European Journal of Innovation Management

# Made in Vietnam: Internal, collaborative, and regional knowledge sources and product innovation in Vietnamese firms

Thuy Phung Minh Thu, Joris Knoben, Patrick Vermeulen, Dat Tho Tran,

# Made in Vietnam

## Internal, collaborative, and regional knowledge sources and product innovation in Vietnamese firms

Thuy Phung Minh Thu
*Institute for Management Research, Radboud University, Nijmegen, The Netherlands and*
*Faculty of Management Science, National Economics University, Hanoi, Vietnam*
Joris Knoben and Patrick Vermeulen
*Institute for Management Research, Radboud University, Nijmegen, The Netherlands, and*
Dat Tho Tran
*National Economics University, Hanoi, Vietnam*

Received 4 October 2017
Revised 8 February 2018
28 March 2018
29 March 2018
30 March 2018
Accepted 30 March 2018



### Abstract

**Purpose** – The purpose of this paper is to simultaneously test the association between three different sources of knowledge (internal, collaborative and regional) and innovation. This study aims to expand the insights by assessing these associations in the context of a rapidly developing and liberalizing economy; Vietnam. By conducting this study with Vietnamese data, the authors can assess whether the association between different sources of knowledge and innovation shows systematic differences to those in advanced economies.

**Design/methodology/approach** – In this study, the authors utilize data from two main sources: The World Bank Enterprise Survey and the Innovation Capabilities Survey. These firm-level surveys comprise non-agricultural formal and private sector firms. For Vietnam, 300 manufacturing firms have been included in the sample. The authors use a series of binary logistic regression models to analyze the data.

**Findings** – The analyses reveal that internal R&D has a strong positive association with product innovation. In contrast to findings in Western economies, not all kinds of collaborative knowledge sources have a significant association with innovation. Only collaborative knowledge gained from inside the supply chain is positively related to product innovation. Unexpectedly, negative effects from using too much external knowledge were also found.

**Research limitations/implications** – Due to the cross-sectional nature of the data causality could not be inferred from the study. Moreover, a relatively large number of the measures were dichotomous due the large number of missing observations for more detailed measurements of the variables.

**Practical implications** – When developing their innovation strategy firms in developing countries should take into account that collaborating with partners useful, but only if they collaborate within the supply chain. As such, firms should increase their interaction with suppliers and customers and put their efforts on the development of customized solutions for them.

**Social implications** – The Vietnamese Government could implement policies that help to enhance the quality of universities and research institutes. In most developed countries, universities and research institutes are vital sources of knowledge for innovation whereas they are not in Vietnam.

**Originality/value** – This paper contributes to the growing body of literature on firm-level innovation in developing countries. It identifies several core differences between the drivers of innovation in developed and developing contexts. Surprisingly, a feature that was expected to differ, the negative effect of over-search of external knowledge on innovation, was also found in Vietnam.

**Keywords** Alliances, Product innovation, Resources

**Paper type** Research paper

## 1. Introduction

Innovation has been studied as an indicator for firm performance in numerous studies (Artz *et al.,* 2010; Calantone *et al.,* 2002; Darroch, 2005; Hitt *et al.,* 1997; Kasseeah, 2013). Additionally, a firm's capacity to generate innovations has consistently been considered a

European Journal of Innovation Management
Vol. 21 No. 4, 2018
pp. 581-600

1460-1060
DOI 10.1108/EJIM-10-2017-0134

source of sustained competitive advantage (Barney, 1991). Innovation often originates from the exchange and recombination of knowledge. Therefore, firms need to acquire new knowledge from numerous sources to continuously generate innovations and maintain their competitive edge (Porter, 1990).

Firm-level resources allow firms to distinguish themselves from their competitors and develop a competitive advantage. According to the resource-based view (RBV) of the firm, this is only possible, however, when resources are valuable, rare, inimitable and non-substitutable (Barney, 1991). Even though knowledge is crucial for all type of firms, the exact type of knowledge that is most useful might differ between larger and smaller firms. Large companies engaged in internationalization pay particular attention to internal knowledge as a source of innovation (Scaringella, 2016). SMEs on the other hand are resource-constraint so they need to draw on knowledge networks that tie a broad set of partners, customers and suppliers together to take advantage of innovation resources. As such, these firms could benefit from an "open innovation" approach.

According to Chesbrough (2003, p. XXIV), "open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as firms look to advance their technology." Hence, open innovation refers to the capability of firms to connect with other actors and develop connections in order to make use of external sources and ideas (Chesbrough, 2003; Sakkab, 2002). Firms that are solely focused on internal knowledge sources, miss opportunities and potentially suffer from lock-in of existing ways of doing business (Uzzi, 1997). Several recent studies suggest that a growing number of firms pursue an open innovation strategy, which means involving both inbound activities (focusing on external knowledge sources and collaboration with external stakeholders) and outbound activities (generating knowledge through R&D for own uses and commercializing innovations) (Greco *et al.,* 2015; Schroll and Mild, 2012; West and Bogers, 2014). In a related stream of literature, Boschma (2005) and Asheim and Isaksen (1997) argue that firms can learn and gain external knowledge by being located in a region with other firms. Hence, knowledge might flow from various sources, which can be internal, collaborative, and regional sources.

Internal knowledge sources could be generated by firms through in-house R&D activities, employee training or managers' experience (Chen and Huang, 2009; Frenz and Ietto-Gillies, 2009; Martínez-Ros and Orfila-Sintes, 2012). Collaborative knowledge sources could come from collaborative activities between firms and their counterparts from inside the supply chain, such as competitors, suppliers and customers, or from outside the supply chain, such as universities and research institutes (Lin *et al.,* 2002). Regional knowledge sources come to firms from the information available in the region where firms are located, because knowledge may spill over across firms, especially when the distance between them is small (Boschma, 2005; Knoben and Oerlemans, 2006). Boschma (2005) states that short distances could bring people together, favor information contacts and facilitate the exchange of tacit knowledge. Hence, within the same region, firms could have access to specialized labor sources and gain knowledge from their expertise. Furthermore, more recent attention has focused on the effect of internal firm dynamics, inter-firm linkages and regions on innovation (Doloreux and Lord-Tarte, 2013; Giuliani, 2006; Wang and Lin, 2012). Similarly, this study therefore aims to simultaneously test the relationship between three different sources of knowledge (internal, collaborative and regional) and innovation.

In doing so, we will use firm-level data from Vietnam to analyze those relationships. A great deal of previous research on innovation is conducted in developed economies and those findings are not necessarily applicable to developing economies. The case of Vietnam is especially salient to analyze as it has changed from a central planning regime where the central government decided output targets and prices, domestic and international trade with bureaucratic controls to a more market-based economy since 1986. Thirty years after the

enactment of Vietnam's "doi moi" (renovation) policy in 1986, the country has increased economic liberalization and achieved structural reforms needed to modernize the economy and to produce more competitive, export-driven industries. State-owned enterprises now account for roughly 40 percent of GDP. Vietnam has enjoyed rapid economic growth, which has been among the fastest in the world, with a mean of 6.4 percent a year since 2000. Remarkably, it has been transformed from one of the poorest to a lower middle-income country (World Bank and Ministry of Planning and Investment of Vietnam, 2016). With a population of almost 93 million people (GSO, 2017), Vietnam is a densely populated developing country with 34.6 percent of the population living in urban areas. Even though its poverty has declined significantly, the country is working to create jobs to meet the challenge of a labor force that is growing every year by more than one million people.

Although Vietnam does have firms and industries actively engaged in innovation, the overall innovation system is weak. Vietnam ranks 11th out of 12 East Asian countries in terms of human resource capacity (3.79 out of 10) reported by OECD and The World Bank (2014). Firms in transition economies exhibit a number of striking differences with firms in developed countries, such as a lack of complete discretion to acquire and allocate resources and little knowledge and experience to compete in a competitive, market-based economy (Peng, 2000). By conducting this study with Vietnamese data, we can assess whether the association between different sources of knowledge and innovation shows systematic differences to those in advanced economies.

The following part of this paper will first provide an overview of the theoretical background and the hypotheses. Next, the empirical data and research methodology are presented. Afterwards, the analysis will be reported together with the results summary. Lastly, we provide a discussion on our results and conclusion.

## 2. Theoretical background

Innovation can reduce production costs and improve the quality of firms' goods and services. Numerous empirical studies suggest that innovation enhances firm performance (Artz *et al.*, 2010; Hitt *et al.*, 1997; Neely and Hii, 2012). In this study, we focus on product innovation, which is defined as "a good or service that is new or significantly improved. This includes significant improvements in technical specifications, components and materials, software in the product, user friendliness or other functional characteristics" (OECD/Eurostat, 2005, p. 48). It is now well established from a variety of studies that the ability of firms to introduce product innovation is considered to be a key determinant of organizational performance and sustainable development (Danneels, 2002; Laursen *et al.,* 2012). Many authors have emphasized the vital role of knowledge in building and sustaining innovation (Quintane *et al.,* 2011; Schulze and Hoegl, 2008). As such, innovation is defined as a knowledge-based commodity. Hence, firms need to have knowledge to innovate and thus to profit from innovation (Lundvall, 2007, 2009). Therefore, this study will also focus on the association of knowledge with innovation. In doing so, we will use three different sources of knowledge: internal knowledge sources, collaborative knowledge sources and regional knowledge sources.

First, internal knowledge sources for innovation have been researched extensively in developed and developing countries alike (Barasa *et al.,* 2017; Baumann and Kritikos, 2016; De Oliveira Cabral, 2010; Roper *et al.,* 2017; Svetina and Prodan, 2008). Internal knowledge sources could be generated from internal R&D, which has become a classical explanation for innovation in the sense that firms with higher level of internal R&D are expected to be more innovative (Caloghirou *et al.,* 2004; Frenz and Ietto-Gillies, 2009). Another example of internal knowledge sources is managers' experience and skills. With their experience and skills, managers understand and respond effectively with changes in their competitive environment. Additionally, managers could rely on their experience and skills accumulated

over time to make decision in identifying innovation opportunities (Bantel and Jackson, 1989; Liu and Buck, 2007; McGee and Dowling, 1994).

Second, collaborative knowledge sources have been relevant to innovation generation and firms are aware of the necessity of establishing R&D collaboration to obtain expertise which cannot be generated in-house (Frenz and Ietto-Gillies, 2009). Collaboration with other firms and institutions in R&D is a crucial way to make external resources usable (Becker and Dietz, 2004; Bougrain and Haudeville, 2002). Several lines of evidence suggest that there is a positive influence between collaborative knowledge sources and innovation (Becker and Dietz, 2004; Frenz and Ietto-Gillies, 2009). West and Bogers (2014) state that focal firms can improve efficiency through scale economies and access to innovation when they use external sourcing. Laursen and Salter (2006) argued that collaborative knowledge sources are embedded within communities and networks in which different actors work together and supply ideas and knowledge to each other. However, collaborative knowledge sources do not always bring benefits to firms. Laursen and Salter (2006) argue that even though knowledge from outsiders is beneficial in general, firms that over-search may be confronted with negative consequences for their innovation performance. Firms might not be able to handle too many ideas at a time or choose the best option out of them. Moreover, disproportionate use of collaborative knowledge and an undue management burden caused by a high number of partners and external costs could affect innovative performance negatively (Bayona-Saez *et al.,* 2017).

Third, data from several studies suggest that regional knowledge sources influence firms in improving their innovation performance (Boschma, 2005; Cantwell and Iammarino, 2000; Moulaert and Sekia, 2003). Doloreux and Lord-Tarte (2013) also consider geographical proximity as an important determinant of knowledge dissemination. Targeting on a regional scale is the best approach to boost the development of innovation (Isaksen and Onsager, 2010). Regional knowledge refers to knowledge that firms can obtain even when they do not enter any proactive collaboration with others. When firms are located in close proximity or in the same region, they can gain benefits such as access to specialized labor, access to specialized inputs, access to technology spillovers, and access to greater demand. The first three types of benefits bring firms unique or efficient access to the supply of necessary resources including knowledge resources (McCann and Folta, 2008). Boschma and Frenken (2006) also mention the three advantages and emphasize that innovation is more likely in areas displaying strong geographical clustering.

## 3. Hypotheses

As explained above, different sources of knowledge can have a different association with firm-level innovation. Following this line of thought, we hypothesize that in a transition country like Vietnam, with a weak innovation system, knowledge even plays a more vital role compared to advanced economies. Below, we develop our hypotheses that link the different knowledge sources to innovation.

### *3.1 Internal knowledge sources*

The ability of firms to create knowledge internally could lead them to be more innovative and successful (Nonaka and Takeuchi, 1995). The RBV also emphasizes the important role of internal knowledge sources, which could be generated from human resources (employee training, managerial experience and skills) and technology resources (Barney, 1991; Wright *et al.,* 1994). Moreover, Porter (1991) mentions the needs for firms to upgrade their internal advantages to sustain and extend competitive advantages. When firms are in a highly competitive environment, they are forced to innovate and by developing internal knowledge continuously, firms could create temporary knowledge monopolies. Besides, firms that invest in R&D extend their internal knowledge base, which also allows them to

increase their innovation output (Barasa *et al.*, 2017; Baumann and Kritikos, 2016; De Oliveira Cabral, 2010; Roper *et al.*, 2017; Svetina and Prodan, 2008). Within the context of Vietnam, we also propose that internal knowledge sources, such as internal R&D and managerial experience, will influence product innovation positively.

Many recent studies have shown a positive relationship between internal knowledge sources from R&D, manager experience and firm innovation (Austin, 2002; Barasa *et al.*, 2017; Frenz and Ietto-Gillies, 2009; Goedhuys *et al.,* 2013). When opening up their economies, most developing countries make their manufacturing firms face the fierce competitive conditions of globalization. Hence, firms in those economies need to have the ability to assimilate, master and improve technologies to provide the international market with high quality products. That ability is affected by several factors including internal R&D and the quality of management (Goedhuys *et al.*, 2013). Goedhuys *et al.* (2013) state that firms conduct internal R&D as an alternative to imported technology or build up absorptive capacity to benefit from outside R&D, while qualified managers help firms in converting research results into marketable products and absorb external market information.

Moreover, managers play a vital position in analyzing the situation to understand and describe a firms' economic performance. Managerial experience is generally considered to be an important input for successful innovation (Schilirò, 2010; Shane, 2003). It also reflects an important tacit skill required to select the most promising innovation projects (Custódio *et al.,* in press). Hence, the managerial ability to manage the resource portfolio into bundles of unique capabilities that can be leveraged within a certain competitive environment is critical for developing new innovative products (Ireland and Webb, 2007). As such, we argue that prior experience in innovative activities provides managers a basis to more fully understand the challenges of innovation, which makes these managers more tolerant of the uncertainty and ambiguity it brings (Birkinshaw *et al.,* 2008). We formulate the following hypotheses:

*H1a.* The stronger a firm's internal R&D, the higher the likelihood that that firm produces a product innovation.

*H1b.* The longer is the time that the top manager of a firm working in this sector, the higher is the likelihood that the firm produces a product innovation.

### *3.2 Collaborative knowledge sources*

Various scholars, most prominently in the literature on open innovation, have emphasized that firms are likely to face difficulties when innovating in isolation and suggest that firms gain access to their most valuable knowledge through collaboration (Greco *et al.*, 2015; Hamel and Prahalad, 1994; Shan *et al.,* 1994; West and Bogers, 2014). Doloreux and Lord-Tarte (2013) even state that the closed or linear model where firms rely on only internal R&D has become obsolete and is considered insufficient in today's market. Indeed, firms can benefit from innovative activities of competing firms, academic institutions and supply chain partners (Isaksson *et al.,* 2016). Laursen and Salter (2006) also showed that firms that access a broader range of collaborative knowledge sources (e.g. collaborating with universities, competitors, and customers) and use them more deeply, increase their innovation performance. Hence, instead of creating new knowledge internally firms can also combine or recombine their existing knowledge with that of others to create new combinations of knowledge (Oerlemans and Knoben, 2010).

In this study, we expect the level of collaborative knowledge, whether from inside or outside the supply chain, will benefit a firm's innovative performance. However, the degree to which knowledge from inside or outside the supply chain affects innovation might be different. It has been demonstrated that joining alliance networks can enhance firm learning and innovation (Ahuja, 2000; Soh, 2003; Walker *et al.,* 1997). Pittaway *et al.* (2004) emphasize

that network relationships with suppliers, customers and intermediaries are vital factors affecting firms' innovation performance and productivity, as different partners control different sources of knowledge and information, which will influence firms differently. Furthermore, firms that do not collaborate nor exchange knowledge, limit their knowledge base in long term. Several lines of evidence suggest that collaborative knowledge sources are critical not only to create in-house innovations, but also for learning about innovative work practices that other organizations have done or adopted (Biemans, 1991; Erickson and Jacoby, 2003). Empirical findings from South African firms showed that these firms used different external sources, including business organizations: buyers, suppliers, competitors, consultants and sectoral institutes; technological knowledge sources: public research labs, universities, innovation centers; and codified knowledge sources: patents, electronic databases (Oerlemans and Knoben, 2010).

Using knowledge from competitors and suppliers seems to increase the number of innovations within a firm, while others sources such as universities and institutes have less effects on the innovative potential of firms (Oerlemans and Knoben, 2010; Doloreux and Lord-Tarte (2013). However, Laursen and Salter (2006) also provided evidence for an inverted U-shape relationship between the number of collaborative knowledge and innovative performance. In addition, they also found a curvilinear effect related to how deep firm's use collaborative knowledge. They concluded that when firms adopt too many collaborative knowledge sources or if firms use more than three sources of collaborative knowledge deeply in their innovative activities, the declining returns are likely to begin. Evidence from several recent studies found an inverted U-shape as well (Bayona-Saez *et al.*, 2017; Chiang and Hung, 2010; Garriga *et al.,* 2013). However, given our specific research context in a lower middle-income country with a still underdeveloped technological environment, the amount of collaborative knowledge sources is probably more restricted compared to more advanced countries. This means that we do not expect that firms are confronted with external information overload. Yet, given the negative effect of over-search on innovation in developed countries, we will tentatively explore the existence of this relationship in Vietnam in a separate analysis (in line with Bayona-Saez *et al.* (2017), Hung and Chou (2013), Laursen and Salter (2006)). We formulate the following hypotheses:

*H2a.* The stronger a firm's collaborative knowledge gained from inside the supply chain, the higher the likelihood that that firm produces product innovation.

*H2b.* The stronger a firms' collaborative knowledge gained from outside the supply chain, the higher the likelihood that that firm produces a product innovation.

### *3.3 Regional knowledge sources*

Access to resources that are not internal to the firm can also stem from simply being located in a region where many other firms are located, a so-called agglomeration (Weterings and Knoben, 2013). Within that region, firms could take advantage of available specialized labor, specialized inputs, technological spillovers, and demand market thickening (McCann and Folta, 2008). A large body of research shows that tacit knowledge can be implanted in geographic regions, enabling firms within these regions to draw from this knowledge (Boschma, 2005; Sorenson and Baum, 2003; Tsuji and Miyahara, 2010). Additionally, social scientists have long recognized the importance of geography for innovation (Doloreux and Lord-Tarte, 2013; Frenken *et al.,* 2005; Funk, 2013; Laursen *et al.*, 2012). Being in scientific communities and recruiting skilled employees provide knowledge that help firms innovate and generate competitive advantage. McCann and Folta (2008) state that if firms are located in clusters, there is a pooled market for workers with specialized skills, which benefits both workers and firms.

Moreover, when firms require specialized inputs such as tools, suppliers, manufacturing facilities or services, being in the same region with other firms in the same or similar fields would help them to reduce transaction costs. Schumpeter (1934) mentioned that proximity is helpful as it enables access to diverse knowledge that firms can recombine in novel ways to make discoveries. Furthermore, the benefit of being in the same region with other firms can help a firm to stay informed of technological knowledge, which helps them to be more innovative (Funk, 2013). Proximity is considered an important condition for knowledge sharing, transfer and technology acquisition (Gertler, 1995). Firms' innovation processes can change remarkably across regions (Doloreux and Lord-Tarte, 2013). Being close to firms from the same or similar industry could bring firms benefits in terms of labor market pooling and transport cost savings. At the same time, being with firms from outside its industry could provide firms with knowledge spillovers (Beaudry and Schiffauerova, 2009). For those reasons, we suppose that when firms are located in a region with more firms or a region with high levels of R&D activities, it is more likely for them to innovate:

*H3a.* The stronger the knowledge base of the region a firm is located in the higher the likelihood that that firm produces a product innovation.

*H3b.* The higher the population of the region a firm is located in the higher the likelihood that that firm produces a product innovation.

## 4. Data and method

### *4.1 Data*

The data used in this study are from two main sources: The World Bank Enterprise Survey (ES) conducted between November 2014 and April 2016 and the Innovation Capabilities Survey (ICS) conducted from October 2016 to February 2017. The ES is an ongoing project covering over 155,000 firms in 148 countries, collecting data based on firms' experiences and enterprises' perception of the business environment and investment climate. This firm-level survey comprises non-agricultural formal, private sector firms. The ICS in this study is a follow-up and complementary to the ES. Respondents are randomly selected from the ES sample. For Vietnam, 300 manufacturing firms have been included in the sample. The ICS focuses on innovative activities and innovative capabilities of manufacturing firms. The standardized questionnaires have been translated into local languages and back-translated into English to check its accuracy.

The World Bank uses stratified random sampling as the sampling methodology, which means that all population units are grouped within homogeneous groups and simple random samples are selected within each group. This method helps to obtain unbiased estimates from different subdivisions of the population with some known level of precision as well as obtain unbiased estimates for the whole population. In most cases, stratified sampling is more precise and may produce a smaller bound on the error of estimation than using a simple sampling method. The strata for the surveys are firm size, business sector and geographic region within a country.

The data for this study are merged from the most recent version of the ES and the ICS conducted in Vietnam. Unsurprisingly, the data contain missing observations; hence our analyses will use fewer observations than the full sample.

### *4.2 Variables*

*Dependent variable*. Innovation is measured by using the question "From fiscal year 2011/2012 thru 2013/2014, did this establishment introduce any new or significantly improved product or service?" from the ICS. We code a variable equal to one if firms respond affirmatively and a variable equal to zero if firms respond negatively to the question. Our measure of innovation is in line with previous studies.

*Independent variables*. Internal knowledge sources: we measure internal knowledge sources using internal R&D and top manager experience. Internal R&D has been used as the explanatory variable for innovation output in many studies (Crépon *et al.,* 1998; Frenz and Ietto-Gillies, 2009). Internal R&D is defined as creative work undertaken to increase knowledge for developing innovative products and processes. Moreover, we also use top manager experience as another explanatory variable for internal knowledge sources. It has been shown to have a relationship with innovation (Bantel and Jackson, 1989; Daellenbach *et al.,* 1999; Li *et al.,* 2013). We use questions from the ICS to measure these variables. Internal R& D is measured with the question: "Between fiscal year 2011/2012 and fiscal year 2013/2014, did this establishment conduct internal R&D?". We code it equal to 1 if firms choose yes and zero otherwise[1].

For manager experience we used: "how many years of experience working in this sector does the Top Manager have?"

Collaborative knowledge sources: collaborative knowledge that is generated inside the supply chain of a firm such as competitors, suppliers and customers was measured by the following questions respectively: "Thinking about innovation, has this establishment used information or ideas from competitors for any innovation activity undertaken between fiscal year 2011/2012 and fiscal year 2013/2014?" (Question b1b); "Thinking about innovation, has this establishment used information or ideas from suppliers for any innovation activity undertaken between fiscal year 2011/2012 and fiscal year 2013/2014?" (Question b1c); and "Thinking about innovation, has this establishment used information or ideas from customers' feedback for any innovation activity undertaken between fiscal year 2011/2012 and 2013/2014?" (Question b1j). We constructed the variable similar with the 'breadth' variable used in studies of Bayona-Saez *et al.* (2017) and Laursen and Salter (2006) by creating a combination of three sources of collaborative knowledge. Each source is coded as a binary variable where 0 means "NO" and 1 means "YES." The sources coded are then added up to maximum of 3 where 0 means non-usage and 3 means using all three sources.

Collaborative knowledge generated from outside a firm's supply chain such as universities and research institutes is measured by the question "Thinking about innovation, has this establishment used information or ideas from universities and research institutes for any innovation activity undertaken between fiscal year 2011/2012 and fiscal year 2013/2014?" (question b1e). We code the variable equal to 1 if the answer is yes.

Regional knowledge sources: Regional knowledge sources are measured with regional R&D and firm location. Regional R&D is measured using the mean of internal R&D over regions as firms could take advantage of being in the same region with other firms when they can enjoy technological diffusion, information and knowledge flows among them (Funk, 2013; Laursen *et al.*, 2012). In addition, we use the question "size of the locality?" to measure firm location. It is emphasized that the city size where firms are located could affect the level of innovation (Feldman and Audretsch, 1999; Taylor *et al.,* 2006). We recode location equal to 1 if the answer is a city with population less than 50.000, equal to 2 if the answer is a city with population ranges from 50.000 to 250.000, equal to 3 if the answer is a city with population ranges from 250,000 to 1 million, and equal to 4 if the answer is a city with population over 1 million. We follow Beaudry and Schiffauerova (2009) and Baptista and Swann (1998). In their study, they use population as a proxy for agglomeration effects.

*Control variables*. We measure the control variables using information from the ES.

Firm size: firm size is used as a control variable in various studies and supports the finding that the larger the firm is the higher its level of innovation. Data from several studies suggest that because of having more employees, firms can benefit from economies of scale in innovation (Ayyagari *et al.,* 2011; Barasa *et al.*, 2017). Moreover, investment in R&D could be affected by firm size as large firms are more likely to secure the funding needed for

large-scale R&D (Shefer and Frenkel, 2005). Hence, in this study, we also use firm size as one of the control variables and check for consistency with previous studies. The question that we use is: "how many permanent, full-time individuals worked in this establishment?"

Firm age: firm age has been found to have a significant effect on innovation (Balasubramanian and Lee, 2008; Hansen, 1992). It is widely believed that a major proportion of industrial R&D is undertaken by larger and older firms. However, it is also observed that in the high-tech industrial branch, a large number of startups that are young and relatively small engage intensely in innovative activities (Shefer and Frenkel, 2005). Furthermore, Huergo and Jaumandreu (2004) claim that entrant firms tend to present the highest probability of innovation while the oldest firms tend to show lower innovative probability. Thus, this study aims to investigate the relationship between firm age and innovation to figure out if any connection exists based on empirical data of firms in Vietnam. In this study, we calculate firm age by taking the difference between 2015 and the year in which the establishment began operations. Table I provides an overview of our variables.

### 4.3 Method

To measure the dependent variable, we use a dummy variable that takes the value of "1" if a firm has introduced any new or significantly improved innovative product and "0" if otherwise. Hence, a binary logistic regression model was chosen for analyzing the data. This method has been used in previous studies using similar data structures (Ayyagari *et al.*, 2011; Barasa *et al.*, 2017).

| Variable | Measurement | Source | Question no. |
|---|---|---|---|
| *Innovation* | | | |
| Product innovation | Firm introduced any new product or service: "1" Yes "0" No | ICS | *H3a*, *H3b*, *H3c* |
| *Internal knowledge sources* | | | |
| Manager experience | Top manager's number of working experience year in this sector | ES | B7 |
| Internal R&D | Dummy variable: "1" Yes "0" No | ICS | B01 |
| *Collaborative knowledge sources* | | | |
| Inside the supply chain | Innovation developed with competitors, customers, and supplier: "1" if b1b is Yes, 2 if b1b and b1c or b1j is Yes and "3" if all b1b, b1c and b1j are Yes, "0" none of the three is "Yes" | ICS | |
| Competitors | Information or ideas from competitors: "1" Yes "0" No | ICS | B1b |
| Suppliers | Information or ideas from suppliers: "1" Yes "0" No | ICS | B1c |
| Customers | Information or ideas from customers' feedback: "1" Yes "0" No | ICS | B1j |
| Outside the supply chain | Information or ideas from universities and research institutes: "1" Yes "0" No | ICS | B1e |
| *Regional knowledge sources* | | | |
| Regional R&D (log) | % of firms conducting internal R&D within a region using mean of the internal R&D over the 4 regions in Vietnam | ICS | B1 |
| Firm location | City with population of less than 50.000 equal "1"<br>City with population from 50.000 to less than 250.000 equal "2"<br>City with population from 250.000 to less than 1 million equal "3"<br>City with population over 1 million equal "4" | ES | A3 |
| *Control variables* | | | |
| Age | Number of year since establishment | ES | B5 |
| Size | Number of permanent, full-time employees | ES | L1 |

**Table I.**
Variable measurement

## 5. Results

The descriptive statistics and correlation matrix for all variables are provided in Table II. The firms in our sample have an average age of 13.73 years old and the average number of employees is 148. A large majority of the firms are located in a city with population over 1 million (84 percent). Most of the firms do not conduct internal R&D (83.45 percent). In all, 57 percent of the firms have collaboration inside their supply chain while only 16 percent of the firms have collaboration outside the supply chain. The World Bank conducted the survey in four Vietnamese regions, which are the Red River Delta, North Central area and Central coastal, South East and Mekong River Delta. The South East region has the largest number of firms with 105 firms, next is the Red River Delta with 89 firms. These two regions are overrepresented, probably due to the presence of the two biggest cities in the country: Ho Chi Minh city and Hanoi. Regional knowledge creation has an average of 16.65.

In total, 37 percent of the firms in our sample reported that they have introduced new products. The average rate of product innovation in Vietnam is markedly higher than the average rate of innovation observed in EU-28 (23.7 percent). Cirera and Muzi (2016) argue that such high levels of self-reported innovation in developing countries partly arise from a rather subjective definition of an innovation in the surveys, especially since innovations are likely to be more incremental and less radical.

In the method section, we mentioned that a binary logistic regression model is used for our hypotheses. Model 1 is a baseline model, in which we include only control variables to evaluate the independent variables explanatory value. We add internal knowledge sources in Model 2. Model 3 adds the collaborative knowledge sources, whereas model 4 includes the regional knowledge sources. Model 5 assesses all independent variables simultaneously. Given that the AIC/BIC indicate that model 5 has the best model fit we mainly interpret our results based on this model. Table III reports all the results of the models. In order to check for multicollinearity, we calculated VIFs. The mean of VIF is 1.26, which is well below 10 as are all individual VIFs. As such, we conclude that multicollinearity is not an issue in our data.

Our results show that the control variables (firm age and size) have no significant association with firms' likelihood to innovate. With regard to the direct effect of internal knowledge sources on innovation, we find that internal R&D is positively and statistically significant correlated with firm innovation. *H1a* is supported: a firm's likelihood to innovate increases when there is an increase in internal R&D. On the other hand, for *H1b* the result is positive, but not significant. Therefore, we conclude that the managerial experience of firms in Vietnam has no relationship with innovation.

| | Mean | SD | VIF | Min. | Max. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Product innovation | 0.37 | 0.48 | – | 0.00 | 1.00 | – | | | | | | | |
| 2 Age (log) | 2.41 | 0.62 | 1.34 | 0.10 | 4.22 | 0.00 | – | | | | | | |
| 3 Size (log) | 3.73 | 1.39 | 1.22 | 0.69 | 8.85 | −0.02 | 0.37 | – | | | | | |
| 4 Manager experience | 18.37 | 9.41 | 1.22 | 2.00 | 56.00 | 0.03 | 0.38 | 0.18 | – | | | | |
| 5 Internal R&D | 0.15 | 0.36 | 1.22 | 0.00 | 1.00 | 0.34 | 0.05 | 0.12 | −0.04 | – | | | |
| 6 Inside the supply chain knowledge | 1.27 | 1.29 | 1.42 | 0.00 | 3.00 | 0.57 | 0.03 | 0.05 | −0.07 | 0.36 | – | | |
| 7 Outside the supply chain knowledge | 0.15 | 0.36 | 1.37 | 0.00 | 1.00 | 0.30 | 0.09 | 0.11 | 0.01 | 0.32 | 0.48 | – | |
| 8 Regional R&D | 16.56 | 8.23 | 1.16 | 6.67 | 27.45 | 0.02 | 0.05 | 0.03 | −0.11 | 0.21 | 0.18 | 0.14 | – |
| 9 Firm location | 3.54 | 1.06 | 1.15 | 1.00 | 4.00 | 0.05 | −0.11 | −0.19 | 0.08 | −0.06 | −0.11 | −0.09 | −0.28 |

**Table II.**
Descriptive statistics and correlations

**Table III.**
Logistic regression model results

| | Model 1 DV = Product Innovation = 1 | | | Model 2 DV = Product Innovation = 1 | | | Model 3 DV = Product Innovation = 1 | | | Model 4 DV = Product Innovation = = 1 | | | Model 5 DV = Product Innovation = 1 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *B* | SE | P > \|z\| | *B* | SE | *P* > \|z\| | *B* | SE | *P* > \|z\| | *B* | SE | *P* > \|z\| | *B* | SE | *P* > \|z\| |
| Age (log) | 0.04 | 0.25 | 0.88 | −0.05 | 0.23 | 0.83 | −0.00 | 0.31 | 0.99 | 0.04 | 0.24 | 0.86 | −0.09 | 0.25 | 0.73 |
| Size (log) | −0.03 | 0.13 | 0.81 | −0.11 | 0.17 | 0.49 | −0.11 | 0.16 | 0.50 | −0.02 | 0.14 | 0.91 | −0.13 | 0.19 | 0.50 |
| Manager experience | | | | 0.02 | 0.02 | 0.42 | | | | | | | 0.03 | 0.02 | 0.20 |
| Internal R&D | | | | 2.06*** | 0.24 | 0.00 | | | | | | | 1.46*** | 0.21 | 0.00 |
| Inside supply chain knowledge | | | | | | | 1.04*** | 0.30 | 0.00 | | | | 1.09*** | 0.34 | 0.00 |
| Outside supply chain knowledge | | | | | | | 0.22 | 0.21 | 0.30 | | | | 0.03 | 0.39 | 0.94 |
| Regional R&D | | | | | | | | | | 0.01 | 0.02 | 0.64 | −0.03 | 0.03 | 0.26 |
| Firm Location | | | | | | | | | | 0.13 | 0.09 | 0.13 | 0.27* | 0.15 | 0.07 |
| Constant | −0.52 | 0.56 | 0.35 | −0.64 | 0.75 | 0.40 | −1.71*** | 0.32 | 0.00 | −1.21 | 1.09 | 0.27 | −2.63*** | 0.32 | 0.00 |
| Observations | | 284.00 | | | 284.00 | | | 284.00 | | | 284.00 | | | 284.00 | |
| Prob > $\chi^2$ | | 0.97 | | | 0.00 | | | 0.00 | | | 0.00 | | | 0.00 | |
| Pseudo $R^2$ | | 0.00 | | | 0.09 | | | 0.26 | | | 0.00 | | | 0.31 | |
| AIC | | 379.00 | | | 344.77 | | | 281.04 | | | 377.82 | | | 261.56 | |
| BIC | | 389.96 | | | 355.72 | | | 291.98 | | | 388.77 | | | 272.51 | |

**Notes:** All reported standard errors are robust clustered standard errors at the regional levels. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

With regard to the relationship between collaborative knowledge sources and product innovation the results confirm that a firm's collaborative knowledge gained from inside the supply chain (customers, suppliers, competitors) is positively related to the product innovation of that firm. On the other hand, it shows no significant relationship between collaboration with universities or research institutes and innovation. Khanna and Palepu (2005) mention that in developed economies, firms can rely on a variety of institutions to minimize market failure, while firms in emerging markets are, for example, confronted with institutional voids, i.e. weak linkages between firms and universities and/or research institutes. As such, *H2a* is strongly supported, while there is no support for *H2b*.

For regional knowledge sources we find no significant relationship between regional R&D, product innovation. Hence, we could not accept *H3a*. However, the location of firms is significant positively correlated with product innovation. Firms in a city with larger populations are likely to produce more product innovation than their counterparts in less crowded cities. That might be explained by the fact that in big cities more facilities and infrastructure are available for firms to utilize. Moreover, in densely populated cities, firms might be able to find more suitable personnel who bring new knowledge (Glaeser and Mare, 2001). As such, *H3b* is accepted.

As mentioned in our theoretical background several studies from the open innovation literature, suggest that specific sources of knowledge might be more relevant than others and that over-search of external knowledge might be detrimental to innovation (Bayona-Saez *et al.*, 2017; Hung and Chou, 2013; Laursen and Salter, 2006). To probe the existence of such effects in our setting, we performed two additional explorative analyses. Specifically, we checked the association of the knowledge sources with innovation separately and tested for an inverted U-shape effect. The results of these analyses are reported in Table IV. With regard to the former, we found that only knowledge from customers is positively and significantly associated with product innovation. This is in line with the study of Doloreux and Lord-Tarte (2013), which

| | Model 6 DV = Product Innovation = 1 | | | Model 7 DV = Product Innovation = 1 | | | Model 8 DV = Product Innovation = 1 | | |
|---|---|---|---|---|---|---|---|---|---|
| | *B* | SE | *P* > \|z\| | *B* | SE | *P* > \|z\| | *B* | SE | *P* > \|z\| |
| Age (log) | −0.05 | 0.30 | 0.86 | −0.13 | 0.24 | 0.58 | −0.09 | 0.24 | 0.72 |
| Size (log) | −0.14 | 0.17 | 0.39 | −0.15 | 0.18 | 0.41 | −0.19 | 0.17 | 0.24 |
| Manager experience | | | | 0.02 | 0.02 | 0.31 | 0.02 | 0.03 | 0.40 |
| Internal R&D | | | | 1.45*** | 0.10 | 0.00 | 1.30*** | 0.03 | 0.00 |
| Inside supply chain knowledge | 3.68*** | 1.09 | 0.00 | 3.88*** | 1.25 | 0.00 | | | |
| Inside supply chain knowledge-squared | −0.86*** | 0.27 | 0.00 | −0.90*** | 0.30 | 0.00 | | | |
| Knowledge from competitors | | | | | | | 0.30 | 0.50 | 0.56 |
| Knowledge from suppliers | | | | | | | −0.34 | 0.34 | 0.31 |
| Knowledge from customers | | | | | | | 3.88*** | 1.22 | 0.00 |
| Outside supply chain knowledge | 0.57 | 0.44 | 0.20 | 0.45 | 0.57 | 0.42 | 0.50 | 0.49 | 0.31 |
| Regional R&D | | | | −0.05 | 0.04 | 0.22 | −0.05 | 0.04 | 0.18 |
| Firm Location | | | | 0.27** | 0.14 | 0.05 | 0.17 | 0.11 | 0.15 |
| Constant | −2.34*** | 0.34 | 0.00 | −3.08*** | 0.57 | 0.00 | −2.80*** | 0.59 | 0.00 |
| Observations | 284.00 | | | 284.00 | | | 284.00 | | |
| Prob > $\chi^2$ | 0.00 | | | 0.00 | | | 0.00 | | |
| Pseudo $R^2$ | 0.34 | | | 0.39 | | | 0.41 | | |
| AIC | 253.19 | | | 233.71 | | | 225.61 | | |
| BIC | 264.14 | | | 244.65 | | | 236.55 | | |

**Table IV.**
Robustness tests

**Notes:** All reported standard errors are robust clustered standard errors at the regional levels. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

emphasizes that the tastes of customers are paramount and customer ideas are a highly important source of information for product development. With regard to the latter, the results in Table IV, which are plotted in Figure 1, demonstrate an inverted U-shape relationship between knowledge from inside the supply chain and product innovation. Moreover, we test whether the point estimate for the highest value of knowledge use differs significantly from the second highest score and find a significant different ($p = 0.003$). This indicates that the downward sloping part of the inverted U-shape is statistically significant and that we truly find a negative relationship between high levels of usage of knowledge from the supply chain and innovation. That means searching for knowledge from collaboration is important, but too much openness might have a negative impact on product innovation. We find this shape of the association highly surprising given the low-tech environment that we study and the limited number of different knowledge sources that we distinguish. We will get back to the implications of this finding in our discussion section below.

## 6. Discussion and conclusion

The results of our study confirm the vital role of internal R&D in Vietnamese manufacturing firms for product innovation. It also reveals that a firms' collaborative knowledge gained from inside the supply chain is positively correlated with the likelihood that firms produce product innovation. These findings are in line with findings from a study conducted in South Africa (Knoben and Oerlemans, 2010). Hence, the need to create a network with customers, suppliers and competitors to enhance product innovation is highly relevant to firms in developing countries.

This study found no significant relationship between collaborative knowledge gained from outside the supply chain and product innovation. This is not uncommon in developing countries, as firms hardly engage in collaborative activities with knowledge institutes (London, 2011). This may be due to a lack of capabilities to negotiate, learn and share information with each other (London, 2011). Furthermore, Bauer (2011) finds that the collaboration between firms and knowledge institutes in Vietnam is not always effective. In addition, it is reported by OECD and The World Bank (2014) that the physical infrastructure in universities and state research institutes in Vietnam remains undeveloped. Another issue is that the Vietnamese educational system is still unrelated to market needs and of low quality. Together, this makes it extremely challenging to engage in collaborative activities or to reap the benefits of such activities. A more fundamental problem might be related to the fact that Vietnam still has characteristics of a central planning economy.

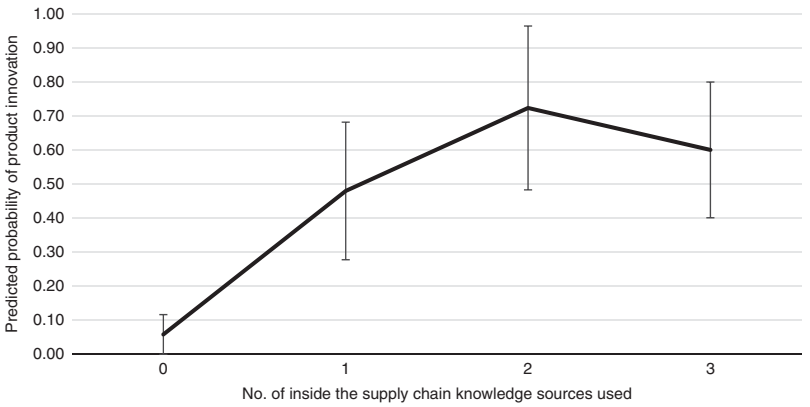


**Figure 1.**
Product innovation and using knowledge sources from the supply chain

Prior studies have also noted the importance of the location of firms (Asheim and Gertler, 2005; Isaksen and Onsager, 2010; Reuer and Lahiri, 2013). In line with this literature, our results show that firm location does indeed matter. Being located near other firms might facilitate inter-firm interactions and linkages among these firms. It is also easier to engage in all kinds of ties in a populous region. One of the explanations why regional R&D does not work in the case of Vietnam is that knowledge-producing organizations and states agencies are generally slow and reluctant to exchange information and knowledge. Moreover, the information is scattered in different agencies, ministries and research institutes, while there is limited regional coordination, no data compilation or editing. Hence, those obstacles cause firms to having to spend much time and money to get access to knowledge (Bauer, 2011).

As explained by Khanna and Palepu (2005, 2010), there is a high degree of information asymmetry in emerging markets, which might be the reason why collaboration outside the supply chain and regional R&D sources does not work. The presence of institutional voids hinders firms to reap the benefits of potential collaborative activities. Similarly, Vrgovic *et al.* (2012) mention the vital role of institutions when firms seek actors with whom they should collaborate. They argue that firms in developing countries often have limited information sources and lack of financial resources to gather relevant information. Firms in emerging markets, like Vietnam, need to have three markets functioning well: product markets (soft and hard infrastructure), capital markets (information and financial intermediaries) and labor markets (such as educational institution, placement agencies, employment regulations, unions) (Khanna and Palepu, 2010).

This study has some limitations that we would like to highlight. First, the data is based on information about innovative activities of firms between 2013 and 2015. This made it difficult to analyze the sustainability of firms' innovativeness and evaluate the prior innovation history. Moreover, because some of the independent variables refer to the same period as the dependent variable, causality may not be inferred. The observed firms are private firms and mostly are SMEs. Consequently, we might only see part of the total range of firms. In addition, given the cross-sectional nature of our data there is little we can do in terms of endogeneity. Finally, our sample size after we merged the ES and the ICS become too small to test with a subset (e.g. by size, by age, by location, etc.).

From a practical perspective, it is useful to remind managers that investing in internal R&D might help them to increase the level of innovation in their firms. Moreover, collaborating with partners is also useful, but managers should be aware that only collaborating within the supply chain seems to bring fruitful results. In addition, firms should increase their interaction with customers and put their efforts on the development of customized solutions to develop new products. Furthermore, firms could consider relocating to a region with higher numbers of other firms, as it is likely that they could increase their product innovation activities as a result.

From a policy perspective, our study also has implications. More than 80 percent of the firms in our sample do not engage in any internal R&D, regardless of its importance for innovation. This may be due to the fact that they lack the financial means to invest in internal R&D. Private firms find it very difficult to get access to credit (Le, 2012). Moreover, Lê *et al.* (2016) report that Vietnam's state budget spending on science and technology in 2015 is about 763 million USD, equal to 1.52 percent of the total state expenditure. This amount is very small in comparison with other countries. The Vietnamese government could implement policies that help to enhance the quality of universities and research institutes as well as create opportunities for them to collaborate more with private sector firms. In most developed countries, universities and research institutes are vital sources of knowledge for innovation (Doloreux and Lord-Tarte, 2013; Greco *et al.*, 2015). Hence, policy makers in Vietnam could develop policies based on the principle of innovating by networking and by exploring the potential of social capital across different regions (Morgan, 2007).

However, some caution is needed here. In our theoretical background we explained that the open innovation literature suggests that over-search might have a negative effect on innovation (Bayona-Saez *et al.*, 2017; Hung and Chou, 2013; Laursen and Salter, 2006). Indeed, although we did not formally hypothesize about this possible effect, we were surprised to learn that even in a low-tech environment too much openness had a negative correlation with product innovation. This negative correlation of over-search might be related to the fact that the firms in our sample operate in environments where external knowledge availability is at a relatively low level. This means that the costs associated with finding more partners do not outweigh the benefits. Hence, especially in the context of developing countries, collaborating more intensely with partners could be more useful than finding additional partners.

Several limitations to our study suggest avenues for future research. One of the possible future research topics is to analyze the effect of knowledge sources over a longer period of time. Future research could also use panel data to examine the causal effects of different knowledge sources on innovation output. Another possible topic could be to analyze the impact of knowledge sources on state-owned enterprises and compare these findings with private firms. Finally, we also encourage large-scale studies to provide more detail on the nature of innovation, the various types of knowledge sources and increase the number of observations to be able to test with various subsets of populations (regions, age or size).



## Note

1. Clearly, using richer measurements instead of a dummy variable would be preferable. However, the response rate for more detailed questions pertaining to R&D is very low. Specifically, only 16 percent of the firms provide such information. The reason for this high missingness is that Vietnamese firms are very sensitive to disclosing detailed information about their operations and performance.

## References

Ahuja, G. (2000), "Collaboration networks, structural holes, and innovation: a longitudinal study", *Administrative Science Quarterly*, Vol. 45 No. 3, pp. 425-455.

Artz, K.W., Norman, P.M., Hatfield, D.E. and Cardinal, L.B. (2010), "A longitudinal study of the impact of R&D, patents, and product innovation on firm performance", *Journal of Product Innovation Management*, Vol. 27 No. 5, pp. 725-740.

Asheim, B.T. and Gertler, M.S. (2005), *The Geography of Innovation: Regional Innovation Systems*, in Fagerberg, J. and Mowery, D.C. (Eds), Oxford University Press, Oxford.

Asheim, B.T. and Isaksen, A. (1997), "Location, agglomeration and innovation: towards regional innovation systems in Norway?", *European Planning Studies*, Vol. 5 No. 3, pp. 299-330.

Austin, J.E. (2002), *Managing in Developing Countries: Strategic Analysis and Operating Techniques*, The Free Press, New York, NY.

Ayyagari, M., Demirgüç-Kunt, A. and Maksimovic, V. (2011), "Firm innovation in emerging markets: the role of finance, governance, and competition", *Journal of Financial and Quantitative Analysis*, Vol. 46 No. 6, pp. 1545-1580.

Balasubramanian, N. and Lee, J. (2008), "Firm age and innovation", *Industrial and Corporate Change*, Vol. 17 No. 5, pp. 1019-1047.

Bantel, K.A. and Jackson, S.E. (1989), "Top management and innovations in banking: does the composition of the top team make a difference?", *Strategic Management Journal*, Vol. 10 No. S1, pp. 107-124.

Baptista, R. and Swann, P. (1998), "Do firms in clusters innovate more?", *Research Policy*, Vol. 27 No. 5, pp. 525-540.

Barasa, L., Knoben, J., Vermeulen, P., Kimuyu, P. and Kinyanjui, B. (2017), "Institutions, resources and innovation in East Africa: a firm level approach", *Research Policy*, Vol. 46 No. 1, pp. 280-291, doi: 10.1016/j.respol.2016.11.008.

Barney, J. (1991), "Firm resources and sustained competitive advantage", *Journal of Management*, Vol. 17 No. 1, pp. 99-120.

Bauer, T. (2011), *The Challenge of Knowledge Sharing: Practices of the Vietnamese Science Community in Ho Chi Minh City and the Mekong Delta*, Vol. 17, LIT Verlag, Münster.

Baumann, J. and Kritikos, A.S. (2016), "The link between R&D, innovation and productivity: are micro firms different?", *Research Policy*, Vol. 45 No. 6, pp. 1263-1274, available at: https://doi.org/10.1016/j.respol.2016.03.008

Bayona-Saez, C., Cruz-Cázares, C., García-Marco, T. and Sánchez García, M. (2017), "Open innovation in the food and beverage industry", *Management Decision*, Vol. 55 No. 3, pp. 526-546.

Beaudry, C. and Schiffauerova, A. (2009), "Who's right, Marshall or Jacobs? The localization versus urbanization debate", *Research Policy*, Vol. 38 No. 2, pp. 318-337.

Becker, W. and Dietz, J. (2004), "R&D cooperation and innovation activities of firms – evidence for the German manufacturing industry", *Research Policy*, Vol. 33 No. 2, pp. 209-223, available at: https://doi.org/10.1016/j.respol.2003.07.003

Biemans, W.G. (1991), "User and third-party involvement in developing medical equipment innovations", *Technovation*, Vol. 11 No. 3, pp. 163-182.

Birkinshaw, J., Hamel, G. and Mol, M.J. (2008), "Management innovation", *Academy of Management Review*, Vol. 33 No. 4, pp. 825-845.

Boschma, R.A. (2005), "Proximity and innovation: a critical assessment", *Regional Studies*, Vol. 39 No. 1, pp. 61-74, available at: http://doi.org/10.1080/0034340052000320887

Boschma, R.A. and Frenken, K. (2006), "Why is economic geography not an evolutionary science? Towards an evolutionary economic geography", *Journal of Economic Geography*, Vol. 6 No. 3, pp. 273-302.

Bougrain, F. and Haudeville, B. (2002), "Innovation, collaboration and SMEs internal research capacities", *Research Policy*, Vol. 31 No. 5, pp. 735-747.

Calantone, R.J., Cavusgil, S.T. and Zhao, Y. (2002), "Learning orientation, firm innovation capability, and firm performance", *Industrial Marketing Management*, Vol. 31 No. 6, pp. 515-524.

Caloghirou, Y., Kastelli, I. and Tsakanikas, A. (2004), "Internal capabilities and external knowledge sources: complements or substitutes for innovative performance?", *Technovation*, Vol. 24 No. 1, pp. 29-39.

Cantwell, J. and Iammarino, S. (2000), "Multinational corporations and the location of technological innovation in the UK regions", *Regional Studies*, Vol. 34 No. 4, pp. 317-332.

Chen, C.-J. and Huang, J.-W. (2009), "Strategic human resource practices and innovation performance – the mediating role of knowledge management capacity", *Journal of Business Research*, Vol. 62 No. 1, pp. 104-114.

Chesbrough, H. (2003), *Open Innovation*, Harvard Business School Publishing, Boston, MA.

Chiang, Y.H. and Hung, K.P. (2010), "Exploring open search strategies and perceived innovation performance from the perspective of inter-organizational knowledge flows", *R&D Management*, Vol. 40 No. 3, pp. 292-299, available at: http://doi.org/10.1111/j.1467-9310.2010.00588.x

Cirera, X. and Muzi, S. (2016), "Measuring firm-level innovation using short questionnaires: evidence from an experiment", World Bank Policy Research.

Crépon, B., Duguet, E. and Mairessec, J. (1998), "Research, innovation and productivity: an econometric analysis at the firm level", *Economics of Innovation and New Technology*, Vol. 7 No. 2, pp. 115-158.

Custódio, C., Ferreira, M.A. and Matos, P. (in press), "Do general managerial skills spur innovation?", *Management Science*, available at: https://doi.org/10.1287/mnsc.2017.2828

Daellenbach, U.S., McCarthy, A.M. and Schoenecker, T.S. (1999), "Commitment to innovation: the impact of top management team characteristics", *R&D Management*, Vol. 29 No. 3, pp. 199-208.

Danneels, E. (2002), "The dynamics of product innovation and firm competences", *Strategic Management Journal*, Vol. 23 No. 12, pp. 1095-1121.

Darroch, J. (2005), "Knowledge management, innovation and firm performance", *Journal of Knowledge Management*, Vol. 9 No. 3, pp. 101-115.

De Oliveira Cabral, J.E. (2010), "Firms' dynamic capabilities, innovative types and sustainability: a theoretical framework", paper presented at the XVI International Conference On Industrial Engineering And Operations Management, São Carlos.

Doloreux, D. and Lord-Tarte, E. (2013), "The organisation of innovation in the wine industry: open innovation, external sources of knowledge and proximity", *European Journal of Innovation Management*, Vol. 16 No. 2, pp. 171-189.

Erickson, C.L. and Jacoby, S.M. (2003), "The effect of employer networks on workplace innovation and training", *ILR Review*, Vol. 56 No. 2, pp. 203-223.

Feldman, M.P. and Audretsch, D.B. (1999), "Innovation in cities: science-based diversity, specialization and localized competition", *European Economic Review*, Vol. 43 No. 2, pp. 409-429.

Frenken, K., van Oort, F.G., Verburg, T. and Boschma, R.A. (2005), *Variety and Regional Economic Growth in the Netherlands* (0502), Utrecht University, available at: http://econ.geo.uu.nl/peeg/peeg0502.pdf

Frenz, M. and Ietto-Gillies, G. (2009), "The impact on innovation performance of different sources of knowledge: evidence from the UK community innovation survey", *Research Policy*, Vol. 38 No. 7, pp. 1125-1135, available at: https://doi.org/10.1016/j.respol.2009.05.002

Funk, R.J. (2013), "Making the most of where you are: geography, networks, and innovation in organizations", *Academy of Management Journal*, Vol. 57 No. 1, pp. 193-222, available at: https://doi.org/10.5465/amj.2012.0585

Garriga, H., Von Krogh, G. and Spaeth, S. (2013), "How constraints and knowledge impact open innovation", *Strategic Management Journal*, Vol. 34 No. 9, pp. 1134-1144.

Gertler, M.S. (1995), "'Being there': proximity, organization, and culture in the development and adoption of advanced manufacturing technologies", *Economic Geography*, Vol. 71 No. 1, pp. 1-26.

Giuliani, E. (2006), "The selective nature of knowledge networks in clusters: evidence from the wine industry", *Journal of Economic Geography*, Vol. 7 No. 2, pp. 139-168.

Glaeser, E.L. and Mare, D.C. (2001), "Cities and skills", *Journal of Labor Economics*, Vol. 19 No. 2, pp. 316-342.

Goedhuys, M., Janz, N. and Mohnen, P. (2013), "Knowledge-based productivity in 'low-tech' industries: evidence from firms in developing countries", *Industrial and Corporate Change*, Vol. 23 No. 1, pp. 1-23.

Greco, M., Grimaldi, M. and Cricelli, L. (2015), "Open innovation actions and innovation performance: a literature review of European empirical evidence", *European Journal of Innovation Management*, Vol. 18 No. 2, pp. 150-171.

GSO, G.S.O.o.V. (2017), "Social economic situation in 2016", available at: www.gso.gov.vn/default.aspx?tabid=714 (accessed April 10, 2017).

Hamel, G. and Prahalad, C.K. (1994), "Competing for the future", *Harvard Business School Press*, Vol. 72 No. 4, pp. 122-128.

Hansen, J.A. (1992), "Innovation, firm size, and firm age", *Small Business Economics*, Vol. 4 No. 1, pp. 37-44.

Hitt, M.A., Hoskisson, R.E. and Kim, H. (1997), "International diversification: effects on innovation and firm performance in product-diversified firms", *Academy of Management Journal*, Vol. 40 No. 4, pp. 767-798.

Huergo, E. and Jaumandreu, J. (2004), "How does probability of innovation change with firm age?", *Small Business Economics*, Vol. 22 No. 3, pp. 193-207.

Hung, K.-P. and Chou, C. (2013), "The impact of open innovation on firm performance: the moderating effects of internal R&D and environmental turbulence", *Technovation*, Vol. 33 No. 10, pp. 368-380.

Ireland, R.D. and Webb, J.W. (2007), "Strategic entrepreneurship: creating competitive advantage through streams of innovation", *Business Horizons*, Vol. 50 No. 1, pp. 49-59.

Isaksen, A. and Onsager, K. (2010), "Regions, networks and innovative performance: the case of knowledge-intensive industries in Norway", *European Urban and Regional Studies*, Vol. 17 No. 3, pp. 227-243.

Isaksson, O.H.D., Simeth, M. and Seifert, R.W. (2016), "Knowledge spillovers in the supply chain: evidence from the high tech sectors", *Research Policy*, Vol. 45 No. 3, pp. 699-706, available at: https://doi.org/10.1016/j.respol.2015.12.007

Kasseeah, H. (2013), "Innovation and performance in small- and medium-sized enterprises: evidence from Mauritius", *Innovation and Development*, Vol. 3 No. 2, pp. 259-275, available at: http://dx.doi.org/10.1080/2157930X.2013.825069

Khanna, T. and Palepu, K.G. (2005), "Spotting institutional voids in emerging markets", Vols 106-014, Harvard Business Review, Boston, MA.

Khanna, T. and Palepu, K.G. (2010), *Winning in Emerging Markets: A Road Map for Strategy and Execution*, Harvard Business School Publishing, Boston, MA.

Knoben, J. and Oerlemans, L.A.G. (2006), "Proximity and inter-organizational collaboration: a literature review", *International Journal of Management Reviews*, Vol. 8 No. 2, pp. 71-89.

Knoben, J. and Oerlemans, L.A.G. (2010), "The importance of external knowledge sources for the newness of innovations of South African firms", *International Journal of Innovation and Regional Development*, Vol. 2 No. 3, pp. 165-181.

Laursen, K. and Salter, A. (2006), "Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms", *Strategic Management Journal*, Vol. 27 No. 2, pp. 131-150.

Laursen, K., Masciarelli, F. and Prencipe, A. (2012), "Regions matter: how localized social capital affects innovation and external knowledge acquisition", *Organization Science*, Vol. 23 No. 1, pp. 177-193, available at: https://doi.org/10.1287/orsc.1110.0650

Le, P.N.M. (2012), "What determines the access to credit by SMEs? A case study in Vietnam", *Journal of Management Research*, Vol. 4 No. 4, p. 90.

Lê, X.D., Dao, M.T., Le, T.K.V., Vu, A.T., Tran, T.T.H., Nguyen, M.Q. and Ho, N.L. (2016), *Vietnam Science and Technology 2015*, Science and Technology Publishing, Hanoi.

Li, C.-R., Lin, C.-J. and Huang, H.-C. (2013), "Top management team social capital, exploration-based innovation, and exploitation-based innovation in SMEs", *Technology Analysis & Strategic Management*, Vol. 26 No. 1, pp. 69-85, available at: https://doi.org/10.1080/09537325.2013.850157

Lin, C., Hung, H.-C., Wu, J.-Y. and Lin, B. (2002), "A knowledge management architecture in collaborative supply chain", *Journal of Computer Information Systems*, Vol. 42 No. 5, pp. 83-94, available at: https://doi.org/10.1080/08874417.2002.11647612

Liu, X. and Buck, T. (2007), "Innovation performance and channels for international technology spillovers: evidence from Chinese high-tech industries", *Research Policy*, Vol. 36 No. 3, pp. 355-366.

London, J.D. (2011), *Education in Vietnam*, Institute of Southeast Asian Studies, Singapore.

Lundvall, B. (2007), "National innovation systems – analytical concept and development tool", *Industry and Innovation*, Vol. 14 No. 1, pp. 95-119.

Lundvall, B. (2009), "Innovation as an interactive process: user-producer interaction to the national system of innovation", *African Journal of Science, Technology, Innovation and Development*, Vol. 1 Nos 2/3, pp. 10-34.

McCann, B.T. and Folta, T.B. (2008), "Location matters: where we have been and where we might go in agglomeration research", *Journal of Management*, Vol. 34 No. 3, pp. 532-565.

McGee, J.E. and Dowling, M.J. (1994), "Using R&D cooperative arrangements to leverage managerial experience: a study of technology-intensive new ventures", *Journal of Business Venturing*, Vol. 9 No. 1, pp. 33-48.

Martínez-Ros, E. and Orfila-Sintes, F. (2012), "Training plans, manager's characteristics and innovation in the accommodation industry", *International Journal of Hospitality Management*, Vol. 31 No. 3, pp. 686-694.

Morgan, K. (2007), "The learning region: institutions, innovation and regional renewal", *Regional Studies*, Vol. 41 No. S1, pp. S147-S159.

Moulaert, F. and Sekia, F. (2003), "Territorial innovation models: a critical survey", *Regional Studies*, Vol. 37 No. 3, pp. 289-302, available at: https://doi.org/10.1080/0034340032000065442

Neely, A. and Hii, J. (2012), "The innovative capacity of firms", *Nang Yan Business Journal*, Vol. 1 No. 1, pp. 47-53.

Nonaka, I. and Takeuchi, H. (1995), *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*, Oxford University Press, New York, NY.

OECD and The World Bank (2014), *Science, Technology and Innovation in Viet Nam*, OECD Publishing, Paris.

OECD/Eurostat (2005), *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, 3rd ed., OECD Publishing, Paris.

Oerlemans, L. and Knoben, J. (2010), "Configurations of knowledge transfer relations: an empirically based taxonomy and its determinants", *Journal of Engineering and Technology Management*, Vol. 27 No. 1, pp. 33-51.

Peng, M.W. (2000), *Business Strategies in Transition Economies*, Sage Publications, Thousand Oaks, CA.

Pittaway, L., Robertson, M., Munir, K., Denyer, D. and Neely, A. (2004), "Networking and innovation: a systematic review of the evidence", *International Journal of Management Reviews*, Vol. 5 Nos 3/4, pp. 137-168.

Porter, M.E. (1990), "The competitive advantage of nations", *Harvard Business Review*, Vol. 68 No. 2, pp. 73-93.

Porter, M.E. (1991), "Towards a dynamic theory of strategy", *Strategic Management Journal*, Vol. 12 No. S2, pp. 95-117.

Quintane, E., de Castro, M.G., Casselman, M.R., Reiche, S.B. and Nylund, P.A. (2011), "Innovation as a knowledge-based outcome", *Journal of Knowledge Management*, Vol. 15 No. 6, pp. 928-947, available at: https://doi.org/10.1108/13673271111179299

Reuer, J.J. and Lahiri, N. (2013), "Searching for alliance partners: effects of geographic distance on the formation of R&D collaborations", *Organization Science*, Vol. 25 No. 1, pp. 283-298.

Roper, S., Love, J.H. and Bonner, K. (2017), "Firms' knowledge search and local knowledge externalities in innovation performance", *Research Policy*, Vol. 46 No. 1, pp. 43-56, available at: https://doi.org/10.1016/j.respol.2016.10.004

Sakkab, N.Y. (2002), "Connect & develop complements: research & develop at P&G", *Research Technology Management*, Vol. 45 No. 2, pp. 38-45.

Scaringella, L. (2016), "Knowledge, knowledge dynamics, and innovation", *European Journal of Innovation Management*, Vol. 19 No. 3, pp. 337-361, available at: https://doi.org/10.1108/ejim-05-2015-0031

Schilirò, D. (2010), "Investing in knowledge: knowledge, human capital and institutions for the long run growth", *Governance of Innovation*, pp. 33-50.

Schroll, A. and Mild, A. (2012), "A critical review of empirical research on open innovation adoption", *Journal für Betriebswirtschaft*, Vol. 62 No. 2, pp. 85-118.

Schulze, A. and Hoegl, M. (2008), "Organizational knowledge creation and the generation of new product ideas: a behavioral approach", *Research Policy*, Vol. 37 No. 10, pp. 1742-1750, available at: https://doi.org/10.1016/j.respol.2008.07.002

Schumpeter, J.A. (1934), *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*, Vol. 55, Transaction Publishers, Piscataway.

Shan, W., Walker, G. and Kogut, B. (1994), "Interfirm cooperation and startup innovation in the biotechnology industry", *Strategic Management Journal*, Vol. 15 No. 5, pp. 387-394.

Shane, S.A. (2003), *A General Theory of Entrepreneurship: The Individual-Opportunity Nexus*, Edward Elgar Publishing, Cheltenham.

Shefer, D. and Frenkel, A. (2005), "R&D, firm size and innovation: an empirical analysis", *Technovation*, Vol. 25 No. 1, pp. 25-32.

Soh, P.-H. (2003), "The role of networking alliances in information acquisition and its implications for new product performance", *Journal of Business Venturing*, Vol. 18 No. 6, pp. 727-744.

Sorenson, O. and Baum, J.A. (2003), "Editors' introduction: geography and strategy: the strategic management of space and place", *Geography and Strategy*, Emerald Group Publishing Limited, Bingley, pp. 1-19.

Svetina, A.C. and Prodan, I. (2008), "How internal and external sources of knowledge contribute to firms' innovation performance", *Managing Global Transitions*, Vol. 6 No. 3, p. 277.

Taylor, P., Derudder, B., Saey, P. and Witlox, F. (2006), *Cities in Globalization: Practices, Policies and Theories*, Routledge, New York, NY.

Tsuji, M. and Miyahara, S. (2010), "Empirical analysis of innovation and the proximity of information linkages in ASEAN economies: case of Indonesia, the Philippines, Thailand and Vietnam", *in Fostering Production and Science & Technology Linkages to Stimulate Innovation in ASEAN. ERIA Research Project*, ERIA, pp. 384-457.

Uzzi, B. (1997), "Social structure and competition in interfirm networks: the paradox of embeddedness", *Administrative Science Quartely*, Vol. 42 No. 1, pp. 35-67.

Vrgovic, P., Vidicki, P., Glassman, B. and Walton, A. (2012), "Open innovation for SMEs in developing countries – an intermediated communication network model for collaboration beyond obstacles", *Innovation*, Vol. 14 No. 3, pp. 290-302.

Walker, G., Kogut, B. and Shan, W. (1997), "Organization science, social capital, structural holes and the formation of an industry network", *Organization Science*, Vol. 8 No. 2, pp. 109-125.

Wang, C.C. and Lin, G.C. (2012), "Dynamics of innovation in a globalizing China: regional environment, inter-firm relations and firm attributes", *Journal of Economic Geography*, Vol. 13 No. 3, pp. 397-418.

West, J. and Bogers, M. (2014), "Leveraging external sources of innovation: a review of research on open innovation", *Journal of Product Innovation Management*, Vol. 31 No. 4, pp. 814-831, available at: http://doi.org/10.1111/jpim.12125

Weterings, A. and Knoben, J. (2013), "Footloose: an analysis of the drivers of firm relocations over different distances", *Papers in Regional Science*, Vol. 92 No. 4, pp. 791-809, available at: https://dx.doi.org/10.1111/j.1435-5957.2012.00440.x

World Bank and Ministry of Planning and Investment of Vietnam (2016), "Vietnam 2035: toward prosperity, creativity, equity, and democracy", World Bank, Washington, DC, doi: 10.1596/978-1-4648-0824-1.

Wright, P.M., McMahan, G.C. and McWilliams, A. (1994), "Human resources and sustained competitive advantage: a resource-based perspective", *International Journal of Human Resource Management*, Vol. 5 No. 2, pp. 301-326.

**Corresponding author**
Joris Knoben can be contacted at: j.knoben@fm.ru.nl