R&D MANAGEMENT

Giving fish or teaching to fish? An empirical study of the effects of government research and development policies

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This study compares how government research and development (R&D) subsidy and knowledge transfer from universities and public research institutions stimulate a firm's new product development. More importantly, we emphasize that the effects of these governmental R&D policies on new product development can be achieved not only directly, but also via a mediating role – a firm's innovation capability. Furthermore, we test how other external knowledge sources (such as knowledge from universities and public research institutions) interact with government R&D support to stimulate new product development. The results, based on an investigation of 270 Chinese firms, suggest that both government R&D subsidy and knowledge transfer from universities and public research institutions enhance new product development. The results also show that although government R&D subsidy and knowledge transfer from universities and public research institutions has a direct impact on new product development, innovation capability does mediate the above relationships. Moreover, unlike the findings that other external knowledge sources have a direct influence on new product development as indicated by the previous literature, our findings suggest that external knowledge sources substitute with the government R&D subsidies and complement with knowledge transfer from universities and public research institutions. The results confirm the old sayings that teaching to fish (knowledge transfer from universities and public research institutions can complement with other external knowledge sources) is much better than giving fish (government R&D subsidies substitute other external knowledge sources). This paper enriches current literature of government R&D support policies to firm new product development by providing empirical evidences.

1. Introduction

Give a man a fish, you feed him for a day. Teach him how to fish, you feed him for a lifetime. (Lao-Tzu)

It is well recognized that government research and development (R&D) subsidy is a representative incentive to encourage a firm's innovation activities (Herrera and Nieto, 2008). The capacity to be continually innovative is a key source of competitive advantage for firms (Schilling, 2005; Dodgson et al., 2008).

The government R&D subsidy is even more important for firms in emerging economies, such as China, because firms in these countries usually lack sufficient financial capital for costly R&D activities (Xu and Xu, 2013). The method of how the government designs its R&D subsidy policies will influence a firm's decision on innovation activities. In general, government subsidies have primarily been applied to innovation inputs, and some prior researchers argue that firms' R&D expenditures are impossible in the absence of governmental subsidies (Georghiou and Roessner, 2000). Specifically in the Chinese context, governmental funding is also the main financial source of universities and public research institutions, which are another important knowledge sources for a firm's innovation. It is generally accepted that universities and public research institutions are vital sources of innovation because they provide both technical personnel and cutting-edge scientific knowledge (Whittington et al., 2009). Universities, in particular, are key sources for both star scientists and technical employees (Kenney, 1988; Murray, 2002). Furthermore, because universities and public research institutions operate largely on the basis of the norms of open science, the explored knowledge and technologies from universities and public research institutions are more accessible than those from other organizations (Owen-Smith and Powell, 2004). Thus, knowledge transfer from universities and public research institutions becomes even more important for a firm's innovation.

It is widely regarded that both R&D subsidies and knowledge transfer may have positive impacts on new product development. However, government R&D subsidies and knowledge transfers from universities and public research institutions (indirect government subsidies) enhance a firm's innovation in different mechanisms. Government subsidies are like giving a man a fish (i.e. giving a firm monetary subsidies), whereas knowledge transfer from universities and public research institutions is like teaching a man how to fish (i.e. apply transferred knowledge to innovate). Government subsidies only enhance a firm's resources on innovation activities that might not carry out any result, whereas knowledge transfers from universities and public research institutions can improve a firm's sustained competitiveness on innovation. The former one may be a stimulus for firms to conduct new product development in a short run, whereas the latter one may help firms to nurture capabilities for a longer term. Moreover, we also believed that pure financial support does not benefit, or even jeopardize, firms' new product development, such as crowding out other external resources and knowledge, whereas the knowledge transfer from universities and research institutions can actually boost firms' new product development. Thus, the comparison of these two types of government supports has both theoretical and practical contributions.

More importantly, government R&D subsidies and knowledge transfers from universities and public research institutions do not just appear and enhance a firm's innovation by themselves when effectively utilized. As the knowledge-based view (KBV) suggested, knowledge determines firm organization and performance, and knowledge development within firms from experiential learning is facilitated by R&D-related resources and problem-solving capabilities (Grant, 1996). Therefore, firms need to possess the capacity to facilitate the knowledge transfer. Put simply, firms must have innovation capabilities in order to utilize their external resources and knowledge effectively (Zahra and George, 2002). Yet little research has addressed the links among government support, innovation capabilities, and innovation [Cohen and Levinthal (1990)'s study is a good exception]. We will fill this research gap by incorporating these variables (i.e. government support, innovation capabilities, and innovation) in one research framework using 270 Chinese firms.

The results of this study offer important contributions to the KBV as well as the research on a firm's innovation strategy. First, we compared the effects of government subsidy and knowledge transfer on a firm's new product development. Although previous research finds that both government R&D subsidy (Edler and Georghiou, 2007) and knowledge transfer from universities and public research institutions (Owen-Smith and Powell, 2004) are vital to a firm's new product development, none of them compares their various effects in one research framework. Thus, our study extends current literature by investigating how government subsidy and knowledge transfer differently influence a firm's new product development in emerging economies.

Second, we advance the field's theoretical understanding of firm innovation by explicitly including innovation capabilities as a viable mediator between governmental supports and new product development. Previous studies find the inconsistent effects of government subsidies on a firm's innovation (Cohen and Noll, 1991). Proponents believe that the knowledge spillover externalities provide the most prominent justification for government subsidies (Jones and Williams, 1998), whereas critics note the possibility of public-spending crowd-out private investment (Goolsbee, 1998; David et al., 2000), which may weaken a firm's long-term innovation capability. Another possible explanation for the different impact of government subsidies on firm's new product development is the difference of innovation capabilities among firms. Our results show that innovation capabilities plays an important mediating role in the relationship between the governmental supports, including R&D subsidies and knowledge transfer, and a firm's new product development. The findings help us to better understand that firms possessing abundant government supports may not be as innovative as their rivals with comparatively less supports (Mytelka and Smith, 2002). An important source of the difference between these rival firms may be, and likely is, the innovation capabilities (Noble et al., 2002; Atuahene-Gima, 2005; Baker and Sinkula, 2007), absorptive capacity (Cohen and Levinthal, 1990), or dynamic capability (Teece et al., 1997) for integrating government supports, which have been extended from the KBV. Thus, with respect to new product development, our results support the proposition by Teece et al. (1997) that the ability of a firm to acquire, utilize, and develop valuable resources and capabilities is largely related to its acquisition of knowledge externally to the firm and the integration of such knowledge with the firm's owned ones.

Finally, we contribute to the current literature by indicating that although government R&D subsidies and knowledge transfer from universities and institutions facilitate firms to innovate, it may also crowd out other technological sources (Goolsbee, 1998; David et al., 2000). In order to differentiate the influence of government R&D supports with other external knowledge sources, such as suppliers, customers, and competitors, we include these external knowledge resources as moderators in this study. The results interestingly show a different outcome: government R&D subsidies substitute other external knowledge sources, whereas knowledge transfer from universities and institutions complements other external knowledge sources. This comparison is helpful to clarify why knowledge transfer from universities and institutions is superior for firms than direct financial subsidies.

The paper begins with reviewing the literature particularly with an emphasis on government support and its relationship with a firm's new product development. After literature review, we develop theoretical hypotheses for the role of government support, innovation capabilities, and the moderating effects of other external knowledge sources. Following the hypothesis development, we present the research method. The paper closes with result discussions and a conclusion for contributions and implications.

2. Theoretical development and hypotheses

2.1. Government R&D support

There are two viable ways for governments to initiate a firm's new product development. The first one is government subsidy. For decades, government subsidies have primarily been offered to be used on R&D inputs. There are several reasons explaining why government subsidy is important to firm innovation. First, R&D activities are capital intensive and time-consuming activities, and some firms may hardly have enough capital to innovate (Harrison et al., 2001). Therefore, government subsidy is a crucial external source to help firms conduct new product development. Second, because technology imitation by rivals may prevent firms from innovation, government R&D subsidy may be a tool to encourage the development of the new products. Government R&D subsidy has the characteristics of high spillover and low appropriability rate because the government already covers the R&D expenses and the government encourages technology spillover. Thus, as a by-product of government subsidies, firms could improve their R&D capabilities or keep their technology development without facing higher failure risk emerged from knowledge imitation. Finally, firms usually develop the products with the similar functions at the almost same time. Government subsidies may lessen this problem by signaling the market that certain types of products are currently encouraged to develop. Firms could avoid wasteful duplication of R&D efforts and spend valuable R&D resources to the other needed new product development. As a result, government R&D subsidies may help to improve a firm's new product development.

Hypothesis 1: *The government R&D subsidy is positively related to a firm's new product development.*

The other form of government R&D supports is knowledge transfer from universities and public research institutions to firms. We regard knowledge transfer from universities and public research institutions as a type of government support because almost all of the universities and public research institutions are financially funded and subsidized by the Chinese government. Thus, we regard universities and public research institutions as another source of government supports for innovation activities. The role of government funding on university research is widely accepted and the subsequent effects on technical progress and economic growth are well established (Rosenberg and Nelson, 1994). Although the primary goals of universities and public research institutions are to conduct basic research and to deliver teaching, universities and public research institutions do also transfer the generated knowledge to their research partners and thereby accelerate knowledge transfer so as to enable firms to develop new products (Mansfield, 1998; Spencer, 2001; Cohen et al., 2002). The KBV of the firm emphasizes the importance of knowledge development and integration (Macher and Boerner, 2012). Firms can create value through knowledge transfer across organizations (Grant, 1996). Knowledge transfer, from the KBV perspective, enhances firms to access and acquire external sources of knowledge as well as to integrate with internal resources to develop new knowledge, which may lead to new product development. Therefore, government supports in the form of knowledge transfer from universities and public research institutions facilitate a firm's new product development. This leads to our hypothesis:

Hypothesis 2: *Knowledge transfer between firms and universities as well as public research institutions is positively related to a firm's new product development.*

2.2. Innovation capabilities

According to KBV, an organization's principal function is to create, integrate, and apply knowledge. In addition, sustainable competitive advantages and performance differences result when firms have unique knowledge based on the capability of managing different knowledge areas (Conner and Prahalad, 1996; Grant, 1996). Therefore, the knowledge management capability is crucial to create, integrate, and apply knowledge. Innovation capabilities, one of knowledge management capabilities, are defined as a set of organizational routines and processes, by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability (Slater and Narver, 1995; Noble et al., 2002; Atuahene-Gima, 2005; Baker and Sinkula, 2007). Innovation capabilities are a crucial resource of competitive advantage because they are hard to imitate and they depend on the level of knowledge inside a firm (Atuahene-Gima, 2005). Particularly, as firms seek for government R&D supports for new product development, the higher innovation capabilities help firms better acquire, assimilate, transform, and exploit knowledge from government R&D supports in the form of government subsidies or knowledge transfer (Cohen and Levinthal, 1990), which in turn improve their capabilities of internal new product development. With a higher level of innovation capabilities, firms can better utilize the financial capital to acquire new technologies, equipment, or even experts (human capital). For example, Rao and Drazin (2002) find that identifying and hiring talented employees from rivals enables firms to increase the likelihood of producing innovative products. Moreover, firms can extend the skills of the firms' most knowledgeable employees by training current employees (Hitt et al., 2001), which can be a capital-intensive activity. Thus, R&D subsidies from the government may be helpful for enhancing a firm's innovation capability. In the meantime, prior studies find that higher technical skills are necessary conditions for firms to integrate internal R&D with government R&D supports, which facilitate new product development (Leiponen, 2005). Muscio (2007) also asserts the importance of innovation capabilities, which are created and accumulated by R&D efforts and R&D human capital, on small- and medium-sized firms' capabilities to collaborate with other firms, universities, or knowledge transfer centers. Therefore, we can argue that innovation capabilities transform the potential of the government R&D supports, both R&D subsidies and knowledge transfer from universities and public research institutions, into new product development. In other words, innovation capabilities positively mediate the relationship between new product development and government R&D subsidy, as well as knowledge transfer from universities and public research institutions.

Hypothesis 3a: *Innovation capabilities positively mediate the relationship between government R&D subsidy and a firm's new product development.*

Hypothesis 3b: *Innovation capabilities positively mediate the relationship between knowledge transfer from universities and public research institutions and a firm's new product development.*

2.3. Other external knowledge sources

For the past few decades, firms have been increasingly making use of complementary resources from external sources because a single firm is hard to have enough needed resources to sustain its current competitive advantages and simultaneously to create new competitive advantages (Harrison et al., 2001). Chesbrough (2003) suggests that many innovative firms have shifted to an 'open innovation' model, using a wide range of external actors and sources to help them achieve and sustain innovation. Even large firms find themselves difficult to maintain research efforts simultaneously along with all technological fronts (Luo, 2007). As a result, firms may seek to acquire technologies from external parties (Langner and Seidel, 2009; Thorgren et al., 2009). There are several types of external parties for new product

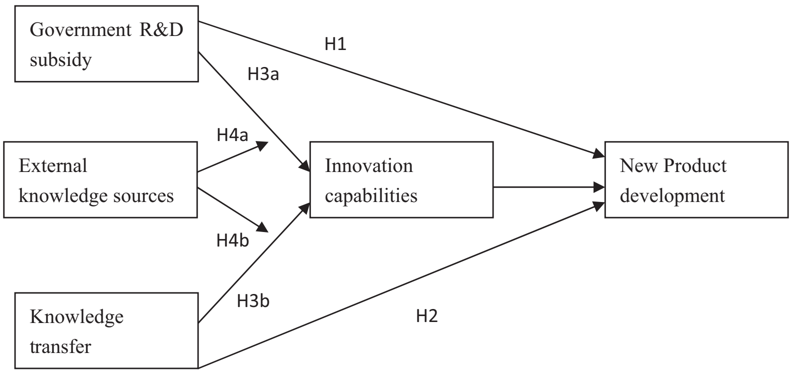

Figure 1. Conceptual model. H, hypothesis.

development in prior research. For instant, suppliers and customers play a vital role in knowledge transfer (Håkansson, 1987; Takeishi, 2001). Moreover, knowledge transfer from competitors is also helpful in the exchange of knowledge related to effective methods for rapidly improving product innovation (Luo, 2007). Even supportive institutions, such as accounting and law firms as well as governmental agencies, can provide valuable knowledge for a firm's new product development (Hislop, 2002).

Previous literature indicates that government R&D supports complement with other external knowledge sources to improve new product development (Feldman and Kelley, 2006). On one hand, firms that receive government R&D supports may simply have better R&D projects. The announcement of government subsidies may serve as a signal for a good project to other investors (Lerner, 1999; Narayanan et al., 2000), particularly for those small and medium firms who would otherwise have the difficulty of attracting the attention of potential investors. On the other hand, when a government agency with a reputation for high standards and scientific integrity, such as universities and public research institutions, regards a high-risk research project as worthy of a monetary investment or worthy of knowledge transfer to the firms, it certifies that the developed knowledge has merit and has better commercialization potential for profitability than the firm's own new product development. Thus, we expect that there will be a complementary relationship between government R&D supports and a firm's new product development by external knowledge sources.

Hypothesis 4a: *With other external knowledge sources, such as suppliers, customers, or competitors, government R&D subsidy is more positively related to new product development.*

Hypothesis 4b: *With other external knowledge sources, such as suppliers, customers, or competitors, government knowledge transfer is more positively related to new product development.*

Figure 1 provides the framework of this research.

3. Methods

3.1. Sample and data collection

The analysis unit in this research is at the firm level. The sample firms included industries such as the information and communication, manufacturing, energy, and chemical industries. Hoskisson et al. (2000) recommend that when doing research in emerging economies, employing local researchers and using face-to-face interviews would be key methods to obtain reliable and valid data. Thus, in the data collection process, we adopted the guidelines developed by Song and Parry (1997). In order to conduct a survey in the Chinese context, we employed the translation and back-translation technique. A pretest interview was conducted through individual interviews with 10 managers from top- or middle-level positions within their organizations. On the basis of these pretest interviews, we further refined the questionnaire and then finalized the survey.

The data collection took place in three stages. At the first stage, we chose 21 out of 31 provinces in mainland China according to their locations, including eastern and costal region (11 provinces), middle region (4 provinces), and northwestern region (6 provinces). Because China is such a big country where the economic development can be divided into different regions (Tsui et al., 2004), our sampling method can reduce the regional difference bias. For each province, we randomly chose 100 firms from the published *Yellow Pages*, making the number of 2,100 firms in our sample population. At the second stage, eight professional interviewers made calls (3,150 in total) to the firms and tried to contact their

Table 1. Reliability and validity

Construct/Indicator	Cronbach alpha	Standardized loadings	Variance extracted
New product development	0.79		0.83
1. Frequency of new product development		0.90	
2. Novelty of new product development		0.90	
Government R&D subsidy	0.75		0.79
1. Importance of government R&D subsidy		0.89	
2. Importance of research commissioned by government		0.89	
Innovation capabilities	0.96		0.85
1. The importance of human capital		0.92	
2. Key personnel in innovation process		0.92	
3. Steady capital supplement		0.94	
4. Mechanisms of transforming research into production development		0.94	
5. Knowledge and technology information		0.88	
External knowledge sources	0.90		0.76
1. Suppliers		0.85	
2. Customers		0.91	
3. Competitors		0.91	
4. Consultant		0.82	

executives, such as chief executive officers, vice presidents of marketing, chief marketing officers, or chief technology officers, who oversee firms' new product development and innovation activities. Five hundred and thirty firms agreed to participate in the research. At the third stage, we sent professional interviewers to the firms and conducted onsite interviews. We finally conducted 308 face-to-face interviews with the structured questionnaire. After eliminating 38 incomplete responses with excessive missing data, we retained 270 complete questionnaires for our final analysis, with a valid response rate of 51% (270/530). Moreover, among 270 firms, 148 firms either received government R&D subsidies or knowledge transfer from public research institutions, whereas 122 firms did not receive any R&D support from government, suggesting low sampling bias.

For the nonresponse bias in the stages one and two, we performed the *t*-test comparing participating versus nonparticipating firms in terms of industry difference, number of employees, and sales growth. Results of this test indicated that there were no statistically significant differences ($P > 0.05$). Moreover, the top 10 provinces in our valid data are also in the top 10 gross domestic product list in 2007 (*China Statistical Yearbook* 2008), suggesting that our sample data are the representative of the national population in China.

3.2. Measurement

We measured questionnaire items with a 7-point Likert scale as shown in Appendix A, while their psychometric properties, which surpassed accepted norms, are discussed below and listed in Table 1.

3.2.1. Dependent variables

Several scholars have suggested that a comparative measurement approach is more effective at eliciting accurate responses about product innovation than a request for specific figures because many firms regard specific product innovation information as proprietary and confidential (Tomaskovic-Devey et al., 1994; Lau and Ngo, 2001). We therefore measured a firm's product innovation via comparison between the focal firm and its rivals in the industry. Following Zahra and Covin (1993) and Li and Atuahene-Gima (2001), we inquired about (1) a firm's comparative frequency of new product development and (2) the comparative novelty of its products (7-point Likert scale, 1 = 'very low', 7 = 'very high'). The Cronbach's alpha of this variable was 0.79, which was acceptable.

3.2.2. Independent variables

Government R&D supports can stimulate innovation in firms through both R&D subsidies and knowledge transfers (Bartholomew, 1997; Hall and Van Reenen, 2000). *Government R&D subsidy* was measured by the importance of R&D expenditures originated from government R&D subsidies and the importance of the research commissioned by the government to a firm's new product development. The Cronbach's alpha of this variable was 0.75. Similarly, *Government knowledge transfer* was measured by the importance of the knowledge transfer from universities and public research institutions to a firm's new product development.

Scales for *innovation capability* were adopted from the previous research (Guan and Ma, 2003; Burgelman et al., 2004). A five-item scale was used to measure the actually conditions of innovation capabilities of the firm. According to prior studies, innovation capabilities are defined as a set of organizational routines and processes, by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capability (Slater and Narver, 1995; Noble et al., 2002; Atuahene-Gima, 2005; Baker and Sinkula, 2007). However, these organizational routines and processes are also the function of a firm's resources and capacities to acquire, assimilate, transform, and exploit knowledge (Macher and Boerner, 2012). Thus, our study attempted to measure innovation capabilities by considering multiple factors. The first three items were mainly used to measure the R&D resource-exploiting capability, which represents a firm's ability to mobilize and expand its technological, human, and financial resources (Guan and Ma, 2003). These three items reflect a firm's capacity of applying appropriate process technologies to produce these new products, capacity of developing and adopting new product and processing technologies to satisfy the future needs, and capacity of responding to accidental technology activities and unexpected opportunities created by competitors (Adler and Shenbar, 1990). The fourth item was used to measure a firm's mechanisms, including routines and processes, for transferring knowledge from research to product development, whereas the fifth item was used to measure a firm's access to knowledge and technology information (Guan and Ma, 2003; Macher and Boerner, 2012). Thus, our measurement for innovation capabilities might thoroughly reflect a firm's resources, capacities, routines, and processes of acquiring, assimilating, transforming, and exploiting knowledge. The Cronbach's alpha was 0.96.

The types of *external knowledge sources* were operationalized by rating how often the four different types of external knowledge sources, including suppliers, customers, competitors, and consultants (Belderbos et al., 2004; Segarra-Blasco and Arauzo-Carod, 2008), were used by each firm (7-point Likert scale, 1 = 'the company does not use them', 7 = 'the company always uses them'). The Cronbach's alpha was 0.90, which was also acceptable as a measure for external knowledge sources.

3.2.3. Control variables

Large firms are usually deemed more powerful compared with small- and medium-sized firms because they have scale advantages in gaining resources for their business operations and innovation activities (Ettlie and Rubenstein, 1987). In this study, we used the logarithms of employees as the indicator of *firm size*. Moreover, we controlled for the *competitive intensity* of a firm's industry because 'when rivalry is fierce, companies must innovate in both products and processes, explore new markets, and find novel ways to compete' (Zahra, 1993, p. 319). The item used to measure competitive intensity was listed in Appendix A. *Stage of product life cycle* is also likely a variable affecting innovation efforts as well (Rink and Swan, 1979; Day, 1981). Thus, we controlled for this effect with an item that inquired about the stage of a firm's primary product. We controlled for *R&D expenditures* using the logarithm of R&D expenditures. Appendix A provides the measurement of all survey-based variables.

3.3. Reliability and validity

To assess the reliability and validity of the measures, we took several steps. First, because the sample included multiple respondents from 38 firms, we conducted an analysis of inter-rater agreement (Nunnally and Bernstein, 1994). The inter-rater classification coefficients were used to evaluate the agreement between different respondents. The intraclass correlation coefficient (1) was larger than 0.72 ($P < 0.05$) and ICC (2) was larger than 0.88 ($P < 0.05$), which suggests homogeneity between paired respondents. Although the 38 pairings accounted for less than 30% of the sample, they provided some confidence as to the reliability of the data (Shrout and Fleiss, 1979). Second, we addressed concerns about common method bias. Harman's (1967) one-factor test showed that the measures loaded cleanly on separate factors. Our analyses indicated that neither a single factor nor a general factor accounted for the majority of the covariance in the measures. Third, we analyzed the correlation between the new product development data and R&D expenditure data (Table 2). The results, 0.46 ($P < 0.01$), supported the survey's validity and reduced concerns of a single-respondent bias. All the above analytical approaches suggest that common method bias and single respondent bias were not serious concerns for our study (Podsakoff and Organ, 1986).

Moreover, we also analyzed each item's reliability and validity. The reliability, which measures construct identity (Campbell and Fiske, 1959), was strongly supported. Each loading for the multi-item variables

Table 2. Means, standard deviations, and correlations

	Mean	SD	1	2	3	4	5	6	7	8
1 New product development Innovation	3.68	1.31								
2 Firm size	5.58	1.94	0.18*							
3 Competition intensity	3.63	0.92	0.06	−0.01						
4 Product life cycle	2.31	0.80	0.10	0.16*	−0.02					
5 R&D expenditure	3.76	2.13	0.46**	0.21**	−0.02	−0.06				
6 Government R&D subsidy	1.41	1.48	0.21**	0.13	−0.14*	0.01	0.23**			
7 Knowledge transfer	3.39	2.42	0.20**	−0.00	0.10	−0.05	0.25**	0.29**		
8 Innovation capabilities	4.26	2.13	0.35**	0.04	0.07	−0.02	0.32**	0.35**	0.58**	
9 External knowledge Sources	2.85	1.93	0.36**	0.12	0.11	0.10	0.38**	0.40**	0.49**	0.57**

Correlations greater than 0.13 are significant at $^*P < 0.05$, and those greater than 0.17 are significant at $^{**}P < 0.01$. SD, standard deviation.

was significantly related to the appropriate underlying factor. All standardized item loadings (see Table 1) were well above the cutoff of 0.60 (Hildebrandt, 1987), supporting reliability of this research.

4. Results

Table 2 shows the descriptive statistics and correlations of the variables. Overall, the magnitudes of the correlations and variance inflation factors, which are all below 10, suggest that multicollinearity is not a problem in the models (Neter et al., 1990).

Table 3 shows the results of regression models estimating the effects of government R&D subsidy, knowledge transfer from universities and public research institutions, external knowledge sources, and innovation capabilities on new product development. Hypotheses 3a and 3b suggested the mediation role of innovation capabilities. To test the mediation effect, we followed the procedures outlined by Baron and Kenny (1986). We first assessed whether government R&D subsidy and knowledge transfer from universities and public research institutions were significantly related to new product development, and both of them were supported in Model 2 and Model 3 ($P < 0.05$), suggesting the direct effects of government R&D subsidy and knowledge transfer from universities and public research institutions on new product development were supported (Hypotheses 1 and 2 were supported). Second, as Model 4 showed, innovation capabilities were significant predictors of new product development ($P < 0.001$). Then, we tested the significant effects of government R&D subsidy and knowledge transfer from universities and public research institutions on innovation capabilities (see Model 5 and Model 6, $P < 0.01$ for both of them). Finally, when we introduced innovation capabilities into the Model 2 and Model 3 (see Model 7 and Model 8), we found that the beta coefficients for government R&D subsidy and knowledge transfer were less significant ($P > 0.05$). Thus, Hypothesis 3a and Hypothesis 3b were supported.

We also tested the moderated effect of external knowledge sources on the mediation relationships. Following Aiken and West (1991), we mean-centered the variables (transforming the data into deviation score form with means equal to zero) and reran the regression to minimize any distortion due to high correlations between the interaction term and its component variables. As Model 9 and Model 10 show, government R&D subsidy ($P < 0.01$), knowledge transfer from universities and public research institutions ($P < 0.01$), external knowledge sources ($P < 0.01$) and their moderating effects ($P < 0.05$ for both of them) were significant predictors of innovation capabilities. However, the interaction of government R&D subsidy and external knowledge sources negatively affects innovation capabilities, which was against our positive-relationship prediction. Thus, Hypothesis 4a was not supported, but Hypothesis 4b was supported. The result suggests that government R&D subsidies substitute other external knowledge sources whereas knowledge transfer from universities and public research institutions complements other external knowledge sources.

5. Discussion

Our findings suggest both government R&D subsidy (giving fish) and knowledge transfer from universities and public research institutions (teaching to fish) improve new product development. However, should we give fish for one day or teach to fish for a life? Taking the government R&D support as an example, our research suggests that teaching to fish is much helpful than giving fish. More importantly, our findings suggest that innovation capability plays an important bridge role in the above relationships. This

Table 3. Results of hierarchical regression models

Model	Model 1	Model 2	Model 3	Model 4	Model 5	Model6	Model 7	Model 8	Model 9	Model 10
Dependent variable	New product development	New product development	New product development	New product development	Innovation capabilities	Innovation capabilities	New product development	New product development	Innovation capabilities	Innovation capabilities
Firm size	0.05	0.04	0.05	0.05	–0.07	0.01	0.05	0.05	–0.04	–0.05
Competition intensity	0.05	0.07	0.3	0.01	0.36*	0.15	0.02	0.01	0.12	0.05
Product life cycle	0.14	0.14	0.13	0.13	0.06	0.01	0.13	0.13	–0.16	–0.15
R&D expenditure	0.28***	0.26***	0.25***	0.13***	0.27***	0.18**	0.23***	0.23***	0.11	0.08
Government R&D subsidy		0.12*			0.51***		0.05		0.60***	
Knowledge transfer			0.08*			0.49***		0.01		0.72***
Innovation capabilities				0.15***			0.13**	0.14**		
External knowledge sources									0.88***	0.82***
Government R&D subsidy × external knowledge sources									–0.28*	
Knowledge transfer × external knowledge sources										0.46*
R^2	0.24	0.25	0.26	0.29	0.23	0.40	0.29	0.29	0.44	0.53
ΔR^2		0.01	0.02	0.05			0.04	0.03	0.11	0.13
F	28.00***	22.08***	23.28***	27.06***	19.79***	44.17***	21.57***	21.57***	34.44***	49.43***

*$P < 0.05$,
**$P < 0.01$,
***$P < 0.001$ (two-tailed test).
R&D, research and development.

means that the effort of innovation capabilities to absorb the supported government resources realizes this latent potential for new product development. Finally, the results show that external knowledge sources interact with government R&D support differently between these two mediating relationships. Firms normally access various external knowledge sources simultaneously. Our findings suggest that external knowledge sources substitute with the government R&D subsidies (vice versa) but complement with knowledge transfer from universities and public research institutions. The results confirm the old sayings that teaching to fish (knowledge transfer from universities and public research institutions can complement with other external knowledge sources) is much better than giving fish (R&D subsidies substitute other external knowledge sources).

Prior innovation literature suggests that government R&D supports improve a firm's innovation (Herrera and Nieto, 2008) and our model support this relationship (Model 1). Government R&D subsidies enhance new product development by providing R&D financial supports. Because new product development is a capital-intense and time-consuming activity with a higher risk, sufficient R&D capital allows continuously product development actions for multiple projects (Dierickx and Cool, 1989; Kor and Mahoney, 2005). On the other hand, knowledge transfer from universities and public research institutions allows important technology exchanges, which can improve the firm's new product development efforts.

Furthermore, in line with Cohen and Levinthal (1990), absorptive capacity promotes new product development through the integration, transformation, and exploitation of both internal knowledge and external knowledge. However, these results underscore the importance of the combined effects of government R&D support and innovation capabilities. Our theoretical and empirical models demonstrate that such direct effects are not the most accurate model of new product development.

Building from the nascent literature stream on innovation capabilities (Atuahene-Gima, 2005), we argue how and why a firm's internal capability – innovation capability – mediates the relationship between government R&D support and new product development. Our findings suggest that government R&D support can be viewed as the first stage of the overall new product development process, but it is the firm's innovation capabilities to effectively integrate, transform, and exploit these resources that actually yield new product development. These results contribute to innovation research by more accurately pointing out the effect of government R&D support mediated by innovation capabilities on new product development.

Although innovation capabilities fully mediate the relationship between government R&D support and new product development, the combined effect of government R&D support and other external knowledge sources is often neglected in prior research. Our study also shows that external knowledge sources substitute for government R&D subsidies, although they complement with knowledge transfer from universities and public research institutions. Although the prior theoretical argument suggests that firms may increase their internal R&D efforts when they receive government subsidies, we believe that government subsidies may provide a perverse incentive that crowds out other external R&D efforts (David et al., 2000). On the contrary, knowledge transfer from universities and public research institutions generates a firm's incentive to search more technologies for the sake of new product development. Our results indicate that knowledge transfer is a better tool for the government to motivate a firm's new product development, just like the old saying: teaching a man to fish.

6. Conclusion

Our research contributes to innovation research domains and also offers insight into the practice of governmental policies for enhancing a firm's innovation competence. Our results suggest that government R&D support and a firm's internal and external resources as a whole are critical determinants for new product development when the government intends to improve a firm's competitive advantages through R&D subsidies or knowledge transfer. This research contributes to the exiting literature by elaborating the importance of knowledge transfer from universities and research institutions on a firm's new product development from the KBV's perspective. It is the processes of knowledge transfer (teaching how to fish) instead of financial subsidies (giving fish) to better enhance a firm's new product development. In order to facilitate the knowledge transfer processes, the firm should possess superior internal innovation capabilities to absorb and integrate external resources and knowledge. Moreover, our study also contributes to the current literature by examining the effect of government support with the Chinese data. It is well known that firms in emerging economies, such as China, lack sufficient financial capital for high-cost R&D activities. Therefore, it is especially crucial for firms in emerging economies to effectively and efficiently use government support, including financial

R&D subsidies and knowledge transfer, to enhance their R&D activities. Our empirical results suggest that knowledge transfer (teaching how to fish) is a better mechanism of government supports than R&D subsidies (giving fish) in the context of China.

It is essential for both governmental policy makers and managers to understand the interaction between government R&D support and a firm's internal innovation capabilities and external knowledge resources. Government supports for R&D activities has been regarded as a viable way to enhance national innovation. Therefore, governments have spent a significant amount of money on R&D subsidies. For example, the Chinese government's R&D expenditures were more than 10 billion US dollars in 2012. However, the different support mechanisms may lead to various results as shown in our findings. Although both the direct R&D subsidy and knowledge transfer from the university and public research institutions can improve firms' new product development, such two effects of government support may reflect two different important implications to the government. First, firms that receive government support must possess high-level innovation capabilities, which allow the firms to integrate government support into their new product development. Second, the direct R&D subsidy may crowd out the other external knowledge sources. Based on these two findings, the government should create an appropriate criterion to select the receiver of government supports. A firm with a higher level of innovation capabilities should be considered as a more qualified receiver. Moreover, governments also need to choose the form of supports with cautions. The encouragement and support of knowledge transfer from universities and public research institutions is a better way to improve new product development than the direct R&D subsidy. As a result, our findings provide more insights by categorizing government supports into the direct R&D subsidy and knowledge transfer from the university and public research institutions.

From the perspective of managers, although government support is a valuable supplement to a firm's internal R&D resources, the firm's innovation capabilities is complementary to integrate and exploit the external resources and knowledge, which may be crowded out if the firm also receives the government R&D subsidies. Managers, therefore, should be cautious about how to use their innovation capabilities to exploit external resources and knowledge while receiving R&D subsidies.

There are several interesting future research directions to pursue based on the results of this study. First, in terms of causality, the time-lagged effects of government R&D support on new product development may exist. Further studies are suggested to use longitudinal data and longer time lags between government R&D support, innovation capabilities, and new product development. Second, although government R&D subsidy and knowledge transfer are two critical types of government policies for innovation stimulation (Deeds et al., 1997), other forms of government incentives may be also worth for further investigation. For instance, the government-sponsored R&D programs and government procurement may affect a firm's innovation capabilities and new product development differently. Third, the sample was collected mainly from Chinese firms, and therefore the results may not be fully generalizable in other countries. Future research is suggested to compare the Chinese firms and firms in other countries.

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Appendix A

New product development

Rate your venture relative to its major competitors over the last 3 years the extent to which it has:

(1) The frequency of new product development;
(2) The novelty of new product development.

(7-Point Likert scale: 1 = extremely high, 7 = extremely low)

Government R&D subsidy

Rate the degree to which of these statements describes your new product development:

(1) The importance of the government R&D subsidy to firm's new product development;
(2) The importance of the research commissioned by government to firm's new product development.

(7-Point Likert scale: 1 = not important at all, 7 = extremely important).

Government knowledge transfer

(1) The importance of the knowledge transfer from universities and public research institutions to firms new product development.

(7-Point Likert scale: 1 = not important at all, 7 = extremely important).

Innovation capabilities

Please indicate the level of the following capabilities

(1) You company attaches importance to human resource;
(2) Your company selects key personnel in each functional department into the innovation process;
(3) Your company provides steady capital supplement in innovation activity;
(4) Your company has good mechanisms for transferring knowledge from research to product development;
(5) You company has access to knowledge and technology information.

(7-Point Likert scale: 1 = strongly disagree, 7 = strongly agree)

External knowledge sources

Please describe the relationship with these companies as the source of knowledge:

(1) Suppliers;
(2) Customers;
(3) Competitors;
(4) Consultants.

(7-Point Likert scale: 1 = 'the company does not use them', 7 = 'the company always uses them')

Firm size (log employee number)
Industry development stage (1 = introduction; 2 = growth; 3 = maturity; 4 = decline)
Competition intensity (7-point Likert scale: = no competition at all, 7 = intensive competition)

R&D expenditure

Please indicate your firm's R&D expenditure as compared to your industry's average. (7-Point Likert scale: 1 = very low, 7 = very high)