Technovation 122 (2023) 102662

Contents lists available at ScienceDirect

Technovation

journal homepage: www.elsevier.com/locate/technovation

International R&D sourcing, innovation and firm age: The advantage of 'born-international sourcers'☆

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ARTICLE INFO

Keywords:
International sourcing
Firm age
Born-international
R&D
Innovation
Fractional regression models
Moderation
Panel data

ABSTRACT

We study how international knowledge sourcing affects the innovation performance of firms of different ages (from inception to mature). Specifically, we analyze (i) the contribution of international R&D sourcing to product innovations having a high degree of novelty—i.e. products that are new to the market; and (ii) the moderating role of firm age in this relationship. In doing so, we contrast two arguments that have created a debate in the literature: One is that experience plays a key role in successfully managing the inherent complexity of offshoring; another is that firms internationalizing at an early stage enjoy the learning advantages of newness. Based on a panel of over 9000 firms based in Spain spanning from 2008 to 2016, our findings indicate that international R&D sourcing is positively related to product innovations having a high degree of novelty, and that firm age exerts a negative moderating effect on the international R&D sourcing-innovation relationship. These results allow us to conclude that the innovation benefits of internationalizing the acquisition of knowledge are greater for younger firms. We identify the advantage of firms performing international R&D sourcing during their early stages and introduce the concept of 'born-international sourcers', to identify firms that engage in international sourcing strategies from an early stage.

1. Introduction

> '*We've all heard stories of entrepreneurs who have lost a minor fortune trying to save money, getting things done in Asia, Europe or South America. As the founder of a tech company, I have tried almost every form of outsourcing, with results ranging from catastrophic to exceptional. I started with an idea for an app but lacked the knowledge or money to hire my own developers, so I outsourced.*.' Rebekah Campbell, founder and former CEO of Posse Pty. Ltd. (Campbell, 2014).

Technological advances and highly competitive markets force many firms to search for novel configurations of their value chains and to look beyond their home country for new sources of competitive advantage. The result is the international disaggregation of value chains, with companies increasingly expanding the search for knowledge and innovation across national borders (Ambos et al., 2021; Castellani et al., 2022; Nieto and Rodríguez, 2022). The consequences of this rising phenomenon, and particularly its implications for firm performance, are a hot topic of debate among management scholars (Lampert and Kim, 2019; Pereira et al., 2019; Rodríguez et al., 2022; Sommer and Bhandari, 2022), a debate that transcends academia and has important implications for business management and the design of public policies (Alvstam, Ivarsson, and Petersen, 2019; The Economist, 2013; The Guardian, 2011).

Nearly three decades ago, Monczka and Trent (1991) already claimed that a proactive international sourcing strategy would, in many cases, make the difference between success and failure in competitive markets. This statement becomes even truer today, given the competitive pressures of globalized markets, which lead even new ventures to engage in international procurement. There is growing evidence that a

☆ Authors appear in alphabetical order. We thank the Area Editor, Max von Zedtwitz, and the two anonymous reviewers for their helpful comments and suggestions. We also thank Álvaro Cuervo-Cazurra, Ravi Rammamurti, Annique Un and other scholars who provided suggestions to improve an earlier version of this paper in the Nardone Speaker Series at D'Amore-McKim School of Business (Northeastern University, Boston, USA). This project was funded by the Government Research Agency of Spanish Ministry of Science and Innovation (PID2019-106874GB-I00/AEI/10.13039/501100011033). This work is developed with the support of Madrid Government (Comunidad de Madrid-Spain) with the project Excellence of University Professors (EPUC3M20) in the context of the V PRICIT (Regional Programme of Research and Technological Innovation). Funding for APC: Universidad Carlos III de Madrid (Read & Publish Agreement CRUE-CSIC 2022)

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https://doi.org/10.1016/j.technovation.2022.102662
Received 13 March 2021; Received in revised form 4 October 2022; Accepted 18 November 2022
Available online 5 December 2022

diversity of players, including SMEs, can benefit from international sourcing strategies (Di Gregorio et al., 2009; Khraishi et al., 2022; Nieto et al., 2022; Nieto and Rodríguez, 2022; Rodríguez and Nieto, 2016; Rosenbusch et al., 2011) and that R&D offshoring contributes to firm innovativeness (Ambos and Ambos, 2011; Cuervo-Cazurra et al., 2018; Steinberg et al., 2017; Un and Rodríguez, 2018a). However, research also suggests that firms vary greatly in their ability to realize such benefits (Baier et al., 2015) and that creating value from offshored activities may be difficult (Mukherjee et al., 2013). As the opening quote by serial entrepreneur Rebekah Campbell illustrates, business experiences with offshoring are often mixed, 'ranging from catastrophic to exceptional'. There is, therefore, a need for research that builds a deeper understanding of the factors that shape the relationship between international R&D sourcing and innovation performance (Gusenbauer et al., 2015; Nieto and Rodríguez, 2022). In this study we focus on advancing such understanding by analyzing (i) the contribution of international R&D sourcing[1] to a firm's ability to pioneer the introduction of novel products into the market before its competitors—i.e. new-to-the-market product innovation[2]; and (ii) the moderating role of firm age in this relationship. We test these relationships on data from a Spanish panel of more than 9000 firms from a diversity of manufacturing and service industries between 2008 and 2016.

With this study we contribute theoretically and empirically to highly topical debates at the intersection of innovation, international business, and entrepreneurship. First, in the intersection between international business and innovation research, we contribute to the discussion on the implications of international R&D sourcing strategies for innovation performance; more specifically on their impact on the successful introduction of products that are new to the market, and therefore have the potential to give the firm a competitive edge over its rivals. Previous research has shown that R&D offshoring contributes positively to product and process innovation (Bertrand and Mol, 2013; Nieto and Rodríguez, 2011), as well as to firm innovativeness—i.e. to products that are new to the firm (Mihalache et al., 2012). These studies, however, are limited to analyzing whether firms innovate or not and whether they get more revenue from products that are new to the firm. In this study, we move forward and focus on the potential effects of international R&D sourcing on the revenues from product innovations with a high degree of novelty— namely new-to-the market product innovations, which are those that imply the introduction of products that are not only new to the focal firm but also new to the markets in which it operates (García and Calantone, 2002). As Leiponen and Helfat (2011) show, such a distinction is important because the determinants of both kinds of innovation may differ. We contend that international sourcing may unlock unique combinations of knowledge, enabling firms to go beyond imitation and develop highly novel products that are new to their markets.

Second, we contribute to an emerging literature on the role that organizational contingencies play in shaping the implications of international sourcing strategies. Previous studies have explored the effects of firm size on offshoring (Roza et al., 2011), and whether and how SMEs can also benefit from R&D offshoring (Baier et al., 2015; Khraishi et al., 2022; Rodríguez and Nieto, 2016). Meanwhile, the role of firm age has received far less attention in this literature, which largely overlooks longstanding debates on the different organizational contexts of younger and older firms and how they impact strategic performance (Anderson and Eshima, 2013; Naldi and Davidsson, 2014; Rosenbusch et al., 2011), innovation (Coad et al., 2018), international strategies (Li et al., 2019; Zhou and Wu, 2014), and the management of international knowledge (Anderson and Eshima, 2013; Naldi and Davidsson, 2014). By explicitly considering the moderating role of firm age, this study draws from these debates in order to produce novel theoretical arguments and empirical evidence on the effects of international R&D sourcing along the life cycle of the business, from new ventures to mature older firms. A proper understanding of the effects of firm age "*may be of interest to firms that seek to plan ahead, or to counter the effects of aging, or the policy-maker to better understand the needs and challenges of firms of different ages, perhaps in order to design a more effective policy that may be targeted to a certain age group (*e.g.*, young tech-based firms who suffer from liabilities of newness)*" (Coad, 2018: 14).

Third, we also contribute to a central debate in the intersection between international business and entrepreneurship, namely whether it is advantageous for firms to internationalize early or later in their life cycles (Jones et al., 2011; Keupp and Gassmann, 2009; Cavusgil and Knight, 2015). Most previous literature has focused on the outward strategies (Zander et al., 2015) of the so-called born-global (Cavusgil and Knight, 2015) or born-international firms (Johanson and Martin, 2015; Kundu and Katz, 2003); meanwhile, we focus on inward strategies, more concretely on firms sourcing knowledge and research inputs across borders. There is a growing body of research that favors early internationalization (e.g., McDougall et al., 1994; Oviatt and McDougall, 1994; Autio et al., 2000; Cavusgil and Knight, 2015), thus challenging traditional process theories on international business. A central argument in this literature is that younger organizations enjoy a 'learning advantage of newness' (LAN) that places them in a better position to seize the rich opportunities that internationalization brings for organizational learning (Zahra et al., 2018). We build on this argument to introduce the concept of 'born-international sourcers' to identify firms that engage in offshoring strategies from an early stage. In particular, by focusing on the international sourcing of R&D, we capture explicit efforts by firms to source knowledge and learn from foreign countries, much in line with the original concepts of international new ventures (Oviatt and McDougall, 1994) and LAN (Autio et al., 2000).

In order to produce a nuanced view of the role of firm age, this study carefully gauges arguments from two academic lines of reasoning. On the one hand, the key role of organizational maturity and accumulated experience in enabling knowledge transfers (Rabbiosi and Santangelo, 2013) and successfully managing the inherent complexity of offshoring, particularly when it involves knowledge-based tasks (Jensen and Pedersen, 2012; Larsen et al., 2013); on the other hand, the LAN enjoyed by firms internationalizing at an early stage (Autio et al., 2000; Zahra et al., 2018; Zhou and Wu, 2014). In other words, we analyze whether the liability of newness (Cohen and Levinthal, 1990; Henderson, 1999) or the liability of aging (Ranger-Moore, 1997) arguments prevail when it comes to benefitting from international knowledge sourcing for innovation.

2. Theoretical background and hypotheses

2.1. The role of international R&D sourcing on product innovations with a high degree of novelty

Firms looking abroad to improve their innovation capabilities can access knowledge in different innovation systems and combine this with

[1] In this paper, international R&D sourcing is defined as the acquisition of R&D inputs, which have been produced in a foreign location, and are transferred to the firm in the home country via imports (Coucke and Sleuwaegen, 2008; Nieto and Rodríguez, 2011). In accordance with this definition and given the terms of *'international sourcing'* has been used as a synonym for '*import'* or *'offshoring'* in the literature (e.g., Coucke and Sleuwaegen, 2008; Gleich et al., 2017; Nassimbeni, 2006; Rodríguez and Nieto, 2016), we use the terms of international R&D sourcing and R&D offshoring interchangeably in the text. In addition, we highlight that this study excludes the theoretical analyses of the captive component of offshoring and, thus, its objectives and drivers -such as demand-pull factors (see a review in Papanastassiou et al., 2020), but captures the effect of captive offshoring in the empirical analyses (in similar way to previous studies such as Bertrand and Mol, 2013).

[2] The 'new-to-the-market' concept refers to the markets, either domestic or international, in which the company sells its products; it does not exclude that the products might have been available elsewhere. Thus, it refers to any markets where the firm is active (and therefore where it faces competition).

their own resources and market knowledge in order to build bundles of resources that are distinct from those of their domestic competitors (Jensen and Pedersen, 2012). There are significant asymmetries in the international distribution of knowledge and innovation advantages (D'Agostino et al., 2013), and clusters of specific knowledge and cutting-edge technology exist in different locations (Manning, 2014). The increasing dispersion of knowledge and talent (Manning et al., 2008), along with a pressing need for superior innovation capabilities, is pushing firms to expand their sources of technology and interact with different actors that are geographically dispersed (Narula and Zanfei, 2005).

In an increasingly interconnected competitive environment, relying solely on domestic sources of knowledge is unlikely to be an optimal strategy for acquiring cutting-edge technological capabilities (Cantwell and Zhang, 2013). Accordingly, many firms are becoming aware of the potential benefits of offshoring their R&D activities (Ambos and Ambos, 2011; Rodríguez and Nieto, 2016), especially to improve their innovation capabilities (Bertrand and Mol, 2013; Mihalache et al., 2012; Nieto and Rodríguez, 2011; Steinberg et al., 2017). R&D offshoring strategies provide firms with opportunities to access highly qualified personnel that may be hard or expensive to find within national borders (Lewin et al., 2009), so firms searching globally may access talent at a lower cost (Manning et al., 2008; Manning et al., 2012), as well as new knowledge and technology (Maskell et al., 2007) that would otherwise be unavailable or uneconomical to them. The benefits of offshoring, thus, are twofold. Initially, firms may be motivated by cost savings (Lewin et al., 2009; Maskell et al., 2007; Rodríguez and Nieto, 2016), as reducing costs is as imperative for knowledge-based tasks as for any business process. In itself, this can enhance the financial viability of innovation projects. However, sourcing R&D from international suppliers also carries the potential to augment the firm's home-based capabilities as it taps into local knowledge, bringing opportunities for novel products and up-market moves (Kenney et al., 2009). This is consistent with previous literature showing that, beyond cost, R&D offshoring and outsourcing are attracted to locations characterized by factors such as the availability of talent and good structures for knowledge creation, absorption, and appropriation (Bunyaratavej et al., 2008; Rilla and Squicciarini, 2011).

The potential benefits of international sourcing of R&D can be especially useful for companies looking to develop and launch innovations that are new to the firm's market—i.e. not previously introduced by a competitor. Whereas new-to-the-market products may differ vastly in their scope and degree of novelty, they are intrinsically distinct from the development of products that, while new to the firm, are already known in its market (García and Calantone, 2002; Leiponen and Helfat, 2011). Kleinknecht et al. (2002) label the former as 'true' (vs. 'imitative') innovations. True innovations typically imply a high level of novelty and more advanced and unique technological knowledge that has not been previously disseminated in the market (Kaufmann and Tödtling, 2001). Expanding R&D sourcing internationally may allow firms to broaden the scope of their technology search efforts and acquire such knowledge, thus fostering the development of products that are truly new to the firm's market.

Moreover, offshoring allows firms to focus on their core capabilities and, consequently, provides them with the organizational flexibility both to reorganize their innovation efforts and improve their capacities to respond to changing market needs by developing new products and speeding up their innovation process (Kedia and Mukherjee, 2009). This benefit from offshoring would also provide substantial advantages to firms aiming to pioneer product innovation in their markets.

In conclusion, we posit that firms that adopt R&D offshoring strategies can source more heterogeneous knowledge and also access resources in different countries in more advantageous conditions than in their home markets.This is particularly relevant for sourcing cutting-edge knowledge that is still not widely disseminated, and that could not, therefore, be obtained domestically (at least, not in a time- and cost-efficient manner). Hence, we formulate the following hypothesis::

Hypothesis 1. International R&D sourcing is positively related to the successful introduction of new-to-the-market product innovations, so that the more a firm relies on offshore R&D sources, the more sales it realizes from new products not previously introduced by any competitors.

2.2. The organizational challenges of R&D offshoring and the moderating effects of firm age

It is well known that age influences the various organizational capabilities and resources available to the firm, including the ability to integrate and assimilate the knowledge required to innovate (Kotha et al., 2011; Sørensen and Stuart, 2000; Withers et al., 2011). How this affects the outcomes of international R&D sourcing is unclear, though. On the one hand, mature organizations enjoy greater experience, which may equip them to better manage the complexities of offshored relationships, while younger firms would suffer from a liability of newness (Cohen and Levinthal, 1990; Henderson, 1999). On the other hand, younger firms may benefit to a greater extent from the learning opportunities that offshoring brings, suggesting that mature organizations suffer from a liability of aging (Ranger-Moore, 1997). In what follows, we discuss both views, along with the subsequent competing research hypotheses. We do not make any aprioristic assumption as to which arguments should prevail, leaving the answer to the discussion of the empirical findings in this study.

2.2.1. Advantages of mature organizations: the role of experience in managing the organizational challenges of R&D offshoring

Offshoring strategies can lead to complex decision processes, governance structures, and communication channels (Bals et al., 2013). The offshoring of knowledge-based activities with high added value presents a higher degree of complexity (Lampel and Bhalla, 2011), and therefore leads to greater organizational challenges (Andersson and Pedersen, 2010; Lewin et al., 2009). R&D as a core and knowledge-based activity is particularly challenging to manage at an international level; R&D offshoring leads to a complex configuration of the innovation process and involves significant coordination costs. Searching for technology resources internationally and managing geographically dispersed innovation venues can be demanding in terms of organizational and managerial resources (Andersson and Pedersen, 2010). There are a number of reasons for this including difficulties of communication (De Meyer, 1991; Nobel and Birkinshaw, 1998), protection of knowledge (Alcácer and Zhao, 2012), and coordination among distant–in terms of both physical and cognitive distance–organizational units (Keupp and Gassmann, 2009). When firms aim to integrate foreign outsourced R&D in their innovation process, they have to deal not only with differences between firms, but also between countries. The greater the cognitive distance between a firm and its sources of knowledge, the more difficult assimilating and using that knowledge becomes (Nooteboom et al., 2007). The paradox is that the very same international knowledge asymmetries that make offshoring valuable also make it challenging, leading to what Un and Rodríguez (2018a) labeled the 'liability of foreignness in R&D outsourcing'.

The effects of offshoring will thus depend on the ability of firms to manage such challenges, reduce the complexity involved in offshoring strategies (Bals et al., 2013; Ceci and Prencipe, 2013; Larsen et al., 2013), and integrate knowledge across geographically dispersed R&D activities (Singh, 2008). In this regard, one strand of the literature argues that experience is a key factor in offshoring (Jensen et al., 2013a,b; Larsen et al., 2013), as firms with experience in international sourcing develop competences that allow them to leverage the advantages of offshoring (Manning et al., 2008). Experience accumulated over time allows firms to build capabilities (Leonard-Barton, 1995) in a path-dependent process that is subject to time-compression

diseconomies, meaning that it takes time to adjust knowledge stocks, and that trying to accelerate the process is often inefficient and uneconomical (Collis, 1994; Dierickx and Cool, 1989). Therefore, insofar as experience may be related to age, older firms have accumulated more of the experience, knowledge and capabilities that are needed to produce innovations (Withers et al., 2011). As Sørensen and Stuart (2000: 85) noted, 'older high-technology firms will have perfected the routines, structures, incentive programs, and other infrastructures that are needed to develop new technologies and bring them to market'.

In addition, older firms are also more likely to have a broader knowledge base, as they have built an array of competencies (Gopalakrishnan and Bierly, 2006) cumulatively over time (Miyazaki, 1994). This provides them with 'combinative capabilities' (Kogut and Zander, 1992) to integrate diverse knowledge more efficiently. From this perspective, as organizations mature, they develop the set of competences they need to manage a complex and geographically disintegrated value chain and to integrate offshore knowledge in their innovation process.

We summarize these arguments about the key role of experience in firms, which enables them to successfully manage the offshoring R&D challenges in order to innovate and overcome the liability of foreign R&D outsourcing, in the following hypothesis.

Hypothesis 2a. The positive relationship between international R&D sourcing and new-to-the-market product innovations is positively moderated by firm age, such that the benefits of sourcing R&D overseas in terms of innovation performance are more positive for older firms.

2.2.2. Advantages of younger organizations: do 'born-international sourcers' have a 'learning advantage of newness'?

Another strand of the literature argues that previous experience may also be a limiting factor in the ability of the firm to search for new knowledge across borders. Prior research has shown that, compared to younger companies, older firms often fall into cognitive myopia (Coad et al., 2016), as they are more entrenched within their existing cognitive frameworks (Ardito et al., 2019), which they have developed and solidified over time. As a result, they tend to search for new knowledge in the proximity of their current experience, which may interfere with learning at a distance (Levinthal and March 1993). As they age, firms tend to exploit areas of established competence, while rejecting distant knowledge coming from explorative learning (Ardito et al., 2019; Sørensen and Stuart, 2000).

The learning myopia of older organizations somehow negates the potential benefits of international R&D sourcing, in terms of access to novel and heterogeneous knowledge, often distant from a firm's previous experience. In order to fully realize the learning opportunities of offshoring, firms often need to develop new routines in order to access, integrate, and exploit new knowledge from their international operations (Sapienza et al., 2005). Learning new routines typically requires that the existing ones, rooted in domestic operations, are unlearned (Barkema and Vermeulen, 1998; Knight and Cavusgil, 2004). However, established routines are often tacit and embedded in organizational culture, which makes them costly and difficult to change (Autio et al., 2000; Barkema and Vermeulen, 1998). International R&D sourcing in older firms may trigger considerable internal resistance as it collides with organizational practices and mental models deeply embedded in the existing 'dominant logic' of the organization (Bettis and Prahalad, 1995). Consequently, many firms tend to replicate domestic processes and routines at a foreign location (Farrell, 2005) and adopt a gradualist approach and arm's-length relationships with foreign suppliers; this is characterized by the resistance of domestic R&D operations to give up control of knowledge generation (Bardhan, 2006).

A growing body of research suggests that new ventures have advantages over established firms in terms of learning, when internationalizing their operations (Zahra et al., 2018). From this LAN perspective, firms internationalizing at a younger age may be in a better position to adapt to an international context, since these firms are less constrained by the past (Zhou and Wu, 2014). They have fewer routines to unlearn and managing geographically dispersed activities comes naturally to them. They develop internationally-oriented capabilities (Knight and Cavusgil, 2004) that facilitate the integration of foreign knowledge. Younger firms also benefit from lighter organizational structures, simpler information flows, and lower levels of organizational inertia (Hannan and Freeman, 1977), all of which equate to greater flexibility and fewer impediments to sharing and integrating knowledge across the organization. Innovation in particular involves an element of discovery and creativity in the use of new knowledge that relies on the flexible and improvisational processes that young firms excel at, rather than the structured and planned knowledge management systems that characterize older firms (Naldi and Davidsson, 2014).

Consistently with this view, Zahra et al. (2018) point out that the LAN is more likely to hold when firms emphasize the exploration—rather than exploitation—of knowledge in their internationalization. Innovative firms exploring new knowledge domains cannot rely on their existing routines as the foundation of new international capabilities—particularly so when aiming to develop truly novel products. The more different the technological environments between the home and host countries, the less firms can leverage domestic routines when they venture internationally (Barkema et al., 1996; Kogut and Zander, 1993), and consequently the greater the LAN (Zahra et al., 2018). 'Born-international sourcers' will thus be more capable of utilizing knowledge that is very different to that of their home countries, and this can lead to innovations that are truly new to the market.

Moreover, R&D offshoring often involves high interdependence between international operations, as a single center rarely controls the whole process from start to finish; hence successful coordination of international supply is heavily dependent on intense information sharing and open communication (Manning et al., 2012). Along similar lines, Foss et al. (2013) highlight that firms need to decentralize decision-making in order to benefit from dispersed external knowledge. Information sharing is easier in young entrepreneurial firms, in which decision-making processes are more fluid; this allows for richer communication and greater cohesion in the organization (Mosakowski, 1998), while maintaining straightforward decision-making processes and ensuring internal consistency. This open-minded approach to international knowledge sourcing is a distinct organizational advantage in creating truly novel products.

The arguments above lead us to postulate the following research hypothesis:

Hypothesis 2b. The positive relationship between international R&D sourcing and new-to-the-market product innovations is negatively moderated by firm age, such that the benefits of sourcing R&D overseas in terms of innovation performance are more positive for younger firms.

3. Research methods

3.1. Data and sample

For our empirical analysis, we use data from the Technological Innovation Panel (TIP), a database based on the Community Innovation Survey (CIS) questionnaire that compiles comprehensive information on the technological activities of a large number of Spanish firms. The TIP has been widely used in previous research on technological innovation (e.g., García-Quevedo et al., 2018; Rodríguez and Nieto, 2016). The sample comprises an unbalanced panel of over 9000 firms from a wide range of industries, both manufacturing and service, for the period 2008 to 2016. Within developed economies, Spain occupies a middle position in terms of its technological competences, as shown by the UNCTAD Innovation Capability Index (UNCTAD, 2005). It is neither a technology leader, such as the United States or the Nordic countries, nor a laggard. It is also a rather average country in terms of its net technology balance of

payments (OECD, 2009). Therefore, given its empirical setting, this study should contribute to building a body of evidence on international R&D sourcing that will be generalizable to a number of different industry and national contexts.

3.2. Variables

Dependent variable. *New-to-the-market product innovation.* We measure this variable as the share of a firm's turnover that comes from new products that are not merely imitative of the competition, but truly novel or innovative in the markets in which the firm operates—even if they may have been available in different markets (Belderbos et al., 2004; Leiponen and Helfat, 2011; Tether, 2002). Innovation sales-based variables have been widely used in previous research to measure innovation output (e.g., Laursen and Salter, 2006; Leiponen and Helfat, 2011; Grimpe and Kaiser, 2010). Unlike binary variables merely measuring whether a firm launches new products or not, sales data capture to what extent innovations are successfully adopted by the market (Atuahene-Gima and Li, 2004). Unlike patent counts —another popular measure of innovation output— innovation sales-based variables capture innovations that are not patented (Liu and Buck, 2007), yielding greater cross-industry validity (Wu, 2012).

By considering exclusively sales of products that are new to the market—in other words, innovations that the firm pioneers before any of its competitors—we capture 'true' (as opposed to 'imitative') innovation (Kleinknecht et al., 2002). Innovation novelty, as measured in this study, should not be confused with radicalness, which is defined in terms of the disruptive impact of innovations, and their potential to transform (or create) markets (Organization for Economic Cooperation and Development and Eurostat, 2018).

Independent variable. *International R&D sourcing.* Following previous research (Bertrand and Mol, 2013; Nieto and Rodríguez, 2011; Rodríguez and Nieto, 2016), we operationalize this variable as the acquisition of R&D services from external suppliers in foreign countries, as a percentage of the total R&D spending of the firm (Steinberg et al., 2017). Since R&D investments take some time to translate into innovative outputs (Belderbos et al., 2004) and these, in turn, require additional time to be translated into marketable new products and generate sales (Rodríguez and Nieto, 2016), we include the variable with a two-year lag.

Moderating variable. *Firm age* is measured as years since the business was founded (McKelvie et al., 2007; Naldi and Davidsson, 2014). Since the distribution of the raw age variable is dispersed and skewed, we use the logarithmic form in our empirical analysis (Sheskin, 2003; Weinberg, 2008).

Control variables. Consistently with previous literature (Belderbos et al., 2004; Grimpe and Kaiser, 2010; Laursen and Salter, 2006; Veugelers and Cassiman, 1999), we control for a number of potentially confounding factors, which are presented, along with the measures employed in Table 1.

Firstly, we control for innovation-related activities that add to the firm's stock of technological knowledge and potentially to its innovation capacity (Becheikh et al., 2006; Bertrand and Mol, 2013): the acquisition of R&D services that take place in the firm's own offshore research centers (*Captive R&D offshoring)*, R&D activities developed at home country (*Onshore R&D);* and technological cooperation with external partners (*Cooperation*) (Becker and Dietz, 2004; Un and Rodríguez, 2018b). These variables are included with a two-year lag to take account of the time necessary to translate R&D inputs into innovation output and, subsequently, into sales.

Secondly, we control for other firm-specific characteristics that may be related to innovation performance. Larger firms may benefit from better access to financial and human resources, as well as larger customer bases, so we control for *firm size* (Becheikh et al., 2006; Leiponen and Helfat, 2011; Zahra et al., 2003). We include a variable (*Group)* to capture whether the firm belongs to a business group or not (Cuervo-Cazurra et al., 2018), given that previous studies reveal that being part of a corporate group may facilitate access to valuable resources (Khanna and Yafeh, 2007). We also control for the potential advantage of foreignness in innovation (Un, 2011) by including a variable (*Foreign ownership*) that captures whether or not international shareholders hold a majority stake in the company. Since a firm's international presence may augment the possibilities of commercializing new products and deriving sales from them (Kafouros et al., 2008; Patel et al., 2014), we include two variables to control for the span and intensity of a firm's outward internationalization (*International span* and *International intensity*). Lastly, we also include a set of industry and year dummies in order to control for differences in innovation behavior across industries (Malerba, 2005) and over time.

Table 1
Definition and operationalization of variables.

Variable	Definition and operationalization
Dependent variable	
New-to-the-market product innovation	% of a company's turnover that comes from new or improved products, introduced in the last two years, that were not previously offered by any of its competitors (new to the market).
Independent variable	
International R&D sourcing	Acquisition of R&D services from external foreign suppliers, expressed as % of the firm's total R&D spending
Moderator variable	
Firm age	Years since the company was founded (log)
Control variables	
Captive R&D offshoring	R&D expenses in a firm's own facilities overseas as a % of total R&D spending
Onshore R&D	Acquisition of R&D services in the home country as % of total R&D spending
Cooperation	Binary variable, taking value 1 if the firm cooperates with other organizations for innovation purposes, and 0 otherwise
International span	Ordinal variable capturing the markets in which the firm sells its products (0 if only Spain, 1 if it includes other EU and associated countries, 2 if it includes other non-EU countries, and 3 if it includes both).
International intensity	Proportion of sales from international markets (calculated as a percentage of the firm's total sales).
Firm size	Number of employees (log)
Foreign ownership	Binary variable taking value 1 if a majority of the firm's equity (>50%) is owned by foreign stockholders, and 0 otherwise
Group	Binary variable taking value 1 if the firm is part of a group of companies, and 0 otherwise
Industry	Binary variables for industry classification
Year	Binary variables for the years in our sample (2008–2016)

3.3. Econometric model

The dependent variable in this study measures the sales of innovative products and services as a fraction of total revenue and takes values between 0 and 1. Consequently, we use the fractional probit estimator (Papke and Wooldridge, 1996, 2008) described in Wooldridge (2011), which handles unbalanced panel data when the dependent variable is bounded between 0 and 1 and explicitly allows for certain forms of heteroscedasticity. This approach overcomes the shortcomings of traditional methodologies in dealing with fractional dependent variables.

Conventional regression methods such as OLS produce biased estimates with censored dependent variables. A common modeling strategy employed to deal with a censored dependent variable is to use the logarithmic transformation of the dependent variable; since variables of this type are highly skewed, several authors add a small number in order to transform zeros to positive numbers and thereafter take the logarithm and use a Tobit regression. Examples of studies using this kind of

Table 2
Descriptive statistics, correlations, and collinearity diagnostics of the independent and control variables.

		1	2	3	4	5	6	7	8	9	10	11	VIF	1/ VIF
1	New-to-the-market product innovation	1												
2	Onshore $R\&D_{t-2}$	0.094	1										1.13	0.882
3	Cooperation $_{t-2}$	0.114	0.316	1									1.14	0.876
4	Size $_{t-2}$	−0.014	0.093	0.122	1								1.49	0.672
5	Group $_{t-2}$	−0.013	0.083	0.135	0.485	1							1.46	0.685
6	Foreign ownership $_{t-2}$	0.004	−0.006	0.047	0.291	0.394	1						1.25	0.802
7	International span $_{t-2}$	0.055	0.103	0.062	0.131	0.123	0.144	1					1.07	0.938
8	International intensity $_{t-2}$	0.001	0.004	−0.001	−0.025	−0.013	−0.001	0.008	1				1.00	0.999
9	Captive R&D offshoring $_{t-2}$	0.011	−0.053	0.032	0.108	0.131	0.204	0.081	0.002	1			1.06	0.947
10	International R&D sourcing $_{t-2}$	0.030	0.003	0.099	0.026	0.037	0.038	0.074	−0.001	0.003	1		1.02	0.983
11	Firm age $_{t}$	−0.050	0.028	0.021	0.338	0.123	0.103	0.160	−0.014	0.041	0.012	1	1.15	0.868
	Mean	0.093	27.764	0.390	4.201	0.451	0.171	1.761	0.000	1.248	1.867	33.167		
	Std. Dev.	0.222	44.069	0.488	1.631	0.498	0.376	1.341	0.001	10.498	11.279	19.092		
	Min	0	0	0	0	0	0	0	0	0	0	2		
	Max	1	100	1	10.625	1	1	3	0.135	100	100	142		
											Mean VIF		1.18	

All value correlations are significant to the 5% level, n = 42,991.

transformation of the dependent variable and/or a Tobit model are Berchicci (2013), Laursen and Salter (2006), Roper and Hewitt-Dundas (2015), Sofka and Grimpe (2010) and Tang et al. (2015), among others. Additionally, a logit transformation of the dependent variable has been proposed in the literature to handle proportions. According to Baum (2008), it is not appropriate to use Tobit regression techniques when modeling proportions, since the observed data are not censored and the logit transformation of the dependent variable does not take into account zeros or ones. In our case, these values (zeros and ones) may not be excluded, since they are vitally important, particularly for variables measuring sales of new products or services as fractions of their total sales, such as our dependent variable. Some previous works have used the same methodological approach for similar dependent variables (e.g., Naldi and Davidsson, 2014).

We follow methodological best practice in the existing literature on the relationship between R&D offshoring and innovation (e.g., Bertrand and Mol, 2013), in order to manage potential threats to causality, by: i) taking advantage of a panel structure of data and controlling for time invariant unobserved firm heterogeneity (Cassiman and Golovko, 2011)—we use longitudinal models and apply panel techniques to them for the period of nine years used from the survey; and ii) using an independent variable with a two-year lag, therefore ensuring temporal precedence, acknowledging that R&D inputs take time to transform into output (Gashi et al., 2014). This approach guarantees that the data on R&D activities in the previous years are those that exert an impact on sales from new-to-the-market innovation in succeeding years, thus minimizing any potential problem of endogeneity (Rodríguez and Nieto, 2016).

4. Analysis and results

4.1. Descriptive statistics

Table 2 contains the descriptive statistics of the variables in the study (with the exception of the sector and year dummy variables), along with correlation coefficients and the variance inflation factors (VIF), which suggest that there is no problem of multicollinearity (Chaterjee and Price, 1991). The average size of firms in our sample is 334 employees (it is included in Table 2 as a logarithm), while the average age is 33.16 years.

We present further information on the distribution of the variables of interest in Table 3, which shows some interesting findings related to international R&D sourcing activities by firm age; we group companies into five categories according to their age. A first group includes firms up to six years old, which is consistent with the consensus definition of "new ventures" in the entrepreneurship literature (McDougall et al., 2003)[3]; the remaining four categories include firms from seven to twelve, thirteen to twenty-five, twenty-six to fifty, and over fifty years old, respectively. The average share of sales attributable to new-to-the-market products (column 2) seems to be, to some extent, inversely related to age. It represents 10% of sales in new ventures, peaks at 13% for firms between 7 and 12 years old, and declines progressively for older firms, until reaching 7% in firms over 50 years old. These figures suggest that young companies are more entrepreneurial than established ones, new-to-the-market innovations having a greater weight within their product portfolio. Meanwhile, the mean value of the main independent variable, international R&D sourcing (column 1) is highest for new ventures up to six years old (3.21%), followed by mature firms over 50 years old (2.37%). Table 3 also shows the distribution of observations across age groups and industry types (classified by their technological intensity), both for our full sample (column 3) and for the subsamples of firms conducting R&D offshoring (column 4) and introducing new-to-the-market product innovations (column 5).

We offer some additional descriptive statistics in Table 4 by grouping the observations according to the value of the independent variable. The distribution of the dependent variable is highly skewed, with just 4.3% of observations reporting above-average values and most firms not engaging in international R&D sourcing at all. It can be observed that the mean values of the variables of interest take higher values for firms showing above-average international R&D sourcing. As expected, businesses that engage in international knowledge sourcing are more innovation-oriented and engage in more onshore R&D and technological alliances. They are also slightly larger and older, and more likely to sell internationally.

4.2. Results

Table 5 contains the results of the fractional probit regression models. Due to methodological restrictions, we excluded 404 observations corresponding to firms with just one observation (Wooldridge, 2011), resulting in a final sample size of 42,991 observations for 8603

[3] Zahra et al. (2000) stated that different age ranges have been used in the literature, but there is a growing consensus that firms 6 years old and younger are new ventures (Brush, 1995; Brush and Vanderwerf, 1992). Previously, researchers have used different cutoff points, such as 12 (Covin et al., 1990) and 8 years (McDougall, 1989; Zahra, 1996). In this paper, we are consistent with the growing consensus in the literature and identify a first group with firms that are 6 years old or younger.

Table 3
International R&D sourcing and innovation outcomes by firm age and sector categories.

	Mean values		Percentage of observations		
	International R&D sourcing	Sales from new-to-the-market product innovations (proportion)	Full sample	Firms conducting International R&D sourcing	Firms introducing new-to-the-market product innovations
	1	2	3	4	5
Firm age					
<7	3.21	0.10	0.08	0.36	0.11
7–12	1.68	0.13	2.25	3.06	2.74
13–25	1.75	0.10	39.60	34.84	39.46
26–50	1.80	0.08	43.87	41.37	43.29
>50	2.37	0.07	14.20	20.38	14.41
Sector					
High-medium tech	2.90	0.10	26.10	41.4	31.5
Medium-low tech	1.50	0.07	30.42	23.7	28.5
Knowledge-intensive business services (KIBS)	1.58	0.11	27.57	24.9	29.2
Less knowledge-intensive services (LKIBS)	0.92	0.05	9.79	4.2	6.6
Other activities	2.00	0.06	6.13	5.8	4.2

Table 4
Descriptive statistics of the independent and dependent variables by international R&D sourcing.

Variable	International R&D sourcing$_{t-2}$ (below mean) n = 41,126		International R&D sourcing$_{t-2}$ (above mean) n = 1865	
	Mean	S.D.	Mean	S.D.
Sales from new-to-the-market product innovations (proportion)	0.09	0.22	0.15	0.26
New-to-the-market product innovations (binary)	0.31	0.46	0.52	0.50
Onshore $_{t-2}$	26.57	44.08	54.06	34.57
Cooperation $_{t-2}$	0.37	0.48	0.71	0.45
Size $_{t-2}$	4.18	1.63	4.71	1.57
Group $_{t-2}$	0.44	0.50	0.61	0.49
Foreign ownership $_{t-2}$	0.17	0.37	0.25	0.43
International span $_{t-2}$	1.73	1.35	2.41	1.07
International intensity $_{t-2}$	0.00001	0.00071	0.00001	0.00006
Firm age $_{t}$	33.05	18.99	35.81	20.98

International R&D sourcing t−2 mean = 1.86.

firms. Model 1 is the base model including only the control variables; Model 2 tests the main effect of *International R&D sourcing* (hypothesis 1) and Model 3 includes the interaction between *International R&D sourcing* and *Firm age* (hypotheses 2a and 2b). The overall fit of the models is good, as indicated by the Wald χ^2 statistic, which is significant at the 1% level in all three of them.

The coefficient of *International R&D sourcing* is positive and significant, which supports our first hypothesis. The estimated coefficient of the interaction term is negative and statistically significant (p-value <0.05), indicating that the positive effects of *International R&D sourcing* are indeed larger for younger firms, which supports hypothesis 2b. The Wald goodness-of-fit test[4] confirms that the inclusion of the interaction term significantly improves the fit of the model (P-value <0.01).

Fig. 1 illustrates the moderation effect of firm age on the relationship between *International R&D sourcing* and *New-to-the-market product innovations*. Young firms (age = one Stdev. Below sample mean) are benefiting comparatively more than older firms (age = one Stdev. Above sample mean) from international R&D sourcing.

The results for the control variables reveal that the coefficients for *Captive R&D offshoring, Onshore R&D* and *Cooperation* variables are all positive and statistically significant throughout all models, indicating that these variables contribute to sales of new-to-the-market innovative products. Thus, companies setting a captive center of R&D abroad, performing R&D activities in their home country and cooperating with other companies perform comparatively better in terms of innovation output. This is to be expected, since these variables are a proxy for the overall level of innovation efforts. Interestingly, the coefficient for *Group* is negative and statistically significant indicating that belonging to a group of companies is negatively associated with sales of new-to-the-market products. Even though belonging to a corporate group may provide firms with relevant resources, it may also increase organizational inertia and hinder the kind of creative behavior that leads to highly novel product innovations. The coefficient for *International intensity* is non-significant, but that of *International span* is positive and significant, suggesting that international exposure is associated with the ability of firms to capture entrepreneurial opportunities and generate product innovations. Finally, the coefficients for *Foreign ownership* and *Firm size* are non-significant; it is plausible that the effects of belonging to a MNE are captured, at least partially, by the *Group* and *International span* variables.

4.3. Robustness tests and additional analyses

We checked the robustness of our results in several ways. First, in order to explore to what extent our findings are specific for *New-to-the-market product innovations*, as we claim in the theoretical arguments leading to hypothesis 1, we re-estimated our research models taking *New-to-the-firm product innovations* as our dependent variable—in other words, sales of products that are novel to the focal firm, but already existed in the market. The results (see Appendix, Models 1 to 3 in Table A) show that both the direct effect of *International R&D sourcing* and the moderating effect of *Firm age* are both non-significant. Therefore, we find evidence suggesting that international R&D sourcing contributes to the successful commercialization of 'true' innovations—products that are new to the market—but not necessarily so to the introduction of 'imitative' innovations. This is a significant departure from the findings of previous research, which had not disentangled these distinct effects when analyzing the implications of offshoring.

Second, we also analyzed whether *Firm age* also moderates the effects of *Captive R&D offshoring*—R&D activities that are conducted in the firm's own international facilities—on product innovation, finding that

[4] The likelihood-ratio test to compare nested models is not applicable when a robust variance-covariance matrix is specified.

Table 5
Fractional probit model results.

	New-to-the-market product innovations		
	Model 1	Model 2	Model 3
International R&D sourcing$_{t-2}$		0.001712***	0.005306**
		(0.000502)	(0.002085)
International R&D sourcing$_{t-2}$ x Firm age $_t$			−0.000404***
			(0.000043)
Firm age $_t$		−0.003457***	−0.003452***
		(0.000397)	(0.000407)
Captive R&D offshoring $_{t-2}$	0.001439**	0.001428**	0.001418**
	(0.000580)	(0.000580)	(0.000585)
Onshore $_{t-2}$	0.001754***	0.001774***	0.001771***
	(0.000150)	(0.000151)	(0.000152)
Cooperation $_{t-2}$	0.243169***	0.238793***	0.242582***
	(0.013925)	(0.014021)	(0.014173)
Size $_{t-2}$	−0.016206***	−0.002053	−0.001772
	(0.004750)	(0.004956)	(0.005007)
Group $_{t-2}$	−0.075690***	−0.084301***	−0.083678***
	(0.015994)	(0.016015)	(0.016191)
Foreign Ownership $_{t-2}$	0.032578*	0.031762*	0.030594
	(0.019111)	(0.019063)	(0.019348)
International span $_{t-2}$	0.067333***	0.068514***	0.069818***
	(0.005939)	(0.005947)	(0.005989)
International intensity $_{t-2}$	−3.462561	−3.987493	−4.161032
	(6.283126)	(6.371903)	(6.482820)
Industry dummies	yes	yes	yes
Year dummies	yes	yes	yes
Intercept	−1.229871***	−1.181719***	−1.170936***
	(0.035045)	(0.036027)	(0.036517)
Wald chi2	1392.28***	1474.00***	1435.24***
Log pseudolikelihood	−12927.997	−12901.064	−12897.507
Observations	42,991	42,991	42,991

Robust standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

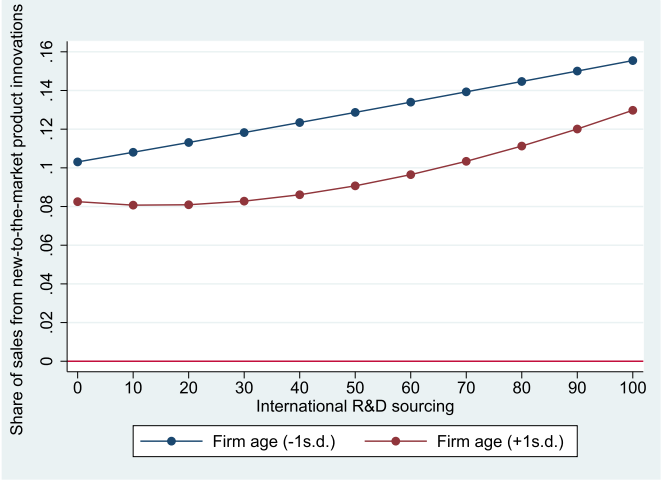

Fig. 1. Graphical representation of the interaction effect of Firm age on the relationship between International R&D sourcing and New-to-the-market product innovation.

moderation effect to be non-significant.[5] This result differs from our main models, which considered outsourced R&D offshoring. Different governance modes of R&D offshoring present different challenges, since they are different in terms of needs, resource commitments and strategic implications (Elia et al., 2014; Nieto and Rodríguez, 2022), thus calling for different organizational traits. We find that whereas 'born-international-sourcers' benefit to a greater extent than older firms from contract offshoring—the LAN being a plausible explanation—such advantage does not span to captive offshoring.

Third, we have also considered the alternative role of other variables that are linked to firm experience and whose effects might somehow be confounded with those of age. We analyzed the interaction between *International R&D sourcing* and both *International span* and *International intensity*, two dimensions that capture the experience of the firm in foreign markets (Castellani and Zanfei, 2004). We found that *International span* reduced the benefits of R&D offshoring, whereas the coefficient moderating effects of *International intensity* were non-significant. Perhaps more importantly for our purposes, the interaction between *International R&D sourcing* and *Firm age* remained negative and significant after these additional moderations were introduced into the model. These results provide further evidence supporting our theoretical arguments; the benefits of international sourcing seem to be driven mostly by the ability of a firm to learn from diverse sources of knowledge, rather than by its presence in international markets. We also considered the role played by previous offshoring experience in shaping the results produced from international sourcing strategies. Experience may help firms cope with the complexity and risks of offshoring knowledge-based activities (Larsen et al., 2013; Haleem et al., 2018). In order to capture this effect, we replaced our independent variable by a cumulative index measuring how many years a company had acquired R&D services from offshore sources over time, since the beginning of our dataset; we found similar results to those of our main models above. R&D offshoring experience showed a positive and significant effect on *New-to-the-market product innovations*, which was negatively moderated by *Firm age*.

Fourth, we also evaluated the potential effects of the majority of the firm's equity being owned by foreign stockholders; being part of a multinational group may influence the way companies perceive and implement R&D offshoring and international activity. Holl and Rama (2014), using a sample comparable to ours, show that foreign subsidiaries do indeed follow a different pattern of external technology sourcing. We found that foreign ownership did not affect the outcomes of R&D offshoring, nor the moderating effects of firm age. In other words, our results hold up for both domestically-owned and foreign-owned enterprises.

Finally, we also evaluated the potential non-linear effects of age by introducing a quadratic term into our models. Since age carries both advantages and disadvantages in terms of innovation performance, it could be plausibly argued that its moderating effects might be non-linear–possibly taking an inverted-U-shape. However, we did not find any significant quadratic effects, which is in line with the linear interaction model that we hypothesize.

Overall, the results of the additional models and sensitivity checks were reassuring and they confirmed the robustness of our findings, in terms of both the positive effects of offshoring on revenue from new-to-the-market product innovations, and the moderating role of firm age.

5. Discussion and implications for theory and practice

The offshoring of knowledge-based activities such as R&D has been gaining in importance in recent years (Castellani et al., 2022; Rosenbusch et al., 2019; Thakur-Wernz et al., 2020), but its strategic implications, and particularly its effects on innovativeness, are still poorly understood (Bertrand and Mol, 2013; Nieto and Rodríguez, 2022; Steinberg et al., 2017; Un and Rodríguez, 2018a). This study makes two main contributions in this regard. First, we find that sourcing R&D from international suppliers contributes to the revenue obtained from products that are new to the market in which a firm operates. Second, we evidence that newer companies benefit from this effect to a larger extent than more mature organizations. In what follows, we discuss the implications of these findings for academia, managerial practice, and public policy.

[5] The results, along with those of any additional analyses that are not reported in the article, are available on request from the authors.

5.1. Implications for academia

The literature on the internationalization of R&D has traditionally been concerned with international R&D activities in MNEs (e.g., Awate et al., 2014; Belderbos et al., 2015; Narula and Zanfei, 2005). The results in this article, meanwhile, apply to a wide range of companies of diverse ages and sizes, whether they are part of a MNE group or not. Thus, we contribute to an emerging research stream that emphasizes that the phenomenon of the internationalization of R&D activities is not exclusive to MNEs, but that all firms should be aware of the potential benefits of R&D offshoring (Baier et al., 2015; Rodríguez and Nieto, 2016).

Unlike previous works showing that offshoring may contribute to revenue from new-to-the-firm products (Mihalache et al., 2012; Steinberg et al., 2017), we find that firms can benefit from the internationalization of R&D mostly by pioneering the launch of highly novel products into the market, rather than conducting merely imitative innovation projects. This suggests that searching for R&D inputs across borders may equip firms with more differentiated and heterogeneous knowledge, which, in turn, leads to these firms pioneering innovative products into the market. R&D offshoring unlocks access to talent and knowledge that is not available domestically (Lewin et al., 2009; Manning et al., 2012), enabling firms to take advantage of asymmetries in the international distribution of advanced knowledge (D'Agostino et al., 2013). We argue that the more novel an innovation is, the scarcer and harder to access the required knowledge becomes, which, in turn, makes searching R&D inputs internationally more beneficial to the firm.

This study also casts light on how organizational contexts shape the effects of the internationalization of the innovation value chain. Previous literature claims that realizing the benefits of offshoring is far from trivial, and requires firms to manage the challenges of a dispersed value chain (Andersson and Pedersen, 2010; Larsen et al., 2013) and learn from their international operations (Zahra et al., 2018). It is plausible to assume that not every firm is equally suited to navigate such challenges and extract the full benefits from R&D offshoring. In this regard, some recent work has examined the effects of R&D offshoring within SMEs (Rodríguez and Nieto, 2016) and the effects of captive innovation offshoring on the effectiveness of organizational adaptation (Baier et al., 2015). Despite this, we still have a very limited understanding of how the characteristics of the organization—which include, but are not limited to, size and age—shape the performance implications of the international sourcing of knowledge services. This study, by explicitly modeling the interaction between firm age and international R&D sourcing, advances this line of research and contributes not only to research on offshoring, but also to the broader innovation management literature. In particular, our findings are relevant to the research streams analyzing the effects of firm age on innovation (Balasubramanian and Lee, 2008; McKelvie et al., 2007; Sørensen and Stuart, 2000; Withers et al., 2011) and the potentially distinct innovation behavior of new ventures (Criscuolo et al., 2012; Kotha et al., 2011).

In the theory section, drawing from different streams of previous literature, we presented two competing views on the moderating effects of age. Our findings strongly suggest that younger companies benefit from international R&D sourcing to a greater extent than mature ones. This is consistent with the LAN argument, suggesting that firms internationalizing at an early stage are better equipped to learn from their international operations and capitalize on the knowledge they acquire abroad. The moderating role of age is substantial; as an illustration, taking coefficients from Model 3 in Table 5, we find that the expected positive effects of R&D offshoring are about two thirds greater for a six-year-old firm than for a twelve-year-old one. From a theoretical standpoint, these result suggest that, even though young firms may lack some of the experience and organizational and managerial resources of mature organizations, their lower inertia and lighter structures, as well as the fact that they do not need to unlearn domestic-oriented processes and routines in order to accommodate international R&D activities, seem to more than offset any potential liability of newness. These results also carry important lessons for older firms. The problems associated with maturity are by no means deterministic; mature companies can try to mimic some of the characteristics of their younger counterparts in order to accommodate international R&D operations and fully benefit from the advantages of offshoring.

This study also contributes to the literature in the intersection of international business and entrepreneurship. We shed light on the effects of the internationalization of R&D on innovation in recently-born firms, which have remained largely unexplored thus far. INVs (Oviatt and McDougall, 1994) and born-global firms (Knight and Cavusgil, 2004) are defined as business organizations that, from their inception, seek to derive significant competitive advantages from both the use of resources from multiple countries and the sale of outputs to multiple countries (Oviatt and McDougall, 1994: 49). Most previous literature, however, has focused on their outward internationalization strategies (Zander et al., 2015), whereby the firm sells its products abroad, largely overlooking the international sourcing of resources. In this study, we focus on inward internationalization strategies, whereby firms incorporate foreign inputs into their home country activities in order to improve their competitiveness—which is consistent with the definition of INVs (Oviatt and McDougall, 1994). In particular, we identify firms—which we can label 'born-international R&D sourcers'—that source R&D services abroad from the early stages of their life cycles. Indeed, we find evidence that these 'born-international sourcers' are far from being an exceptional phenomenon, with a noteworthy proportion of new ventures sourcing knowledge overseas. Our results show that international R&D sourcing strategies can help young firms to access key knowledge assets, thus fostering their innovativeness to a greater extent than mature organizations. Accordingly, we draw attention to this phenomenon of 'born-international-R&D-sourcers', which we believe merits further study in future research.

From an empirical standpoint, the use of a large panel with a representative sample of manufacturing and services firms, which contains firms with a wide range of ages, sizes and industries, makes it possible to perform rigorous quantitative analyses yielding highly generalizable results. As for the geographical setting, Spain ranks 29th out of 51 high-income economies in terms of its environment for innovation, according to the Global Innovation Index 2021 (WIPO, 2021). In other words, it occupies a middling position among developed countries, despite relatively low R&D spending–1.4% of GDP in 2020, compared to an average 2.7% for OECD countries (OECD, 2022). Therefore, our findings can be plausibly generalized to a large number of countries that have solid innovation systems but are not at the forefront of technological development. Caution should be exercised, however, when trying to extrapolate our results to countries with either very advanced or very weak innovation systems, for which international knowledge sourcing may have a different impact on innovation. In summary, the findings in this study must be interpreted in the light of its empirical setting, since decisions on the location of R&D activities, including domestic vs. international sourcing, are contingent on the locational advantages of different countries, which are typically Ricardian resource endowments (Kedia and Mukharjee, 2009), including factors such as innovation infrastructure and the institutional environment (Demirbag and Glaister, 2010).

Finally, it is also worth mentioning that the use of a fractional Tobit model with heteroskedasticity-robust errors (Wooldridge, 2011) overcomes the shortcomings of traditional methodologies in dealing with fractional dependent variables. The literature on innovation and/or internationalization makes extensive use of proportions (or their logarithmic transformations) as dependent variables (Grimpe and Kaiser, 2010; Laursen and Salter, 2006; Roper and Hewitt-Dundas, 2015, among others). The use of fractional Tobit models, although not totally novel (see, for example Naldi and Davidsson, 2014), is not widespread in this field, even though econometric research has shown that traditional approaches are not appropriate (Baum, 2008).

5.2. Managerial implications

The findings in this paper also have implications for practice. In the current globalized and hypercompetitive markets, managers are constantly looking for strategies to be more innovative and competitive. R&D offshoring strategies allow firms to access both knowledge and highly qualified personnel in foreign countries under more advantageous conditions. Our study extends this idea and shows the relevance of R&D offshoring to creating and selling product innovations with a higher degree of novelty, and consequently increasing firm competitiveness. Managers should therefore be aware of the special potential of international R&D sourcing activities for achieving new-to-the-market product innovations. In other words, they should consider the fit between their innovation objectives and their R&D sourcing decisions.

Our results also suggest that the organizational characteristics of newborn businesses—light structures and a lack of deeply embedded routines—provide a favorable setting for integrating foreign knowledge into domestic operations. International R&D sourcing activities may therefore provide younger firms with R&D inputs that they could not get otherwise. This can allow them to overcome the limited R&D investment capacity (due to scarce resources) that is typical of new ventures. Specifically, our findings emphasize that firms, on average, are better off when they develop proactive international R&D-sourcing strategies early in their life cycle, rather than adopting 'wait-and-see' postures. Consequently, we provide compelling evidence that should encourage prospective and nascent entrepreneurs to extend the search for technological resources beyond their home countries. In the case of managers in established (older) firms, they should be aware that, to better capitalize on the benefits from R&D offshoring to achieve product innovations with a higher degree of novelty, they should look into the organizational characteristics of younger firms, and apply them to their own organizations. This should enable them to be more successful in their international R&D sourcing strategies.

5.3. Policy implications

Our study also has implications for policy making. We show that, by sourcing R&D internationally, firms are able to successfully launch highly novel products into the market, boosting their innovativeness and competitiveness and, according to previous research, also fostering knowledge creation in the home country (Piscitello and Santangelo, 2009; D'Agostino et al., 2013). This comes to reinforce previous research suggesting innovation and internationalization policy reinforce each other in a virtuous circle (Bannò and Varum, 2013). Moreover, our findings also suggest that the focus of policy should expand to consider not only outward, but also inward, internationalization. Whereas significant resources are devoted to promote international sales via exports or foreign subsidiaries–in the context of Spain, for example, see the ICEX Next programme by ICEX, the Spanish Institute for Foreign Trade (ICEX España Exportación e Inversiones, n.d.), internationalization of knowledge inputs receive comparatively less attention. Some governments may even be wary that offshoring of R&D activities may somehow compete with the development of domestic knowledge and innovation. This study suggests that, on the contrary, sourcing R&D across borders may boost the innovativeness and competitiveness of domestic firms, which should lead policy makers to push policies that facilitate and promote international inflows of knowledge and technology to help local firms to be more innovative. For example, EU-wide initiatives led by the European Commission, such as the support for business innovation provided by the Enterprise Europe Network, or the European Cluster Collaboration Platform, may prove useful instruments in this regard. It is worth noting that, while international trade of services is liberalized under the WTO's General Agreement on Trade in Services (GATS), innovation-related services such as research, engineering, design, and software, among others, can sometimes be embodied in goods exports. Unlike traditional GATS services, trade of these "services in boxes" is not liberalized and often pays tariffs (Antimiani and Cernat, 2017; Foltea, 2018). Further liberalization of international flows for these services may not only bring direct gains to GDP and global trade (Antimiani and Cernat, 2017) but, according to the arguments and evidence presented in this study, it could potentially boost innovativeness at the firm level.

In order to maximize these positive outcomes, policies should target those companies that are likely to extract the most benefits from these strategies. It is common to find policies targeted at the internationalization of SMES–as an illustration, see a summary of the main actions taken by the European Commission in this regard (Directorate General for Internal Market, Industry, Entrepreneurship and SMEs, n.d.) It is often assumed that SMEs face distinct challenges in foreign markets, and that promoting their international expansion is beneficial for economic growth, competitiveness, and innovation. Meanwhile, little attention is paid to the stage of their life cycles at which companies internationalize, and in particular to the key role of international new ventures. For example, in a recent review of 576 EU Entrepreneurship Policy Documents between 1990 and 2016, Arenal et al. (2021) find that, whereas research and innovation is a major theme, internationalization is only mentioned in the context of SMEs. Our results suggest that, insofar as international R&D sourcing is concerned, age matters, and that the earlier a firm expands across borders, the greater the impact on innovation. It follows that policy makers should encourage the internationalization of technology sourcing in new ventures from an early stage. This could be done in a number of different ways, including: (i) disseminating the advantages of being a "born-international sourcer"; (ii) setting incentives to companies for developing cross-border R&D sourcing strategies from their inception; and (iii) providing support and tools for companies to access and benefit from knowledge available in other countries–for instance, tax incentives, information, and administrative support to help firms find, negotiate, and contract with appropriate foreign R&D suppliers. Targeting this support towards young firms will help new ventures negotiate the challenges and existential risks that they often encounter in the first few years of existence. The policy implications of this study, therefore, are aligned with calls in previous research to focus policy on firm age, rather than merely on firm size (Coad, 2018; Lawless, 2014).

6. Limitations and future research

Despite the academic, practical and policy implications of our research, this paper has certain limitations that provide potential avenues for future research. The findings in this study suggest that firms can engage with international R&D suppliers in order to develop highly innovative products. Whereas the benefits of such a strategy can be substantial, so are the risks and the challenges, particularly for young firms with limited resources. Further research should evaluate those risks by considering other measures of innovation performance that are often overlooked in the literature, such as the failure of innovation projects (D'Este et al., 2016; García-Quevedo et al., 2018; Santamaría et al., 2021). Particularly in the case of new ventures, we need to understand how they can navigate the trials of offshoring and strike the right balance between innovativeness and risk.

Additionally, future research may also build on our arguments and findings in order to explore the relationships between firm age and the internationalization of R&D and innovation. In line with the offshoring literature, we have focused solely on the acquisition of R&D services from offshore providers. However, the internationalization of the innovation value chain is a complex and multidimensional phenomenon (Papasnastassiou, Pearce, and Zanfei, 2020) that can mean different things to different companies; it involves not only imports and exports of R&D, but also multinational collaborations and networks, and different forms, both formal and informal, of knowledge flows across borders. Moreover, further research could identify other potential contingencies, both internal and external to the firm, which might moderate the R&D

offshoring-innovation relationship; for example, firms may resort to international sources as a way to overcome internal or external impediments to innovation. Finally, we introduced in this study the concept of 'born-international-sourcers' to identify firms that source key resources internationally from their inception as a way to foster their innovativeness. Further research may 'zoom into' this phenomenon in order to cast additional light on its implications for firm innovation and competitiveness.

Data availability

The dataset is available to researchers (on request) from the Spanish National Statistics Bureau (INE).

APPENDIX

Table A
Additional tests: Results for new-to-the-firm product innovation.

	New-to-the-firm product innovations		
	Model 1	Model 2	Model 3
International R&D sourcing $_{t-2}$		0.000606	0.005670***
		(0.000490)	(0.002179)
International R&D sourcing $_{t-2}$ *x Firm age* $_{t}$			−0.000028
			(0.000035)
Firm age $_{t}$		−0.001930***	−0.006082**
		(0.000365)	(0.002751)
Captive R&D offshoring $_{t-2}$	0.001373**	0.001363**	0.001560**
	(0.000570)	(0.000570)	(0.000648)
Onshore $_{t-2}$	0.000863***	0.000865***	0.000979***
	(0.000145)	(0.000146)	(0.000175)
Cooperation $_{t-2}$	0.048289***	0.046877***	0.051763***
	(0.013479)	(0.013566)	(0.015005)
Size $_{t-2}$	0.024452***	0.032434***	0.034609***
	(0.004520)	(0.004741)	(0.005407)
Group $_{t-2}$	0.003606	−0.001374	−0.001351
	(0.015253)	(0.015289)	(0.016972)
Foreign Ownership $_{t-2}$	−0.021343	−0.021335	−0.022250
	(0.018117)	(0.018094)	(0.019965)
International span $_{t-2}$	0.028888***	0.030070***	0.032791***
	(0.005438)	(0.005448)	(0.006166)
International intensity $_{t-2}$	−1.263255	−1.570097	−1.746136
	(6.688353)	(6.681519)	(6.989600)
Industry dummies	yes	yes	yes
Year dummies	yes	yes	yes
Intercept	−1.050768***	−1.023111***	−0.999895***
	(0.032398)	(0.033005)	(0.042853)
Wald chi2	960.45***	986.66***	838.67***
Log pseudolikelihood	−16446.237	−16436.458	−16434.077
Observations	42,991	42,991	42,991

Fractional Probit Model Results with new to the firm product innovations as dependent variable.
Robust standard errors in parentheses.
***p < 0.01, **p < 0.05, *p < 0.1.

References

Alcácer, J., Zhao, M., 2012. Local R&D strategies and multilocation firms: the role of internal linkages. Manag. Sci. 58 (4), 734–753.

Alvstam, C., Ivarsson, I., Petersen, B., 2019. Are multinationals and governments from emerging economies configuring global value chains in new ways? Int. J. Emerg. Mark. 15 (1), 111–130.

Ambos, B., Ambos, T.C., 2011. Meeting the challenge of offshoring R&D: an examination of firm and location specific factors. R&D Management 41 (2), 107–119.

Ambos, B., Brandl, K., Perri, A., Scalera, V.G., Van Assche, A., 2021. The nature of innovation in global value chains. J. World Bus. 56 (4), 101221.

Anderson, B.S., Eshima, Y., 2013. The influence of firm age and intangible resources on the relationship between entrepreneurial orientation and firm growth among Japanese SMEs. J. Bus. Ventur. 28 (3), 413–429.

Andersson, U., Pedersen, T., 2010. Organizational design mechanisms for the R&D function in a world of offshoring. Scand. J. Manag. 26 (4), 431–438.

Antimiani, Alessandro, Cernat, Lucian, 2017. Liberalizing Global Trade in Mode 5 Services: How Much Is it Worth?, DG TRADE Chief Economist Notes 2017-4. Directorate General for Trade, European Commission.

Ardito, L., Petruzzelli, A.M., Albino, V., 2019. The influence of alliance ambidexterity on innovation performance and the moderating role of firm age. IEEE Trans. Eng. Manag. 68 (2), 370–377.

Arenal, A., Feijoo, C., Moreno, A., Ramos, S., Armuña, C., 2021. Entrepreneurship policy agenda in the European Union: a text mining perspective. Rev. Pol. Res. 38 (2), 243–271.

Atuahene-Gima, K., Li, H., 2004. Strategic decision comprehensiveness and new product development outcomes in new technology ventures. Acad. Manag. J. 47 (4), 583–597.

Autio, E., Sapienza, H.J., Almeida, J.G., 2000. Effects of age at entry, knowledge intensity, and imitability on international growth. Acad. Manag. J. 43 (5), 909–924.

Awate, S., Larsen, M.M., Mudambi, R., 2014. Accessing vs sourcing knowledge: a comparative study of R&D internationalization between emerging and advanced economy firms. J. Int. Bus. Stud. 46 (1), 63–86.

Baier, E., Rammer, C., Schubert, T., 2015. The impact of captive innovation offshoring on the effectiveness of organizational adaptation. J. Int. Manag. 21 (2), 150–165.

Balasubramanian, N., Lee, J., 2008. Firm age and innovation. Ind. Corp. Change 17 (5), 1019–1047.

Bals, L., Jensen, P.D.Ø., Larsen, M.M., Pedersen, T., 2013. Exploring layers of complexity in offshoring research and practice. In: Pedersen, T., Bals, L., Jensen, P.D.Ø., Larsen, M.M. (Eds.), The Offshoring Challenge. Springer London, London, UK, pp. 1–18.

Bannò, M., Morandi, V., Varum, C.A., 2013. Public policy for innovation and internationalization: are they worth it? Appl. Econ. Lett. 20 (10), 927–930.

Bardhan, A.D., 2006. Managing globalization of R&D: organizing for offshoring innovation. Hum. Syst. Manag. 25 (2), 103–114.

Barkema, H.G., Vermeulen, F., 1998. International expansion through start-up or acquisition: a learning perspective. Acad. Manag. J. 41 (1), 7–26.

Barkema, H.G., Bell, J.H.J., Pennings, J.M., 1996. Foreign entry, cultural barriers, and learning. Strat. Manag. J. 17 (2), 152–166.

Baum, C.F., 2008. Stata tip 63: modeling proportions. STATA J. 8 (2), 299.

Becheikh, N., Landry, R., Amara, N., 2006. Lessons from innovation empirical studies in the manufacturing sector: a systematic review of the literature from 1993–2003. Technovation 26 (5), 644–664.
Becker, W., Dietz, J., 2004. R&D cooperation and innovation activities of firms—evidence for the German manufacturing industry. Res. Pol. 33 (2), 209–223.
Belderbos, R., Carree, M., Lokshin, B., 2004. Cooperative R&D and firm performance. Res. Pol. 33 (10), 1477–1492.
Belderbos, R., Lokshin, B., Sadowski, B., 2015. The returns to foreign R&D. J. Int. Bus. Stud. 46 (4), 491–504.
Berchicci, L., 2013. Towards an open R&D system: internal R&D investment, external knowledge acquisition and innovative performance. Res. Pol. 42 (1), 117–127.
Bertrand, O., Mol, M.J., 2013. The antecedents and innovation effects of domestic and offshore R&D outsourcing: the contingent impact of cognitive distance and absorptive capacity. Strat. Manag. J. 34 (6), 751–760.
Bettis, R.A., Prahalad, C.K., 1995. The dominant logic: retrospective and extension. Strat. Manag. J. 16 (1), 5–14.
Brush, C.G., 1995. International Entrepreneurship: the Effects of Firm Age on Motives of Internationalization. Garland, New York.
Brush, C.G., Vanderwerf, P.A., 1992. A comparison of methods and sources for obtaining estimates of new venture performance. J. Bus. Ventur. 7, 157–170.
Bunyaratavej, K., Hahn, E.D., Doh, J.P., 2008. Multinational investment and host country development: location efficiencies for services offshoring. J. World Bus. 43 (2), 227–242.
Campbell, R., 2014. What I Learned (The Hard Way) about Outsourcing. The New York Times. March 4. https://boss.blogs.nytimes.com/2014/03/04/what-i-learned-the-hard-way-about-outsourcing/?_r=0. (Accessed 23 October 2017).
Cantwell, J.A., Zhang, F., 2013. Do foreign-owned subsidiaries in China follow a distinctive pattern of technological knowledge sourcing? Manag. Organ. Rev. 9 (3), 489–512.
Cassiman, B., Golovko, E., 2011. Innovation and internationalization through exports. J. Int. Bus. Stud. 42 (1), 56–75.
Castellani, D., Perri, A., Scalera, V.G., Zanfei, A., 2022. Cross-Border Innovation in a Changing World. Players, Places, and Policies. Oxford University Press, pp. 1–372.
Castellani, D., Zanfei, A., 2004. Choosing international linkage strategies in the electronics industry: the role of multinational experience. J. Econ. Behav. Organ. 53 (4), 447–475.
Cavusgil, S.T., Knight, G., 2015. The born global firm: an entrepreneurial and capabilities perspective on early and rapid internationalization. J. Int. Bus. Stud. 46 (1), 3–16.
Ceci, F., Prencipe, A., 2013. Does distance hinder coordination? Identifying and bridging boundaries of offshored work. J. Int. Manag. 19 (4), 324–332.
Chaterjee, S., Price, B., 1991. Regression Analysis by Example. John Wiley and Sons, New York.
Coad, A., 2018. Firm age: a survey. J. Evol. Econ. 28 (1), 13–43.
Coad, A., Segarra, A., Teruel, M., 2016. Innovation and firm growth: does firm age play a role? Res. Pol. 45 (2), 387–400.
Coad, A., Holm, J.R., Krafft, J., Quatraro, F., 2018. Firm age and performance. J. Evol. Econ. 28 (1), 1–11.
Cohen, W.M., Levinthal, D.A., 1990. Absorptive capacity: a new perspective on learning and innovation. Adm. Sci. Q. 35 (1), 128–152.
Collis, D.J., 1994. Research note: how valuable are organizational capabilities? Strat. Manag. J. 15 (S1), 143–152.
Coucke, K., Sleuwaegen, L., 2008. Offshoring as a survival strategy: evidence from manufacturing firms in Belgium. J. Int. Bus. Stud. 39 (8), 1261–1277.
Covin, J.G., Slevin, D.P., Covin, T.J., 1990. Content and performance of growth-seeking strategies: a comparison of small firms in high- and low-technology industries. J. Bus. Ventur. 5, 391–412.
Criscuolo, P., Nicolaou, N., Salter, A., 2012. The elixir or burden of youth? Exploring differences in innovation between start-ups and established firms. Res. Pol. 41 (2), 319–333.
Cuervo-Cazurra, A., Nieto, M.J., Rodríguez, A., 2018. The impact of R&D sources on new product development: sources of funds and the diversity versus control of knowledge debate. Long. Range Plan. 51 (5), 649–665.
D'Este, P., Amara, N., Olmos-Peñuela, J., 2016. Fostering novelty while reducing failure: balancing the twin challenges of product innovation. Technol. Forecast. Soc. Change 113, 280–292.
De Meyer, A., 1991. Tech talk: how managers are stimulating global R&D communication. MIT Sloan Manag. Rev. 32 (3), 49.
Demirbag, M., Glaister, K.W., 2010. Factors determining offshore location choice for R&D projects: a comparative study of developed and emerging regions. J. Manag. Stud. 47 (8), 7 1534–1560.
Di Gregorio, D., Musteen, M., Thomas, D.E., 2009. Offshore outsourcing as a source of international competitiveness for SMEs. J. Int. Bus. Stud. 40 (6), 969–988.
Dierickx, I., Cool, K., 1989. Asset stock accumulation and sustainability of competitive advantage. Manag. Sci. 35 (12), 1504–1511.
Directorate General for Internal Market, Industry, Entrepreneurship and SMEs. SME Internationalisation beyond the EU. European commission. https://single-market-economy.ec.europa.eu/smes/sme-strategy/improving-smes-access-marktets/sme-internationalisation-beyond-eu_en.
D'Agostino, L.M., Laursen, K., Santangelo, G.D., 2013. The impact of R&D offshoring on the home knowledge production of OECD investing regions. J. Econ. Geogr. 13 (1), 145–175.
Elia, S., Caniato, F., Luzzini, D., Piscitello, L., 2014. Governance choice in global sourcing of services: the impact on service quality and cost saving performance. Global Strategy Journal 4 (3), 181–199.
Farrell, D., 2005. Offshoring: value creation through economic change. J. Manag. Stud. 42 (3), 675–683.
Foltea, M.M., 2018. *How To Include 'Mode 5' Services Commitments in Bilateral Free Trade Agreements and at Multilateral Stage?* EPRS. European Parliamentary Research Service, Belgium.
Foss, N.J., Lyngsie, J., Zahra, S.A., 2013. The role of external knowledge sources and organizational design in the process of opportunity exploitation. Strat. Manag. J. 34 (12), 1453–1471.
Garcia, R., Calantone, R., 2002. A critical look at technological innovation typology and innovativeness terminology: a literature review. J. Prod. Innovat. Manag. 19 (2), 110–132.
García-Quevedo, J., Segarra-Blasco, A., Teruel, M., 2018. Financial constraints and the failure of innovation projects. Technol. Forecast. Soc. Change 127, 127–140.
Gashi, P., Hashi, I., Pugh, G., 2014. Export behaviour of SMEs in transition countries. Small Bus. Econ. 42 (2), 407–435.
Gleich, W., Schmeisser, B., Zschoche, M., 2017. The influence of competition on international sourcing strategies in the service sector. Int. Bus. Rev. 26 (2), 279–287.
Gopalakrishnan, S., Bierly, P.E., 2006. The impact of firm size and age on knowledge strategies during product development: a study of the drug delivery industry. Engineering Management, IEEE Transactions on 53 (1), 3–16.
Grimpe, C., Kaiser, U., 2010. Balancing internal and external knowledge acquisition: the gains and pains from R&D outsourcing. J. Manag. Stud. 47 (8), 1483–1509.
Gusenbauer, M., Massini, S., Fink, M., 2015. Innovation offshoring by small and medium-sized enterprises–establishing the research gap. In: Oshri, I., Kotlarsky, J., Willcocks, L.P. (Eds.), Achieving Success and Innovation in Global Sourcing: Perspectives and Practices. Springer International Publishing, pp. 156–170.
Haleem, F., Farooq, S., Wæhrens, B.V., Boer, H., 2018. Offshoring experience and performance: the role of realized drivers and risk management. Supply Chain Manag.: Int. J. 23 (6), 531–544.
Hannan, M.T., Freeman, J., 1977. The population ecology of organizations. Am. J. Sociol. 929–964.
Henderson, A.D., 1999. Firm strategy and age dependence: a contingent view of the liabilities of newness, adolescence, and obsolescence. Adm. Sci. Q. 44 (2), 281–314.
Holl, A., Rama, R., 2014. Foreign subsidiaries and technology sourcing in Spain. Ind. Innovat. 21 (1), 43–64.
España exportación e Inversiones n.d. ICEX Next, el Programa para Internacionalizar tu Empresa. Gobierno de España, Ministerio de Industria, Comercio, y Turismo.
Jensen, P.D.Ø., Pedersen, T., 2012. Offshoring and international competitiveness: antecedents of offshoring advanced tasks. J. Acad. Market. Sci. 40 (2), 313–328.
Jensen, P.D.Ø., Larsen, M.M., Pedersen, T., 2013a. The organizational design of offshoring: taking stock and moving forward. J. Int. Manag. 19 (4), 315–323.
Jensen, P.D.Ø., Pedersen, T., Petersen, B., 2013b. Do expectations match reality when firms consider the risks of offshoring? A comparison of risk assessment by firms with and without offshoring experience. In: Pedersen, T., Bals, L., Jensen, P.D.Ø., Larsen, M.M. (Eds.), The Offshoring Challenge. Springer London, London, UK, pp. 287–299.
Johanson, M., Martín, O.M., 2015. The incremental expansion of Born Internationals: a comparison of new and old Born Internationals. Int. Bus. Rev. 24 (3), 476–496.
Jones, M.V., Coviello, N., Tang, Y.K., 2011. International entrepreneurship research 1989–2009: a domain ontology and thematic analysis. J. Bus. Ventur. 26 (6), 632–659.
Kafouros, M.I., Buckley, P.J., Sharp, J.A., Wang, C., 2008. The role of internationalization in explaining innovation performance. Technovation 28 (1), 63–74.
Kaufmann, A., Tödtling, F., 2001. Science–industry interaction in the process of innovation: the importance of boundary-crossing between systems. Res. Pol. 30 (5), 791–804.
Kedia, B.L., Mukherjee, D., 2009. Understanding offshoring: a research framework based on disintegration, location and externalization advantages. J. World Bus. 44 (3), 250–261.
Kenney, M., Massini, S., Murtha, T.P., 2009. Offshoring administrative and technical work: new fields for understanding the global enterprise. J. Int. Bus. Stud. 40, 887–900.
Keupp, M.M., Gassmann, O., 2009. The past and the future of international entrepreneurship: a review and suggestions for developing the field. J. Manag. 35 (3), 600–633.
Khanna, T., Yafeh, Y., 2007. Business groups in emerging markets: paragons or parasites? J. Econ. Lit. 45 (2), 331–372.
Khraishi, A., Paulraj, A., Huq, F., Seepana, C., 2022. Knowledge management in offshoring innovation by SMEs: role of internal knowledge creation capability, absorptive capacity and formal knowledge-sharing routines. Supply Chain Manag.: Int. J. https://doi.org/10.1108/SCM-05-2021-0256. Available online March 8.
Kleinknecht, A., Van Montfort, K., Brouwer, E., 2002. The non-trivial choice between innovation indicators. Econ. Innovat. N. Technol. 11 (2), 109–121.
Knight, G.A., Cavusgil, S.T., 2004. Innovation, organizational capabilities, and the born-global firm. J. Int. Bus. Stud. 35 (2), 124–141.
Kogut, B., Zander, U., 1992. Knowledge of the firm, combinative capabilities, and the replication of technology. Organ. Sci. 3 (3), 383–397.
Kogut, B., Zander, U., 1993. Knowledge of the firm and the evolutionary theory of the multinational corporation. J. Int. Bus. Stud. 24, 625–645.
Kotha, R., Zheng, Y., George, G., 2011. Entry into new niches: the effects of firm age and the expansion of technological capabilities on innovative output and impact. Strat. Manag. J. 32 (9), 1011–1024.
Kundu, S.K., Katz, J.A., 2003. Born-international SMEs: BI-level impacts of resources and intentions. Small Bus. Econ. 20 (1), 25–47.
Lampel, J., Bhalla, A., 2011. Living with offshoring: the impact of offshoring on the evolution of organizational configurations. J. World Bus. 46 (3), 346–358.

Lampert, C.M., Kim, M., 2019. Going far to go further: offshoring, exploration, and R&D performance. J. Bus. Res. 103, 376–386.
Larsen, M.M., Manning, S., Pedersen, T., 2013. Uncovering the hidden costs of offshoring: the interplay of complexity, organizational design, and experience. Strat. Manag. J. 34 (5), 533–552.
Laursen, K., Salter, A., 2006. Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. Strat. Manag. J. 27 (2), 131–150.
Lawless, M., 2014. Age or size? Contributions to job creation. Small Bus. Econ. 42 (4), 815–830.
Leiponen, A., Helfat, C.E., 2011. Location, decentralization, and knowledge sources for innovation. Organ. Sci. 22 (3), 641–658.
Leonard-Barton, D., 1995. Wellsprings of Knowledge: Building and Sustaining the Sources of Innovation. Harvard University Press, Boston, MA.
Levinthal, D.A., March, J.G., 1993. The myopia of learning. Strat. Manag. J. 14 (S2), 95–112.
Lewin, A.Y., Massini, S., Peeters, C., 2009. Why are companies offshoring innovation? The emerging global race for talent. J. Int. Bus. Stud. 40 (6), 901–925.
Li, Y., Zhang, Y.A., Shi, W., 2019. Navigating geographic and cultural distances in international expansion: the paradoxical roles of firm size, age, and ownership. Strat. Manag. J. https://doi.org/10.1002/smj.3098.
Liu, X., Buck, T., 2007. Innovation performance and channels for international technology spillovers: evidence from Chinese high-tech industries. Res. Pol. 36 (3), 355–366.
Malerba, F., 2005. Sectoral systems of innovation: a framework for linking innovation to the knowledge base, structure and dynamics of sectors. Econ. Innovat. N. Technol. 14 (1–2), 63–82.
Manning, S., 2014. Mitigate, tolerate or relocate? Offshoring challenges, strategic imperatives and resource constraints. J. World Bus. 49 (4), 522–535.
Manning, S., Massini, S., Lewin, A.Y., 2008. A Dynamic Perspective on Next-Generation Offshoring: the Global Sourcing of Science and Engineering Talent. Academy of Management Perspectives, pp. 35–54.
Manning, S., Sydow, J., Windeler, A., 2012. Securing access to lower-cost talent globally: the dynamics of active embedding and field structuration. Reg. Stud. 46 (9), 1201–1218.
Maskell, P., Pedersen, T., Petersen, B., Dick-Nielsen, J., 2007. Learning paths to offshore outsourcing: from cost reduction to knowledge seeking. Ind. Innovat. 14 (3), 239–257.
McDougall, P.P., 1989. International versus domestic entrepreneurship: new venture strategic behavior and industry structure. J. Bus. Ventur. 4 (6), 387–400.
McDougall, P.P., Shane, S., Oviatt, B.M., 1994. Explaining the formation of international new ventures: the limits of theories from international business research. J. Bus. Ventur. 9 (6), 469–487.
McDougall, P.P., Oviatt, B.M., Shrader, R.C., 2003. A comparison of international and domestic new ventures. J. Int. Enterpren. 1 (1), 59–82.
McKelvie, A., Wiklund, J., Short, J., 2007. The new venture innovation process: examining the role of absorptive capacity. Adv. Entrepreneursh. Firm Emergence Growth 10, 159–186.
Mihalache, O.R., Jansen, J.J., Van Den Bosch, F.A., Volberda, H.W., 2012. Offshoring and firm innovation: the moderating role of top management team attributes. Strat. Manag. J. 33 (13), 1480–1498.
Miyazaki, K., 1994. Search, learning and accumulation of technological competences; the case of optoelectronics. Ind. Corp. Change 3 (3), 631–654.
Monczka, R.M., Trent, R.J., 1991. Global sourcing: a development approach. J. Supply Chain Manag. 27 (2), 2–8.
Mosakowski, E., 1998. Entrepreneurial resources, organizational choices, and competitive outcomes. Organ. Sci. 9 (6), 625–643.
Mukherjee, D., Gaur, A.S., Datta, A., 2013. Creating value through offshore outsourcing: an integrative framework. J. Int. Manag. 19 (4), 377–389.
Naldi, L., Davidsson, P., 2014. Entrepreneurial growth: the role of international knowledge acquisition as moderated by firm age. J. Bus. Ventur. 29 (5), 687–703.
Narula, R., Zanfei, A., 2005. Globalization of innovation: the role of muntinational enterprises. In: Fagerberg, J., Moweryand, D., Nelson, R. (Eds.), *The Oxford Handbook of Innovation*: 318-345. Oxford University Press, Oxford.
Nassimbeni, G., 2006. International sourcing: empirical evidence from a sample of Italian firms. Int. J. Prod. Econ. 103 (2), 694–706.
Nieto, M.J., Rodríguez, A., 2011. Offshoring of R&D: looking abroad to improve innovation performance. J. Int. Bus. Stud. 42 (3), 345–361.
Nieto, M.J., Rodríguez, A., 2022. Cross-border R&D sourcing strategies: different governance modes and 'new' players. In: Castellani, D., Perri, A., Scalera, V.G., Zanfei, A. (Eds.), Cross-Border Innovation in a Changing World: Players, Places and Policies. Oxford University Press, pp. 215–239. https://doi.org/10.1093/oso/9780198870067.003.0008.
Nieto, M.J., Rodríguez, A., Hernández, V., 2022. International sourcing and the productivity of SMEs in transition countries: formal and informal 'region effects' and the communist footprint. J. Bus. Res. 145, 347–359.
Nobel, R., Birkinshaw, J., 1998. Innovation in multinational corporations: control and communication patterns in international R&D operations. Strat. Manag. J. 19 (5), 479–496.
Nooteboom, B., Van Haverbeke, W., Duysters, G., Gilsing, V., Van den Oord, A., 2007. Optimal cognitive distance and absorptive capacity. Res. Pol. 36 (7), 1016–1034.
Organization for Economic Cooperation and Development (Oecd), 2009. OECD Science, Technology and Industry Scoreboard 2009. OECD Publishing, Paris.
Organization for Economic Cooperation and Development (Oecd), 2022. Main Science and Technology Indicators, vol. 2021. Organization for Economic Cooperation and Development, Paris, 2.
Organization for Economic Cooperation and Development (OECD) and Eurostat, 2018. Oslo Manual 2018. Guidelines for Collecting, Reporting, and Using Data on Innovation, fourth ed. OECD Publishing.
Oviatt, B.M., McDougall, P.P., 1994. Toward a theory of international new ventures. J. Int. Bus. Stud. 25 (1), 45–64.
Papanastassiou, M., Pearce, R., Zanfei, A., 2020. Changing perspectives on the internationalization of R&D and innovation by multinational enterprises: a review of the literature. J. Int. Bus. Stud. 51 (4), 623–664.
Papke, L.E., Wooldridge, J.M., 1996. Econometric methods for fractional response variables with an application to 401(K) plan participation rates. J. Appl. Econom. 11, 619–632.
Papke, L.E., Wooldridge, J.M., 2008. Panel data methods for fractional response variables with an application to test pass rates. J. Econom. 145 (1–2), 121–133.
Patel, P.C., Fernhaber, S.A., McDougall-Covin, P.P., van der Have, R.P., 2014. Beating competitors to international markets: the value of geographically balanced networks for innovation. Strat. Manag. J. 35 (5), 691–711.
Pereira, V., Munjal, S., Ishizaka, A., 2019. Outsourcing and offshoring decision making and its implications for businesses-A synthesis of research pursuing five pertinent questions. J. Bus. Res. 103, 348–355.
Piscitello, L., Santangelo, G.D., 2009. Does R&D Offshoring Displace or Strengthen Knowledge Production at Home? Evidence from OECD Countries. SSRN (January 28, 2009).
Rabbiosi, L., Santangelo, G.D., 2013. Parent company benefits from reverse knowledge transfer: the role of the liability of newness in MNEs. J. World Bus. 48 (1), 160–170.
Ranger-Moore, J., 1997. Bigger may be better, but is older wiser? Organizational age and size in the New York life insurance industry. Am. Socio. Rev. 62 (6), 903–920.
Rilla, N., Squicciarini, M., 2011. R&D (re) location and offshore outsourcing: a management perspective. Int. J. Manag. Rev. 13 (4), 393–413.
Rodríguez, A., Nieto, M.J., 2016. Does R&D offshoring lead to SME growth? Different governance modes and the mediating role of innovation. Strat. Manag. J. 37 (8), 1734–1753.
Rodríguez, A., Hernández, V., Nieto, M.J., 2022. International and domestic external knowledge in the innovation performance of firms from transition economies: the role of institutions. Technol. Forecast. Soc. Change 176, 121442.
Roper, S., Hewitt-Dundas, N., 2015. Knowledge stocks, knowledge flows and innovation: evidence from matched patents and innovation panel data. Res. Pol. 44 (7), 1327–1340.
Rosenbusch, N., Brinckmann, J., Bausch, A., 2011. Is innovation always beneficial? A meta-analysis of the relationship between innovation and performance in SMEs. J. Bus. Ventur. 26, 441–457.
Rosenbusch, N., Gusenbauer, M., Hatak, I., Fink, M., Meyer, K.E., 2019. Innovation offshoring, institutional context and innovation performance: a meta-analysis. J. Manag. Stud. 56 (1), 203–233.
Roza, M., Van den Bosch, F.A., Volberda, H.W., 2011. Offshoring strategy: motives, functions, locations, and governance modes of small, medium-sized and large firms. Int. Bus. Rev. 20 (3), 314–323.
Santamaría, L., Nieto, M.J., Rodríguez, A., 2021. Failed and successful innovations: the role of geographic proximity and international diversity of partners in technological collaboration. Technol. Forecast. Soc. Change 166, 120575.
Sapienza, H.J., De Clercq, D., Sandberg, W.R., 2005. Antecedents of international and domestic learning effort. J. Bus. Ventur. 20 (4), 437–457.
Sheskin, D.J., 2003. Handbook of Parametric and Nonparametric Statistical Procedures. Chapman and Hall/CRC.
Singh, J., 2008. Distributed R&D, cross-regional knowledge integration and quality of innovative output. Res. Pol. 37 (1), 77–96.
Sofka, W., Grimpe, C., 2010. Specialized search and innovation performance–evidence across Europe. R&D Management 40 (3), 310–323.
Sommer, D., Bhandari, K.R., 2022. Internationalization of R&D and innovation performance in the pharma industry. J. Int. Manag. 28 (3), 100927.
Sørensen, J.B., Stuart, T.E., 2000. Aging, obsolescence, and organizational innovation. Adm. Sci. Q. 45 (1), 81–112.
Steinberg, P.J., Procher, V.D., Urbig, D., 2017. Too much or too little of R&D offshoring: the impact of captive offshoring and contract offshoring on innovation performance. Res. Pol. 46 (10), 1810–1823.
Tang, Y., Li, J., Yang, H., 2015. What I see, what I do how executive hubris affects firm innovation. J. Manag. 41 (6), 1698–1723.
Tether, B.S., 2002. Who co-operates for innovation, and why: an empirical analysis. Res. Pol. 31 (6), 947–967.
Thakur-Wernz, P., Bruyaka, O., Contractor, F., 2020. Antecedents and relative performance of sourcing choices for new product development projects. Technovation 90, 102097.
The Economist, 2013. Outsourcing and Offshoring. Here, There and Everywhere. Special Report. January, 19th.
The Guardian, 2011. Offshoring Guidance Relevant for the Whole Public Sector. Retrieved from. https://www.theguardian.com/public-leaders-network/2011/aug/01/offshoring-guidance-relevant-public-sector.
Un, C.A., 2011. The advantage of foreignness in innovation. Strat. Manag. J. 32 (11), 1232–1242.
Un, C.A., Rodríguez, A., 2018a. Learning from R&D outsourcing vs. learning by R&D outsourcing. Technovation 72, 24–33.
Un, C.A., Rodríguez, A., 2018b. Local and global knowledge complementarity: R&D collaborations and innovation of foreign and domestic firms. J. Int. Manag. 24 (2), 137–152.
United Nations Conference and Trade and Development Unctad, 2005. Transnational Corporations and the Internationalization of R&D. United Nations, New York and Geneva.

Veugelers, R., Cassiman, B., 1999. Make and buy in innovation strategies: evidence from Belgian manufacturing firms. Res. Pol. 28 (1), 63–80.
Weinberg, S.L. S.K. Abramowitz, 2008. Statistics Using SPSS: an Integrative Approach, second ed. Cambridge University Press, Cambridge.
Withers, M.C., Drnevich, P.L., Marino, L., 2011. Doing more with less: the disordinal implications of firm age for leveraging capabilities for innovation activity. J. Small Bus. Manag. 49 (4), 515–536.
Wooldridge, J.M., 2011. Fractional response models with endogenous explanatory variables and heterogeneity. In: *CHI11 Stata Conference (No. 12)*. Stata Users Group.
World Intellectual Property Organization (Wipo), 2021. Global Innovation Index 2021: Tracking Innovation through the COVID-19 Crisis. World Intellectual Property Organization, Geneva.
Wu, J., 2012. Technological collaboration in product innovation: the role of market competition and sectoral technological intensity. Res. Pol. 41 (2), 489–496.
Zahra, S.A., 1996. Technology strategy and new venture performance: a study of corporate-sponsored and independent biotechnology ventures. J. Bus. Ventur. 11, 289–321.
Zahra, S.A., Ireland, R.D., Hitt, M.A., 2000. International expansion by new venture firms: international diversity, mode of market entry, technological learning, and performance. Acad. Manag. J. 43 (5), 925–950.
Zahra, S.A., Matherne, B.P., Carleton, J.M., 2003. Technological resource leveraging and the internationalisation of new ventures. J. Int. Enterpren. 1 (2), 163–186.
Zahra, S.A., Zheng, C., Yu, J., 2018. Learning advantages of newness: a reconceptualization and contingent framework. J. Int. Enterpren. 16 (1), 12–37.
Zander, I., McDougall-Covin, P., Rose, E.L., 2015. Born globals and international business: evolution of a field of research. J. Int. Bus. Stud. 46 (1), 27–35.
Zhou, L., Wu, A., 2014. Earliness of internationalization and performance outcomes: exploring the moderating effects of venture age and international commitment. J. World Bus. 49 (1), 132–142.