Wu, Chang, Wang, & Lee, 2010; Dezi, Santoro, Gabteni & Pellicelli, 2018).

### **Research Hypotheses**

Globalization is an important factor contributing to a shift towards open innovation (Bogers, Chesbrough & Moedas, 2018). As firms are driven to change because of intensifying innovation-based globalized competition and increasing complexity of knowledge and products, innovation policy needs to evolve in order to reflect the new global industrial landscape (Chaston & Scott, 2012; Campanella, Della Peruta, Bresciani, & Dezi, 2017). Moreover, a growing international division of labor and knowledge has increased the number and geographical diversity of relevant knowledge sites, forcing firms to access external knowledge to support their value chain activities (Rothaermel & Hess, 2007) and, thus, to create and manage connections with other organizations (Hess & Rothaermel, 2011). In a globally competitive environment, the generation and transfer of knowledge are key to sustainable competitive advantage (Mudambi & Tallman, 2010).

From another point of view, opportunities to access foreign markets and upgrade technological capabilities, products, and services have increased due to falling transport costs and trade barriers, and greater market opportunities (Bresciani & Ferraris, 2016). Especially in Italy and all over Europe, foreign sales have prevented firms from suffering crisis especially during the last crisis that Europe faced from 2008 on.

In this regard, internationalization can be viewed as an entrepreneurial opportunity seeking behavior in SMEs, whereas SMEs managers seek to explore how current and new products and services can be sold abroad. However, an issue that has not been empirically tested in prior empirical research on open innovation is the existence of a complementary link between knowledge search and internationalization. One exception is Battisti et al. (2015), which did not find a positive synergistic effect between the intensity of knowledge sourcing and international sales. However, the authors focused on the service industry and therefore more insights are needed in this regard, especially in the specific context of SMEs.

Accordingly, literature has shown that firms, both larger and smaller ones, with broad and deep external ties are more likely to develop successful innovations that are both new to the firm and new to the world products and services (Laursen & Salter, 2006; Cruz-González, López-Sáez, Emilio Navas-Lopez & Delgado-Verde, 2014). As a consequence, innovative SMEs will be more active in international markets due to their successful innovations, which very likely will be successful abroad too. In addition, from a resource-based view and a knowledge-based view perspective, SMEs typically lack the resources and competences to organize the whole innovation process. Therefore, they need to be open to external sources not only to innovate (Vrontis, Thrassou, Santoro & Papa, 2017) but also to pursue internationalization strategies (Villar et al., 2014). To sum up, we posit that searching for knowledge, both widely and deeply, is linearly related to internationalization as involving different stakeholders in the innovation process can help in a) developing products/services that are appreciated globally, b) acquiring knowledge on how to

grow internationally, and c) developing competences to sell products/services abroad successfully.

For these reasons, we propose the following research hypotheses:

*Hypothesis 1a: knowledge search breadth is positively associated with internationalization measured by firm's foreign sales on total sales.*

*Hypothesis 1b: knowledge search depth is positively associated with internationalization measured by firm's foreign sales on total sales.*

Firm age is arguably an essential proxy for organizational processes, including innovation and internationalization processes (Thornhill & Amit, 2003; Petruzzelli, Ardito & Savino, 2018). Given that the accumulation of prior knowledge is conducive to a firm's acquisition, assimilation, and application of external technologies for innovation effort (Cohen & Levinthal, 1990), we posit that older firms are capable of accumulating knowledge for innovation and internationalization processes. It is argued that the production of a firm improves with a firm's age because the firm is likely to establish well-embedded and robust routines from previous operating experiences (Nelson & Winter, 1982). From the lens of organizational learning, the previous experiences of external knowledge searching serve as lessons for a firm's current and future knowledge sourcing and help to extend the cognitive limits of the firm's management team (Love, Roper, & Vahte, 2014). Furthermore, older firms are more likely to have slack resources (Penrose, 1959), such as human capital and various types of infrastructure or equipment, to enhance the firm's capability to exploit technical opportunities and internationalization

opportunity as well (Ahuja & Lampert, 2001; Carr, Haggard, Hmieleski & Zahra, 2010).

Older firms are more likely to have an experienced workforce in a given knowledge domain and a long-lasting organizational memory (Arora, Gambardella, Magazzini, & Pammolli, 2009) that increase the accuracy of their search and selection process towards mature knowledge and reduce the likelihood of its misapplication. Therefore, old organizations are likely to select knowledge in a better way, which ultimately will contribute to both innovation and internationalization strategy.

As a consequence, this research posits the hypothesis that, while knowledge sourcing strategies are beneficial for both older and younger organizations alike, older organizations benefit more from such strategies because of their accumulated experience, knowledge and competences, which are the basis for internationalization strategies.

Thereby, we hypothesize the following:

*Hypothesis 2a: firm age moderates the relationship between knowledge search breadth and internationalization measured by firm's foreign sales on total sales.*

*Hypothesis 2b: firm age moderates the relationship between knowledge search depth and internationalization measured by firm's foreign sales on total sales.*

< figure 1 here >

## **Methodology**

### Sample and data

An empirical research was carried out on a sample of Italian firms, and data were assessed through quantitative methods. The quantitative methodology was chosen due to the nature of the topic, which calls for more fine-grained approaches to explore relationships among variables already used in empirical studies. Moreover, the quantitative approach is widely used in this field of research as many variables are available which allow for exploring relationships deeply (Laursen and Salter, 2006; van de Vrande et al., 2009; Parida, Westerberg & Frishammar, 2012; Spithoven et al., 2013). As a first step, 1200 Italian firms from different sectors of both manufacturing and service industries were randomly selected from the Italian database AIDA-Bureau van Dijk, which contains comprehensive information on companies in Italy, with up to ten years of history, such as standardized annual accounts, financial ratios, sectoral activities, and ownership data. This database is suitable for research on firms' competitiveness as well as for economic integration, applied microeconomics and corporate finance, and it is one of the most suitable sources of information on firms' data in Italy. Random selection is used in the management field (Terziovski & Sohal, 2000).

Despite the random selection, we have considered only companies that are SMEs according to the European classification<sup>1</sup>. Accordingly, SMEs are companies with up to 249 employees and either less than 50 million euro of turnover or a balance sheet total of less than 43 million euro.

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<sup>1</sup> [https://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition\\_en](https://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition_en)

Second, a questionnaire was sent along with a brief introduction of the research scope by using one or more of the companies' direct email addresses. If the email address was not available, the firm was approached by phone requesting an email address, and then the questionnaire was sent. The questionnaire, composed of several questions (open and closed), was answered and returned by 135 CEOs, which were the selected respondents. All of the respondents had more than 3 years of tenure in their firm. This expertise further supports the validity of the informants for reporting data about their organization (Cruz-González et al., 2015).

SMEs of the sample belong to a wide array of manufacturing and service industries such as automotive, beverage, engineering, financial services (table 1).

< table 1 here >

The questionnaire was developed according to the previously discussed literature in the sense that all the questions and variables were taken from previous studies. It was divided in two parts with both open and closed questions. Therefore, the questionnaire was structured by starting from ancillary questions and ending with more-focused ones.

The first part investigated general information about the firm, such as industry, number of employees, age and internationalization. The second part specifically investigated approaches to innovation, knowledge sourcing strategy, and internal R&D.

The single questions have been separated in order to reduce the risk of rationalizing the answers of the respondents. Moreover, dependent and independent variables have

been placed in different positions within the questionnaire to limit potential consistency artefacts and common method variance (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

Furthermore, we assessed the potential differences between early and late respondents to limit non-response bias (Kanuk & Berenson, 1975). To do so, the order of responses to the survey was recorded and there was not a significant correlation between firm age and firm size, suggesting that concern regarding non response bias is minimal (Hawes and Crittenden, 1984).

The hypotheses were tested through the OLS regression model, which is considered to be a suitable method in innovation management studies (Benner & Tushman, 2002; Blindenbach-Driessen & Van Den Ende, 2010; Chen, Vanhaverbeke, & Du, 2016), is appropriate to test moderation effects, and is a proper method for our dependent variable (internationalization) (Ferraris & Bresciani, 2016).

### Study variables

The dependent variable is internationalization (*Intz*) and it has been measured as the ratio of exports/sales volume in 2017. Among the objective indicators of internationalization performance, this ratio is by far the most common in the literature and has been widely used in other studies (Katsikeas, Leonidou, & Morgan, 2000; Majocchi, Bacchiocchi, & Mayrhofer, 2005; Villar, Alegre, & Pla-Barber, 2014).

We employed the variables knowledge search breadth (KSB) and knowledge search depth (KSD) (Laursen & Salter, 2006) to quantify respectively the number of sources exploited to acquire knowledge and the intensity with which they were exploited.

With regard to the measure “Breadth”, we asked the respondents which of the 16 available sources they had used in the past 3 years to acquire knowledge (see table 2). For the measure “Depth”, we asked them to assign a value of importance to the external sources (on a 5-point Likert scale), counting only those with a score of 4 or 5.

< table 2 here >

Because we followed Laursen & Salter (2006) in measuring open search strategies, we think our scales should possess acceptable validity.

Given that it could affect innovation processes positively or negatively (Huergo & Jaumandreu 2004), firm age, that is the number of years since founding, is the moderating variable of our conceptual model.

We finally included several control variables. R&D intensity is calculated as the share of investments in R&D to total sales for the year. Because it could affect innovation, it likely impacts internal capacities for innovation, and it has been used as proxy of absorptive capacity (Cohen & Levinthal, 1990; Blindenbach-Driessen & van den Ende 2014). The firm size was included because larger firms have more resources (Dewar and Dutton, 1986). We added a dummy variable concerning the industry, dividing between services and manufacturing (Blindenbach-Driessen & van den Ende 2014). Finally, we checked for the environmental dynamism (ED) and technological dynamism (TD) of the industry; this is in line with previous empirical studies (for example see Jaworski & Kohli, 1993).

< table 3 here >

Looking at the descriptive statistics, it is shown that firms in the sample are small and medium. Fifty firms are small (less than 50 employees) and 85 are medium sized firms (less than 250 employees). On average, firms have quite high internationalization performance (31% of sales come from foreign countries). KSB and KSD are on average 6.52/16 and 3.21/16 (tab. 4), respectively.

< table 4 here >

This study follows the procedure suggested by Friedrich (1982) to reduce or eliminate any bias resulting from multicollinearity because of interaction terms. Before calculating the interaction terms, the variables were mean-centered to avoid multicollinearity issues. In addition, a VIF (variance inflation factor) test was used to evaluate the effect of multicollinearity. VIFs for variables are smaller than 10, ranging from 1.030 to 1.703 (O'brien, 2007). Table 5 shows the correlations among variables and descriptive statistics.

< table 5 here >

## **Findings**

The results of the hierarchical regressions are presented in Table 6. First, we estimate Model 1, which only contains the control variables. Model 2 contains the direct and linear effect of *KSB* and *KSD* on internationalization. Model 3 tests the moderating effect of *age* over the relationship between *KSB* and internationalization, while Model 4 tests the moderating effect of *age* over the relationship between *KSD* and internationalization.

The data confirm a positive and significant relationship between the dependent variable (*intz*) and the first independent variable (*KSB*) ( $\beta=0.674^{***}$ ), allowing us to accept Hypothesis 1. By contrast, we did not find a significant relationship between the dependent variable (*intz*) and the second independent variable (*KSD*) ( $\beta=0.105$ ). Nevertheless, it is true that this effect could be affected by *KSB*. In fact, we tried to test the *KSD* effect in a new model and its impact becomes positive and significant. Therefore, Hypothesis 2 could be partially confirmed.

Regarding the moderating effects, we did not find confirmation for Hypothesis 3 and Hypothesis 4 as the interaction term between *KSB* and *age* is not significant ( $\beta=-0.213$ ), and the interaction term between *KSD* and *age* is significant but negative ( $\beta=-0.368^*$ ). In model 4, the effect of 'linear effect of *KSD*' on internationalization becomes significant and strong. Again, for this reason we think HP. 2 could be partially confirmed.

Overall, these findings confirm those of studies suggesting the benefits of *KSB* and *KSD* (Laursen & Salter, 2006; Berchicci, 2013). However, our findings also indicate that *age* is not complementary to knowledge sourcing strategy, partially contrasting

previous studies (Ahuja & Lampert, 2001; Arora, Gambardella, Magazzini, & Pammolli, 2009; Carr, Haggard, Hmieleski & Zahra, 2010).

< table 6 here >

## **Discussion and conclusions**

### *Discussion of findings*

Our findings point to the importance of increasing the breadth and depth of external ties for SMEs internationalization, providing a more fine-grained picture of the relationship between open innovation and internationalization. The positive association between KSB and internationalization (Hypothesis 1) supports the arguments that searching widely from different external sources of knowledge helps SMEs in developing products that are competitive in the international landscape. We explain this dynamic by recalling the concept of heterogeneity of knowledge (Laursen & Salter, 2006; Santoro et al., 2018), which stands at the basis of the open innovation paradigm and the KBV as well (Chesbrough & Appleyard, 2007). Moreover, we predicted that KSD is positively associated with SMEs internationalization (Hypothesis 2). Our findings are quite controversial in this regard. In fact, we found a non-significant effect in Model 2 and a strong positive and significant effect in model 4. In addition, we ran a model not presented in Table 6, which tried to predict the linear effect of KSD without including KSB, and its effect was positive and

significant. To sum up, we can partially accept Hypothesis 2. The logic of this hypothesis was based on the fact that KSD helps SMEs in searching knowledge deeply from one or more sources, increasing the knowledge specialization (Carneiro, 2000; Loermans, 2002; Del Giudice & Della Peruta, 2016). KSD can be resulting in specific partnerships for innovating or in developing joint projects (Ferraris et al., 2017) which finally can result in international growth.

We did not find support for the moderation effect of age on the relationship between KSB and internationalization (Hypothesis 3) and the moderation effect of age on the relationship between KSD and internationalization (Hypothesis 4). The lack of support for these hypotheses may indicate that age and knowledge sourcing strategy are not complementary in the sense that their joint effect on internationalization is not so strong. This suggests that knowledge searching has an impact on internationalization regardless the SMEs' age and experience, despite what the main literature posited (Nelson & Winter, 1982; Thornhill & Amit, 2003; Arora, Gambardella, Magazzini, & Pammolli, 2009; Petruzzelli, Ardito & Savino, 2018).

### ***Theoretical implications***

In terms of theoretical implications, this study adds to the recent literature on open innovation by shedding light on the relationship between knowledge sourcing strategy and internationalization strategy, which has been neglected so far. In this regard, several authors have argued that if firms want to realize the full potential of co-creation, they need to involve several types of external stakeholders in the process (Swan, Newell, Scarbrough & Hislop, 1999; Laursen & Salter, 2006; Del Giudice,

Carayannis & Maggioni, 2017). By embracing co-creation with various types of external stakeholders, firms can achieve several advantages such as risk reduction, reduced time to market, and increased innovation performance (Laursen & Salter, 2006; Ferraris et al., 2018). However, so far, there has been a scarcity of studies assessing the relationship between open innovation and internationalization processes. We contribute to the literature by indicating that search breadth and depth of knowledge provide SMEs with resources and competences for developing innovative products that can be accepted by international markets. Accordingly, Battisti et al. (2015) did not find a positive synergistic effect between the intensity of knowledge sourcing and international sales. However, the authors focused on the service industry and they focus on the potential complementary effect of internationalization and search depth on innovation performance, thus neglecting the linear effect of both search breadth and depth on internationalization which, for the best of our knowledge, hasn't been tested so far.

A second theoretical implication regards the insights concerning the moderating effect of the age on the relationship between knowledge sourcing and internationalization, which is not supported by our data. In this regard, while it is true that previous studies have suggested that firm age is arguably an essential proxy for organizational processes (Thornhill & Amit, 2003; Petruzzelli, Ardito & Savino, 2018) and that age and experience affect innovation (Arora, Gambardella, Magazzini, & Pammolli, 2009), we did not find support for the effect on internationalization.

The third theoretical contribution concerns the context of analysis, which is SMEs. In this respect, the literature on open innovation in SMEs is young (Del Brìo &

Junquera, 2003; Larsen & Lewis, 2007; Van de Vrande et al., 2009). Given the lack of studies on the relationship between open innovation and internationalization in SMEs, we can contribute to the theory by stating that SMEs can face the liability of smallness in internationalization processes by leveraging knowledge sourcing breadth and depth.

### ***Managerial implications***

Managerially speaking, this paper suggests that SMEs managers should embrace open innovation for facing the international scenario with the right weapons. Knowledge sourcing strategy is considered essential for SMEs. SMEs typically lack the resources and competences to organize the whole innovation process. Therefore, they need to be open to external sources not only to innovate but also to pursue internationalization strategies (Villar et al., 2014). Internationalisation processes are extremely important for firms which have encountered maturity in internal markets where sales are stagnating. This research posits that searching for knowledge, both widely and deeply, is vital for SMEs internationalization and involving different stakeholders in the innovation process can help in developing products/services that are appreciated globally and in acquiring knowledge on how to grow internationally. For example, working with suppliers (especially those located in foreign countries) can bring ideas and specific knowledge about new raw materials for innovating and selling new products new products in international markets. Collaborating with partners or even with competitors can support the entry into foreign markets with innovative products. Finally, adopting customer engagement processes, especially

with foreign customers, can provide useful market knowledge for adapting to new market needs. Adopting a wide open approach, i.e. including different sources, allows SMEs to increase tacit and explicit knowledge and therefore to better know the international markets and to serve them with innovative products.

In addition, the research suggests that the benefits of being open are not favored by the firm age. Indeed, in the case of knowledge search depth, firm age has a negative effect on the relationship between openness and internationalization. Evidently, the firm age involves a certain corporate culture that is more closed and tied to the values of the past. This culture, which outlines a resistance to change through collaborative processes, holds back international performance. Therefore, older companies should experiment with new cultural and managerial approaches.

### ***Limitations and future research***

Naturally, this study has a number of limitations, some of which open for future research directions. First, we focus on both manufacturing and service SMEs and thus findings must be taken carefully. Nevertheless, the dummy industry did not show a significant impact on the dependent variable or on the main independent variables either. This means that findings can be generalized for both industries. Despite this, future studies could be focused on specific sectors. Second, we focus on a single country and thus the analyses may be affected by the economic and socio-cultural characteristics of the country. Future studies could test the same relationships in other areas, conducting cross-country analyses or including some country-related variables. Third, knowledge sourcing and internationalization strategies entail costs. In this

study we just considered internationalization as an export strategy, measured by foreign sales on total sales. Future studies could try to explore the relationship between export performance in relationship to the extra costs sustained for knowledge sourcing strategy and internationalization.

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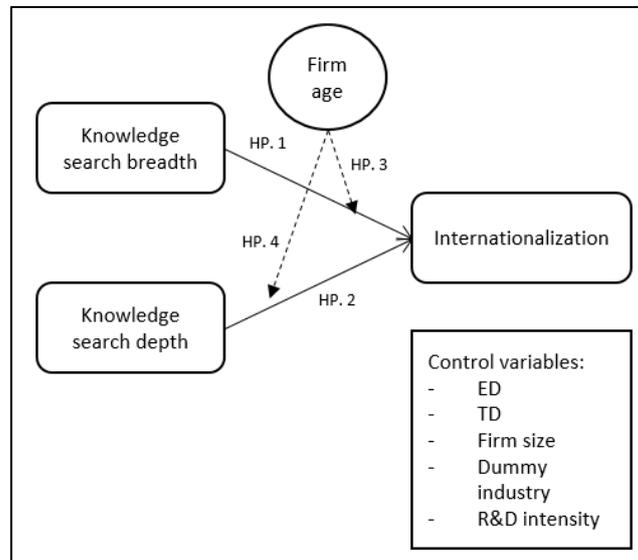
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**Figure 1. Conceptual model and hypotheses**



**Table 1. Sectors**

	N	%
Automotive	16	11,9
Beverage	14	10,4
Engineering	5	3,7
Financial services	3	2,2
Food	16	11,9
Human Resources	4	3,0
IT hardware	4	3,0
IT services	42	31,1
Machinery	6	4,4
Metals	6	4,4
Retail	13	9,6
Textiles	6	4,4
<b>Total</b>	<b>135</b>	<b>100,0</b>

Type	Knowledge sources
Market	Suppliers of equipment, materials, components, software
Market	Clients or customers
Market	Competitors
Market	Consultants
Market	Commercial laboratories/R&D enterprises
Institutional	Universities or other higher education institutes
Institutional	Government research organizations
Institutional	Other public sector
Institutional	Private research institutes
Other	Professional conferences, meetings
Other	Trade associations
Other	Technical/trade press, computer databases
Other	Fairs, exhibitions
Specialized	Technical standards
Specialized	Health and safety standards and regulations
Specialized	Environmental standards and regulations

**Table 2. External knowledge sources**

*Source: adapted from Laursen and Salter (2006, p.139)*

**Table 3. Study variables**

<i>Variable</i>	<i>Explanation</i>	<i>References</i>	<i>Role within the model</i>
<i>ED</i>	Environmental changes in our local market are intense (Likert scale 1-7)	Jansen <i>et al.</i> , 2009	Control variable
<i>TD</i>	The technology in our industry is changing rapid (Likert scale 1-7)	Jaworski and Kohli, 1993	Control variable
<i>Firm size</i>	The number of employees	Dewar and Dutton, 1986	Control variable
<i>Dummy industry</i>	0=services; 1=manufacturing	Blindenbach-Driessen and van den Ende, 2014	Control variable
<i>R&amp;D intensity</i>	% of R&D investments on total sales	Blindenbach-Driessen and van den Ende 2014	Control variable
<i>Intz</i>	Ratio of exports/sales volume in 2017	Villar, Alegre, & Pla-Barber, 2014	Dependent variable
<i>Firm age</i>	The number of years since founding	Huergo and Jaumandreu, 2004	Moderating variable
<i>KSB</i>	Number of external sources of knowledge used to innovate	Laursen & Salter 2006	Independent variable
<i>KSD</i>	Number of external sources of knowledge used to innovate steadily and with greater intensity	Laursen & Salter 2006	Independent variable

**Table 4. Descriptive statistics**

	N	Min	Max	Mean	St. deviation
Size	135	26	241	77.06	52.111
IndDummy	135	.00	1.00	.5407	.50019
TD	135	1	7	3,84	1.679
ED	135	1	7	4,76	1.672
R&D	135	.000	.480	.10927	.132867
KSB	135	2	16	6.52	2.957
KSD	135	0	8	3.21	1.825
Age	135	3	92	26.91	21.211
Intz	135	.00	1.00	.3114	.24660

**Table 5. Correlation matrix**

	Size	IndDummy	TD	ED	R&D	EKS breadth	EKS depth	Age	Intz
Size	1	.026	.079	.117	.120	-.042	.122	.178*	-.019
IndDummy	.026	1	.012	-.095	-.005	-.105	-.083	.654**	-.244**
TD	.079	.012	1	.043	.138	.125	.254**	-.155	.247**
ED	.117	-.095	.043	1	-.256**	.052	-.087	-.014	-.024
R&D	.120	-.005	.138	-.256**	1	-.236**	-.098	.148	-.066
KSB	-.042	-.105	.125	.052	-.236**	1	.582**	-.156	.752**
KSD	.122	-.083	.254**	-.087	-.098	.582**	1	-.074	.538**
Age	.178*	.654**	-.155	-.014	.148	-.156	-.074	1	-.275**
Intz	-.019	-.244**	.247**	-.024	-.066	.752**	.538**	-.275**	1

Notes: \*p<0.05; \*\*p<0.01

**Table 6. Regressions**

	<b>INTZ</b>	<b>INTZ</b>	<b>INTZ</b>	<b>INTZ</b>
<u>VARIABLES</u>	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>	<i>Model 4</i>
<i>Size</i>	-0.007	0.000	-0.001	-0.093

<b><i>IndDummy</i></b>	-0.257**	-0.117	-0.124	-0.080
<b><i>TD</i></b>	0.272**	0.115	0.154**	0.110
<b><i>ED</i></b>	-0.092	-0.045	-0.066	0.008
<b><i>R&amp;D</i></b>	-0.128	0.087	0.072	0.000
<b><i>KSB</i></b>		0.674***	0.833***	
<b><i>KSD</i></b>		0.105		0.735***
<b><i>Age</i></b>		-0.081	0.117	0.107
<b><i>Age * KSB</i></b>			-0.213	
<b><i>Age * KSD</i></b>				-0.368*
<b><i>R</i></b>	0.375	0.799	0.799	0.619
<b><i>R<sup>2</sup></i></b>	0.141	0.638	0.638	0.383
<b><i>ADJUSTED R<sup>2</sup></i></b>	0.108	0.616	0.615	0.344
<b><i>F-VALUE</i></b>	4.230**	27.815***	27.747***	9.783***

Notes: \*p<0.05; \*\*p<0.01; \*\*\*p<0.001

Source: own elaboration