Small Bus Econ
https://doi.org/10.1007/s11187-019-00175-4

Does organizational structure facilitate inbound and outbound open innovation in SMEs?

Simona Gentile-Lüdecke · Rui Torres de Oliveira · Justin Paul

Accepted: 17 April 2019

Abstract Based on the evolutionary theory of the firm, this paper examines how traditional variables that describe a firm's organizational structure—formalization, specialization, and centralization—affect the adoption of inbound and outbound open innovation. Using a cross-sectional survey of Chinese small and medium enterprises, our study shows that organizational structure matters for open innovation and that formalization, specialization, and centralization have diverse effects on the OI practices implemented by SMEs. Results indicate that *specialization* and *centralization* have a critical role in open innovation practices as they both foster the use of inbound and outbound open innovation. *Formalization* negatively affects outbound, but it is positively associated with inbound open innovation.

Keywords Open innovation · SMEs · Evolutionary theory of organizations · Organizational structure

S. Gentile-Lüdecke
Heilbronn University of Applied Sciences, Reinhold-Würth-Hochschule, Campus Künzelsau, Daimlerstrasse 35, 74653 Künzelsau, Germany
e-mail: simona.gentile-luedecke@hs-heilbronn.de

R. Torres de Oliveira (✉)
Business School, Australian Centre for Entrepreneurship, Queensland University of Technology, Brisbane, Queensland 4000, Australia
e-mail: rui.torresdeoliveira@qut.edu.au

J. Paul
University of Puerto Rico, San Juan, PR, USA
e-mail: justin.paul@upr.edu

Published online: 14 May 2019

JEL classification M10 · L26

1 Introduction

Staying innovative over the years is a significant challenge to organization and to their managers. The idea that firms need to move from purely internal research and development (R&D) capabilities to an open innovation (OI) approach (Chesbrough 2006), accessing and using technological knowledge from external sources (Cohen and Levinthal 1990; Tsai and Wang 2008), inbound OI, and actively commercializing internal technologies outside their boundaries (Gambardella et al. 2007), outbound OI, represents an important shift on the daily activities of organizations. Under a rapidly changing business environment, firms can no longer afford to depend on their own innovation processes as internal R&D (Rigby and Zook 2002) but need to extend their innovation sources in order to improve their technology. Open innovation is important because it helps reduce costs, accelerates time to market, increases differentiation in the market, and creates new revenue streams for the firms (Chesbrough 2007). However, moving from a *non-invented here* syndrome (Katz and Allen 1982) to *proudly developed elsewhere* (Elmquist et al. 2009) is in practice a complex managerial exercise (Antons and Piller 2015).

Small and medium enterprises (SMEs) represent a unique context in terms of OI (Usman et al. n.d., p. 3) because of their resource and capability endowments, skill sets, and the strong connection between entrepreneur and the OI strategy of the firm (van de Vrande et al. 2009;

Vanhaverbeke et al. 2012). Past research indicate that SMEs are more dependent on OI (Spithoven et al. 2013) and can achieve greater benefits from OI than larger firms because of their increased willingness to take risks, their ability to react to changing environments, and their reduced level of bureaucracy (Dufour and Son 2015). For some authors (e.g., Gassmann et al. 2010), OI represents for SMEs an important means to overcome their lack of managerial and technical skills and increase their profitability.

Recent research has indicated that implementing OI requires firms to create organizational solutions that permit them to access external knowledge and that it is equally important that companies modify their internal organization to allow for sharing, adapting, and integrating externally accessed knowledge (Ahn et al. 2016; Brunswicker and Vahnaverbeke 2015; Huang et al. 2015; Spithoven et al. 2010). However, most research has addressed OI processes in large, R&D intensive companies and only few studies have looked at SMEs (West et al. 2014). Moreover, the attention of the scholars has been directed mostly to inbound OI with limited attention to outbound OI practices (West and Bogers 2014). Despite the benefits from OI on SMEs, we still do not know to what extent internal aspects of organizational structure may influence the propensity of SMEs to adopt an OI model. In this study, we aim to fill this gap and we look at how the traditional variables that define organizational structure (Pertusa-Ortega et al. 2010)—formalization, specialization, and centralization—facilitate the adoption of inbound and outbound OI.

Investigating how organizational structure impacts on the adoption of OI in SMEs is important because organizational barriers to new innovation models are particularly relevant for SMEs as these firms generally lack structured internal knowledge sharing, acquisition, and utilization (Varis and Littunen 2010) and lack the nurturing of an innovation culture to exploit novel knowledge (Terziowski 2010). If, as we hypothesize, OI adoption requires specific organizational structures, then our results should inform practitioners on how to better design their organization in the case of business models based on OI approaches. Aligned with this view, many calls exist to uncover these organizational dynamics. Chiaroni et al. (2010, p. 1), for example, state that "an issue that deserves further attention is the anatomy of the organizational change process through which a firm evolves from being a closed firm to an open innovation firm." Furthermore, Bianchi et al. (2011, p. 23) assert that "there are few contributions that look at how firms organize themselves to make the most out of OI, i.e. on the organizational implications of this emerging innovation management paradigm." Organizational structure has been considered to be among the first and most important determinants of innovation (Damanpour 1991), and organizational variation in how firms coordinate internal activities can have a relevant impact on innovation (Van de Ven 1986).

To conduct our investigation, we build on the evolutionary theory of the firm. A central tenet of the evolutionary theory (Nelson and Winter 1982) highlights organizational routines as the fundamental ways of doing things in the firms. While classical organization structure theory sees organizations as having firm boundaries, in an OI approach, boundaries are no longer stable and changes of organizational routines are needed to resist barrier to openness (Lewin et al. 2017). Hence, by focusing on formalization, centralization, and specialization, we consider how their contribution to the routinization of activities may impact the propensity to use an OI model.

The study is based on survey data of SMEs from China. Our focus on the Chinese settings relates to their increasing importance within the emerging economy context and, thus, in the global economy. Since China's economic reform, Chinese SMEs now stand out in technological innovation and are the most active firms in China's market economy (Chen et al. 2017). Moreover, Chinese private SMEs are beginning to play a significant role in driving sectorial cooperation and innovation and initiating OI practices, such as outlicensing and spin-offs, to facilitate the commercialization of new technologies developed in-house (Chen 2006; Fu and Xiong 2011). Finally, OI from emerging economies' SMEs is still under studied (Zeng et al. 2010), particularly in terms of organizational structure (West et al. 2014). The context is, therefore, a suitable one for the investigation we aim to carry on.

Our study contributes to the literature on organizational structure and OI in the SME context, shedding light on the organizational structure variables that may facilitate the use of OI strategies. This is important for SMEs because their flexibility and adaptable work environment can be of great support to adjust organizational structure to open up the innovation process. Moreover, by looking at both inbound and outbound OI, this study provides an important contribution to the research on SMEs and OI, which frequently referred exclusively to inbound OI.

2 Theoretical background and hypotheses

2.1 Open innovation and SMEs

OI has been defined by Chesbrough et al. (2006, p. 1) as the "purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively." Thus, OI falls generally into two categories: inbound and outbound (Dahlander and Gann 2010). Following the same author, inbound innovation is about sourcing and acquiring expertise from outside the organization and scanning the external environment for new information to identify, select, utilize, and internalize ideas whereas outbound innovation is the purposive commercialization of internally developed ideas in the organization's external environment. This may be through selective revealing or through selling the technology or service to customers (Chesbrough and Bogers 2014, p. 17). Until now, studies have largely focused on inbound OI (West and Bogers 2014); that is, the practice of *exploring* and integrating external knowledge for technology development (Parida et al. 2012). Less attention has been reserved for outbound OI, which is the purposive outflows of knowledge or technology *exploitation* activities (Inauen and Schenker-Wiki 2012), including the spin-off of new ventures based on prior technology development and the out-licensing of technologies to other organizations (van de Vrande et al. 2009; West et al. 2014). Studies that focus on SMEs (Bianchi et al. 2010; Brunswicker and Vahnaverbeke 2015; Dufour and Son 2015; Parida et al. 2012; Spithoven et al. 2013; van de Vrande et al. 2009; Vanhaverbeke 2017) indicate that SMEs are adopting OI to overcome different challenges, i.e., lack of necessary resources and complementary assets, increasing globalization and funding constraints. Moreover, they indicate that SMEs have flexible organizational structures that are more adaptable to change. This flexibility and adoptability can allow SMEs to benefit from OI more than large firms (Dufour and Son 2015; Parida et al. 2012). Research has indicated that implementing OI requires adaptive organizational structure. Furthermore, the organizational structures and routines needed for exploring external created knowledge are considered to be different from those needed for exploiting internally developed knowledge (Lubatkin et al. 2006).

As suggested by Laursen and Salter (2006, p. 146), "firms who are more open to external sources or search channels are more likely to have [a] higher level of innovative performance." On the other hand, however, openness in innovation can also have potential disadvantages (Fey and Birkinshaw 2005; Huang and Rice 2009). In fact, having a large number of innovation partners may lead to problems in managing and monitoring these relationships (Sieg et al. 2010), and the absorption of knowledge from many different sources may become challenging. This may be even more in the case for SMEs, where the management teams are smaller and there is a lower capacity to organize and manage a larger set of external linkages.

Prior research on OI and SMEs mostly refers to inbound OI, and our knowledge is still limited about the challenges generated by the adoption of outbound OI—*selling* and *revealing*[1]—by SMEs (Ahn et al. 2015). Outbound OI generally imposes a higher level of managerial challenge due to the imperfections in the market for technology (Arora et al. 2001) and the lack of formalized internal processes (Dahl and Pedersen 2004), and this can create even more constraints for SMEs. Looking at the specific case of SMEs, because of restricted manufacturing and distribution capability (Lee et al. 2010), these firms are less prone to commercialize everything by themselves and are more inclined to collaborate with external partners to facilitate and speed up commercialization of their technologies (Alvarez and Barney 2001). On the other hand, selling technology may also have a downside effect. SMEs are less likely than large firms to have knowledge "*for sale*" unrelated to their core process, which they could unload without competitive implications (Torkelli et al. 2009). Thus, the process of decision-making as well as the competence base of the managerial level play an important role. Overall, we argue that the organizational dimension of OI is important, and how SMEs coordinate internal activities and the level at which strategic innovation decisions are taken have a significant impact on the OI practices adopted by SMEs.

2.2 Open innovation and organizational structure

We use the evolutionary theory of organizations (Dosi and Marengo 2007; Nelson and Winter 1982) to

[1] In this research, we refer to selling and revealing as per Dahlander and Gann's (2010) definition. Revealing refers to internal resources that are revealed to the external environment, and selling refers to how firms commercialize internal knowledge through licensing or selling.

examine the effects of organizational structure on OI practices, both inbound and outbound. There are different reasons to use this theoretical perspective. According to evolutionary theory, firms' behavior is determined by firm-specific routines that guide members in conducting their task (Nelson and Winter 1982). Innovation is one of the activities with which evolutionary theory is concerned. As Nelson and Winter (1982, p. 133) indicate "… we propose to assimilate to our concept of routine all of the patterning of organizational activity, including the patterning of particular ways of attempting to innovate." Moreover, according to this theory, organizational structure is important for the performance of these activities. The organizational structure present at any given time tends to be relatively fixed for the moment, and actions are constrained by organizational routines (Nelson and Winter 1982). Routines create continuity and reinforce the internal stability of the firm.

When talking about OI, in order to increase openness, firms have to deviate from existing routines. Shifting routines has a cost, as it introduces "*hesitation*" in the organization; however, doing so can give firms flexibility, diversity, and adaptability, but firms also have to cope with the uncertainties involved (Nelson and Winter 1982). At its most general level, the evolutionary approach sees economic organizations as problem-solving arrangements (Dosi and Marengo 2007). The same authors argue that firms have problem-solving competencies associated with their own routines, which are embedded in the patterns of intra-organizational division of labor and assignments of decision entitlements. Hence, the evolutionary perspective recognizes the importance of organizational structure for performing innovation activities. Following Mintzberg (1979), we define organizational structure as the result of the combination of the ways in which work can be divided into different tasks, the coordination of which must be ensured.

Organizational structure was considered among one of the most relevant determinants of innovation when the very first studies on innovation were conducted (Damanpour 1991; Subramanian and Nilakanta 1996). It has been shown to impact firms' effectiveness regarding the communication and processing of information (Galbraith and Nathanson 1978; Mintzberg et al. 2003; Olson et al. 2005), and it has also been connected to firms' ability to generate knowledge (Pertusa-Ortega et al. 2010) or absorb, proceed upon, learn from external knowledge (Jansen et al. 2005; Van den Bosch and Volberda 1999), and relate to external parties (Lane and Lubatkin 1998).

Looking at organizational structure, we focus on three dimensions—formalization, centralization, and specialization—that past research suggests to be critical in a broader context of knowledge search and innovation (Damanpour 1991; Ihl et al. 2012; Pertusa-Ortega et al. 2010; Rivkin and Siggelkow 2003). Indeed, many scholars have confirmed the centrality of these dimensions (Burton et al. 2002; Gulati et al. 2009; Mintzberg 1979). Burton et al. (2002, p. 1436) state that centralization, formalization, and specialization are central properties of the organizational structure. Calantone et al. (2010, p. 1070) consider decentralization, informalization, and functional differentiation to be key structure dimensions, while Pertusa-Ortega et al. (2010, p. 312) refer to these dimensions as the main organizational structure dimensions. These dimensions have also been analyzed by scholars in the context of SME literature, revealing a difference with respect to large firms. Prajogo and McDermott (2014) argue that SMEs have more focus on formalization, less on specialization, and a stronger tendency toward centralization than larger firms in terms of organizational structure. Spanos et al. (2001), looking at Greek SMEs, find that SMEs place more emphasis on formalization and have a stronger tendency toward centralization compared to large firms. Meijaard et al. (2005), in a study of small Dutch firms, identify heterogeneity among SMEs in terms of centralization, formalization, and specialization and state that small firms are very diverse in terms of organizational structure, both across sector and size classes.

Previous studies have also looked at the influence of the above-mentioned dimensions of organizational structure on the propensity to innovate and on performance gains (Ihl et al. 2012; Palmié et al. 2016; Pertusa-Ortega et al. 2010; Sahay and Gupta 2011). However, less is known about their influence when looking specifically at inbound and outbound OI (Bogers et al. 2017). Therefore, we wish to fill this gap, and, in this study, we examine how those dimensions of organizational structure affect the adoption of open forms of innovation by SMEs.

Specialization and OI Specialization refers to the division of tasks and activities into subtasks and the assignment of these tasks to specific members or units of the organization (Mintzberg et al. 2003). Research has

indicated that SMEs have naturally a lower degree of specialization than larger firms. In firms with high degree of specialization (also called horizontal differentiation), tasks are performed by someone with that function and no other (Pugh et al. 1968, p. 73). According to Friedrickson (1986) and Robbins (1990), the degree of specialization that exists in a firm is an indication of the level of structural complexity of an organization. This vision is shared by Pertusa-Ortega et al. (2010), who indicate that horizontal differentiation leads to a higher organizational complexity. This complexity entails grouping together individuals "who share a common knowledge base for the development of joint projects" (Pertusa-Ortega et al. 2010, p. 213). Greater specialization is likely to improve employee skills because they become specialized in the activities they perform. Moreover, it leads to the development of a common understanding of knowledge within subunits. According to Lane and Lubatkin (1998), prior related knowledge is conducive to searching and absorbing knowledge from external sources. Thus, considering external knowledge search, specialization may facilitate inbound OI. According to evolutionary theory (Nelson and Winter 1982), specialization may lead to earlier routinization, reduce hesitation, and increase the effect of investment in knowledge.

SMEs need to sell their findings in order to enlarge their resource pool (Dufour and Son 2015); however, when considering outbound OI, one has to bear in mind that knowledge is a highly idiosyncratic good (Teece 2000) and knowledge transactions require specific skills of both parties involved. When transferring knowledge outside the firm, besides the challenges of transferring knowledge, the imperfections inherent in knowledge markets may lead to appropriability issues and to high transaction costs (Brockhoff 1992). Unlike large firms, SMEs might not be able to create external business units to promote their innovations because of lack of resources (van de Vrande et al. 2009). Because of the high transaction costs inherent in looking for an external partner and in transferring knowledge, the negotiation phase may carry the risk of disclosing too much about transferable knowledge, generating a potential loss of competitive/technological edge (Kutvonen 2011). Thus, a higher degree of specialization should contribute to reduce the risk of potential loss. Indeed, Damanpour (1991) finds that specialization has a higher impact on the later stage of the innovation process, e.g., specialization positively impacts the exploration stage but, even more, on the exploitation stage (Damanpour 1991, p. 580). Thus, we suggest the following:

H1a: A higher degree of specialization positively relates to inbound OI activities.

H1b: A higher degree of specialization positively relates to outbound OI activities.

Formalization and OI Formalization comprises a control mechanism for organizational work, through the definition of labor standards, rules, procedures, and protocols that are generally documented to regulate employee behavior (Caruana et al. 1998; Mintzberg 1979). A long-running debate has been taking place in the innovation literature on the relative strengths and weaknesses of formality and informality in SMEs (Qian and Li 2003). Those who support formality have argued that SMEs need to improve their organizational capabilities by formalizing their structures and systems in order to become more efficient (Bessant and Tidd 2007; Prakash and Gupta 2008). Those who support informality, however, argue that SMEs do not need to formalize their structures and systems due to the limited range of products that they develop for niche markets. At the base of their argument is the premise that flexible structures are a significant source of SMEs' competitive advantage over large firms (Fiengenbaum and Karnani 1991; Qian and Li 2003).

Previous research on the effect of formalization on innovation shows ambiguous results; some studies show non-significant relationships between formalization and knowledge creation (Pertusa-Ortega et al. 2010), whereas others (Ihl et al. 2012) find that firms with high levels of internal formalization are able to gain more from a given (high) number of knowledge sources.

As formalization makes an organization bureaucratic, it can act as an inhibitor for considering OI, particularly in the case of inbound OI, because, as the environment becomes more dynamic, firms that have institutionalized rules and routines may have difficulty in adjusting their knowledge to the new situation and to search for external knowledge. Formalization contributes to the routinization of decision-making, and, according to evolutionary theory, the routinization of activities suppresses hesitation (Nelson and Winter 1982). However, high formalization inhibits spontaneity, creativity, and risk-taking among employees; the creation of systems and routines may interfere with experimentation and creative problem-solving behavior (Zmud 1982). Formalization reduces flexibility as it hinders individuals

from deviating from established behavior, and this may be a drawback for inbound OI as flexibility has been found to facilitate innovation processes (Damanpour 1991).

On the other side, the clear definition of rules is important for outbound OI. Formalization results in higher process efficiency, and it allows to codify best practices and provides an organizational memory that facilitates the diffusion of organizational capabilities and the transfer of knowledge (Pertusa-Ortega et al. 2010). The establishment of systematic technology exploration processes may help to develop capabilities for identification of partner technological knowledge (Giannopoulou et al. 2011). If external knowledge exploration processes are developed through formalized processes and structures, the evaluation of possible partners should be facilitated (Oltra et al. 2018). Thus, the existence of norms and explicit procedures can encourage implementation of outbound innovation practices. Thus, we hypothesize the following:

H2a: A higher degree of formalization negatively relates to inbound OI activities.

H2b: A higher degree of formalization positively relates to outbound OI activities.

Centralization and OI Centralization corresponds to a locus of decision rights within the organization (Caruana et al. 1998). Some scholars have asserted that centralization can have a positive effect on innovation, especially in dynamic environment conditions (Adler and Borys 1996); that is, once a decision is taken, centralization involves unambiguous responsibilities and can facilitate the implementation of a decision.

Other authors propose a negative relationship between centralization and innovation outcomes. Studies on innovation that draw from a knowledge-based view (e.g., Grant 1996; Kogut and Zander 1993; Nahapiet and Ghoshal 2000) indicate that concentration of power in top management teams limits the flow of creativity and represents a barrier for the search of external knowledge. High decisional centralization may block or delay certain problems for the company as it limits the free flow of ideas (Sheremata 2000). Colombo and Delmastro (2008) identified several sources of organizational failures due to centralization, such as the occurrence of transmission leaks, delays, distortion of intra-firm communication, and overload due to narrow communication channels. According to evolutionary theory, this process of transmission of information may take time as the information is rarely perfect (Nelson and Winter 1982, p. 67). Centralization may cause a reduction in the production of creative solutions and hinder interdepartmental communication as well as the frequent circulation and sharing of ideas (Souitaris 2001) due to the existence of time-consuming formal communication channels (Pertusa-Ortega et al. 2010). Firms with centralized structures may find it difficult to act on the identification of relevant external knowledge sources in a timely and efficient manner and to build relations with these knowledge sources that allow them to gain access to their knowledge (Foss et al. 2013). Decentralization, on the other hand, allows individuals to act autonomously, and this freedom of action can encourage employees to look for open forms of innovation. Studies have indicated that decentralization facilitates knowledge integration and knowledge sharing (Foss et al. 2011). Decentralization allows that employees, who are able to select the relevant sources and information that fit with firm needs (Foss et al. 2011), act as gatekeepers, since they continuously interact with external agents.

In SMEs, the decision-making process is typically highly centralized; important decisions, such as OI adoption, will be strongly influenced by the characteristics of their chief executive officers (Ahn et al. 2017) who can be either the main catalyst for change or the main stumbling block to change (Dufour and Son 2015). Thus, as centralization narrows communication channels, it reduces the quality and quantity of ideas and knowledge shared and retrieved and diminishes the likelihood that unit members seek innovative and new solutions. This is likely to restrain the innovation outcome in the case of inbound OI. On the other hand, when an organization is centralized, the greater level of authority and responsibility in management can make them more receptive to opportunity of technological exploitation and can facilitate a better commitment and cooperation with external partners as well as in the resolution of conflicts (Zhou and Li 2012). Outward knowledge transfer requires individuals to devote efforts in completing transactions that often go beyond established norms because of the imperfections of markets for technology (Guilhon et al. 2004). This makes outbound OI arguably more dependent on top decisions, and centralizing the decision authority may facilitate the implementation of agreements with external partners. Based on the above-mentioned discussion, we would expect the following:

H3a: A higher degree of centralization negatively relates to inbound OI activities.

H3b: A higher degree of centralization positively relates to outbound OI activities.

Figure 1 represents the study's conceptual framework.

3 Methods

3.1 Data

If the adoption of OI business models is relevant for SMEs in developed economies, some might argue that the mechanisms of OI adoption are even more relevant to emerging economies due to the fact that those firms are eager to catch up developed country firms (Torres de Oliveira and Rottig 2018) and due to the specific institutional and business system environment in place (Whitley 1999). Based on that, this study utilized a cross-sectional survey, focusing on a sample of Chinese SMEs located in the coastal regions of Zhejiang and Shanghai.

We have chosen Chinese firms due to China's weight in the global economy, allied with the fact that much of China's recent economic growth has happened due to the success of their SMEs.[2] Furthermore, past research has neglected emerging economies' SMEs when studying OI and organizational structure and several calls ask for more research on such settings (e.g., West et al. 2014; Zeng et al. 2010). Moreover, Chinese private SMEs have begun to play a significant role in driving sectorial cooperation and innovation, initiating outbound OI practices, such as out-licensing and spin-offs, to facilitate the commercialization of new technologies developed in-house (Chen 2006; Fu and Xiong 2011). The choice of Zhejiang province is also deliberate, as this region is one of the most private entrepreneurial regions of China (NBS China 2018).

Scholars have indicated that small, privately owned enterprises are becoming more active in cooperation and regional innovation initiatives than their larger counterparts (Fu and Xiong 2011), and this is especially true for those firms that are clustered in technologically advanced regions, such as in eastern and southern China. A cross-industry sample was chosen to increase the generalizability of our findings based on the survey administered from June 2017 to September 2017. Access to the companies was obtained first through a random selection of firms, based on their industry, in the different industrial parks and office buildings in Ningbo and Shanghai based on local knowledge from the head of one of the Chinese technological parks. The surveys were delivered in hand to one senior manager and were collected in the following working day or the day after if not ready. We delivered 153 surveys, and we managed to collect 64 surveys using this technique, corresponding to a 42% response rate. For each completed survey, we asked the senior manager to inform us of two other firms and their managers' name and contact in order to follow a snowball sampling technique. This approach is particularly useful in China where guanxi (personal relationships) significantly facilitates access (Easterby-Smith and Malina 1999; Torres de Oliveira and Figueira 2018a,b). From an initial pool of 197 surveys released following the snowball sampling, we received 92 useful questionnaires, corresponding to a 47% response rate, which is justified by the guanxi relational support that we were able to harness. In total, we gathered 156 useful questionnaires.

The respondents held senior management positions, including CEOs, directors/managing directors, and general managers. This ensures that the respondents had strong knowledge with the innovation in their firms and possessed the authority for strategic decision-making that creates major changes in SMEs, similar to previous studies in China (Torres de Oliveira and Rottig 2018). The definition of an SME in China is complex, depending on industry categories in terms of the number of employees, sales turnover, and assets (Chinese National Bureau of Statistics 2018). The categorizing of a Chinese firm as an SME is based on the SME Promotion Law of China, which has been lastly revised in 2017. The relevant size of SMEs in China is significantly larger than other countries, such as 250 in EU countries (EU 2016) and 500 employees in USA (United States International Trade Commission 2010). For instance, SMEs in industrial sectors can have a maximum of 2000 workers. Therefore, we only explored firms having less than 2000 employees. In our sample, 90% have less than 1000 employees and 67% less than 500 employees. Regarding the ownership type, 70% are privately owned firms.

[2] According to recent official data (China Statistics Press 2016), in 2015, SMEs made up about 97.9% of all registered companies in China. They also contributed nearly 58% of gross domestic product (GDP) and employed about 82% of the total workforce, being responsible for nearly 75% of the new jobs every year.

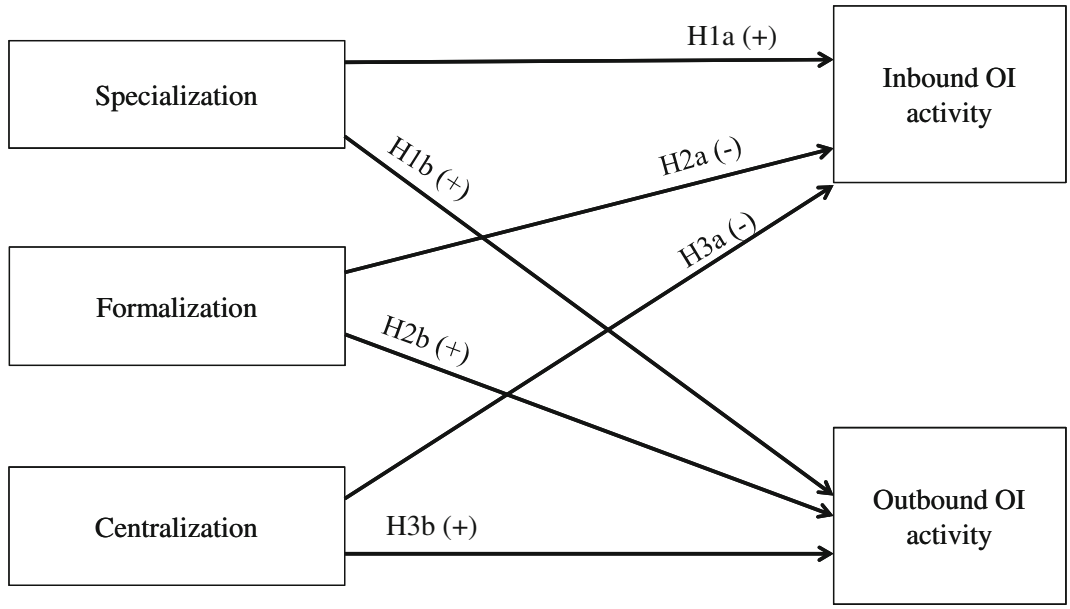

Fig. 1 Conceptual framework

Table 1 presents the surveyed firms' degree of innovation, represented by the share of turnover related to the introduction of new products/services in the previous three years. We have distinguished the products/services that are new to the market and new to the firm. The companies are classified in five different sectors of activity. Table 1 also shows the level of R&D intensity measured by the ratio of R&D expenses on sales.

Descriptive data indicate that all the companies in the sample show similar characteristics in terms of innovation performance. With the exception of the firms in the consumer goods sector, the companies in our sample have an R&D intensity of about 12%, and the average share of turnover generated by products/services new to the market and by products/services new to the firms is 30.09 and 29.18%, respectively.

Table 2 shows the surveyed firms' level of adoption of OI, differentiated by the type of OI practices. Overall, the majority of the firms registered a high level of openness in terms of external knowledge search and ties with external actors to carry out innovation activities and a good level of outbound OI practices. Following the classification of Laursen and Salter (2006), the 10 ties that we included in our survey were suppliers, customers, competitors, consultants, universities, government research institutes, conferences/trade fairs, scientific journals, industry associations, and technical standards. With a classification per sector of activity, Table 2 shows that 60% of the surveyed firms use the practice of out-licensing and 87% of the firms (137 firms out of 156) show an activity of external knowledge search.

Table 1 Innovation performance of surveyed firms by sector of activity

Sector	Number of firms	Share of turnover from products/services new to the market	Share of turnover from products/services new to the firm	R&D intensity (R&D expenses/sales)
Basic materials, energy, utilities	49	24.22	32.18	18.47
Industrial goods	46	24.33	27.13	19.64
Consumer goods	11	30.09	29.18	12.27
Services	40	27.55	29.05	23.27
Pharma, biotech, healthcare	10	32.4	28.3	21.5

Table 2 Adoption of inbound OI activity and outbound OI activity by surveyed firms

Sector	Number of firms	Outbound OI activity (number of firms)	Inbound OI activity
Basic materials, energy, utilities	49	29	41
Industrial goods	46	29	40
Consumer goods	11	5	10
Services	40	24	36
Pharma, biotech, healthcare	10	7	10

In order to have an overview of the level of openness of our firms, we looked at the mean value of each source of knowledge. The results show that all surveyed firms, to some extent, are at a high level of openness, illustrated in a high mean value (ranging from 3.65 to 4.31 out of 5). We verified the proportion of those firms that also used outbound OI. Results indicate that relevant numbers of the surveyed firms (just above 40%), across all the sectors of activity, use both inbound and outbound OI.

4 Variables and measures

4.1 Dependent variables

We used two variables to measure, respectively, inbound OI and outbound OI. Inbound OI was measured as the external search of knowledge following Laursen and Salter (2006). In the survey, firms were asked to rank the importance of each of 10 sources of information for innovation (1 = unimportant, 5 = very important), A dummy variable for each information source was created when a firm reported 4 or 5. We then added all dummies to make our *Inbound OI* variable firms; so, a higher value means a higher level of external search inbound OI in knowledge acquisition used in innovation activities.

Outbound innovation was operationalized as outlicensing (*outbound OI*). Following Ahn et al. (2017), we asked the companies if in the last three years they had licensed out internally developed knowledge to external parties. The variable was measured using a binary variable (where 0 corresponds to "not adopted" and 1 to "adopted").

4.2 Independent variables

The measure of *formalization* was adapted from Pertusa-Ortega et al. (2010). We asked companies to what extent they agreed or disagreed with the fact that innovation activities in their company were based on strict process steps and detailed task description. To investigate *specialization*, and following Gibson and Birkinshaw (2004), we asked the firms to indicate to what extent they agreed/disagreed with the fact that innovation activities in their company were happening on well-developed patterns of specialization and coordination, i.e., if innovation were being developed in specific and separated functional areas of the firm or if, by the contrary, the innovations were being developed using transversal information among different functional areas of the firms during the innovation process. These two variables were measured using a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). Following Ihl et al. (2012), we measured *centralization* by asking the respondents to indicate to what level decisions on prioritization, coordination, allocation, and utilization of innovation projects and innovation procedures were made (1 = team-member level, 2 = team-leader level, 3 = head-of-department level, 4 = top-management level, and 5 = CEO level). The responses were averaged for each firm, with a higher value indicating a higher level of centralization.

4.3 Control variables

Similar to other studies, we used seven control variables. Firm size (sale turnover in renminbi) and firm age (the number of years since incorporation) were included as larger younger firms tend to be more innovative (Huergo and Jaumandreu 2004). As we used a cross-industry survey, we controlled for sector of activity and then introduced these into the analysis as dummy variables. This is important because past research (e.g., Mina et al. 2014; West et al. 2014) reveals industry differences regarding innovation. For example, service firms are less likely to build informal or formal collaborative arrangements compared to manufacturing firms (Beers and Zand 2014; Gesing et al. 2015). We also included ownership forms of the firm as measured whether firms are privately held or not. While the private owned firms are more likely to take risk initially associated with innovation activities (Tan 2001), other types of firms, such as state-owned enterprises might

have privileges in accessing to resources (Luo et al. 2016). Subsidiary or stand-alone status of the firm is also controlled since past research (e.g., Hobday and Colpan 2010) found that whether the firm is a part of an enterprise group or not impacts innovation. Moreover, we controlled for firms' innovation performance in the last fiscal year, as the density of innovation influences the organization's value creation and value capture and future OI options (Teece 2010). We adapted the measure from Ihl et al. (2012) and distinguished between the share of turnover generated by the introduction of products/services new to the firms and new to the market. Finally, we also controlled for the company's level of open-mindedness, as it is an important aspect that influences communication and knowledge exchange (Dameron and Torset 2014; Grant 1996). We adapted the measure from Wagner (2013) and asked firms to what extent they agreed/disagreed with their managers motivating employees to think outside existing paths (1 = strongly disagree, 5 = strongly agree). Table 3 presents the study's variables and their measurement.

4.4 Common method bias

As the data were drawn from a single respondent in each organization, common method variance needed to be checked to be sure that the data were free of response bias. The test for checking common method variance used in this study was Harman's single-factor test, as suggested by Podsakoff and Organ (1986). All items were forced into one factor. Results of the unrotated solution produced a poor result, as indicated by only a 22.64% variance extracted and more than 80% of the items suffering from poor factor loading that fell below 0.5. These results suggest that common method variance was not a significant problem in the dataset.

Additionally, we used a confirmatory factor analysis approach to test common bias, as suggested by Podsakoff et al. (2003). We introduced a latent variable and related all manifest variables to it. We constrained the paths to be equal and constrained the common variance of the latent factor to 1. The common variance is estimated as the square of the common factor of each path before standardization. Results suggest that common method variance was not a significant problem in the dataset and that no serious threat of common method bias exists in this study.

5 Results

For the analysis, we used linear regression for the dependent variable *inbound OI* and logistic regression for the dependent variable *outbound OI*, due to its binary value. To assess model fitness of the logistic regression, Cox and Snell's R^2 and Nagelkerke's R^2 were reported before the regression multi-collinearity was checked. For all variables, the variation inflation factor (VIF) values were less than 2.0, well below the value of 10 that can cause a serious collinearity problem (Myers 1990). Table 4 shows the mean, standard deviation, and correlation among variables.

Table 5 indicates the results of models 1 and 2, measuring the relationship between inbound OI and organizational dimensions. Model 1 presents the base model only with control variables, and model 2 includes the organizational dimensions to the analysis. Four variables show a positive and significant association to *inbound OI*, which are as follows: *open-mindedness* (control variable), *formalization*, *specialization*, and *centralization*. The higher the level of *specialization*, the higher the search for external knowledge by the surveyed firms. Specifically, one unit increase in the level of specialization will increase the number of sources of external knowledge by 0.926; this result confirms our expectation expressed in H1a. Results also indicate that the level of *centralization* is positive and significantly correlated to *inbound OI*. The sign of the relationship is different from what we expected, as we considered that a high level of centralization would rather diminish the likelihood of employees to look for innovative external knowledge. However, in our sample, when the innovative decision-making reaches one level higher, for instance, from team leader to head of department, firms will use 0.996 more sources of external knowledge. Thus, H3a is not supported. Finally, we expected that *formalization* would be negatively correlated to *inbound OI*; however, our results again show a positive significant relationship but only in a half size effect as such caused by *centralization* and *specialization*, thereby H2a is also not supported.

Table 6 indicates the results of models 3 and 4, measuring the relationship between outbound OI and the three dimensions of organizational structure. Model 3 is the baseline model with control variables, and model 4 includes the organizational dimensions.

Results indicate that all our variables are significantly associated with the practice of out-licensing. First,

Table 3 List of variables

Variable name	Definition	Measure	Adapted from
Dependent variables			
Inbound OI	How important were the following sources of knowledge to carry out new innovation projects of your firms or to achieve the completion of existing innovations projects? (suppliers of equipment, materials, services or software; clients or customers; competitors; consultants, commercial labs; universities or other higher education institutions; government or public research institutes; conference, trade fairs; scientific journals; professionals, industry associations; technical, industry or service standards.)	1 = unimportant 5 = very important	Laursen and Salter (2006)
Outbound OI	During the last three years, has your company licensed out internally developed technology to external parties?	1 = yes 0 = no	Ahn et al. (2017)
Independent variables			
Formalization	Innovation activities in our firm are based on strict process steps and detailed task descriptions.	1 = strongly disagree 5 = strongly agree	Pertusa-Ortega et al. (2010)
Specialization	Innovation activities in our company are separated into different functional areas.	1 = strongly disagree 5 = strongly agree	Gibson and Birkinshaw (2004)
Centralization	What level of decisions regarding the following aspects are usually made: - The prioritization of innovation projects - The coordination of innovation projects - The allocation of innovation projects - The utilization of specific innovation methods, procedures.	1 = team member 2 = team leader 3 = head of department 4 = top management 5 = CEO	Ihl et al. (2012)
Control variables			
Size	Sale turnover of the firm	In Renminbi	Huergo and Jaumandreu (2004)
Age	Year of activities since the creation of the firm	Count	Huergo and Jaumandreu (2004)
Sector	Sector of activities in which the company operates	Categorical	Laursen and Salter (2006)
Private firm	Private ownership of the company	1 = yes 0 = no	Tan (2001)
Member of group of enterprise	Is the company a part of an enterprise group	1 = yes 0 = no	Hobday and Colpan (2010)
Share of turnover from products/services new to the market	Share of turnover of the products/services new to the market that have been introduced during the last three years.	Percent	Ihl et al. (2012)
Share of turnover from products/services new to the market	Share of turnover of the products/services new to the firm that have been introduced during the last three years.	Percent	Ihl et al. (2012)
Open-mindedness	Managers in our firm motivate employees to think outside the box.	1 = strongly disagree 5 = strongly agree	Wagner (2013)

Table 4 Mean, standard deviation, and Pearson's correlation

		Mean	SD	1	2	3	4	5	6	7
1	Inbound OI	7.308	2.184							
2	Outbound OI	0.603	0.491	0.073						
3	Formalization	4.173	0.828	0.373***	−0.147					
4	Specialization	3.987	0.533	0.347***	0.054	0.283***				
5	Centralization	3.46	0.616	0.373***	0.219**	0.159*	0.077			
6	Sale turnover (log)	8.669	1.785	0.23**	0.071	0.073	0.076	0.154		
7	Firm age (log)	2.621	0.594	0.065	0.015	0.042	−0.022	0.067	0.494***	
8	Private firm	0.686	0.466	−0.057	−0.126	0.025	−0.12	0.007	−0.335***	−0.295***
9	Member of group of enterprise	1.737	0.442	0.038	0.021	0.019	−0.069	0.026	−0.172	−0.092
10	Basic materials, energy, utilities industries	0.314	0.466	−0.032	−0.015	0.042	−0.036	−0.023	0.033	0.048
11	Industrial goods industries	0.295	0.457	0.07	0.037	0.018	−0.011	−0.015	0.065	0.163*
12	Consumer goods industries	0.071	0.257	−0.05	−0.083	−0.118	0.101	0.028	−0.024	−0.015
13	Services industries	0.256	0.438	−0.029	−0.003	−0.016	−0.041	0.02	−0.029	−0.247**
14	Share of turnover from products/services new to the market	26.045	17.159	0.247**	0.103	0.231	−0.016	0.138	0.06	−0.088
15	Share of turnover from products/services new to the firm	29.429	16.972	0.192*	−0.019	0.022	0.076	0.023	0.069	−0.095
16	Open-mindedness	4.429	0.701	0.288***	−0.101	0.316***	0.395***	0.044	0.046	0.018

	8	9	10	11	12	13	14	15
1								
2								
3								
4								
5								
6								
7								
8								
9	0.129							
10	0.012	−0.035						
11	−0.168*	−0.157	−0.438***					
12	0.025	0.108	−0.186*	−0.178*				
13	0.081	0.117	−0.397***	−0.38***	−0.162*			
14	0.119	−0.01	−0.072	−0.065	0.065	0.052		
15	0.109	−0.06	0.11	−0.088	−0.004	−0.013	0.414***	
16	0.06	−0.05	0.137	−0.076	0.046	−0.13	0.093	0.258**

*$p < 0.1$

**$p < 0.05$

***$p < 0.01$

Table 5 Linear regression inbound OI activity and organizational structure

	Model 1 coefficient	Model 2 coefficient
Sale turnover (log)	0.284*** (2.95)	0.196** (2.04)
Firm age (log)	− 0.192 (− 0.58)	− 0.122 (− 0.41)
Private firm	− 0.187 (− 0.47	− 0.098 (− 0.29)
Member of group of enterprise	0.572 (1.36)	0.503 (1.49)
Basic materials, energy, utilities industries	− 0.424 (− 0.61	− 0.249 (− 0.39)
Industrial goods industries	0.147 (0.21)	0.234 (0.35)
Consumer goods industries	− 0.878 (− 1.07)	− 0.744 (− 1.03)
Services industries	− 0.305 (− 0.42)	− 0.222 (− 0.33)
Share of turnover from products/services new to the market	0.025** (2.69)	0.015* (1.73)
Share of turnover from products/services new to the firm	0.005 (0.59)	0.012 (1.27)
Open-mindedness	0.837*** (3.56)	0.323 (1.43)
Formalization		0.476** (2.32)
Specialization		0.926*** (2.89)
Centralization		0.996*** (3.60)
R^2	0.2027	0.3782
Number of observations	156	156

Pharma, biotech, and healthcare industries is reference. *T* statistics are displayed in parenthesis

*$p < 0.1$

**$p < 0.05$

***$p < 0.01$

results show a significant relation between *specialization* and outbound OI ($Z = 1.69$), supporting H1b. The reported odds ratio further clarifies that for each increase in the level of specialization, the odds of having outbound OI increase by a factor of 2.049. *Formalization* is negatively related to out-licensing practices ($Z = -2.97$), which means that an increase in formalization reduces the odds of outbound OI adoption of a firm 2.353 times (1/0.425). This result contradicts to what we expected, as we considered that the existence of norms and precise procedures could encourage the implementation of outbound OI practices; thus, H2b is not supported. Model 4 also shows that for each increase in *centralization* level, the odds of engaging in outbound OI increase 2.503 times. This increase is statistically significant ($Z = 2.76$), thus supporting H3b.

5.1 Robustness checks

Additionally, we conducted a number of robustness checks to provide additional credence to our key prediction. First, our model was tested using a different independent variable (measures of change) that was correlated with our independent variables. This was important to validate the overall predictors and address endogeneity problems. Second, we analyzed other dependent variables by constructing a set of binary variables according to the importance given to a knowledge source. Survey responses of 5 received a value of 1; all other responses received a value of 0. We then summed up the binary values for the 10 sources to formulate our innovation-related variable, which is consistent with Laursen and Salter's (2006) construct. This test produced the same pattern of relationships. We went further and also conducted another test with a new dichotomous outbound OI variable, measured by whether the company started up a new organization drawing on internal knowledge (spin-off) or not. The robustness checks are consistent with our main results; as such, we did not find grounds for concern.

6 Discussion and implications

In this study, we used data from Chinese SMEs to examine whether traditional variables that describe a firm's organizational structure—specialization, formalization, and centralization—influence the adoption of inbound and outbound OI. Using an evolutionary perspective, we aim to find out to what extent the contribution of the above-mentioned variables to routinization of activities impacts the propensity to use an OI model. Results indicate that specialization, formalization, and centralization matter and that they have diverse effects on the OI practices implemented by SMEs.

As hypothesized, *specialization* plays an important role for the search of external knowledge and is significantly related to inbound OI. The positive effect of

Table 6 Logistic regression outbound OI activity and organizational structure

	Model 3 odds ratio	Model 4 odds ratio
Sale turnover (log)	1.081 (0.69)	1.052 (0.44)
Firm age (log)	0.815 (− 0.57)	0.841 (− 0.49)
Private firm	0.531 (− 1.54)	0.483 (− 1.52)
Member of group of enterprise	1.283 (0.64)	1.472 (0.88)
Basic materials, energy, utilities industries	0.594 (− 0.64)	0.74 (− 0.38)
Industrial goods industries	0.613 (− 0.60)	0.72 (− 0.42)
Consumer goods industries	0.286 (− 1.20)	0.174 (− 1.71)
Services industries	0.511 (− 0.81)	0.567 (− 0.70)
Share of turnover from products/services new to the market	1.018 (1.45)	1.03*** (2.67)
Share of turnover from products/services new to the firm	0.995 (− 0.41)	0.987 (− 1.11)
Open-mindedness	0.732 (− 1.26)	0.769 (− 0.81)
Formalization		0.425*** (− 2.97)
Specialization		2.049* (1.69)
Centralization		2.503*** (2.76)
Pseudo R^2	0.0443	0.1239
Number of observations	156	156

Pharma, biotech, and healthcare industries is reference. *Z* statistics are displayed in parenthesis

*$p < 0.1$

**$p < 0.05$

***$p < 0.01$

specialization for the search and use of external knowledge indicates that specialists are readier to search and integrate external knowledge into their knowledge base. Specialization leads to routinization of processes, reducing hesitation. The development of a common understanding of knowledge within subunits and the mutual understanding on a body of knowledge facilitate its application. Lane and Lubatkin (1998) suggest that prior related knowledge is conducive to absorbing knowledge from external sources, and, indeed, specialized firms are associated with a better absorptive capacity (Cohen and Levinthal 1990). This means that they have the ability to assimilate acquired knowledge and to exploit the knowledge in later stages of the innovation process (Damanpour 1991; Spithoven et al. 2010). Our results confirm that the depth of the knowledge base contributes to create an environment that stimulates creativity and boosts willingness to look for specialized knowledge (Pertusa-Ortega et al. 2010). Furthermore, these results seem to suggest that emerging countries' SMEs are following an inter-firm R&D ecosystem approach (Rohrbeck et al. 2009) since firms that have an in-depth external knowledge acquisition and high specialization levels are frequently connected with firms alike and thus building an ecosystem approach (Saebi and Foss 2015). Our results also report that specialization is associated with outbound OI. This result may indicate that specialized expertise may facilitate outbound OI particularly when it comes to cooperation with external partners of the same professional domain. In cooperation with complementary market partners, too much specialization may hinder cooperation due to communication problems. Another potential explanation might lay in the fact that out-licensing, once the deal has been signed, involves a lesser degree of interaction and involvement between the parties than in the case of a spin-off or joint-venture agreement (Chesbrough 2006), and, thus, the level of specialized expertise may not be so relevant. These results empirically confirm previous literature (Chesbrough et al. 2014; West et al. 2006) which explains that firms that have more specialization are better prepared to find potential buyers and sell knowledge. Furthermore, and contrary to traditional literature that does not see outbound knowledge transfer as an ad hoc strategy, our results also confirm that SMEs are following, in a systematic way, an external exploitation strategy as theoretically suggested by Huizingh (2011) and Kutvonen (2011). This has important implications for the business model literature since outbound OI can be seen as an end in itself and not only as a means to internal development, as Teece (2010, p. 185) suggests, but, for that to happen, firms need to have a high level of specialization.

Our results also show that *formalization* is significant and positively associated with the search for external knowledge inbound OI. Past literature has theoretically established that formalization entails that only a limited

number of members of a specific organization will have access to external partners (Jansen et al. 2005), thus reducing the opportunities to search for external knowledge. As a consequence of high formalization, many firms may risk ignoring important innovation stimuli (Jansen et al. 2006). However, our data seem to suggest that, in line with evolutionary theory, routinization of decision-making generated by formalization makes the communication among members of a firm smoother, avoids disruptions, and facilitates the interpretations of incoming messages (Nelson and Winter 1982, p. 104). Hence, by means of formalization, firms may determine accurately what kind of knowledge they need to access externally and what procedures they get it through (Giannopoulou et al. 2011). Indeed, some authors have argued that without formalization external searches would suffer from being "disorganized, sporadic and ineffective" (Okhuysen and Eisenhardt 2002, p. 383). Formalization reduces ambiguity, providing "behavioral directives" (Pertusa-Ortega et al. 2010, p. 312), with positive effects for utilizing external knowledge.

While *formalization* is positively associated with inbound OI, it is negatively associated with outbound OI. Thus, when a company needs to identify opportunities for out-licensing a firm's own technology, then a high degree of formalization represents an obstacle. This seems to indicate that SMEs behave differently from large firms, which rely quite heavily on formalization as a coordination mechanism (Palmié et al. 2016; Terziovski 2010). Formalization risks seem to constrain the flexibility that has been indicated by many scholars as a key success factor of SMEs compared to large firms (e.g., Berends et al. 2013). In outbound processes, it is important for a firm to capture value from external exploitation of internal knowledge. This implies having mechanisms to understand the technology markets and identify the best options to channel out internal knowledge. The selection of partners is a relevant element of this process. A low level of formalization and a higher degree of flexibility may allow firms to search beyond known markets to find appropriate target markets and the best partners. These results entail important theoretical implications, since our knowledge on how formalization shapes the OI paradigm is very limited (Bogers et al. 2017).

The final result of our work refers to *centralization*, finding a positive and significant role of centralization for both types of OI orientations—outbound and inbound. This represents a relevant difference from results from the innovative literature in general and the OI literature in particular, according to which a higher degree of decentralization can increase the effectiveness of OI practices. This is also a different result from what was hypothesized, as we expected centralization to play a significant and positive role for outbound OI but not for inbound OI. We stated that the excessive centralization may limit knowledge-sharing and hinder the search for external knowledge. Research has indicated that decentralization allows employees to act as gatekeepers (Foss et al. 2011) since they continuously interact with external agents or have the specific knowledge to identify the knowledge needed. Our contrasting results may depend from the fact that in SMEs the decision-making process is centralized to the manager with the effect that the manager can be either the main catalyst for change or the main stumbling block for change (Dufour and Son 2015). This may mean that in organizations where people are able to think "*outside the box*," as indicated by the positive and significant relationship of our variables, open-mindedness and inbound OI, the CEO or the top management team has an important role to play in terms of creating an innovation-friendly environment that can foster the search for new knowledge outside the firm. Indeed, the adoption of an OI model can be seen as a deviation from the current innovation routine (Ahn et al. 2017) and can generate resistance and indifference from internal members of a firm. As new knowledge, processes, and structures are adopted through OI, the role of CEO or the top management is critical to eliminate prejudice and support and facilitate OI adoption (Ceci and Iubatti 2012). Research on large firms has shown that support from top management encourages OI adoption and helps to cope with resistance (Huston and Sakkab 2006; Chiaroni et al. 2011). In SMEs, where decision-making is typically centralized in the CEO, the CEO's positive attitude toward OI is critical to eliminate resistance against change. Indeed, research has shown that attitude can influence beliefs, and these can ultimately have an effect on persons' behavior (Fishbein and Ajzen 1975). Hence, the positive attitude of the CEO toward OI can contribute to creating an OI-friendly environment. This result is in line with the recent study of Ahn et al. (2017) which, using data on Korean SMEs, shows that a CEO's positive attitude, entrepreneurial orientation, patience, and education can play important roles in facilitating openness in SMEs. The fact that our companies are SMEs, and not large companies dispersed across markets or regions, might

explain the difference in the results when compared with the results from knowledge-based theory that have emerged from observing large firms (Felin and Hesterly 2007). From a theoretical perspective, our results align with organizational economics research (e.g., Argyres and Silverman 2004; Singh 2008) which argues that centralization represents a decrease in internal transaction costs, namely by economies of communication and coordination costs in R&D. This cost-reduction aspect may even be more important when we consider our sample of firms that show a high degree of ambidexterity (Tushman and O'Reilly III 1996), being active in knowledge exploration and exploitation through both inbound and outbound OI. Senior managers in SMEs participate more directly in the day-to-day implementation of the firm's strategy, as operating managers do in larger firms, and, thus, they are usually closer to the firm's existing competencies and are knowledgeable about when and how to exploit them (Lubatkin et al. 2006). Moreover, they are closer to the market and are able to potentially discover, evaluate, and champion new market opportunities; that is, exploration activities. This level of centralization is more difficult in large firms that have more complex organization systems and where the influence of the CEO or senior management team may be affected by external governance pressures from an independent board of directors and shareholders.

The positive relationship of centralization and outbound OI confirms our expectation. This may mean that when firms are out-licensing knowledge, there is a need of individuals that have the authority and responsibility to complete transactions that often go beyond norms because of the imperfections of markets for technology (Guilhon et al. 2004). Thus, a centralized decision authority may facilitate the implementation of agreements with external partners.

From a theoretical perspective, our study contributes to the ongoing debate on OI, showing a linkage between organizational structure and the adoption of OI practices, in SMEs, a topic that has still not captured the attention of scholars. Moreover, by focusing on both inbound and outbound OI practices, we complement the focus of prior research that has paid more attention to inbound OI. Using the perspective of the evolutionary theory and based upon the analogy between open innovation and routine change, we suggest that specific organizational structures may allow firms to access external knowledge and exploit internally developed knowledge, facilitating the adoption of OI practices. By looking at formalization, specialization, and centralization, our study acknowledges that there are favorable levels of single structural variables that create an adequate environment for both inbound and outbound OI. Results indicate that formalization and specialization allow for a certain routinization of activities, reducing hesitation and uncertainty generated by shifting routines (Nelson and Winter 1982). Moreover, our results on the effect of decision-making structure (centralization) on inbound and outbound OI provide an important reflection on the unique context of SMEs in terms of the tight connection between the CEO and the adoption of an OI model. As an OI model is a change of routine, it requires a powerful promoter to push forward changes (Smith 2007). Adding to previous literature on OI and SMEs (Ahn et al. 2017; Ahn et al. 2018), our study confirms that the micro-foundation of OI, in which key individual choices and behavior shape firm-level strategy, does not need to be underestimated. Finally, our results add to the business model literature by explaining how selling innovation can be an end in itself, meaning that firms can have a value creation and value capture proposition just based on selling innovation, which is yet to be captured by the business model and innovation literature. This means that in an innovation ecosystem, where some should expect to have high levels of OI practices (Adner and Kapoor 2009), we might find firms where their business model focusses on innovation that will be sold to the other partners of such ecosystem. Our results, thus, clarify how organizational structure functions within innovation ecosystems, namely through specialization.

Apart from the theoretical contributions, our results have significant managerial implications. Managers of SMEs need to recognize that they need to build an organization that favors access to external knowledge and the exploitation of internally developed knowledge. By increasing the level of formalization, they are better prepared to gain external knowledge but, at the same time, they need to be aware that a higher degree of flexibility may allow them to search beyond known markets to find appropriate target markets and the best partners for their internally developed knowledge. Furthermore, managers need to create a work context where everyone can make use of their specialization and benefit from that of their colleagues (Pertusa-Ortega et al. 2010) because specialization has proven to be critical for both inbound and outbound OI strategies. Finally, CEOs

and top managers at SMEs need to know that they play a central role in influencing the routine change that the adoption of inbound and outbound OI practices generate, contributing to reduce the uncertainty and to cope with the associated risks.

For policymakers, this paper has two important implications. First, it points to the importance of CEOs and top management teams in facilitating both inbound and outbound OI, indicating that there are potentially important areas for training and management development for this specific group. Many SME owners/managers will benefit from training on OI and the required organizational structure to support their vision and grand strategies. Therefore, governments at different levels can sponsor training programs in strategic management. Second, governments can also consider networking programs among SME owners/managers. Our results suggest that SME managers rely heavily on their external networks for decision identification; thus, it is also important to help them build relationships with other firms, universities, relevant government departments, and other external sources.

Our results are also important to economic growth and societal advances. Past literature from developed economies (Castells and Cardoso 2006) has emphasized the importance of networking on advancing economic growth. However, the business system literature emphasizes the difficulties that firms in emerging economies face to engage in inter-firm activities (e.g., Redding and Witt 2009; Torres de Oliveira and Figueira 2018a,b). Interestingly, our results seem to suggest that emerging economies' SMEs are indeed finding ways to follow inter-firm R&D contacts, similar to an ecosystem approach. Our results further expose how this is particularly important for SMEs in emerging economies and how this can foster OI activities that are linked to product and process innovation (Kapetaniou and Lee 2018). By having high innovation capabilities, firms can better respond to market changes and are expected to higher returns (Wang and Ahmed 2007), which are frequently aligned with societal development (Alvord et al. 2004).

6.1 Limitations and future research

This paper is not free from research limitations. Firstly, the data are cross-sectional and not longitudinal; hence, we are only able to establish associations between variables. Future research should carry out longitudinal studies and consider other organizational factors and aspects of organizational culture that could establish causal relationships, revealing the importance of other internal factors in the adoption of OI practices. Moreover, in considering outbound modes of OI, we only focus on out-licensing agreements. Future research should focus on other forms of transferring technology to external organizations for commercial exploitation that may include new-venture spin-off sale of innovation projects, joint ventures, or others. As different out-licensing strategies may require a different degree of involvement between the parties and a different degree of control, the dimension of organizational structures that we observed may show a divergent influence. Finally, we restricted our analysis to China; other studies could test the generalizability of our results by investigating different settings since cultural aspects might have a causal effect on organizational structuring. This is particularly important due to the uniqueness of the Chinese business system (Torres de Oliveira and Figueira 2018a,b).

Another stream of future research can build on our findings of outbound OI as an end-of-business objective and how business models need to adapt to such a reality. In digital companies, for example, this might become much more the norm than the outliers that we are used to see in physical companies. This is connected with the fact that many digital business strategies work in complex, dynamic ecosystems (Bharadwaj et al. 2013) that seem to require specific organizational structures, of which our knowledge remains limited.

Acknowledgments We thank Professor Per Davidsson for his friendly and constructive peer review of an earlier version of this essay.

References

Adler, P. S., & Borys, B. (1996). Two types of bureaucracy: enabling vs. coercive. *Administrative Science Quarterly, 41*(1), 61–89.

Adner, R., & Kapoor, R. (2009). Value creation in innovation ecosystems: how the structure of technological interdependence affects firm performance in new technology generations. *Strategic Management Journal, 31*(3), 306–333. https://doi.org/10.1002/smj.821.

Ahn, J. M., Minshall, T., & Mortara, L. (2015). Open innovation: a new classification and its impact on firm performance in innovative SMEs. *Journal of Innovation Management, 3*(2), 33–54. https://doi.org/10.1111/radm.12264.

Ahn, J. M., Ju, Y., Moon, T. H., Minshall, T., Probert, D., Sohn, S. Y., & Mortara, L. (2016). Beyond absorptive capacity in open innovation process: the relationships between openness, capacities and firm performance. *Technology Analysis & Strategic Management, 28*(9), 1009–1028. https://doi.org/10.1080/09537325.2016.1181737.

Ahn, J. M., Minshall, T., & Mortara, L. (2017). Understanding the human side of openness: the fit between open innovation modes and CEO characteristics. *R&D Management*. https://doi.org/10.1080/09537325.2016.1181737.

Ahn, J.M., Minshall, T. & Mortara, L. (2018) How do entrepreneurial leaders promote innovation adoption in small firms? In In Vahnaverbeke, W., Frattini, F., Roijakkers, N. and Usman, M. (eds.) Researching Open Innovation in SMEs (3-35). London: World Science. https://doi.org/10.1142/10733

Alvarez, S. A., & Barney, J. (2001). How entrepreneurial firms can benefit from alliance with large partner. *Academy of Management Executive, 15*(1), 139–148. https://doi.org/10.5465/ame.2001.4251563.

Alvord, S. H., Brown, L. D., & Letts, C. W. (2004). Social entrepreneurship and societal transformation: an exploratory study. *The Journal of Applied Behavioral Science, 40*(3), 260–282. https://doi.org/10.1177/0021886304266847.

Antons, D., & Piller, F. (2015). Opening the black box of "not invested here": attitudes, decision biases, and behavioral consequences. *Academy of Management Perspectives, 29*(2), 193–217. https://doi.org/10.5465/amp.2013.0091.

Argyres, N. S., & Silverman, B. S. (2004). R&D, organization structure, and the development of corporate technological knowledge. *Strategic Management Journal, 25*(8–9), 929–958. https://doi.org/10.1002/smj.387.

Arora, A., Fosfuri, A., & Gambardella, A. (2001). *Markets for technology: the economics of innovation and corporate strategy*. Cambridge, MA: MIT Press.

Beers, C., & Zand, F. (2014). R&D cooperation, partner diversity, and innovation performance: an empirical analysis. *Journal of Product Innovation Management, 31*(2), 292–312. https://doi.org/10.1111/jpim.12096.

Berends, H., Jelinek, M., Reymen, M., & Stultiens, R. (2013). Product innovation processes in small firms: combining entrepreneurial effectuation and managerial causation. *Journal of Product Innovation Management, 31*(3), 1–20. https://doi.org/10.1111/jpim.12117.

Bessant, J., & Tidd, J. (2007). *Innovation and entrepreneurship*. Chichester: John Wiley.

Bharadwaj, A., El Sawy, O., Pavlou, P., & Venkatraman, N. (2013). Digital business strategy: toward a next generation of insights. *MIS Quarterly, 37*(2), 471–482.

Bianchi, M., Campodall'Orto, S., Frattini, F., & Vercesi, P. (2010). Enabling open innovation in small-and medium-sized enterprises: how to find alternative applications for your technologies. *R&D Management, 40*(4), 414–431. https://doi.org/10.1111/j.1467-9310.2010.00613.x.

Bianchi, M., Cavaliere, A., Chiaroni, D., Chiesa, V., & Frattini, F. (2011). Organizational modes for open innovation in the biopharmaceutical industry: an exploratory analysis. *Technovation, 31*(1), 22–33. https://doi.org/10.1016/j.technovation.2010.03.002.

Bogers, M., Zobel, A.-K., Afuah, A., Almirall, E., Brunswicker, S., Dahlander, L., et al. (2017). The open innovation research landscape: established perspectives and emerging themes across different levels of analysis. *Industry and Innovation, 24*(1), 8–40. https://doi.org/10.1080/13662716.2016.1240068.

Brockhoff, K. (1992). R&D cooperation between firms—a perceived transaction cost perspective. *Management Science, 38*, 514–524.

Brunswicker, S., & Vahnaverbeke, W. (2015). Open innovation in small and medium-sized enterprises (SMEs): external knowledge sourcing and internal organizational facilitators. *Journal of Small Business and Management, 53*(4), 1241–1263. https://doi.org/10.1111/jsbm.12120.

Burton, R. M., Lauridsen, J., & Obel, B. (2002). Return on assets loss from situational and contingency misfit. *Management Science, 48*(11), 1461–1485.

Calantone, R. J., Harmancioglu, N., & Droge, C. (2010). Inconclusive innovation "returns": a meta-analysis of research on innovation in new product development. *Journal of Product Innovation Management, 27*(7), 1065–1081. https://doi.org/10.1111/j.1540-5885.2010.00771.x.

Caruana, A., Morris, M., & Vella, A. (1998). The effect of centralization and formalization on entrepreneurship in export firms. *Journal of Small Business Management, 36*(1), 16–29.

Castells, M., & Cardoso, G. (2006). *The network society: from knowledge to policy*. Washington, DC: Johns Hopkins Center for Transatlantic Relations.

Ceci, F., & Iubatti, D. (2012). Personal relationships and innovation diffusion in SMEs networks: a content analysis approach. *Research Policy, 41*, 565–579. https://doi.org/10.1016/j.respol.2011.10.003.

Chen, J. (2006). Development of Chinese small and medium-sized enterprises. *Journal of Small Business and Enterprise Development, 13*(2), 140–147.

Chen, J., Zhu, Z., & Zhang, Y. (2017). A study of factors influencing disruptive innovation in Chinese SMEs. *Asian Journal of Technology Innovation, 25*(1), 140–157. https://doi.org/10.1080/19761597.2017.1302552.

Chesbrough, H. W. (2006). *Open innovation: the new imperative for creating and profiting from technology*. Harvard Business Press.

Chesbrough, H. W. (2007). Why companies should have open business models. *MIT Sloan Management Review, 48*(2), 22–28.

Chesbrough, H. W., Vahnaverbeke, W., & West, J. (2006). *Open innovation: researching a new paradigm*. Oxford: Oxford University Press.

Chesbrough, H., Vanhaverbeke, W., & West, J. (2014). *New frontiers in open innovation*. Oxford: OUP.

Chiaroni, D., Chiesa, V., & Frattini, F. (2010). Unravelling the process from closed to open innovation: evidence from mature, asset-intensive industries. *R&D Management, 40*(3), 222–245. https://doi.org/10.1111/j.1467-9310.2010.00589.x.

Chiaroni, D., Chiesa, V., & Frattini, F. (2011). The Open Innovation Journey: How firms dynamically implement the emerging innovation management paradigm. Technovation, 31(1), 34-43.

China Statistics Press. (2016). *China statistical yearbook 2016*. Beijing: China Statistics Press.

Chinese National Bureau of Statistics. (2018). *Statistical criteria for the classification of large, medium and small-micro*

enterprises. Beijing, China: Chinese National Bureau of Statistics.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: a new perspective on learning and innovation. *Administrative Science Quarterly*, 128–152.

Colombo, M. G., & Delmastro, M. (2008). *The economics of organizational design*. New York: Pagrave MacMillan.

Dahl, M., & Pedersen, C. (2004). Knowledge flows through informal contacts in industrial clusters: myth or reality? *Research Policy, 33*(10), 1673–1686. https://doi.org/10.1016/j.respol.2004.10.004.

Dahlander, L., & Gann, D. M. (2010). How open is innovation? *Research Policy, 39*(6), 699–709. https://doi.org/10.1016/j.respol.2010.01.013.

Damanpour, F. (1991). Organizational innovation: a meta-analysis of effects of determinants and moderators. *Academy of Management Journal, 343*(3), 555–590. https://doi.org/10.2307/256406.

Dameron, S., & Torset, C. (2014). The discursive construction of strategists' subjectivities: towards a paradox lens on strategy. *Journal of Management Studies, 51*(2), 291–319. https://doi.org/10.1111/joms.12072.

Dosi, G., & Marengo, L. (2007). Perspectives on the evolutionary theory and behavioural theories of organizations. A tentative roadmap. *Organization Science, 18*(3), 491–502. https://doi.org/10.1287/orsc.1070.0279.

Dufour, J., & Son, P.-E. (2015). Open innovation in SMEs—towards formalization of openness. *Journal of Innovation Management, 3*(3), 90–117.

Easterby-Smith, M., & Malina, D. (1999). Cross cultural collaborative research: towards reflexivity. *Academy of Management Journal, 42*(1), 76–86. https://doi.org/10.5465/256875.

Elmquist, M., Fredberg, T., & Ollila, S. (2009). Exploring the field of open innovation. *European Journal of Innovation Management, 12*(3), 326–345. https://doi.org/10.1108/14601060910974219.

EU, European Union Commision. (2016). *User guide to the SME definition*. Luxembourg: Publications Office of the European Union.

Felin, T., & Hesterly, W. S. (2007). The knowledge-based view, nested heterogeneity, and new value creation: philosophical considerations on the locus of knowledge. *Academy of Management Review, 32*(1), 195–218. https://doi.org/10.5465/amr.2007.23464020.

Fey, C., & Birkinshaw, J. (2005). External sources of knowledge, governance mode and R&D performance. *Journal of Management, 31*(4), 597–621. https://doi.org/10.1177/0149206304272346.

Fiengenbaum, A., & Karnani, A. (1991). Output flexibility: a competitive advantage for small firms. *Strategic Management Journal, 12*, 101–114.

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior. An introduction to theory and research*. Reading, MA: Addison-Wesley.

Foss, N. J., Laursen, K., & Pedersen, T. (2011). Linking customer interaction and innovation: the mediating role of new organizational practices. *Organization Science, 22*(4), 980–999. https://doi.org/10.1287/orsc.1100.0584.

Foss, N. J., Lyngsie, J., & Zahra, S. A. (2013). The role of external knowledge sources and organizational design in the process of opportunity exploitation. *Strategic Management Journal, 34*(12), 1453–1471. https://doi.org/10.1002/smj.2135.

Friedrickson, J. W. (1986). The strategic decision process and organizational structure. *Academy of Management Review, 11*(2), 280–297. https://doi.org/10.2307/258460.

Fu, X., & Xiong, H. (2011). Open innovation in China: policies and practices. *Journal of Science and Technology Policy, 2*(3), 196–218.

Galbraith, J. R., & Nathanson, D. A. (1978). *Strategy implementation: the role of structure and process*. St. Paul, MN: West.

Gambardella, A., Giuri, P., & Luzzi, A. (2007). The market for patents in Europe. *Research Policy, 36*, 1163–1183. https://doi.org/10.1016/j.respol.2007.07.006.

Gassmann, O., Enkel, E., & Chesbrough, H. W. (2010). The future of open innovation. *R&D Management, 40*(3), 213–221. https://doi.org/10.1111/j.1467-9310.2010.00605.x.

Gesing, J., Antons, D., Piening, E. P., Rese, M., & Salge, T. O. (2015). Joining forces or going it alone? On the interplay among external collaboration partner types, interfirm governance modes, and internal R&D. *Journal of Product Innovation Management, 32*(3), 424–440.

Giannopoulou, E., Yström, A., & Ollila, S. (2011). Turning open innovation into practice: open innovation research through the lens of managers. *International Journal of Innovation Management, 15*(03), 505–524. https://doi.org/10.1142/S1363919611003465.

Gibson, C., & Birkinshaw, J. (2004). The antecedents, consequences, and mediating role of the organizational ambidexterity. *Academy of Management Journal, 47*(2), 209–226.

Grant, R. M. (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal, 17*(S2), 109–122.

Guilhon, B., Attia, R., & Rizoulieres, R. (2004). Markets for technology and firms' strategies: the case of the semiconductor industry. *International Journal of Technology Management, 27*(2–3), 123–142. https://doi.org/10.1504/IJTM.2004.003948.

Gulati, R., Puranam, P., & Tushman, M. (2009). Strategy and the design of organizational architecture. *Strategic Management Journal, 30*(5), 575–576.

Hobday, M., & Colpan, A. M. (2010). Technological innovation and business groups. In A. M. Colpan, T. Hikino, & J. R. Lincoln (Eds.), *Oxford handbook of business groups. Oxford handbooks in business and management*. Oxford: Oxford University Press.

Huang, F., & Rice, J. (2009). The role of absorptive capacity in facilitating "open innovation" outcomes: a study of Australian SMEs in the manufacturing sector. *International Journal of Innovation Management, 13*(2), 201–220. https://doi.org/10.1142/S1363919609002261.

Huang, F., Rice, J., & Martin, N. (2015). Does open innovation apply to China? Exploring the contingent role of external knowledge sources and internal absorptive capacity in Chinese large firms and SMEs. *Journal of Management & Organization, 21*(5), 594–613. https://doi.org/10.1017/jimo.2014.79.

Huergo, E., & Jaumandreu, J. (2004). How does probability of innovation change with firm age? *Small Business Economics, 22*(3–4), 193–207. https://doi.org/10.1023/B:SBEJ.0000022220.07366.b5.

Huizingh, E. K. R. E. (2011). Open innovation: state of the art and future perspectives. *Technovation, 31*(1), 2–9. https://doi.org/10.1016/j.technovation.2010.10.002.

Huston, L., & Sakkab, L. (2006). Connect and develop: inside Procter & Gamble's new model for innovation. *Harvard Business Review, 84*, 58–66.

Ihl, C., Piller, F. T., & Wagner, P. (2012). Organizing for open innovation: aligning internal structure with external knowledge search Available at SSRN: https://ssrn.com/abstract=2164766. Accessed june 2018

Inauen, M., & Schenker-Wiki, A. (2012). Fostering radical innovation with open innovation. *European Journal of Innovation Management, 15*(2), 212–231.

Jansen, J. J. P., Van den Bosch, F. A. J., & Volberda, H. W. (2005). Managing potential and realized absorptive capacity: how do organizational antecedents matter? *Academy of Management Journal, 48*(6), 999–1015.

Jansen, J. J. P., Den Bosch, V., Frans, A. J., & Volberda, H. W. (2006). Exploratory innovation, exploitative innovation, and performance: effects of organizational antecedents and environmental moderators. *Management Science, 52*(11), 1661–1674.

Kapetaniou, C., & Lee, S. H. (2018). Geographical proximity and open innovation of SMEs in Cyprus. *Small Business Economics*. https://doi.org/10.1007/s11187-018-0023-7.

Katz, R., & Allen, T. (1982). Investigating the Not Invented Here (NIH) syndrome: a look at the performance, tenure, and communication patterns of 50 R&D Project Groups. *R&D Management*. https://doi.org/10.1111/j.1467-9310.1982.tb00478.x.

Kogut, B., & Zander, U. (1993). Knowledge of the firm and the evolutionary theory of the multinational corporation. *Journal of International Business Studies, 24*(4), 625–645. https://doi.org/10.1057/palgrave.jibs.8490248.

Kutvonen, A. (2011). Strategic application of outbound open innovation. *European Journal of Innovation Management, 14*(4), 460–474. https://doi.org/10.1108/14601061111174916.

Lane, P. J., & Lubatkin, M. (1998). Relative absorptive capacity and interorganizational learning. *Strategic Management Journal, 19*, 461–477.

Laursen, K., & Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. *Strategic Management Journal, 27*(2), 131–150. https://doi.org/10.1002/smj.507.

Lee, S., Park, G., Yoon, B., & Park, J. (2010). Open innovation in SMEs: an intermediary network model. *Research Policy, 39*(2), 290–300. https://doi.org/10.1016/j.respol.2009.12.009.

Lewin, A. Y., Välikangas, L., & Chen, J. (2017). Enabling open innovation: lessons from Haier. *International Journal of Innovation Studies, 1*(1), 5–19. https://doi.org/10.3724/SP.J.1440.101002.

Lubatkin, M., Pimpek, Z., Ling, Y., & Veiga, J. F. (2006). Ambidexterity and performance in small- to medium-sized firms: the pivotal role of top management team behavioral integration. *Journal of Management, 32*, 646–672.

Luo, L., Yang, Y., Luo, Y., & Liu, C. (2016). Export, subsidy and innovation: China's state-owned enterprises versus privately-owned enterprises. *Economic and Political Studies, 4*(2), 137–155. https://doi.org/10.1080/20954816.2016.1180766.

Meijaard, J., Brand, M. J., & Mosselman, M. (2005). Organizational structure and performance in Dutch small firms. *Small Business Economics, 25*(1), 83–96. https://doi.org/10.1007/s11187-005-4259-7.

Mina, A., Bascavusoglu-Moreau, E., & Hughes, A. (2014). Open service innovation and the firm's search for external knowledge. *Research Policy, 43*(5), 853–866. https://doi.org/10.1016/j.respol.2013.07.004.

Mintzberg, H. (1979). *The structuring of organizations: a synthesis of the research*. Englewood Cliffs, New York: Prentice Hall.

Mintzberg, H., Lampel, J., Quinn, J., & Ghoshal, S. (2003). *The strategy process: concepts, contexts and cases* (4th ed.). Upper Saddle River, New Jersey: Prentice-Hall.

Myers, R. (1990). *Classical and modern regression with applications* (2nd ed.). Boston, MA: Duxbury.

Nahapiet, Janine, & Ghoshal, Sumantra. (2000). Social capital, intellectual capital, and the organizational advantage Knowledge and Social Capital (pp. 119–157): Elsevier.

NBS China (2018). National data. Retrieved June 2018, 2018, from http://data.stats.gov.cn/english/. Accessed june 2018

Nelson, R., & Winter, S. (1982). *An evolutionary theory of economic change*. Cambridge, Mass.: Harbard University Press.

Okhuysen, G. A., & Eisenhardt, K. M. (2002). Integrating knowledge in groups: how formal interventions enable flexibility. *Organization Science, 13*(4), 370–386. https://doi.org/10.1287/orsc.13.4.370.2947.

Olson, E., Slater, S. F., & Hult, G. T. M. (2005). The performance implications of fit among business strategy, marketing, organization structure and strategic behaviour. *Journal of Marketing, 69*(3), 49–65. https://doi.org/10.1509/jmkg.69.3.49.66362.

Oltra, M. J., Flor, M. L., & Alfaro, J. A. (2018). Open innovation and firm performance: the role of organizational mechanisms. *Business Process Management Journal, 24*(3), 814–836. https://doi.org/10.1108/BPMJ-05-2016-0098.

Palmié, M., Zeschky, M., Winterhalter, S., Sauter, P. W., Haefner, N., & Gassmann, O. (2016). Coordination mechanisms for international innovation in SMEs: effects on time-to-market and R&D task complexity as a moderator. *Small Business Economics, 46*(2), 273–294. https://doi.org/10.1007/s11187-015-9683-8.

Parida, V., Westerberg, M., & Frishammar, J. (2012). Inbound open innovation activities in high tech SMEs: the impact on innovation performance. *Journal of Small Business and Management, 50*(2), 283–309. https://doi.org/10.1111/j.1540-627X.2012.00354.x.

Pertusa-Ortega, E. M., Zaragoza-Sáez, P., & Claver-Cortés, E. (2010). Can formalization, complexity and centralization influence knowledge performance? *Journal of Business Research, 63*(3), 310–320. https://doi.org/10.1016/j.jbusres.2009.03.015.

Podsakoff, P. M., & Organ, M. (1986). Self reports in organizational research. *Journal of Management, 12*(4), 531–544. https://doi.org/10.1177/014920638601200408.

Podsakoff, P. M., MacKenzie, S. B., & Lee, J.-Y. (2003). Common method bias in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology, 88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879.

Prajogo, D., & McDermott, C. M. (2014). Antecedents of service innovation in SMEs: comparing the effects of external and internal factors. *Journal of Small Business Management, 52*(3), 521–540. https://doi.org/10.1111/jsbm.12047.

Prakash, Y., & Gupta, M. (2008). Exploring the relationship between organisation structure and perceived innovation in the manufacturing sector of India. *Singapore Management Review, 30*(1), 55–76.

Pugh, D. S., Hickson, D. J., Hinings, C. R., & Turner, C. (1968). Dimensions of organization structure. *Administrative Science Quarterly, 13*(1), 65–105.

Qian, G., & Li, L. (2003). Profitability of small-and medium sized enterprises in high-tech industries: the case of the biotechnology industry. *Strategic Management Journal, 24*(9), 881–887. https://doi.org/10.1002/smj.344.

Redding, G., & Witt, M. A. (2009). China's business system and its future trajectory. *Asia Pacific Journal of Management, 26*(3), 381–399.

Rigby, D., & Zook, C. (2002). Open market innovation. *Harvard Business Review, 80*(10), 80–89.

Rivkin, J. W., & Siggelkow, N. (2003). Balancing search and stability: interdependencies among elements of organizational design. *Management Science, 49*(3), 290–311. https://doi.org/10.1287/mnsc.49.3.290.12740.

Robbins, S. P. (1990). *Organization theory: structure, design, and applications*. New Jersey: Prentice Hall.

Rohrbeck, R., Hölzle, K., & Gemünden, H. G. (2009). Opening up for competitive advantage—how Deutsche Telekom creates an open innovation ecosystem. *R&D Management, 39*(4), 420–430.

Saebi, T., & Foss, N. J. (2015). Business models for open innovation: matching heterogeneous open innovation strategies with business model dimensions. *European Management Journal, 33*(3), 201–213.

Sahay, Y. P., & Gupta, M. (2011). Role of organization structure in innovation in the bulk-drug industry. *Indian Journal of Industrial Relations, 46*(3), 450–464.

Sheremata, W. A. (2000). Centrifugal and centripetal forces in radical new product development under time pressure. *Academy of Management Review, 25*(2), 389–408. https://doi.org/10.5465/amr.2000.3312925.

Sieg, J. H., Wallin, M. W., & von Krogh, G. (2010). Managerial challenges in open innovation: a study of innovation intermediation in the chemical industry. *R&D Management, 40*, 281–291. https://doi.org/10.1111/j.1467-9310.2010.00596.x.

Singh, J. (2008). Distributed R&D, cross-regional knowledge integration and quality of innovative output. *Research Policy, 37*(1), 77–96.

Smith, D.J. (2007) The politics of innovation. Why innovations need a godfather. Technovation, 27 (3):95-104. https://doi.org/10.1016/j.technovation.2006.05.001

Souitaris, V. (2001). Strategic influences of technological innovation in Greece. *British Journal of Management, 12*(2), 131–147.

Spanos, Y., Prastacos, G., & Papadakis, V. (2001). Greek firms and EMU: contrasting SMEs and large-sized enterprises. *European Management Journal, 19*(6), 638–648. https://doi.org/10.1016/S0263-2373(01)00089-5.

Spithoven, A., Clarysse, B., & Knockaert, M. (2010). Building absorptive capacity to organise inbound open innovation in traditional industries. *Technovation, 30*(2), 130–141. https://doi.org/10.1016/j.technovation.2009.08.004.

Spithoven, A., Vahnaverbeke, W., & Roijakkers, N. (2013). Open innovation practices in SMEs and large enterprises. *Small Business Economics, 41*(3), 537–562.

Subramanian, A., & Nilakanta, S. (1996). Organizational innovativeness: exploring the relationship between organizational determinants of innovation, types of innovations, and measures or organizational performance. *Omega, 24*(6), 631–647.

Tan, J. (2001). Innovation and risk-taking in a transitional economy: a comparative study of Chinese managers and entrepreneurs. *Journal of Business Venturing, 16*(4), 359–376. https://doi.org/10.1016/S0883-9026(99)00056-7.

Teece, D. J. (2000). *Managing intellectual capital: organizational, strategic, and policy dimensions*. Oxford, New York: Oxford University Press.

Teece, D. J. (2010). Business models, business strategy and innovation. *Long Range Planning, 43*(2), 172–194. https://doi.org/10.1016/j.lrp.2009.07.003.

Terziovski, M. (2010). Innovation practice and its performance implications in small and medium enterprises (SMEs) in the manufacturing sector: a resource-based view. *Strategic Management Journal, 31*(8), 892–902. https://doi.org/10.1002/smj.841.

Torkelli, M. T., Koch, C. J., & Salmi, P. A. S. (2009). The "open innovation" paradigm: a contingency perspective. *Journal of Industrial Engineering and Management, 2*(1), 176–207. https://doi.org/10.3926/jiem.2009.v2n1.p176-207.

Torres de Oliveira, R., & Figueira, S. (2018a). The specificities of interviewing in China. *Qualitative Market Research: An International Journal, 21*(1), 118–134.

Torres de Oliveira, R., & Figueira, S. (2018b). How China's business system works. In M. Books (Ed.), *The savvy investors guide to doing business in China*. Phoenix, USA.

Torres de Oliveira, R., & Rottig, D. (2018). Chinese acquisitions of developed market firms: home semi-formal institutions and a supportive partnering approach. *Journal of Business Research, 93*, 230–241. https://doi.org/10.1016/j.jbusres.2018.04.031.

Tsai, K.-H., & Wang, J.-C. (2008). External technology acquisition and firm performance: a longitudinal study. *Journal of Business Venturing, 23*, 91–112. https://doi.org/10.1016/j.jbusvent.2005.07.002.

Tushman, M. L., & O'Reilly, C. A., III. (1996). Ambidextrous organizations: managing evolutionary and revolutionary change. *California Management Review, 38*(4), 8–29. https://doi.org/10.2307/41165852.

United States International Trade Commission. (2010). United States International Trade Commission.

Usman, M., Roijakkers, N., Vanhaverbeke, W., & Frattini, F. A systematic review of the literature on open innovation in SMEs. In *Researching open innovation in SMEs* (pp. 3–35). London: World Science. https://doi.org/10.1142/10733.

Van de Ven, A. H. (1986). Central problems in the management of innovation. *Management Science, 32*(5), 591–607. https://doi.org/10.1287/mnsc.32.5.590.

van de Vrande, V., De Jong, J. P., Vahnaverbeke, W., & De Rochemont, M. (2009). Open innovation in SMEs: trends, motives and management challenges. *Technovation, 29*(6),

423–437. https://doi.org/10.1016/j.technovation.2008.10.001.

Van den Bosch, F. A. J., & Volberda, H. W. (1999). Coevolution of firm absorptive capacity and knowledge environment: organizational forms and combinative capabilities. *Organization Science, 10*(5), 551–568. https://doi.org/10.1287/orsc.10.5.551.

Vanhaverbeke, W. (2017). *Managing open innovation in SMEs*. Cambridge: Cambridge University Press.

Vanhaverbeke, W., Vermeersch, I., & De Zutter, S. (2012). *Open innovation in SMEs: how can small companies and start-ups benefit from open innovation strategies?* Leuven: Belgium Flanders District of Creativity.

Varis, M., & Littunen, H. (2010). Types of innovation, sources of information and performance in entrepreneurial SMEs. *European Journal of Innovation Management, 13*(2), 128–154. https://doi.org/10.1108/14601061011040221.

Wagner, P. (2013). *Open innovation and organizational alignment: a contingency analysis of external search strategies for innovation performance*. Aachen, Germany: RWTH Aachen University.

Wang, C. L., & Ahmed, P. K. (2007). Dynamic capabilities: a review and research agenda. *International Journal of Management Reviews, 9*(1), 31–51.

West, J., & Bogers, M. (2014). Leveraging external sources of innovation: a review of research on open innovation. *Journal of Product Innovation Management, 31*(4), 814–831. https://doi.org/10.1111/jpim.12125.

West, J., Vanhaverbeke, W., & Chesbrough, H. (2006). Open innovation: a research agenda. *Open Innovation: Researching a New Paradigm*, 285–307.

West, J., Salter, A., Vanhaverbeke, W., & Chesbrough, H. (2014). *Open innovation: the next decade*. Elsevier.

Whitley, R. (1999). *Divergent capitalisms: the social structuring and change of business systems*. Oxford: OUP.

Zeng, S., Xie, X., Xue, M., & Tam, C. M. (2010). Relationship between cooperation networks and innovation performance of SMEs. *Technovation, 30*(3), 181–194. https://doi.org/10.1016/j.technovation.2009.08.003.

Zhou, K. Z., & Li, C. B. (2012). How knowledge affects radical innovation: knowledge base, market knowledge acquisition, and internal knowledge sharing. *Strategic Management Journal, 33*(9), 1090–1102. https://doi.org/10.1002/smj.1959.

Zmud, R. W. (1982). Diffusion of modern software practices: influence of centralization and formalization. *Management Science, 28*(12), 1421–1431.