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The effects of ambidextrous alliances on product innovation

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ABSTRACT

With increasing levels of industrial complexity and advantages of economies of scale, individual firms often find it difficult to deal with every aspect of their business activities. Consequently, firms form alliances with other organizations to overcome the barrier of limited resources. This article, employing the exploration and exploitation lens, classifies alliances according to their objectives and investigates their impacts on providing innovative products to customers. Using data from a nationwide innovation survey of Korean manufacturing firms, we show that exploratory alliances positively affect firms' radical product innovation while exploitative alliances positively affect firms' incremental product innovation. More importantly, we confirm the interaction effect between exploratory alliances and exploitative alliances, which contributes to both radical and incremental innovation. This study highlights the importance of ambidexterity in implementing alliances which contribute to new product development.

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多元性联盟对产品创新的影响

随着产业复杂性水平的上升以及规模经济的优势出现，个人公司发现要想解决来自公司活动各个方面的问题是比较困难的。因此，企业会与其他组织联盟来克服资源有限这一障碍。本文从探索和开发的角度出发，根据联盟的目标以及探究他们对给顾客提供创新产品的影响，以此来对联盟进行分类。探索关注的是捕获或者创造新的技术，而且经常与长期开发的结果相结合，此外探索也追求彻底的创新。与探索不同的是，开发关注的是通过提升现有的技术或者程序来提升效率，而且经常与短期探索的结果相结合，此外开发追求的是渐进性的创新。把这些概念延伸至联盟的领域，因此也就产生了探索性联盟和开发性联盟的概念。就像探索一样，探索性联盟包括研究与开发或者技术联盟，而且探索性联盟肩负着实现彻底性创新的众望，因为通过探索性联盟公司可以从他们的合作伙伴那里获得新的知识，而且可以探索到新的机会。而开发性联盟，包括横向的、纵向的或者互补的联盟，公司肩负着提升效率以及实现渐进性创新的众望。根据需求来选择探索或者开发，很多公司更容易偏向于开发，因为对于公司而言，去探索他们成功的历史是更容易和更舒服的事情。为了解决这一问题，很多研究引入了二元性的概念，以此来平衡探索和开发。相对于追求某一种战略而言，当公司同时使用这两种战略

时，他们可以期望得到更好的表现结果。在本文里，我们把二元性的想法应用到联盟的舞台上，以此来探究二元性联盟对于产品创新的影响。研究的数据来自韩国制造业公司的一个全国创新调查，结果显示探索性联盟对公司彻底性的产品创新有着显著的影响，而开发性联盟对公司渐进性的产品创新有着显著的影响。更重要的是，我们可以证实探索性联盟与开发性联盟间的交互作用，这种交互作用不但可以促进彻底性创新而且同时可以促进渐进性创新。本项研究强调了多元性联盟的重要性，它对新产品的发展有着一定的贡献。

1. Introduction

For many organizations, creating and marketing innovations to customers is a necessary intermediate goal toward achieving the ultimate goal of long-term success. To do this, firms need to understand customers' needs and turn them into innovative products. To achieve innovation, firm capabilities in the form of technology and knowledge are essential (Grant, 1996; Hall, 1993; Senker, 1995; Teece & Pisano, 1994; Winter, 1998). If they do not already possess these capabilities, firms can acquire them through forming alliances with other firms (Ahuja, 2000; Doz & Hamel, 1995; Eisenhardt & Schoonhoven, 1996; Kogut, 1988; Kogut & Zander, 1996). Through alliances, firms can effectively discover market needs and gain capabilities for efficient product innovation.

As studies about inter-firm alliance emerged, a number dealt with possible categorizations of alliances. Among those studies, Koza and Lewin (1998) suggested categorizing them into exploratory alliances and exploitative alliances, combining in their work the concept of exploration and exploitation suggested by March (1991) and the concept of alliances. A firm's exploration aims at capturing new opportunities, developing new technology and expanding into new markets, while its exploitation aims at improving existing technology and improving efficiency (Faems, Looy, & Debackere, 2005; Rothaermel & Deeds, 2004). Because exploration is mainly about learning of new capabilities and technology (Huber, 1991; Levitt & March, 1988), it creates radical innovation in the form of new technology or new products. Exploitation, meanwhile, mainly aims at improving the efficiency of the firm (Lavie & Rosenkopf, 2006), often resulting in product improvement as a result of incremental innovation. If firms are biased towards either exploration or exploitation, it is likely that they will fall into either a failure trap or a success trap. This can be expanded to an alliance perspective. If a firm conducts both exploratory alliance and exploitative alliance activities at the same time, a concept referred to as ambidextrous alliances, the impact of the alliances on the firm's innovation is increased (Levinthal & March, 1993), the explanation being the synergy effects created by the respective strengths of the exploratory and exploitative alliances.

The concept of ambidextrous alliances has slowly emerged as a research topic in alliance-focused literature. Bahemia and Squire (2010) classified alliances by their breadth, depth and ambidexterity dimensions, but only presented a conceptual study. Faems, Janssens, and Neyens (2012), in a study which included an overview of literature, put an emphasis on the heterogeneity of the alliance portfolio to suggest that firms can increase the impact on innovation by forming more alliances. However, this paper too introduces only concepts, and the impact of ambidextrous alliances was not empirically verified.

In this study, we suggest alliances as an effective way of producing innovation that fits customers' needs, especially focusing on the synergistic effect of ambidextrous alliances on product innovation. For this, we first empirically investigate the innovative results of firms engaging in exploratory and exploitative alliances. We find that when a firm pursues exploratory alliances, it improves its performance related to radical innovation, i.e. new products. On the other hand, firms' incremental innovation, i.e. improvement of existing products, is strengthened by entering into exploitative alliances. More importantly, we empirically verify a synergistic effect on innovation, when instead of focusing on a single type of alliance, both exploratory and exploitative alliances are formed at the same time.

We start by introducing the relevant literature from the fields of alliance and organizational learning. Based on existing literature, we form our hypotheses on the relationships between different types of alliances and product innovation. We verify these hypotheses in an empirical analysis based on global alliance data of Korean manufacturing firms and conclude our article with a discussion of the results and resulting implications.

2. Previous literature and hypothesis

2.1 Alliances and innovation performance

Previous literature confirms the positive effects of inter-firm alliances on a firm's innovation outcome (Baum, Calabrese, & Silverman, 2000; Deeds & Hill, 1996; Kelly, Schaan, & Joncas, 2002; Rogers, 2004; Shan, Walker, & Kogut, 1994; Stuart, 2000). Studies have discussed a number of reasons why alliances affect innovation performance. First, the alliances allow firms to access complementary assets (Hagedoorn, 1993; Teece, 1986), which help to make the commercialization or marketing of innovation more efficient (Teece, 1986). Second, through alliances, firms can gain tacit knowledge that is essential for innovation (Ahuja, 2000; Doz & Hamel, 1995; Eisenhardt & Schoonhoven, 1996). Even if tacit knowledge is more difficult to obtain and transfer than explicit knowledge (Howells 1996; Nonaka & Takeuchi 1995; Senker 1995), it helps to increase productivity, access markets and ultimately fulfill the firm's goal of innovation (Eisenhardt & Schoonhoven, 1996; Kogut, 1988; Kogut & Zander, 1996).

Apart from these reasons, through alliances, firms can decrease the risks involved in R&D projects by sharing resources (Faems et al., 2005), enabling them to increase profitability and improve the quality of their products (Soh, 2003).

2.2. The effects of exploratory alliances on radical product innovation

Exploration focuses on capturing or creating new technology (Lavie & Rosenkopf, 2006; Rothaermel & Deeds, 2004; Zhang & Benedetto, 2010). Because the activity mainly seeks to absorb capacity from outside the firm's field (Rosenkopf & Nerkar, 2001), sufficient absorptive capacity is required to help absorb and integrate the new knowledge (Cohen & Levinthal, 1990; Lavie & Rosenkopf, 2006; McGrath, 2001) and help the firm successfully explore by reinforcing responsiveness. Considering these characteristics, exploration generally results in radical innovation, which refers to new technologies or capacities.

Extending this concept to the realm of alliances gives rise to the concept of the exploratory alliance. Exploratory alliances, i.e. alliances formed for the goal of exploration, include R&D or technology alliances. Faems et al. (2005) showed that, like exploration, exploratory

alliances result in radical innovation, because through the exploratory alliance firms can gain new knowledge from their partners (Rothaermel, 2001) and explore new opportunities (Lavie & Rosenkopf, 2006).

Recently, as the manufacturing industry has become more technologically intensive, firms worldwide have started forming R&D alliances (Hagedoorn, 2002), which help decrease costs by sharing resources (Nakamura, Shaver, & Yeung, 1996). An example of a global firm using such a R&D-focused alliance with research institutes is that of Johnson & Johnson, who entered into an alliance with Queensland University for the development of drugs to treat chronic diseases. Similarly, Novartis formed an alliance with the University of Pennsylvania to join their efforts in research into cancer. Because today's high-tech industries require an increasing amount of capabilities and resources, many firms are trying to overcome their own limitations and improve their innovation outcome by forging alliances with other firms or research institutes. We thus can formulate the following hypothesis:

Hypothesis 1: The more a firm engages in exploratory alliances, the more effective it will be in its radical product innovation.

2.3. The effects of exploitative alliances on incremental product innovation

In addition to exploration, March (1991) presents exploitation as an example of a firm's learning. Different from exploration, through which firms explore new technologies or capacities, exploitation focuses on improving existing technologies or services to improve innovation (Guercini & Ranfagni, 2012; Hoang & Rothaermel, 2010; Rothaermel & Deeds, 2004). Exploitation in firms is often coupled with the expectation of short-term results, leading firms to pursue incremental innovation, i.e. the improvement of existing products or services instead of developing new products or services.

Expanding the concept of exploitation to alliances allows identification of exploitative alliances, which mainly focus on increasing efficiency by improving processes or on increasing product quality or sales (Cohen & Levinthal, 1990; Lane & Lubatkin, 1998; Levinthal & March, 1993; March, 1991; Rothaermel & Deeds, 2004). There are three types of exploitative alliances: the vertical alliance, horizontal alliance and complementary alliance. Vertical alliances include alliances with customers and suppliers. For example, alliances with customers allow opportunities to better understand customers and contribute to increased brand value and product innovation (Koivisto & Mattila, 2012; Phan, Thomas, & Heine, 2011; Park & Kincade, 2010). Horizontal alliances serve to create synergy effects with firms in the same industry, and complementary alliances include alliances with service providers such as consulting firms and marketing companies. These kinds of alliances help a firm to promptly sense markets' needs and improve its efficiency, resulting in updated products and services. Through such alliances, firms can capture and diagnose customers' needs, the condition of their corresponding supply of goods and the current and future state of the market or industry. By applying this newly obtained information and knowledge to their existing product offerings, firms can release improved products which better suit the demands of the market.

The process improvements which result from exploitative alliances can contribute to incremental product innovation. Bartel, Ichniowski, and Shaw (2005) show a positive effect on product innovation if firms enter into alliances with consulting firms and adopt and apply new IT technology to their processes. Forming alliances with suppliers and producers

simplifies the procurement of product components and helps to streamline the production process, creating favorable conditions for upgrading the firms' existing products. Adner and Levinthal (2001) state that in many cases, the goal of reducing costs is motivation for innovative efforts such as technological substitution, which can result in product improvement.

In summary, through exploitative alliances, firms can obtain various knowledge to support product improvement and create more efficient processes to facilitate incremental innovation. We can thus state:

Hypothesis 2: The more a firm engages in exploitative alliances, the more effective it will be in its incremental product innovation.

2.4. The effects of ambidextrous alliances on radical product innovation

Feeling the need to choose between exploration and exploitation, many firms are easily biased towards exploitation, because for them it is easier and more comfortable to exploit their successful history. However, this could lead to the firms falling into a success trap, becoming numb and unable to respond to rapid changes in their environment, and ultimately failing due to the competence-destroying forces of the market (Levinthal & March, 1993; March, 1991).

To solve this problem, March (1991) introduced the concept of ambidexterity, to balance exploration and exploitation. Rivkin and Siggelkow (2003) further developed and simulated this theory to demonstrate that firms can indeed obtain better outcomes if they use a balanced strategy (Gibson & Birkinshaw, 2004; He & Wong, 2004; Lubatkin, Simsek, Ling, & Veiga, 2006; O'Reilly & Tushman, 2004; Raisch, Birkinshaw, Probst, & Tushman, 2009).

Firms can expect better performance outcomes when they use both exploration and exploitation at the same time than if they decided to pursue a one-sided strategy (Levinthal & March, 1993, Levinthal, 1997; March, 1991; Rivkin & Siggelkow, 2003).

As stated in Hypothesis 1, firms can create radical innovation through exploratory alliances; however, if they use exploitative alliances in addition to exploratory alliances they can expect improved radical innovation results, for a number of reasons. When firms use exploratory alliances with the purpose of creating new technology or capacity, the result first comes in the form of technology or patents rather than finished products. Therefore, to benefit from radical innovation, a commercialization process, which requires both time and resources, is needed. This is in contrast to the outcomes of incremental innovation, which can go directly to the market. March (1991) also points out this fact and shows that a number of radical innovations have not yet been introduced to the market because of this. Isobe (2000) also shows the existence of, on average, a five-year time gap between ideation and commercialization: in the meantime, engaging in exploitative alliances helps firms to access complementary assets to boost commercialization (Rothaermel, 2001). The targets of exploitative alliances include suppliers, consulting firms or marketing companies, which are partners that can support the firm in efficiently bringing its new products to the market (Rothaermel & Deeds, 2004). If firms only pursue exploratory alliances to achieve radical innovation, they need to perform all the activities related to the commercialization process, from development to marketing, on their own. However, firms could speed up the process of commercialization if they make use of exploitative alliances with other firms possessing the required know-how and experiences. No matter how good the quality of the technology developed through alliances, if the technology cannot reach the market, it threatens

the firms' sustainability. Entering ambidextrous alliances by adding exploitative alliances supports the process from technology development to entering the market and resolves many problems related to the commercialization of newly developed technologies. Thus, we propose the following hypothesis:

Hypothesis 3a: The more a firm engages in both exploratory and exploitative alliances, the more effective it will be in its radical product innovation – more so than if it engages solely in exploratory alliances.

2.5. The effects of ambidextrous alliances on incremental product innovation

On the other hand, when firms excessively focus on exploratory alliances, they are in danger of falling into a failure trap, which leads firms into a vicious cycle of ongoing exploration (Levinthal & March, 1993; March 1991).

Hypothesis 2 states that firms can expect to increase their incremental innovation performance by forming exploitative alliances, but sometimes firms limit the improvement of existing products by only relying on exploitative alliances. According to Henderson and Clark (1990), incremental innovation is defined as an improvement of individual components with no change in the overall product architecture. To improve a component, an influx of new knowledge or technology is needed, and firms can obtain the required capacity by using joint R&D or exploratory alliances with research institutes. They can then apply the newly acquired technologies to existing products and release improved products to the market. For example, Apple has reduced costs and increased the stability of its supply chain by entering into exploitative alliances with a number of suppliers and producers. This makes it possible for firms to have fast and accurate communication with their partners when they want to develop new products, resulting in an advantage in quickly releasing improved products. Apple started selling the iPhone 4S, an improved version of its previously released iPhone 4, in 2011, with the most prominent feature, SIRI, being obtained from an external partner. In addition to exploitative alliances, Apple enters into exploratory alliances with partners that possess new technology, with the intention to obtain the technology and then apply it to existing products in order to achieve incremental innovation. Another case is Norway's shipping industry, in which firms have successfully introduced incremental innovation by forming alliances with technical research institutes. As a result of the R&D alliances, firms were able to improve their existing products by introducing new technologies which helped to increase the speed of ships and decrease their weight (Asheim & Isaksen, 2002). As seen in these cases, ambidextrous alliances have synergistic effects on incremental innovation. Through such alliances, firms can better understand customers' needs and create more efficient processes which lead to the release of improved versions of existing products. Thus, firms can achieve more successful incremental innovation by not only relying on exploitative alliances, instead acquiring new knowledge and technologies from external sources by entering into exploratory alliances. This leads us to the following hypothesis:

Hypothesis 3b: The more a firm engages in both exploitative and exploratory alliances, the more effective it will be in its incremental product innovation – more so than if it engages solely in exploitative alliances.

Table 1. Correlations matrix and descriptive statistics.

Variables	1	2	3	4	5	6	7	Mean	SD
1. Firm size	1							5.12	1.31
2. Firm age	-0.07	1						0.08	0.27
3. R&D intensity	-0.03	0.04	1					0.077	0.54
4. Market location	0.12	-0.07	0.01	1				0.73	0.44
5. Exploratory	0.20***	-0.03	0.02	0.14*	1			1.39	1.23
6. Exploitative	0.12	-0.04	0.04	0.06	0.24***	1		1.42	1.35
7. Exploratory × exploitative	0.24***	-0.02	0.00	0.12	0.70***	0.67***	1	2.52	4.11
8. Radical innovation	0.30	-0.04	-0.02	0.02	0.15	0.05	0.15	4.122	17.09
9. Incremental innovation	0.24	-0.01	-0.02	0.05	0.14	0.08	0.18	10.017	41.89
VIF	1.08	1.01	1.01	1.03	2.40	2.20	4.09		

Note: * p < 0.10, ** p < 0.05, *** p < 0.01.

3. Data and methods

3.1. Sample

To empirically test our hypotheses, we used a data-set compiled from the “Korean Innovation Survey 2005: Manufacturing Sector (KIS)”, collected by the Science & Technology Policy Institute (STEPI) of South Korea. It takes the form of a questionnaire-based survey and is based on the Organization for Economic Cooperation and Development (OECD)’s Oslo Manual. The KIS categorized innovation into product innovation, process innovation, marketing innovation and organization innovation and provides data on the amount of innovation as well as information on firms’ alliance partners and external knowledge providers. KIS 2005 data covers alliances formed in 2002–4, with information such as innovation performance being available for 2004. The KIS 2005 survey was sent to 4507 South Korean manufacturing firms and STEPI retrieved 2738 answers. As we included only firms for which all data variables needed for our analysis were available, our final data-set contained the data of 598 firms, of which 20% had formed international alliances.

3.2. Method

Table 1 shows the correlations among the variables used in our analysis. To rule out problems stemming from multicollinearity, we calculated the variance inflation factor (VIF). The formula of VIF is:

$$\text{VIF} = 1/R_j^2$$

If the VIF is higher than 10, the data-set is said to suffer from multicollinearity (Hair, Anderson, Tatham, & Black, 1995), but as can be seen in Table 1, the highest VIF value is 4.09, showing that no problems with multicollinearity exist.

Because the dependent variable in this study (innovation outcome) is an integer and non-negative value, negative binomial regression or Poisson regression models need to be used. One of the basic assumptions when using a Poisson model is that the sample mean should not differ significantly from the variance of the sample. If the sample variance exceeds the sample mean, the Poisson model could exhibit over-dispersion and a Negative Binomial Model should be used instead (Luo & Deng, 2009). A calculation of mean value and variance of our sample shows that over-dispersion is likely to occur, so for our analysis we decided to employ a Negative Binomial Model.

3.3. Variables

3.3.1. Dependent variable

The dependent variable of this study is the firm’s radical innovation and incremental innovation outcome. To measure it, we used responses to the survey questions dealing with “product innovation” in the innovation section of the KIS. Following the design of the KIS, an innovation is only counted as such when the result of such innovation is brought to the market and affects the firm’s financial status. To measure radical innovation, we count the number of cases in which the firm “released a completely different product from the existing one”, and to measure incremental innovation, we counted the number of cases in which they “released a remarkably improved product from the existing one”.

3.3.2. Independent variables

Faems et al. (2005) stated that the “R” (research) of R&D signifies exploratory alliances while “D” (development) is related to exploitative alliances. This means that if a firm forms an alliance with a research institute for new capabilities, it should be considered as an exploratory alliance. We thus considered alliances with a “private research institute”, “university/advanced research institute” and “government-funded research center/national research institute” as exploratory alliances.

According to the literature mentioned previously, alliances with customers or suppliers can be considered as exploitative alliances. This type of alliance aims directly at receiving information from customers to efficiently improve products or services. We thus consider alliances formed with “customer”, “business service company” and “supplier” as exploitative alliances.

In order to investigate the firms’ alliance partners, we use the responses in the “Collaboration” part of the KIS questionnaire. The relevant question is “Please evaluate the contribution of your partner for innovation activity for the past three years”, and firms responded on a 5-point scale according to the contribution of the respective partners. They marked 5 points if the collaboration partners’ contribution was very useful, and 1 point if their contribution was not useful. In our analysis we calculate the average of the answers regarding the above-mentioned kinds of partners for exploitative and exploratory alliances.

3.3.3. Control variables

In this study, we use four control variables: R&D intensity, firm size, start-up and location of main market.

R&D intensity. Cohen and Levinthal (1990) introduced the concept of absorptive capacity that recognizes, assimilates and commercializes product and is essential to achieve innovation. They showed that this capacity can be enhanced when firms make an investment in R&D. We thus use the firms’ R&D intensity, which is measured by the firm’s R&D expenditure divided by the firm’s sales.

Firm size. Schumpeter (1943) argued that big firms have an advantage in innovation over small firms. According to his theory, big firms can make larger investments in R&D and hedge risks more easily, resulting in a higher possibility of creating innovation. Other studies also show that most innovation is created by large firms (Cohen, Levin, & Mowery, 1987; Mansfield, 1968; Scherer, 1965). Adams and Dirlam (1966) showed that in the steel industry, firms holding a dominant position have an advantage in accomplishing innovation. Consequently, we control for the firm size measured by the logarithm of the total number of employees.

Start-up. Huergo and Jaumandreu (2004) demonstrated the effect of the firm’s age on innovation and found that younger firms have a tendency to be more productive, because they have a greater need to actively compete in markets than do older, established firms. As this affects the firms’ innovation activity, we need to control the age of the firms in our sample. Ouimet and Zarutskie (2014) classified firms by their age; following their approach, we code the variable with a value of 1 if their age is less than 5 years, and 0 otherwise.

Location of main market. If the main market of the firm is located in another country, the result of its innovation activities can more easily become obsolete than is the case for firms competing in the domestic market, and thus firms whose main market is overseas need to innovate more actively (Kang & Kang, 2009). As a result, we controlled the location of the firms' main market. The variable takes the value of 1 if the firms stated that their main market was the "international market" and 0 when it is focusing on the "domestic market".

4. Results

Table 2 shows the results of the negative binomial regression. We tested six models, divided into two parts by the dependent variables: radical innovation and incremental innovation. Models 1 and 4 contain only our four control variables. Models 2 and 5 investigate the direct effects of exploratory and exploitative alliances, while models 3 and 6 investigate the interaction effect of exploratory and exploitative alliances to measure the predicted effect of ambidextrous alliances on innovation performance.

The results of model 2 show how exploratory alliances affect a firm's radical innovation, providing significant evidence to support our Hypothesis 1 ($\beta=0.25, p<0.05$). Model 3 was used to prove Hypothesis 3a. We used a full model including the interaction term and demonstrated that pursuing ambidextrous alliances has a stronger positive impact on radical innovation performance than only using exploratory alliances ($\beta=0.17, p<0.10$). Model 5, investigating the effect of exploitative alliances on incremental innovation, shows a strong support for our Hypothesis 2 ($\beta=0.15, p<0.10$). We used model 6 to support Hypothesis 3b by showing that the interaction term using exploratory and exploitative alliance affects incremental innovation more than is the case when using exploitative alliance alone ($\beta=0.17, p<0.01$).

In models 3 and 6, exploratory alliances or exploitative alliances themselves do not show a significant result, while their interaction effects are confirmed. However, as Baron and Kenny (1986) point out, whether the main effects for predictors (in our case exploratory alliances and exploitative alliances) are significant or not is not directly relevant for testing the interaction hypothesis. We assume that relatively high correlations between the interaction term and the predictors attenuate the significance of the main effects. However, as the VIF values of each variable including the interaction terms indicate (exhibited in Table 1), problems with multicollinearity do not exist in the models we tested.

5. Conclusion and discussion

In this study, following the ideas of March (1991), we divided firms' alliances into exploratory and exploitative alliances and identified their impact on the innovation results. A firm's exploratory alliance leads to it absorbing knowledge and creating new capabilities that are essential for innovation. This is the basis for our Hypothesis 1, that exploratory alliances affect firm's radical innovation. In a similar fashion, we argued that exploitative alliances would have an impact on firms' incremental innovation (Hypothesis 2). Based on the idea that a firm can use exploration and exploitation at the same time to benefit from synergy effects (Levinthal & March, 1993; March, 1991), we investigated the interaction term of exploratory alliances and exploitative alliances (Hypotheses 3a and 3b). The results of our

Table 2. Negative binomial regression results.

	INCREMENTAL INNOVATION PERFORMANCE					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Firm size	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Firm age	-0.42 (0.26)	-0.40 (0.25)	-0.41 (0.25)	0.08 (0.22)	0.01 (0.23)	-0.10 (0.23)
R&D intensity	-1.57 (0.97)	-1.51 (0.94)	-1.33 (0.92)	-0.60 (0.32)	-0.64 (0.32)	-0.06 (0.32)
Market location	-0.09 (0.21)	-0.28 (0.21)	-0.20 (0.21)	0.36 (0.19)	0.20 (0.20)	0.16 (0.19)
Exploratory		0.25** (0.01)	-0.04 (0.13)		0.14 (0.07)	-0.17 (0.11)
Exploitative		-0.01 (0.09)	-0.23 (0.12)		0.15* (0.08)	-0.09 (0.10)
Exploratory X exploitative			0.17* (0.07)			0.17*** (0.05)
Pseudo R ²	0.0089	0.0143	0.0173	0.0078	0.0126	0.0162
N	598	598	598	598	598	598

Notes:

1) * p < 0.10, ** p < 0.05, *** p < 0.01.

2) Standard errors in parentheses.

empirical study, which is based on data from the KIS, an innovation survey conducted with South Korean firms in the manufacturing sector, support all of our hypotheses.

Our study provides new insight into the linkages between different types of alliances and the resulting innovation performance of firms, and offers several implications. First, we identify the innovation effect from an exploration and exploitation perspective. Previous studies about ambidexterity could not clearly distinguish the innovation effects of exploratory, exploitative and ambidextrous alliances, because they focused on investigating the synergy between exploratory alliance and exploitative alliance conceptually, not empirically (Bahemia & Squire, 2010; Faems et al., 2005). Second, we identified the importance of ambidexterity when it comes to alliances. As seen in Table 2, exploratory alliances by themselves do not have a significant effect on incremental innovation. However, if the firm additionally pursues exploitative alliances, it is able to promptly respond to customers' needs and produce relevant products. Exploitative alliances help the firm reach a higher level of commercialization by quickly bringing the products to market. In a similar fashion, exploitative alliances by themselves also do not affect radical innovation, but when used together with exploratory alliances, the resulting synergy effects have an impact on radical innovation. These implications show the importance of pursuing ambidextrous alliances. If possible, firms need to find a way to effectively use both types of alliance to increase the positive effects on both their radical and incremental innovation performance. With this study we contribute to the field of research applying the concepts of exploration, exploitation and ambidexterity to the field of alliances by introducing and testing specific hypotheses in the setting of the Korean manufacturing industry.

While providing valuable insights and adding to the extant literature on alliances and innovation, this study has several limitations. First, because the data used is from 2004, we might have been unable to capture recent trends of the manufacturing industry. We have a more recent data-set from 2008, but the global financial crises of 2008 might affect the data. Second, due to the characteristics of the KIS survey, which serves as the basis for our data-set, we had to rely on their classification of alliance partners, and as the firm names were redacted from the results, we were unable to supplement the data-set with data from other sources. We expect that future research will perform similar analysis using a different data-set that will allow more fine-grained results and provide better insight into innovation performance as a function of the type of alliance.

Disclosure Statement

No potential conflict of interest was reported by the authors.

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