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Stakeholder ties, organizational learning, and business model innovation: A business ecosystem perspective



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Keywords: Business model innovation Stakeholder ties Exploitative learning Exploratory learning	Business model exists within business ecosystems, and stakeholders can exert a key influence on a firm's business model innovation. Drawing insights from the business ecosystem perspective and resource-based view, this study examines how ties with stakeholders can affect a focal firm's business model innovation and how the relationship is contingent upon the firm's learning types. Analyses of 210 Chinese firms reveal that the relationship between intra-industry stakeholder ties and business model innovation is inverted U-shaped, while extra-industry stakeholder ties have a positive effect on business model innovation. The relationships between both intra- industry and extra-industry stakeholder ties and business model innovation are weakened by exploitative learning but strengthened by exploratory learning. Theoretical and practical implications are discussed.

1. Introduction

Business model innovation (BMI), which involves holistic alterations to the structure and architecture of firms' boundary-spanning activity systems for creating, delivering, and capturing value, has recently attracted considerable scholarly attention due to its ability to increase a firm's competitive advantages (Bouncken and Fredrich 2016; Foss and Saebi, 2017). Nowadays, the locus of value creation and value capture has shifted to the business ecosystem (Adner and Kapoor, 2010) composed of interdependent stakeholders (e.g., customers, competitors, suppliers, social organizations, and other institutions) and the relationships between all stakeholders (Moore, 1993; Wei et al., 2017). Firms are relying increasingly on stakeholders in the business ecosystem to jointly create and capture value by redesigning their business models (Amit and Zott, 2015).

An increasing number of scholars have realized that the business model, despite being often studied as a firm-centric concept, is an ecosystem-embedded construct (Amit and Zott, 2015; Frishammar and Parida, 2019). They acknowledge that BMI extends the dyadic relationships involving multiple ecosystem stakeholders (Sjödin et al., 2020). Hence, BMI is not only constrained by firms' internal factors, but also affected by ecosystem-level factors, particularly stakeholders. Despite this, the literature exploring the antecedents of BMI has been guided mainly by the firm-centric view that focuses on the effects of firms' internal factors (e.g., McDonald and Eisenhardt, 2020; Wei et al., 2017), leaving the role of stakeholders largely underexplored. However, given business model researchers' growing interests in the business ecosystem, one intriguing question is what role ecosystem-level factors, particularly stakeholders who constitute the principal subjects of a business ecosystem (Lu et al., 2014), play in driving BMI? Unfortunately, the answer remains unclear.

To address this gap, we explore how different stakeholders in the business ecosystem affect a firm's BMI through their ties to the firm. The business ecosystem perspective suggests that firms survive in complex networks of interdependent stakeholders with complementary resources (Frishammar and Parida, 2019). Along a similar vein, the extended resource-based view (ERBV) indicates that, to obtain competitive advantages in a networked context, firms need to leverage outside resources embedded in a wider network and can only be accessed through the ties with outside actors (Lai et al., 2012; Park et al., 2017). Therefore, in the context of business ecosystem, resources from stakeholders of the ecosystem are crucial for firms to achieve BMI and gain competitive advantages. Ties with stakeholders as a vital source for firms to acquire and synergize these resources are a prerequisite for BMI. Further, it is important to differentiate the types of stakeholders because the resources they provide vary. Intra-industry stakeholders often offer knowledge and information related closely to the industry, whereas extra-industry stakeholders can provide heterogeneous knowledge and

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novel ideas (Geletkanycz and Hambrick, 1997). Therefore, our first research question asks how firms' intra- and extra-industry stakeholder ties affect their BMI.

Resources alone are insufficient for BMI. Rather, firms also need to have the capability to deploy and orchestrate the resources to convert them into outputs effectively (Hsu and Wang, 2012; Yuan et al., 2021). During the innovation process, firms must recombine resources to support new value creation activities (Demil et al., 2015). As a dynamic capability, organizational learning can facilitate firms' reconfiguration and redeployment of the resources provided by stakeholders (García--Morales et al., 2008; Santos-Vijande et al., 2012). Thus, organizational learning represents an important contingent condition for the relationship between stakeholder ties and BMI. Our second research question asks how organizational learning moderates the relationships between firms' intra- and extra-industry stakeholder ties and BMI.

Analyses of 210 Chinese firms show that extra-industry stakeholder ties promote BMI. The relationship between intra-industry stakeholder ties and BMI exhibits an inverted U-shape. That is, it starts as positive and becomes negative as intra-industry stakeholder ties increase beyond a certain point. Furthermore, the relationships between intra- and extraindustry stakeholder ties and BMI are weakened by exploitative learning but strengthened by exploratory learning.

We contribute to the research on BMI in at least two important ways. First, we offer a new perspective for understanding the antecedents of BMI. As a business model is an ecosystem-embedded construct that transcends firm and industry boundaries (Frishammar and Parida, 2019; Zott and Amit, 2013), we focus on the factors at the ecosystem level. We provide a direct response to the call to expand the study of BMI beyond the firm level (Amit and Zott, 2015). In doing so, we deepen the understanding of BMI as more than a stand-alone phenomenon, but as an outcome of joint efforts by multiple stakeholders. Second, we provide a more nuanced understanding of stakeholders' impacts on BMI. Although some scholars have stressed the significance of integrating stakeholders into BMI (Spieth et al., 2016; Zott et al., 2011), the influence of stakeholders on firms' BMI remains largely understudied. We reveal the distinct effects of different stakeholders by theorizing and offering empirical evidence of the effects of intra-versus extra-industry stakeholder ties on firms' BMI. We also show how the effectiveness of stakeholder ties on BMI is contingent on firms' exploitative and exploratory learning, thereby demonstrating the combined effects of firm-level and ecosystem-level factors on BMI.

2. Theoretical background and hypothesis development

2.1. Business model innovation and the business ecosystem

A business model is a holistic system of activities embedded in a value network with multiple parties that is designed to create and capture value (Zott et al., 2011). For strategy scholars, business model research challenges the assumptions of the traditional theories of value creation and capture by considering value creation and capture on the multi-side (e.g., producers, customers, and other members of their value creation ecosystems), rather than on the supply-side only (Massa et al., 2017). A business model aimed at value creation for multiple stakeholders is a system that connects all stakeholders in a business ecosystem and combines their resources.

The content, structure, and governance of an activity system are regarded as the three basic elements of a business model (Zott and Amit, 2010). Content refers to the selection of activities to be performed; structure describes how these activities are connected and in what sequence; and governance refers to who (stakeholders) performs these activities (Amit and Zott, 2012). As a process of reinventing existing business models, BMI consists of a search for new ways to create and capture value for stakeholders by changing the value creation and capture activity system (Bouncken and Fredrich, 2016). It can be achieved by changing and reconfiguring one or a combination of the basic

elements of a business model within the business ecosystem, such as adding novel activities (content), linking activities in novel ways (structure), or changing one or more stakeholders who perform these activities (governance; Amit and Zott, 2012).

Despite a growing body of research recognizing that business models are ecosystem embedded (Amit and Zott, 2015; Frishammar and Parida, 2019), studies investigating the driving factors of BMI with an ecosystem lens have been scarce. Most BMI research was firm-centric, identifying the internal factors as key antecedents of BMI (e.g., Martins et al., 2015; McDonald and Eisenhardt, 2020). For example, research based on the rational positioning view highlights rational design processes and internal constraints as antecedents of BMI (Wei et al., 2017). Scholars drawing on the evolutionary learning view hold that BMI is a result of a trial-and-error process and focus on the role of learning and experimentation (McDonald and Eisenhardt, 2020). Meanwhile, proponents of the cognitive view assert that business models are transformed according to managers' cognitive schema changes (Martins et al., 2015). While these studies have undoubtedly enriched our knowledge on BMI, research that explores the antecedents of BMI from a business ecosystem perspective with a focus on the role of stakeholders-an essential element of the business ecosystem - is still missing. Although researchers recently called for more scholarly attention to the role of stakeholders in BMI because of the accumulated evidence of the proliferation and significance of business ecosystems (Massa et al., 2017; Spieth et al., 2016), how stakeholders influence firms' BMI and how this effect differs for various stakeholders remain unclear.

The business ecosystem perspective recognizes the need to go beyond firm boundaries. It adopts a more systemic perspective to understand how value is created and captured through cooperation with other members of the ecosystem (Power and Jerjian, 2001; Zott and Amit, 2013). Firms increasingly rely on the business ecosystem (Wei et al., 2014a) to collaborate with other stakeholders and to synergize resources held by these stakeholders to jointly create and capture value (Frishammar and Parida, 2019). In addition, ERBV emphasizes external resources as a crucial determinant of a firm's competitive advantages in networked contexts (Lai et al., 2012; Park et al., 2017), and suggests that social ties are an important mechanism to access scarce and valuable resources from outsiders (Zhou et al., 2019). Thus, in the context of business ecosystems, BMI is regarded as the foundation of a firm's competitive advantages and requires focal firms to access and recombine the resources of various stakeholders in the business ecosystem to create and capture new value (Demil et al., 2015; Wei et al., 2017). Expanding a firm's boundaries to build and maintain ties with impactful stakeholders inside and outside the industry is a crucial way to alleviate resource constraints and effectively combine the resources needed for BMI within a business ecosystem (Amit and Zott, 2015).

Furthermore, stakeholders are not all the same; intra- and extraindustry stakeholder ties may have different impacts on BMI as they offer different resources (Geletkanycz and Hambrick, 1997; Yoo et al., 2009). Intra-industry stakeholders are members of the business ecosystem who are in the same industry as a focal firm, such as customers, suppliers, and competitors. They often offer materials and human resources needed for the focal firm's BMI, as well as unpublicized and confidential information and knowledge on existing markets and technologies. Extra-industry stakeholders refer to the members of the business ecosystem outside the industry of the focal firm, such as firms of other industries, universities, the media etc. In addition to capital, materials, and human resources, extra-industry stakeholders can provide the focal firm with diverse information and knowledge on new markets and technologies. Intra-industry/extra-industry stakeholder ties refer to the extent to which a firm's managers have established good connections with members of the business ecosystem within/outside its own industry (Atuahene-Gima et al., 2006).

2.2. Intra- and extra-industry stakeholder ties and business model innovation

We argue for an inverted U-shaped relationship between firms' intraindustry stakeholder ties and their BMI due to two countervailing mechanisms: a positive mechanism vs. a negative mechanism.

The positive mechanism is that intra-industry stakeholder ties can prompt BMI by providing industry-related resources, such as tacit knowledge and nonpublic information within the industry, facilitating firms to discover opportunities for BMI. The essence of a novel business model is to identify new value propositions and adopt new ways of conducting transactions, which can be achieved by, for example, linking current transaction participants in novel ways, adding novel transaction activities, or creating novel transaction mechanisms (Amit and Zott, 2012). By offering nonpublic and inaccessible knowledge about the industry (Geletkanycz and Hambrick, 1997), intra-industry stakeholder ties allow firms to deepen their understanding of industry competitors, consumers, and suppliers, to grasp market changes in a timely fashion, and to discover untapped consumer demand in the current market. In such cases, firms are more likely to discover new value propositions and create novel transaction activities. For instance, consumers are a vital source of new value propositions, and customer experience is an important driving force for BMI (Keiningham et al., 2020). Successful business models of peers or competitors can serve as crucial benchmarks or blueprints for firms' BMI (Amit and Zott, 2015). Suppliers can give a focal firm priority in the supply of techniques or materials required for BMI. The success of MIUI, a well-known mobile Internet company in China, can be attributed to its relationship marketing (i.e., by building close customer relationships) and community economy (i.e., by cultivating a group of enthusiasts to participate in product design) (Yi et al., 2020). Its close relationship with consumers can aid MIUI dig deep into their potential needs and thus find new value propositions promptly.

However, as intra-industry stakeholder ties intensify, the marginal benefits of such ties for providing new knowledge and information are likely to decline and diminish quickly. Complementary resources provided by intra-industry stakeholders are limited due to the commonality of the resource base in the industry (Yoo et al., 2009). Thus, when intra-industry stakeholder ties are strong, the redundancy of resources available to firms is rapidly augmented while the novelty and diversity of resources are lowered, thereby reducing the opportunities of firms to create new business models.

The negative mechanism is that as intra-industry stakeholder ties increase, it may exacerbate barriers for BMI by enhancing resource inertia and adherence to existing business logic. Innovating a business model often requires firms to disrupt their current routines and activity patterns and recombine their resource portfolios in novel ways (Wei et al., 2014a, 2017). Internal resource inertia can be a barrier to such actions (Gilbert, 2005). Resources acquired from intra-industry stakeholders are often similar to a focal firm's own accumulated resources (Geletkanycz and Hambrick, 1997). As such, with the reinforcement of the ties with intra-industry stakeholders, resource homogeneity intensifies, which aggravates resource inertia, leading to the difficulty for incumbent enterprises to break away from the established business logic, because they are more closely embedded in a specific industry network (Christensen and Snyder, 1997). Most intra-industry stakeholders of a firm belong to its existing value network, and the means of value creation and capture are often similar across the given industry. In addition, due to similar work experience, managers in the same industry have much in common in terms of their conceptions and views on the external environment and business opportunities (Yoo et al., 2009). Thus, the stronger the firms' intra-industry stakeholder ties, the more chronically and repeatedly they are exposed to similar and familiar business models. Excessive access to homogeneous resources and ideas from the industry reinforces resource inertia and stickiness to existing business models (Zott and Amit, 2015). In turn, it prevents firms from securing new resources, searching for new markets and new customers,

and/or exploring new opportunities outside their current networks (Martins et al., 2015; Wei et al., 2014a).

In sum, as intra-industry stakeholder ties intensify, the positive effects of intra-industry stakeholder ties diminish, while its negative effects rise and can later dominate the positive effects. As such, we hypothesize an inverted U-shaped relationship between intra-industry stakeholder ties and BMI.

H1. The relationship between a firm's intra-industry stakeholder ties and its BMI is inverted-U shaped.

We argue that extra-industry stakeholder ties can promote firms' BMI by providing heterogeneous resources outside their existing value networks, such as new markets, novel technologies, unique materials, and different human resources. The heterogeneity is conducive to overcoming the inertia of existing resources and business logic and helps generate new value propositions and opportunities. BMI may disrupt an industry's dominant logic and create new markets (Loon and Chik, 2019). As such, it needs to deviate from the firms' existing business logic. Resource inertia is regarded as a major obstacle to BMI (Gilbert, 2005).

First, the acquisition and utilization of heterogeneous resources help reduce the inertia and path dependence caused by existing resources. Resources outside the industry differ from a focal firm's existing resource accumulation (Geletkanycz and Hambrick, 1997). A case in point is Haier, a well-known Chinese household appliance company. By establishing connections with firms from various industries, universities, and research organizations across the world, Haier has integrated distinct resources that it did not originally possess. This has helped the company escape its resource inertia to create a new activity system, the Haier Open Partnership Ecosystem (HOPE). HOPE has enabled Haier to create a new business model that connects external technical experts and creative people with incubators of innovative products, allowing them to together find and realize new value propositions, and thus jointly create and capture new value.

Second, the thinking models of firms and their extra-industry stakeholders often do not rely on the same frame of reference (Yoo et al., 2009). Extra-industry stakeholders' perceptions of the environment and business practices are determined by their different experiences (Geletkanycz and Hambrick, 1997). Thus, these stakeholders offer firms a broader range of non-redundant knowledge and novel views that challenge long-standing beliefs and assumptions in an industry (Atuahene-Gima and Murray, 2007). For example, universities and research institutions are not confined to a specific industry but bridge industries. From these ties, firms can obtain diverse knowledge, learn new perspectives, and acquire inspiration and suggestions by comparing and contrasting their business models with those of other industries (Amit and Zott, 2015). In turn, this can help disrupt the current business logic and reduce the dependence on established business models.

Third, extra-industry ties provide opportunities to introduce new transaction participants and connect previously unconnected parties, which can lead to changes in current transaction structures and governance mechanisms and help firms transform their business models. New partners can also create fresh opportunities by facilitating different resource combinations (Read et al., 2009), which will promote BMI. Therefore, we propose the following hypothesis.

H2. There is a positive relationship between a firm's extra-industry stakeholder ties and its BMI.

2.3. Moderating role of exploitative learning

Whether a firm's resources accessed via the ecosystem can contribute to its BMI is contingent upon the firm's ability to recombine and exploit these resources. Organizational learning is a dynamic capability that enables a firm to synthesize, reallocate, and reconfigure its internal and external resources (García-Morales et al., 2008; Santos-Vijande et al., 2012). Below, we discuss how organizational learning moderates the relationship between a firm's stakeholder ties and its BMI.

Exploitative learning and exploratory learning have been considered as the most important organizational learning mechanisms (March, 1991). They reflect distinct attitudes toward handling and combining resources (Li et al., 2014). Exploitative learning refers to learning from knowledge and skills similar to a firm's current experience, capabilities, and technologies, and involves the refinement and extension of existing capabilities, technologies, and paradigms (March, 1991; Wei et al., 2014b). It emphasizes the full use and enhancement of current knowledge and competencies, and leads to gradual changes and adjustments to existing resource configurations consistent with previous trajectories and experience (March, 1991).

We argue that exploitative learning attenuates the positive effect of intra-industry stakeholder ties on BMI by decreasing firms' ability to find new opportunities for value creation from industry-related resources. As exploitative learning involves the strengthening and refinement of a firm's existing knowledge base (March, 1991), firms with high levels of exploitative learning are more likely to search for and leverage resources similar to their existing resources and experience. They are also likely to pay more attention to familiar knowledge and capabilities. Thus, although intra-industry stakeholders can provide expertise on current markets, technical support, and information on various parties in the industry, firms with high levels of exploitative learning tend to focus on known solutions. This ultimately reduces their ability to identify different value propositions and new opportunities in the resources offered by intra-industry stakeholders.

However, high levels of exploitative learning can increase the inertia of resources similar to firms' existing resource base and support the persistence of established business models. When firms have a high level of exploitative learning, the resources obtained from intra-industry stakeholders tend to be used to further consolidate and expand the existing resource base, thereby strengthening the current business model. Furthermore, it can limit firms' ability to combine available resources in novel ways and further enhance resource inertia and path dependence (March, 1991). High levels of exploitative learning result in long-term adherence to an established business model, which leads to increased cognitive inertia and inhibits the establishment of new dominant logic (Prahalad, 2004). In this case, it becomes more difficult to break away from dominant business logic and existing industry standards and norms to create an entirely new business model.

Overall, when exploitative learning is high, firms' ability to find new opportunities of value creation from resources obtained from intraindustry stakeholders is reduced, while the barriers to their BMI caused by intra-industry stakeholder ties are aggravated. Hence, the inverted U-shaped relationship between intra-industry stakeholder ties and BMI is expected to be flatter and show an earlier onset of the downward slope when exploitative learning is higher. Therefore, we propose the following hypothesis.

H3. Exploitative learning moderates the inverted U-shaped relationship between a firm's intra-industry stakeholder ties and its BMI. Specifically, the inverted U-shaped relationship between intra-industry stakeholder ties and BMI is flatter when exploitative learning is higher.

Exploitative learning weakens the positive effect of extra-industry stakeholder ties on BMI for two main reasons. First, with high levels of exploitative learning, firms are likely to use the heterogeneous resources obtained from stakeholders outside the industry to extend the existing trajectories through refinement, selection, and reuse of current routines (Li et al., 2014). Exploitative learning involves information search within a well-defined and limited solution space closely related to firms' previous experience (Atuahene-Gima and Murry, 2007). It makes firms more inclined to utilize the knowledge that is similar to the knowledge gained from experience and related to their current business. These firms are also more willing to apply heterogeneous resources to refine their present value networks, further strengthening their established business models. As Atuahene-Gima and Murray (2007)

suggested, deeper exploitation within a familiar knowledge base makes the adoption of alternate, newer directions of development difficult.

Second, firms with high levels of exploitative learning are less likely to recognize potential opportunities in different areas. Their willingness to use and commitment to implementing any diverse and novel knowledge provided by extra-industry stakeholders are also low. Firms with exploitative learning tend to focus on areas and use solutions familiar to them, demonstrating myopic bias and making the discovery of truly novel solutions from heterogeneous resources unlikely (Fang et al., 2010). In this case, they are likely to overlook the new opportunities for BMI embedded in diverse information, new markets, and technologies derived from extra-industry stakeholders. This prevents them from readily identifying new value propositions and drawing on different methods of value creation from other domains. Such firms are also less adventurous due to their focus on control, efficiency, and reliability (Deming, 1981; Juran and Gryna, 1988). Thus, even if these firms are exposed to new ideas and perspectives by extra-industry stakeholders, they may not be willing to take risks, disrupt existing systems and structures, or make radical transformations to established business models. Therefore, we propose the following hypothesis.

H4. Exploitative learning negatively moderates the positive relationship between a firm's extra-industry stakeholder ties and its BMI. Specifically, the positive effect of extra-industry stakeholder ties on BMI is weaker when exploitative learning is higher.

2.4. Moderating role of exploratory learning

Exploratory learning is learning from knowledge and skills that are completely new to firms' current capabilities and technological knowledge. It creates new knowledge trajectories (Huang and Li, 2012). The keywords of exploratory learning are "search, variation, risk taking, experimentation, play, flexibility, discovery, and innovation" (March, 1991: p.71). With strong flexibility and acuity, exploratory learning helps firms effectively acquire and reconfigure new knowledge and seek novel ideas to interface with alternatives to their existing organizational actions (Li and Yeh, 2017).

We argue that exploratory learning moderates the inverted U-shaped relationship between intra-industry stakeholder ties and BMI. It further improves firms' ability to identify new opportunities for value creation from resources provided by intra-industry stakeholders. It also decreases resource inertia and adherence to the industry's dominant business logic.

Exploratory learning can facilitate firms' recognition of opportunities for the new value propositions embedded in industry-related resources provided by intra-industry stakeholders. It can also help firms reconfigure these resources in novel ways. Although the heterogeneity of these resources is relatively low, firms with high levels of exploratory learning fully exploit their benefits. Exploratory learning is an uncertain process, and its essence is to experiment with new alternatives (Li and Yeh, 2017; Wei et al., 2014b) and identify new opportunities (Li et al., 2014). Hence, firms with high levels of exploratory learning are more likely to identify new content in a large amount of similar and familiar resources derived from intra-industry stakeholder ties. This contributes to their discovery of new opportunities for value creation. Furthermore, such firms can recombine these resources along a different trajectory to seek new solutions for BMI.

High levels of exploratory learning can also reduce the obstacles caused by strong intra-industry stakeholder ties to firms' BMI. First, firms with high levels of exploratory learning are more likely to overcome resource inertia and disrupt existing value networks, which are reinforced by strong intra-industry stakeholder ties. Demil et al. (2015) suggested that creatively combining existing resources is also a means of realizing new business models. When the level of exploratory learning is high, firms are adept at exploring novel combinations of resources obtained from intra-industry stakeholders (Zhao et al., 2016). Second, firms with high levels of exploratory learning are more willing to experiment and take risks (Li et al., 2014). In this case, firms are more likely to break away from the dominant industry design and the existing industry value network that closely relates them with intra-industry stakeholders (Zhao et al., 2016).

To summarize, when a firm's exploratory learning is high, its ability to find new opportunities of value creation from industry-related resources is enhanced, and the barriers to its BMI caused by excessive intra-industry stakeholder ties are reduced. Hence, the inverted U-shaped relationship between intra-industry stakeholder ties and BMI is likely to exhibit a steeper curve and a later onset of the downward slope. Therefore, we propose the following hypothesis.

H5. Exploratory learning moderates the inverted U-shaped relationship between a firm's intra-industry stakeholder ties and its BMI. Specifically, the inverted U-shaped relationship between intra-industry stakeholder ties and BMI is steeper when exploratory learning is higher.

We further argue that exploratory learning strengthens the positive relationship between extra-industry stakeholder ties and BMI. Firms with high levels of exploratory learning emphasize experimentation and are willing to leverage the new knowledge and skills provided by extraindustry stakeholders. Thus, they are more likely to identify new opportunities based on different resources from various domains. Exploratory learning encourages daring experimentation and innovation (Li et al., 2014). Thus, it can facilitate firms' creative integration of heterogeneous resources obtained from extra-industry stakeholders with existing resources, which is conducive to BMI. In addition, firms committed to exploratory learning tend to utilize and generate knowledge that is unlike their existing knowledge base and has great flexibility and agility (March, 1991). Thus, in the interaction and exchange with extra-industry stakeholders, firms can identify and seize new opportunities quickly and discover new value propositions easily. For instance, when firms with high levels of exploratory learning compare their business models with those of other industries, they are more likely to be inspired to change their current value creation methods. Through cooperation and exchange with universities, scientific research institutions, and other firms outside the field of competition, firms with high levels of exploratory learning can better access and recombine the resources they are offered. This is conducive to creating novel transaction activities and exploring and testing new transaction content, structures, and governance mechanisms. Therefore, we propose the following hypothesis.

H6. Exploratory learning positively moderates the positive relationship between a firm's extra-industry stakeholder ties and its BMI. Specifically, the positive effect of extra-industry stakeholder ties on BMI is stronger when exploratory learning is higher.

An illustration of our conceptual model is shown in Fig. 1.

3. Methodology

3.1. Procedure and participants

We obtained the data for this study by conducting a survey which was designed based on a literature review, consultation with academics, and interviews with senior executives. First, drawing on existing scales, we developed a questionnaire in English and then translated it into Chinese. We also invited a third party to translate the Chinese version back into English to ensure accuracy. To check the instrument validity of the measurement, we invited two academics to identify any ambiguous or irrelevant items in our questionnaire, and then modified the minor discrepancies identified. We also consulted with three experienced entrepreneurs to ensure that our questions reflected business practices, and sought feedback from another three senior executives of three firms, ensuring that all of the items were accurate and could be easily understood. Then, we undertook a pilot study with senior executives from 10 firms. The questionnaire was revised to better fit the study context according to their feedback.

We collected survey data from July to October 2016 in China.¹ Conducting the survey via face-to-face interviews allowed for any of the respondents' queries to be clarified on the spot. For each firm, we assigned three doctoral students to implement the survey onsite. All interviewers were familiar with the relevant research domains and were trained in background knowledge, interview skills, and the exact meaning of each item. We chose senior executives (e.g., CEOs, general managers, and COOs) as our respondents to ensure that they had adequate knowledge of their firms' BMI activities.

We randomly selected 800 firms from a list provided by local governments,² among which 252 indicated a willingness to participate in the survey. After excluding responses with missing data on key variables, the final sample consisted of 210 firms. To test potential nonresponse bias, we compared the responding and non-responding firms in terms of age, size, and sales using T-tests. No statistically significant differences were observed. Thus, non-response bias was not a major problem in this study. The descriptive characteristics of the sample firms are shown in Table 1.

3.2. Common method variance

To minimize the threat of common method variance (CMV) to our estimation, we designed the questionnaire to include three separate parts. Each part included the scales for measuring different variables and was completed by a different senior manager from the same firm. Part A collected basic information on the firm and the scale used to measure exploitative learning. Thus, it often required the CEO to answer. Parts B and C were completed by two other senior executives with adequate knowledge of their firms' operation and strategic activities, such as vice presidents, general managers, and COOs. Part B contained scales used to measure intra-and extra-industry stakeholder ties and exploratory learning. Part C included the BMI scale.

We used the Harman one-factor test and confirmatory factor analysis (CFA) to test for CMV. First, in the unrotated factor solution, the largest factor explained 27.79% of the total variance, indicating there was no threat of CMV. Second, the CFA results show that the model positing that a single factor underlies the study variables, assessed through linking all items to a single factor, did not fit the data well (χ^2 /df = 4.778, RMSEA = 0.135, CFI = 0.506, NFI = 0.453, IFI = 0.512, and GFI = 0.560). In contrast, the measurement models assessed by assigning all of the items to their theoretical constructs fit the data well (χ^2 /df = 1.223, RMSEA = 0.033, CFI = 0.974, NFI = 0.876, IFI = 0.975, and GFI = 0.892). Thus, these results indicated that common-method bias was not a serious threat in this study (Podsakoff and Organ, 1986).

3.3. Measures

3.3.1. Dependent variable

Our dependent variable was *BMI*. Amit and Zott (2012) argued that novelty captures the degree of BMI embodied by the activity system. We measured *BMI* with eight items adapted from Zott and Amit (2007). The items of the scale are listed in Table 2.

The item details for the measure of intra- and extra-industry stakeholder ties, exploitative learning, and explorative learning are also presented in Table 2. A five-point Likert scale, ranging from 1 "strongly disagree" to 5 "strongly agree," was used for all items included in the

¹ To avoid potential bias, we controlled economic and cultural differences by choosing firms from different regions in China, including the Yangtze River Delta in the south, the Pearl River Delta in the east, the Bohai Sea region in the north, and the Middle & Western region.

² The list of registered firms was provided by the Chinese Economy Commerce Committee of local governments, a special administrative part of the government established for corporation management.



Fig. 1. Conceptual model.

Table 1

Descriptive statistics of sample firms.

Items	Categories	Quantity	Percentage
Firm age	Less than 5 years	50	23.81%
	5–10 years	63	30.00%
	11-20 years	72	34.29%
	More than 20 years	25	11.90%
Firm ownership	State-owned	51	24.29%
	Private-owned enterprise	26	51.43%
	Foreign -owned enterprise	27	12.86%
	Others	24	11.42%
Firm Size	Less than 50 employees	51	24.29%
	50-100 employees	31	14.76%
	101-300 employees	50	23.81%
	301-1000 employees	47	22.38%
	More than 1000 employees	31	14.76%
Development stage	Start-up	15	7.14%
	Growth	119	56.67%
	Mature	74	35.24%
	Degeneration	4	0.95%

table.

3.3.2. Independent variables

The measurement scales for intra- and extra-industry ties in the literature focus on the ties between two firms without considering other entities inside or outside the industry. Based on the scales used by Atuahene-Gima et al. (2006) and Atuahene-Gima and Murray (2007), we modified and constructed items to assess firms' ties with various stakeholders in the business ecosystem. We used a four-item scale to measure intra-industry stakeholder ties and a six-item scale to measure extra-industry stakeholder ties. To ensure scale validity, we conducted exploratory factor analysis (EFA), CFA, and Cronbach's a evaluation (Gatignon et al., 2002). The EFA for all of the items in the two scales yielded a two-factor solution and accounted for 61.06% of the total variance. Furthermore, the items attached to each factor were consistent with the scales for each variable, indicating good convergent validity. Measuring the reliability of the scale, the Cronbach's α was 0.77 for intra-industry stakeholder ties and 0.87 for extra-industry stakeholder ties. The CFA also showed that the hypothesized two-factor model fit the data well (RMSEA = 0.081 and CFI = 0.954), providing evidence of the measures' reliability.

3.3.3. Moderating variables

Our measures of *exploitative learning* and *exploratory learning* originated from Atuahene-Gima and Murray (2007). As shown in Table 2, we

adopted four items to measure *exploitative learning* and five items to measure *exploratory learning*.

3.3.4. Control variables

Compared with large and/or older firms, small and/or younger firms maintain a relatively simple organizational structure and operational procedures. As such, they have less inertia and more flexibility, making it easier to transform current business models. *Firm size* is measured by calculating the natural logarithm of the number of employees and *firm age* is measured by calculating the natural logarithm of the number of years since a firm was founded. The attributes that influence firms' innovation change as a firm moves through different development stages (Koberg et al., 1996). We measured firms' *development stage* using values ranging from 1 to 4 (1 = start-up stage, 2 = growth stage, 3 = mature stage, and 4 = degenerating stage). Firms operating in high-technology industries are facing increasingly fierce competition in dynamic business environments where BMI is more frequent and necessary (Pellikka and Malinen, 2014). Thus, we adopted a dummy variable to measure *industry* (1 = high-technology industry and 0 = otherwise).

We also controlled risk orientation, resource flexibility, and differentiation strategy, whose significant roles in firms' innovation activities have been proven (Craig et al., 2014; Li et al., 2017; Zehir et al., 2015). Risk orientation was measured using a reverse five-point Likert scale that reflected the extent to which a firm tends to develop low-risk investment projects relative to its competitors. Resource flexibility was measured by asking the respondents to indicate the extent to which internal units often collaborated on the discovery of new uses for internal resources. Finally, the five-item scale developed by Zott and Amit (2008) was used to measure differentiation strategy. Changing technology is an important driver of BMI (Teece, 2010). We measured technological turbulence using the item, "It is very difficult to forecast the technology development direction in our industry." The literature has suggested that firms are more likely to transform their business models under conditions of perceived threat (Saebi et al., 2017). Thus, we controlled negative interpretation of environment, which reflects the extent to which firms perceive a threat (Plambeck, 2012). It was measured by asking the respondents to indicate the extent to which they believed that the current environment could have negative consequences for their firms.

3.4. Reliability and validity

First, we ran reliability analyses for all measures. As shown in Table 2, the minimum value of the composite reliability of all variables was 0.795, exceeding the cutoff of 0.60 (Bagozzi and Yi, 1988). This indicates the adequate reliability of the constructs. Second, we ran

Table 2

Reliability and validity test.

Variables	Items	Loading	Alpha & AVE
Intra-industry	In the past three years, the top		
stakeholder ties	management team members: Established a good relationship with	0.672	
	customers.		
	Established a good relationship with	0.839	$\alpha = 0.767$
	Established a good relationship with	0.889	AVE =
	managers of distributors.		0.602
	Established a good relationship with managers of other firms in the	0.680	C.R = 0.856
	industry.		0.000
Extra-industry	In the past three years, the top		
stakeholder ties	management team members: Established a good relationship with	0.759	
	various trade associations.	01705	
	Established a good relationship with	0.792	$\alpha =$
	the universities. Established a good relationship with	0.816	0.867 AVE =
	scientific research institutions.		0.605
	Established a good relationship with	0.756	C.R =
	media organizations. Established a good relationship with	0.696	0.901
	other firms' managers in other	01030	
	industries.	0.000	
	various social organizations.	0.838	
Business model	In the past three years:		
innovation	The business model has offered new	0.660	
	combinations of products, services and	0.000	
	information.		
	The business model has given access to	0.702	$\alpha =$
	of participants.		0.904
	The business model has adopted new	0.782	AVE =
	transaction ways.	0.942	0.600 C R
	ways to profit.	0.843	0.923
	The business model has created new	0.827	
	payoff point.	0 799	
	introduced innovations in its business	0.788	
	model.		
	The business model has continuously	0.751	
	routine and norm to conduct business.		
	Overall, the company's business	0.824	
Evoloitativo	model is novel.		
learning	in the past three years.		
-	Our aim was to search for information	0.742	$\alpha =$
	to refine common methods and ideas		0.654
	Our aim was to search for ideas and	0.653	AVE =
	information that we can implement		0.493
	well to ensure productivity rather than those ideas that could lead to		
	implementation mistakes in the		
	project and in the marketplace.		
	We used information acquisition methods (e.g., survey of current	0.721	C.R = 0.795
	customers and competitors) that		017 90
	helped us understand and update the		
	experiences.		
	We emphasized the use of knowledge	0.689	
	related to our existing project		
Exploratory	In the past three years:		
learning			
	In information search, we focused on	0.762	
	strategies that involved		

Table 2 (continued)

Variables	Items	Loading	Alpha & AVE
	experimentation and high market risks. We preferred to collect information with no identifiable strategic market needs to ensure experimentation in the project.	0.822	α = 0.798
	Our aim was to acquire knowledge to develop a project that led us into new areas of learning such as new markets and technological areas.	0.748	AVE = 0.555
	We collected novel information and ideas that went beyond our current market and technological experiences.	0.680	C.R = 0.861
	Our aim was to collect new information that forced us to learn new things in the product.	0.706	

validity analyses for each construct. Following Fornell and Larcker (1981), we used the factor loadings method and average variance extracted (AVE) method to test the convergent validity. The factor loadings of all constructs were significantly above 0.60. Furthermore, as shown in Table 3, the square roots of the AVEs along the diagonal for each construct were significantly higher than the correlations, indicating adequate convergent validity. Following Barclay and Kiefer (2019), we assessed discriminant validity by comparing the AVEs to the maximum shared variance (0.334) and average shared variance (0.085). Both were lower than the AVEs, indicating adequate discriminant validity.

4. Analysis and results

4.1. Results

The descriptive statistics and correlation analysis results for all variables, including the mean values, standard deviations, and correlation coefficients, are presented in Table 3. To assess multicollinearity, we calculated the variance inflation factors (VIFs). The maximal VIF value in all of the models was 2.309, below the cutoff of 10. To further minimize multicollinearity, we mean-centered the independent and moderating variables before generating interaction terms (Aiken and West, 1991). We adopted multivariate regression analysis and the moderated method (Baron and Kenny, 1986) to test our hypotheses. The steps performed to test the hypotheses are detailed in Table 4.

H1 predicted an inverted U-shaped relationship between intraindustry stakeholder ties and BMI. We followed the suggestions of Haans et al. (2016), who pointed out that tests of an inverted U-shaped relationship should meet the following conditions: a) coefficients must be significant and of the expected sign, b) the slope of the curve must be sufficiently steep at both ends of the data range, and c) the turning point of the curve must be located well within the data range. First, Model 3 shows that intra-industry stakeholder ties have a positive and statistically significant effect on BMI ($\beta = 0.105$, p < 0.05) and that the squared term of intra-industry stakeholder ties have a statistically significant negative effect on BMI ($\beta = -0.171$, p < 0.01). Second, we split the data in half based on the turning point, computed as 0.307. We ran two multivariate regression analyses on the split data sets. The coefficient estimate of intra-industry stakeholder ties for the values less than or equal to 0.307 was positive ($\beta = 0.149$, p < 0.05) and the coefficient estimate for the values greater than 0.307 was negative ($\beta = -0.238$, p < 0.1), indicating that both the positive and negative slopes of the curve were statistically significant (Chuang et al., 2018). Third, we plotted the inverted U-shaped relationship as shown in Fig. 2. The turning point of 0.307 fell well within the data range of the centered intra-industry stakeholder ties (-1.712 to 1.287). Thus, the conditions were

Descriptive statistics and correlation mat	trix.															
	Mean	S.D.	1	2	3	4	5	9	7	8	6	10	11	12	13	14
1.Firm size	5.242	1.764	1													
2.Firm age	2.260	0.797	0.529^{**}	1												
3. Development stage	2.300	0.611	0.394^{**}	0.553^{**}	1											
4.Industry (high-tech)	0.566	0.497	0.210^{**}	0.132	0.020	1										
5. Risk orientation	3.238	0.836	0.172^{*}	0.152^{*}	0.112	0.111	1									
6.Resource flexibility	3.524	0.837	-0.073	-0.108	-0.084	0.042	0.026	1								
7. Differentiation strategy	3.627	0.708	0.012	-0.063	-0.164*	0.200^{**}	-0.009	0.291^{**}	1							
8. Technological turbulence	2.976	0.925	0.012	0.067	0.004	0.071	0.211^{**}	0.097	0.043	1						
9. Negative interpretation of environment	2.648	1.084	0.082	0.135	0.203^{**}	0.070	0.225^{**}	-0.049	-0.011	0.197^{**}	1					
10. BMI	3.498	0.720	-0.127	-0.110	-0.127	0.088	-0.096	0.555^{**}	0.416^{**}	0.138^{*}	-0.084	(0.776)				
11.Exploitative learning	3.747	0.546	-0.045	-0.094	-0.148*	0.082	-0.053	0.178^{**}	0.436^{**}	0.071	-0.149^{*}	0.203^{**}	(0.702)			
12.Exploratory learning	3.567	0.683	-0.216^{**}	-0.237^{**}	-0.141*	0.020	0.003	0.528^{**}	0.321^{**}	0.155^{*}	-0.018	0.578^{**}	0.145^{*}	(0.745)		
13.Intra-industry stakeholder ties	3.710	0.600	0.005	-0.067	-0.078	0.073	-0.019	0.266^{**}	0.260^{**}	0.036	-0.115	0.288^{**}	0.161^{*}	0.210^{**}	(0.775)	
14.Extra-industry stakeholder ties	3.550	0.718	0.153^{*}	0.029	-0.082	0.238^{**}	0.007	0.280^{**}	0.273^{**}	0.066	-0.148^{*}	0.290^{**}	0.134	0.202^{**}	0.517^{**}	(0.778)
<i>Note:</i> $N = 210$. *, and ** indicate that co	orrelation	is signific	cant at the 0	.05, 0.01 lev	el (two taile	d). Numbe	rs in parent	thesis on di	iagonal line	are the sq	luare root o	f AVE.				

Fable :

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satisfied, supporting H1.

H2 predicted a positive relationship between extra-industry stakeholder ties and BMI. Model 4 showed that extra-industry stakeholder ties were positively related to BMI ($\beta = 0.230$, p < 0.001). Thus, extraindustry stakeholder ties had a positive effect on BMI, supporting H2.

We carefully tested the moderating effect of curvilinear relationships proposed in H3 and H5. Haans et al. (2016) theorized the moderation of inverted U-shaped relationships, pointing out that the moderators have two main types of influences on inverted U-shaped relationships: a) they lead to a shift to the left or right of the turning point; and b) they lead to a flattening or steepening of the curve. We used the following regression equation to test H3 and H5:

$$Y = \beta_0 + \beta_1 X + \beta_2 X^2 + \beta_3 X Z + \beta_4 X^2 Z + \beta_5 Z$$
(1)

where X is the independent variable and Z is the moderator.

To illustrate how the moderator affects the turning point of the U-shaped relationship, we derived the turning point X^* from Equation (1) by setting the first derivative with respect to X to 0. We obtained the following:

$$X^* = \frac{-\beta_1 - \beta_3 Z}{2\beta_2 + 2\beta_4 Z}$$
(2)

The turning point then depends on the moderator. To show how the turning point changes as Z changes, we took the derivative of this equation with respect to Z and obtained the following:

$$\frac{\partial X^*}{\partial Z} = \frac{\beta_1 \beta_4 - \beta_2 \beta_3}{2(\beta_2 + \beta_4 Z)^2} \tag{3}$$

If $\beta_1\beta_4 - \beta_2\beta_3$ is positive (/negative), the turning point would move to the right (/the left) as Z increases. Second, testing for flattening or steepening is equivalent to testing whether β_4 is significant. A steepening occurs for inverted U-shaped relationships when β_4 is negative.

H3 proposed that exploitative learning negatively moderates the inverted U-shaped relationship between intra-industry stakeholder ties and BMI, which is expected to show a flatter curve and an earlier turn to a downward slope. Models 6 and 8 revealed a significantly positive coefficient for the interaction of exploitative learning with the squared intra-industry stakeholder ties ($\beta = 0.171$, p < 0.01, Model 6; $\beta = 0.170$, p < 0.001, Model 8 in Table 3), indicating the negative moderating effect of exploitative learning on the inverted U-shaped relationship (Haans et al., 2016). Furthermore, according to Models 6 and 8, $\beta_1\beta_4$ – $\beta_2\beta_3 < 0$, indicating that the turning point of the curve moves to the left as exploitative learning increases (Haans et al., 2016). As shown in Fig. 3, at high levels of exploitative learning (1 standard deviation above the mean), the curve was flatter, and the inflection point where intra-industry stakeholder ties started to negatively affect BMI appeared earlier (-0.061 vs. 0.212) than at low levels of exploitative learning (1 standard deviation below the mean). At the apex of the curve, the maximum effect of intra-industry stakeholder ties on BMI decreased sharply (0.106 vs. -0.097) from firms with relatively low to high levels of exploitative learning. Thus, H3 is supported.

H5 suggested that exploratory learning positively moderates the inverted U-shaped relationship between intra-industry stakeholder ties and BMI, which is expected to show a steeper curve and a later turn into a downward slope. As shown in Models 6 and 8, the coefficient of the interaction term between exploratory learning and the squared intra-industry stakeholder ties was significantly negative ($\beta = -0.136$, p < 0.05, Model 6; $\beta = -0.123$, p < 0.1, Model 8). This finding demonstrates the positive moderating effect of exploratory learning on the inverted U-shaped relationship, indicating that the curve is steepening with increasing exploratory learning (Haans et al., 2016). Furthermore, according to Models 6 and 8, $\beta_1\beta_4 - \beta_2\beta_3 > 0$. Thus, the turning point of the curve moves to the right as exploratory learning increases. This moderation effect is illustrated in Fig. 4, showing that when exploratory learning was high, the inverted U-shape was steeper, and the inflection

Table 4

The results of regression analyses.

	Dependent v	ariable: BMI						
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Control variables								
Firm size	-0.116^{\dagger}	-0.120^{\dagger}	-0.128*	-0.125^{\dagger}	-0.125^{\dagger}	-0.091	-0.103^{\dagger}	-0.102^\dagger
	(0.064)	(0.064)	(0.064)	(0.065)	(0.065)	(0.057)	(0.057)	(0.056)
Firm age	0.011	0.069	0.074	-0.038	-0.038	0.107^{\dagger}	0.095	0.091
	(0.068)	(0.065)	(0.065)	(0.067)	(0.068)	(0.060)	(0.060)	(0.059)
Development stage	0.103^{\dagger}	-0.066	-0.063	0.093	0.093	0.060	0.074	0.076
	(0.062)	(0.057)	(0.056)	(0.061)	(0.061)	(0.055)	(0.056)	(0.054)
Industry (high-tech)	-0.034	-0.024	-0.019	-0.020	-0.019	-0.101**	-0.091*	-0.105^{**}
	(0.057)	(0.057)	(0.057)	(0.055)	(0.055)	(0.049)	(0.051)	(0.049)
Risk orientation	099*	-0.125^{**}	-0.129^{**}	-0.095*	-0.097*	-0.168***	-0.180***	-0.184***
	(0.058)	(0.057)	(0.058)	(0.057)	(0.057)	(0.051)	(0.052)	(0.050)
Resource flexibility	0.463***	0.431***	0.432***	0.420***	0.421***	0.278***	0.254***	0.275***
	(0.057)	(0.057)	(0.058)	(0.058)	(0.059)	(0.055)	(0.055)	(0.055)
Differentiation strategy	0.275***	0.273***	0.287***	0.260***	0.265***	0.223***	0.287***	0.259***
	(0.058)	(0.058)	(0.058)	(0.057)	(0.058)	(0.056)	(0.057)	(0.057)
Technological turbulence	0.151**	0.165***	0.163**	0.120*	0.121*	0.160***	0.152***	0.161***
	(0.056)	(0.056)	(0.056)	(0.056)	(0.056)	(0.050)	(0.051)	(0.050)
Negative interpretation of environment	-0.160**	-0.151**	-0.167**	0.069	0.067	-0.143**	-0.108*	-0.119*
	(0.058)	(0.056)	(0.059)	(0.056)	(0.057)	(0.054)	(0.054)	(0.054)
Main effect								
Intra-industry stakeholder ties (IT)		0.116*	0.105*			0.044		0.010
2		(0.057)	(0.064)			(0.052)		(0.055)
Squared intra-industry stakeholder ties (IT ²) (H1)			-0.171**			-0.122*		-0.152*
			(0.064)			(0.057)	a a a a t	(0.062)
Extra-industry stakeholder ties (ET) (H2)				0.230***	0.219***		0.080	0.103
				(0.057)	(0.060)		(0.052)	(0.059)
Squared extra-industry stakeholder fies (ET ²)					-0.030			
					(0.057)			
Moderator						0.100+++	0.107*	0 105***
Exploitative learning						-0.1//***	-0.107*	-0.185***
Provide meteory last miles						(0.058)	(0.054)	(0.058)
Exploratory learning						0.440	0.389***	0.423***
Interaction offerst						(0.070)	(0.057)	(0.070)
Interaction effect						0.007*		0.052
11 × exploitative learning						-0.087**		-0.053
$IT^2 \times exploitative learning (112)$						0.171***		0.170***
11 × exploitative learning (115)						(0.064)		(0.062)
$FT \times exploitative learning (H4)$						(0.004)	0 156**	0.114*
$E1 \times exploitative learning (14)$							-0.130	-0.114
IT v orploratory learning						0 102***	(0.055)	(0.030)
11 × exploratory learning						(0.050)		0.133
$IT^2 \times exploratory learning (H5)$						0.126*		0.123
11 × exploratory learning (115)						(0.069)		(0.068)
$FT \times exploratory learning (H6)$						(0.005)	0 147***	0.097
Li A exploratory rearining (110)							(0.050)	(0.058)
F	8 902***	7 896***	7 644***	7 430***	6 716***	8 374***	9 307***	8 207***
B^2	0.441	0.453	0.461	0 454	0.454	0.619	0.590	0.638
Adjusted R ²	0 391	0.395	0.400	0.393	0.386	0.545	0.527	0.561
$\wedge R^2$	0.071	0.012*	0.008 [†]	0.013*	0.000	0.158***	0.136***	0.019*

Note : Standard errors are shown in parentheses. p < 0.10; p < 0.05; p < 0.01; p

point where intra-industry stakeholder ties started to have a negative effect on BMI appeared later (0.408 vs. -1.517). At low levels of exploratory learning, the relationship between intra-industry stakeholder ties and BMI was nearly negative. At the apex of the curve, the maximum effect of intra-industry stakeholder ties on BMI was significantly increased (0.269 vs. -0.167) for firms with high levels of exploratory learning compared to those with low levels of exploratory learning. Therefore, H5 is supported.

Finally, we tested the moderating role of exploitative/exploratory learning in the relationship between extra-industry stakeholder ties and BMI proposed in H4 and H6. Model 7 showed that the interaction of exploitative learning with extra-industry stakeholder ties negatively affected BMI ($\beta = -0.156$, p < 0.01). Fig. 5 illustrates that the relationship between extra-industry stakeholder ties and BMI was weaker at high levels of exploitative learning than at low levels of exploitative learning, supporting H4. Model 7 also showed that the interaction of exploratory learning with extra-industry stakeholder ties had a

significantly positive effect on BMI ($\beta = 0.147$, p < 0.001). As shown in Fig. 6, at high levels of exploratory learning, the positive effect of extraindustry stakeholder ties on BMI increased more rapidly than at low levels of exploratory learning. Thus, H6 is supported.

4.2. Tests for endogeneity

The cross-sectional nature of our survey raises endogeneity concerns. Firms ready to adopt innovative business models may attach more importance to building and maintaining relationships with external stakeholders. Accordingly, we tested the potential endogeneity with instrumental variables (IVs) using a two-stage least square (2SLS) test. We chose two IVs—government support and TMT bridging ties for intraand extra-industry stakeholder ties. Government support can enhance firms' legitimacy and promote alliances among firms across sectors (Huang et al., 2020). Thus, government support increases firms' opportunities to participate in innovation networks and connect with other



Fig. 2. The effect of intra-industry stakeholder ties on business model innovation.



Fig. 3. Interaction effect, exploitative learning and intra-industry stake-holder ties.

actors. TMTs with bridging ties, a tie characterized by connecting individuals with diverse and heterogeneous backgrounds (Tiwana, 2008), are thus more likely to expand the range of firms' external networks and connect them with various actors.

Following Semadeni et al. (2014), we first undertook the Wald test (F-statistics) of instrument strength. We found that these instruments were jointly strong predictors of the suspected endogenous variables (intra- and extra-industry stakeholder ties), evidenced by values (F = 23.328, p = 0.000, for intra-industry stakeholder ties; F = 20.962, p = 0.000, for extra-industry stakeholder ties) above the Stock-Yogo critical value of 19.93 (Stock and Yogo, 2005). Second, a Sargan test returned non-significant results (p = 0.554, for intra-industry stakeholder ties; p



Fig. 4. Interaction effect, exploratory learning and intra-industry stakeholder ties.



Fig. 5. Interaction effect, exploitative learning and extra-industry stakeholder ties.

= 0.687, for extra-industry stakeholder ties), suggesting that the instruments were exogenous. Overall, these results support the relevance and exogeneity of the instruments (Semadeni et al., 2014). Implementing the 2SLS procedure, the coefficient for intra-industry stakeholder ties square remained significantly negative (β = -0.164, p < 0.05) and that for extra-industry stakeholder ties was significantly positive (β = 0.350, p < 0.05). Finally, we tested for potential endogeneity using Hausman's test of endogeneity, which was insignificant (p = 0.173, for intra-industry stakeholder ties; p = 0.222, for extra-industry stakeholder ties). This result indicates that intra- and extra-industry stakeholder ties were exogenous. Overall, we found no evidence of endogeneity in our



Fig. 6. Interaction effect, exploratory learning and extra-industry stakeholder ties.

model.

5. Discussion

5.1. Main findings

Drawing on the business ecosystem perspective and ERBV, we seek to extend the understanding of how stakeholders affect firms' BMI. We examine the differential impacts of intra- and extra-industry stakeholder ties on BMI and the moderating effect of organizational learning.

Our results suggest that a firm's intra- and extra-industry stakeholder ties have different effects on its BMI due to the different resources they provide. Specifically, we hypothesized an inverted U-shaped relationship between intra-industry stakeholder ties and BMI due to two countervailing mechanisms: a diminishing positive mechanism of access to unique and novel resources; and a rising negative mechanism of resource inertia. We also hypothesized a positive relationship between extra-industry stakeholder ties and BMI. Our analyses provided empirical support for both hypotheses. Scholars have suggested that the benefits of extra-industry stakeholder ties may be greater than those of intra-industry stakeholder ties, as they can offer firms more heterogeneous resources (Geletkanycz and Hambrick, 1997; Yoo et al., 2009). Thus, we provide additional support to previous studies that find that intra- and extra-industry stakeholder ties have differing effects on firms' strategic activities (Atuahene-Gima et al., 2016; Yoo et al., 2009).

Furthermore, our results reveal the role of two types of organizational learning in the process of BMI. We find that exploitative and exploratory learning serve as important moderators in the stakeholder ties-BMI relationship. The moderating effect of organizational learning on the relationship between intra-industry stakeholder ties and BMI is interesting and unique. Our findings show that at higher levels of exploitative learning, the inverted U-shaped relationship between intraindustry stakeholder ties and BMI is flatter, while this relationship is steeper when the level of exploratory learning is higher. Moreover, the positive relationship between extra-industry stakeholder ties and BMI is weakened by exploitative learning but strengthened by exploratory learning. These results mean that exploratory learning can increase the benefits of stakeholder ties for BMI, whereas exploitative learning does not. In addition, by demonstrating the moderating roles of exploitative and exploratory learning, we provide evidence that supports previous research suggesting that dynamic capability plays a significant role in firms' BMI (Teece, 2018). Moreover, although not hypothesized, exploitative and exploratory learning are found to directly affect BMI but their effects are opposite, demonstrating the importance of diverse types of organizational learning for BMI.

In addition, our results reveal significant effects of some relevant control variables on BMI. Innovation often comes with high risk (Craig et al., 2014), and our results support this view by showing that firms with lower risk orientation are less likely to innovate business models. We also find that technological turbulence positively affects BMI, demonstrating that technological change is an important driver of BMI (Teece, 2010). Moreover, the results show that negative interpretation of environment hinders BMI, which is contrary to the point of Saebi et al. (2017) that the perceived threat of environments stimulates the transformation of business models. Although the conflicting results may be due to sample differences, they could also be due to contextual factors such as institutional support of innovation in a country and cultural differences in risk management.

5.2. Theoretical implications

We contribute to research on BMI in two ways. First, unlike previous literature on BMI which often focuses on firm-centric factors, we emphasize the role of ecosystem-level factors such as stakeholders and theoretically and empirically demonstrate how stakeholder ties in a business ecosystem affect firms' BMI. Prior research focuses primarily on the driving role of firm internal factors in BMI (e.g., Martins et al., 2015; McDonald and Eisenhardt, 2020). We not only direct the scholarly attention to external factors of the ecosystem but also dive deep into unraveling the relationship between distinct stakeholder (i.e., intra- and extra-industry stakeholder) ties and BMI. This is a meaningful contribution, because little attention to the role of ecosystem has been paid despite the repeated calls for the identification of BMI antecedents beyond the firm level (Amit and Zott, 2015; Frishammar and Parida, 2019). Our theorization and findings thus offer new insights and enrich the field of research on the drivers of BMI.

Second, we provide a more nuanced understanding of stakeholders' impact on BMI. Our study responds to the calls for consideration of the role of stakeholders in BMI (Spieth et al., 2016) and contributes to a more in-depth exploration of the impact of stakeholders on BMI. On the one hand, adopting the perspective of resource difference and following Geletkanycz and Hambrick (1997), we distinguish the stakeholder ties from the industry effects and find that they have varying impacts on BMI. We provide empirical evidence to support the importance of stakeholders to BMI, adding to the valuable work of Amit and Zott (2015) on stakeholder activities as an antecedent of BMI. On the other hand, we reveal the important boundary conditions of the effect of stakeholder ties on BMI by showing that the effectiveness of stakeholder ties on BMI depends on specific organizational learning (i.e., exploitative vs. exploratory learning) adopted by firms. Our study thus not only deepens the understanding of how organizational learning plays a role in leveraging stakeholder ties, but also demonstrates the joint effects of factors at the firm and ecosystem levels on BMI.

5.3. Managerial implications

This study has several practical implications. First, we offer insights into how firms can overcome resource constraints to leverage the resource pool in their business ecosystem to facilitate BMI. While ties with stakeholders in the business ecosystem can help secure resources for BMI efforts, it is critical for firms to be fully aware that intra- and extra-industry stakeholders have different effects on BMI due to differences in resource characteristics. Deep insight into the current market environment from intra-industry stakeholders can help firms to discover new value creation opportunities; yet they also need to be wary of the resource inertia caused by resource homogeneity when intra-industry stakeholder ties are overly strong. When it comes to ties with stakeholders outside the industry, such as universities, scientific research institutions, and media organizations, these ties can afford firms heterogeneous resources and thereby facilitate their generation of more novel ideas and the discovery of new opportunities to facilitate BMI.

Second, we stress to executives and managers the critical role of capabilities in transforming their resources via stakeholders to BMI. It is as important as resource acquisition to absorb and allocate these resources to facilitate BMI. Firms need to choose the appropriate form of learning to fully utilize these resources. But not all types of learning can play a catalytic role in promoting the effectiveness of stakeholder ties in the BMI process. Firms should consider the idea of a portfolio of stakeholder ties and learning types when implementing their BMI. Engaging in exploratory learning rather than exploitative learning with extraindustry stakeholder ties is more effective. Thus, adopting a portfolio approach to leverage stakeholder ties and organizational learning in BMI maximizes the effectiveness of stakeholder ties on BMI.

Third, although we did not hypothesize the direct impact of organizational learning on BMI, we were able to show that exploratory learning directly facilitates BMI and exploitative learning hinders BMI. Thus, in BMI practice, we advise firms to strengthen exploratory learning to acquire more novel knowledge and stimulus from other fields. Managers need to actively create a stimulating atmosphere to augment exploratory learning activities in their firms. Furthermore, we also caution firms to be alert to the potential negative effects of high exploitative learning in BMI processes. When it comes to BMI, managers should avoid overly focusing on the familiar domains and the utilization of existing knowledge.

5.4. Limitations and future research

This study has several limitations which open avenues for future research. First, we divide the external stakeholders into two categories (i.e., within and outside the industry) without making a more detailed distinction. However, with the development of information technology and the Internet, the boundaries between different industries have become increasingly blurred. In our study, we emphasize the industry in which a firm's main business is located. It is also important to acknowledge that different stakeholders' attitudes toward and desire for BMI can vary, even within the same industry. Such varying attitudes may affect the quality and quantity of resources that stakeholders offer firms. However, we focus more on the characteristics of resources at the industry level. Therefore, future research could divide stakeholders into more refined categories and further explore the different influences of ties with distinct stakeholders (e.g., customers, competitors, and universities) on BMI, and further enrich our research results.

Second, the possible mediating mechanisms affecting the baseline relationship are not considered. For example, we argue that intraindustry stakeholder ties may hinder BMI due to the resource homogeneity and the constraints of existing networks. However, given the database limitations, we could not capture resource homogeneity and inertia. Directly capturing stakeholders' impact on organizational inertia and path dependence and then BMI will be fruitful.

Third, in this study, organization learning is viewed as a dynamic capability, and we focus on how it impacts the stakeholder ties-BMI relationship by affecting the utilization and effectiveness of obtained resources. Scholars could consider other mechanisms that may occur in firms' learning in network ties and potentially impact the stakeholder ties-BMI relationship, such as potential opportunistic behavior or cherry-picking, which in turn affect firms' partnerships or networks.

Fourth, there might be country and design bias in our research design and instrument, thus affecting the generalizability of our findings. For example, our scales of stakeholder ties capture the extent to which firm executives establish good relationships with various stakeholders. Although a "good relationship" is a well-understood concept in Chinese society (Sheng et al., 2011), it may have a different meaning and implication in European countries. Also, the role of external ties may be particularly significant in providing access to valuable sources of resources that may not readily be available through labor markets in emerging economies such as China, because of the lack of necessary institutional infrastructure (Atuahene-Gima et al., 2006). However, in more highly developed markets such as Europe and US., firms can rely on impersonal agents or other channels to access such resources, thus minimizing the role that external stakeholders play. Thus, future research can engage comparative studies to test whether our theoretical model holds in different country contexts. Investigating whether the role of relational governance for ecosystem stakeholders is different in developed and emerging economies, and exploring whether there are distinct governance mechanisms of business ecosystems in different cultural settings to promote BMI, are important.

Finally, the cross-sectional data prevents us from further exploring the effects of stakeholder ties and organizational learning on BMI over time and/or at different stages of BMI. Researchers can combine longitudinal case studies with a portfolio approach to examine the interactions with different stakeholders and the impacts of the portfolio of stakeholder ties and learning mechanisms on BMI over time. Additionally, although we highlight BMI as a set of activities at the ecosystem level, our measurements are made at the firm level, which still takes the firm's perspective of the stakeholders as the starting point, without considering the stakeholders' perspective of the firm. With an ethnography or on-depth case study to gain deeper insights into the interaction among parties involved in emerging ecosystem-embedded business models, future research can reveal insights regarding the process in addition to the outcome of BMI.

Declaration of competing interest

None.

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