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Drivers of Local Firms' Focus on Internal R&D in Emerging Economies and Their International Performance

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A thesis

Submitted in partial fulfillment
of the requirements for the degree of
Master of Science in Management
(Organization Studies with focus on International Business)

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ABSTRACT

Grounded on the resource-based view of the firm, the study of this thesis investigates the effect of four internal and external factors – engineer intensity, location, affiliation with the government, government funding – on Chinese firms' decision to either invest in internal R&D activities or external R&D and the effect of this decision on the firms' international market success. In addition, the moderating role of the presence of foreign firms in China is examined. To understand these relationships, the thesis' theorization focuses on the issue of how firms can combine optimally the two options – "internal R&D" and "external R&D". In this regard I juxtapose internal R&D and external R&D and compare their advantages and disadvantages. To test my model, I apply panel data from the Annual Industrial Survey Database provided by the Chinese National Bureau of Statistics. My results show that three of the four investigated factors affect Chinese firms' resource allocation decisions; and effective resource allocation decisions lead effectively to international market success, strengthened by the presence of foreign firms in China. Moreover the findings bear several theoretical and managerial contributions. First I propose the last dimension of the "VRIO framework" – "organization" – as an endogenous component of the VRIO framework, as my study investigated how firms can effectively combine resources to generate a competitive advantage in terms of international market success. Previous academic literature so far focused on examining whether internal and external R&D are complements or substitutes. My study fills a gap in the literature by investigating the determinants of the efficient combination of the two strategies and the outcome of the combination. One of the managerial implications is that Chinese firms can learn from foreign companies that are present in China.

Keywords: resource-based view, internal R&D, external R&D, international market success, emerging market, China

ACKNOWLEDGEMENTS

I offer my sincerest gratitude to my supervisor, Dr. Marshall Jiang, for his continuous support, guidance and encouragement throughout my whole Master of Science in Management program. As my mentor and advisor, he enabled to expand my knowledge and competence as a researcher. I also appreciate it very much that he always gave prompt responses to all my queries and immediate feedback at every stage of the thesis. It has been an honor to work with him.

I am also very grateful to my thesis committee members, Dr. Dirk De Clercq and Dr. Maxim Voronov, for their insightful suggestions and valuable comments during the development of my thesis. Special thanks to Dr. Dirk De Clercq for providing me deep insights into methodology issues and to Dr. Maxim Voronov for making me become aware of how the process of theorization works. Many thanks also to my external examiner, Dr. Shavin Malhotra, for the feedback he gave me during my thesis defense.

I also want to acknowledge the Dean's office at Goodman School of Business, including the Associate Dean Dr. Ernest Biktimirov, for providing additional funding so that I could attend conferences that helped me to gain experience in presenting my research results in front of other scholars and to obtain new knowledge for my own research during the discussions.

I would like to extend my appreciation to all my new friends in North America who supported me during the two years. Special thanks to my friend, Haiyue (Felix) Xu, for providing me with valuable knowledge and insights into the Chinese culture. Special thanks also to my friend, Asif Malik, for the great conversations we had together regarding economic, political and social issues. Your cultural knowledge and work experience in

different countries enabled me to get a better view of the globalized world. I wish both of you the best for your PhD programs as well as your future. I also want to acknowledge my roommates, Alexander Ivancic and Paige Darling, for the great time we spent together in our leisure time as well as for your invitations at your parents' homes to celebrate national holidays or special events. All the best for your future as well.

Last, but by no means least, I would like to say thank you to my friend, Jan Banning, from Copenhagen Business School for the numerous Skype conversations we had during my two years in Canada. Our discussions regarding research topics and business issues also made important contributions to my learning process.

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1. INTRODUCTION

Among the big challenges that firms are confronted with in today's world are the fast-changing market environments (Berchicci, 2013). Due to the globalization process, the worldwide competitive pressure continually increases and product life cycles become shorter, such that firms have to update their technological know-how and capabilities continuously in order to survive (Christensen, 2013; D'Aveni, 1994; Foster & Kaplan, 2011). Moreover these technological conditions have an impact on the strategic decisions of firms, among which innovation processes and research and development (R&D) activities play critical roles (Holcomb & Hitt, 2007; Howells, Gagliardi, & Malik, 2008). In this regard, the allocation or organization of firms' resources is very important. Not only the answer to the question how firms can make an optimal configuration between internal and external R&D is important, but also the implication of how firms can efficiently organize other important resources such as physical capital resources (Williamson, 1975), human capital resources (Becker, 1964), organizational capital resources (Tomer, 1987) and financial resources (Bower, 1986; Noda & Bower, 1996). These thoughts and issues are summarized under the theoretical perspective of the resource allocation theory in the strategic management literature (Schendel & Hofer, 1978).

In this thesis, the focus of firms' allocation decision is on the allocation of financial resources between internal R&D activities and external R&D. There is a big gap in the literature regarding how firms can combine these two options in the most efficient way to obtain a competitive advantage. Until now, the academic literature mainly focused on answering the question whether these two options are substitutes or complementary to each other (e.g. Arora & Gambardella, 1990; Cassiman & Veugelers, 2006; Ennen &

Richter, 2010; Hagedoorn & Wang, 2012). Moreover, few antecedent variables that have an impact on the firm's decision to focus more on internal R&D or external R&D have been studied, most of them in relative theoretical isolation. My thesis broadens this by combining a concrete theoretical perspective of the issue with an empirical test. To fill this gap in the literature, I developed a theoretical model. First of all, based on the resource-based view (RBV), the study investigates the effect of four internal and external factors – engineer intensity, location, affiliation with the government, government funding – on Chinese firms' decision to either invest in internal R&D activities or external R&D and the effect of this decision on the firms' international market success. Each of these antecedents is a typical representative of each of the four resource categories according to Barney (1991). Second, the study examines the moderating role of the presence of foreign firms in China. While focusing on China as a typical emerging market country, I also try to integrate major issues of the innovation literature into the international business context and fill another gap in the literature in this regard. Another reason that I include Chinese firms in my sample is that previous studies treating firms' technological sourcing decisions between internal R&D and external R&D mainly analyzed firm-level data from westernized developed countries such as USA, UK, Belgium, France, Spain and Italy.

To test my model, I use panel data from 2001 to 2007 of Chinese manufacturing firms from the Annual Industrial Survey Database provided by the Chinese National Bureau of Statistics (CNBS). A big advantage of this database is that it contains very extensive information about Chinese companies. The reason is that all companies, both local and foreign, are required by law to submit their annual financial information and demographic information to CNBS (Chang & Xu, 2008). Chow (1993) also verified the

high accuracy and consistency of the data included in the Annual Industrial Survey Database.

The contribution of the study is multifaceted. First, I extended the RBV by arguing that the last dimension of the "VRIO framework" – "organization" – is an endogenous component (rather than an exogenous one as the RBV suggests) since my study investigated what determines the "O" component (effective combination of resources), and how effective combination of resources can generate a competitive advantage in terms of international market success. Second, instead of discussing whether there is a complementary or substitute effect between internal and external R&D as the literature extensively discussed, this study fills a gap in the literature by investigating the determinants of the two strategies and their most efficient combination. Third, this study is one of the few that empirically tests the RBV. The measures operated in this study are designed based on the typology of resources by Barney (1991). One of the managerial implications is that Chinese firms can learn from foreign companies that are present in China.

The remainder of this thesis is organized as follows: In the next section, I will review the literature on internal and external R&D. Main focus is on the comparison of the advantages and disadvantages of both options. Moreover I will heavily review the academic literature regarding studies that investigated antecedents and consequences of internal and/or external R&D. Section three presents the theorization and the development of the research model. The key elements of the RBV will be reviewed and applied to my model together with the findings of my literature review. In the following section after the reviews, the hypotheses will be developed. In section five I will discuss the methodology with the description of the dataset, the measurement of my variables and data analyses

techniques as well as the results of the study. Finally the discussion section concludes with several theoretical and managerial contributions of my study as well as with recommendations for future research.

2. LITERATURE REVIEW

In this section I will provide an overview of the key constructs and a review of the literature relevant to my model. Specifically, I will first give basic definitions of internal and external R&D. Then I will compare the two closely related activities, particularly pay close attention to identify the advantages and disadvantages of internal and external R&D. Finally I will review comprehensively the studies that investigated antecedents as well as consequences of internal and external R&D.

I adopted the following approach to make a selection of journals for the literature review. First my research topic requires me to think interdisciplinarily. On the one hand, my study focuses on innovation and R&D related issues; on the other hand, the study is situated in an emerging market context, which requires an international perspective. As a result, I need to combine the existing knowledge from these different fields. The Financial Times' Journals List (Top 45) was used as the guidance for journal selection, as the list enjoys great popularity and contains journals with high impact factors[1]. The categories such as "General Management", "Organizational Behavior" and "Economics" are quite relevant for my topic. So in addition to the 45 FT journals, the *Journal of Management, International Journal of the Economics of Business, Oxford Bulletin of Economics and Statistics, R&D Management, Research Policy* and the *International Journal of*

[1] http://www.ft.com/intl/cms/s/2/3405a512-5cbb-11e1-8f1f-00144feabdc0.html#axzz3jRCRKcU0

Technology Management were added to the journal list, due to relevant findings during the review of the primary articles. All these journals that I additionally added enjoy high impact factors and are therefore accepted in the academia. Table 1 below lists all journals that I finally used to search for articles for my literature review in the database (Web of Science – Complete), summarized in main categories. The journals listed in the Financial Times' Top 45 list are shown as non-italic, the other ones as italic.

List of Journals for the Literature Review
(a) General Management
Academy of Management Review Academy of Management Journal Journal of International Business Studies Management International Review Strategic Management Journal *Journal of Management*
(b) Organizational Behavior
Organization Science
(c) Economics
Econometrica Journal of Political Economy The American Economic Review The Rand Journal of Economics *International Journal of the Economics of Business* *Oxford Bulletin of Economics and Statistics*
(d) Practitioners
Sloan Management Review
(d) Other
Administrative Science Quarterly *R&D Management* *Research Policy* *International Journal of Technology Management*

Table 1: List of Journals

2.1. Basic concepts

Even though it is widely known what R&D means, I will shortly discuss a suitable definition for the thesis and then compare the various facets of internal and external R&D.

2.1.1. Research and Development (R&D)

A great definition of R&D can be found on the homepage of the National Science Foundation. R&D activities are defined as "[…] creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications"[2]. An important element of this definition of R&D is that of the knowledge creation. From my perspective, this new knowledge that is created in the first step before making a concrete product is of high importance, especially in today's fast changing world with shorter and shorter product life cycles and a high pace of market evolvement. Moreover, this knowledge-creating facet of R&D shows that lots of resources are needed in R&D activities, such as highly qualified human resources. Therefore it stands to reason that knowledge is the power to finalize a new product or idea and successfully introduce it in the market.

There are two components of R&D activities: "research" on the one hand and "development" on the other hand. In the literature there is a distinction between basic research and applied research. Basic research is defined as "[…] systematic study directed toward fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or

[2] http://www.nsf.gov/statistics/randdef/fedgov.cfm

products in mind"[3]. This is the knowledge-creating stage before the creation of a concrete product. Research institutes and universities usually focus on fundamental or basic research, so companies can have access to it through collaboration with these research organizations. The specific product is realized through applying the basic research. Thus, applied research is defined as "[…] systematic study to gain knowledge or understanding necessary to determine the means by which a recognized and specific need may be met"[4]. In this case, the concrete connection between the knowledge and a product is made. To make a specific product, the development process has to take place. Development is defined as "[…] systematic application of knowledge or understanding, directed toward the production of useful materials, devices, and systems or methods including design, development, and improvement of prototypes and new processes to meet specific requirements"[5].

Important for this thesis is to keep these definitions in the mind because the component of knowledge and its complexity in particular is crucial for a firm's decision about whether to do R&D in-house or to access external knowledge. Creating new knowledge requires a huge amount of resources; yet translating new knowledge into final products is equally complex and cost intensive. Both internal and external R&D require the two processes. Therefore a comparison between internal R&D and external R&D in terms of their advantages and disadvantages is necessary.

[3] http://www.nsf.gov/statistics/randdef/fedgov.cfm
[4] http://www.nsf.gov/statistics/randdef/fedgov.cfm
[5] http://www.nsf.gov/statistics/randdef/fedgov.cfm

2.1.1.1 Internal R&D

In the literature, common similar expressions for internal R&D are internal innovation or in-house innovation (Marta & Woerter, 2013; Montoya, Zarate, & Martin, 2007). Internal R&D refers to the R&D activities that are fully carried out inside the firm. Specifically this means that all resources that are necessary for the internal research and development processes are provided by the firm itself. These resources do not only include physical resources such as technical equipment, but also all other types of resources, such as human resources (e.g. engineers), organizational resources or financial resources. All in all, the firm creates the systematic new knowledge during the R&D process without relying on external help.

2.1.1.2 External R&D

I use the term external R&D as an indication of contractually paid R&D performed by an independent provider that is either a firm or a research organization (Grimpe & Kaiser, 2010). In simple terms, external R&D includes all the systematic technology and knowledge that comes from the outside of the firm. External R&D has many facets. It can include R&D collaboration (e.g. Tsai & Wang, 2009), which includes partnering with universities and research institutes (e.g. Fey & Birkinshaw, 2005; Piga & Vivarelli, 2004). Moreover firms can get access to external knowledge through acquisition of external R&D (e.g. Nicholls-Nixon & Woo, 2003; Tsai & Wang, 2007), R&D alliances with other firms (e.g. Fey and Birkinshaw, 2005; Noorderhaven, 2002), outsourcing of R&D activities (e.g. Bertrand & Mol, 2013; Tsai & Wang, 2009) or inward technology licensing (e.g Tsai & Wang, 2009).

2.1.1.3. Comparison of internal and external R&D

In table 2 I compare the definitions and basic concepts of internal and external R&D. To summarize, the definitions lead to the conclusion that external R&D contains more forms and seems to be more complex in terms of organizing and managing the activities than doing in-house research and development.

Comparison of internal and external R&D	
Internal R&D	**External R&D**
• R&D activities that are fully carried out by the firm itself and inside the firm (in-house innovation) *(Marta & Woerter, 2013; Montoya, Zarate, & Martin, 2007)*. • The firm creates the knowledge by itself.	• Contractually paid R&D performed by an independent provider that is either a firm or a research organization *(Grimpe & Kaiser, 2010)*. • All technology and knowledge that comes from the outside of the firm. • Facets: ○ **R&D collaboration** *(e.g. Fey & Birkinshaw, 2005; Piga & Vivarelli, 2004; Tsai & Wang, 2009)* ○ **R&D alliances** with other firms *(e.g. Fey and Birkinshaw, 2005; Noorderhaven, 2002)* ○ **Acquisition of R&D** *(e.g. Nicholls-Nixon & Woo, 2003; Tsai & Wang, 2007)* ○ **R&D outsourcing** *(e.g. Bertrand & Mol, 2013; Tsai & Wang, 2009)* ○ **Inward technology licensing** *(e.g. Tsai & Wang, 2009)*

Table 2: Comparison of internal and external R&D

2.2. Advantages of internal R&D

Zahra and Nielsen (2002) conducted a study to examine the relationship between sources of manufacturing capabilities and technology commercialization (TC). In detail, the study investigated internal HR-based manufacturing sources and internal technical manufacturing sources as well as external HR-based manufacturing sources and external technical manufacturing sources. The dependent variable TC contained four measures: number of new products, number of radical new products, number of patents and the speed of the technology commercialization. Based on the study's results, the hypotheses with the relationships between internal manufacturing capabilities and technology commercialization are fully supported and the relationships between external manufacturing capabilities and technology commercialization are only partly supported. External HR sources and external technological sources are negatively related to the number of patents and the radicalness of new products, whereas they are positively related to the TC speed of technology commercialization and the number of new products. These results provide useful knowledge about the advantage of internal R&D. Even though external sources can increase the speed and the frequency of technology commercialization, the problem with external sources is that they are not completely new, as the negative impact of external sources on the number of patents and radicalness of the new products in the study shows. Therefore Zahra and Nielsen's (2002) study confirms that firms can more easily gain a competitive advantage when focusing on internal R&D instead of acquiring external R&D.

This advantage of internal R&D is confirmed by other studies. Lei, Hitt and Bettis (1996) developed a model of the development and outcomes of dynamic core competences, which is defined as the firm's ability to identify and solve problems

internally. These core competences are based on organizational learning. Therefore it is argued that firm's core competences produce organizational specialization, which itself results in a sustainable competitive advantage. As internal R&D activities fulfill the characteristics of core competence, Lei, Hitt and Bettis (1996) suggest that internal R&D results in a competitive advantage to a higher degree. These results are echoed by Chiesa, Manzini and Pizzurno (2004). Their empirical study is highly practice-oriented and contains many managerial and organizational implications, confirming that internal R&D activities are the real source of a company's sustainable competitive advantage. They also point out that external R&D can be available to other firms, which might be the major competitors of the focal firm.

There are other advantages of internal R&D. Some research examined that in industries with strict intellectual property rights firms focus more on internal R&D activities as the protection of intellectual property makes the acquisition of external R&D unattractive or nearly impossible. In a study about Belgian manufacturing firms, Veugelers and Cassiman (1999) investigated the relationship between technology protection mechanism and the make-buy decision of firms and came to the result that strong appropriation promotes firms to develop and produce technology by themselves. This finding is confirmed by Love and Roper's (2002) study of UK manufacturing plants that investigated that plants with a high market share in an industry sector tend to conduct more internal R&D, especially when rivalry is very high. One of the conditions for those plants to engage in internal R&D is that these plants have a bigger research staff. The study hypothesizes that plants with this condition are anxious to protect their property rights because the protection of their property rights is not effective when there are

extensive R&D collaborations with other firms. Therefore it is concluded that the protection of intellectual property makes acquiring external R&D unattractive.

There are also types of technologies that have to be developed in-house as (1) there is either no way to trade the technology or (2) it would be entirely inefficient (Barney, 1999). The argumentation of the inefficiency can be understood by the aid of the transaction cost logic: when the transaction costs are too high, a firm cannot afford external R&D. A practical example for the first reason is when no other solution exists in the market and therefore the needed technologies cannot be traded. A needed technology can be very special so that there is no such technology in the market, or the needed technology is so new that it has not been invented. In this case, the focus on internal R&D as the only solution for companies can result in a competitive advantage, especially at the beginning of the innovation process of companies (Barney, 1999).

One big drawback of external R&D sources has been investigated in the literature concerning firms' knowledge development in strategic alliances. It is evident from Larsson's, Bengtsson's, Henriksson's and Sparks' (1998) developed conceptual framework of interorganizational learning that firms' heavy dependence on external R&D results in a general dependence on others. This dependency leads to conflicts between partners on the one hand and impairment of firm's own innovation capability on the other hand, which consequently leads to the loss of a firm's own knowledge. This is in line with the argument that firms can generate a competitive advantage through conducting internal R&D (Lei, Hitt, & Bettis, 1996; Zahra & Nielsen, 2002; Chiesa, Manzini, & Pizzurno, 2004).

A recent study of Swiss firms investigated the different effects of firms' internal and external R&D strategies on their performance, measured by the price cost margin (PCM)

of the firm. Moreover the difference in the risk levels of both innovation strategies was measured in a quantile regression analysis. One of the main results of the study is that external R&D is riskier than internal R&D (Mata & Woerter, 2013). This is in contrast to the findings of other studies (e.g. Chiesa, Manzini, & Pizzurno, 2004) that examined that external R&D can reduce the risk of firms as the outcomes of internal R&D cannot be predicted for sure. However, another result of Marta and Woerter (2013), besides that external R&D is more risky, is that external R&D has a bigger effect on the performance of the firm than in-house innovation.

2.3. Advantages of external R&D

Even though internal R&D is the real source of sustainable competitive advantage, there is also literature present with the position that acquiring external R&D results is an important component for firms to gain a competitive advantage, especially as technologies become more and more complex and because of the increasing pace of the technological developments. This position was mainly supported by Zahra, Sisodia and Das' (1994) conceptual paper that links technology strategy and competitive strategy with company performance. According to their paper, technology sourcing is one of the major dimension of firms' technological strategy and acquiring external R&D allows firms to gain a competitive advantage. This standpoint is also supported by the exploration literature. The conducted study of 56 new business development projects by McGrath (2001) confirms that adding external R&D resources is crucial in new business development processes, especially to be successful in fast changing market environments. In a similar manner Danneels (2002) concluded that the acquisition of external R&D competences for product

innovation helps to build new competences to keep up with the pace of the environmental changes.

A related advantage of external R&D towards the performance of firms was identified in a study conducted by Montoya, Zarate and Martin (2007). They investigated whether the technological sourcing decision, characterized as the choice between internal and external R&D stock, affects the performance of a firm. According to the study, firms that decide to invest small amounts of resources on the technological activity obtain a higher performance when they use external R&D instead of doing in-house innovation. Therefore it can be concluded similarly to the argumentation that external R&D results in a competitive advantage that companies can benefit from external R&D in the way that it can help firms to differentiate themselves in their performance from the rivals under certain conditions.

The study conducted by Zahra and Nielsen (2002) does not only indicate a major advantage of internal R&D, but also examined an advantage of acquiring external R&D. As already mentioned, the paper investigated positive relationships between external sources of manufacturing capabilities and both the speed of technology commercialization and the frequency with which new products are created and introduced in the market. Acquiring external technology results in a higher flexibility of firms, as they can get the desired assets quickly. Innovation processes can be accelerated, which is reflected in the speed of technology commercialization and the higher number of products that can be made (Zahra & Nielsen, 2002). Similarly, the research by Henderson and Cockburn (1996) about the relationship between firm size and research productivity in the pharmaceutical industry suggests that the acquisition of external R&D expands the technological capacity of firms and therefore helps them to surpass their competitors.

Chiesa, Manzini and Pizzurno (2004) conducted an empirical study that consists of an extensive analysis and a case study of companies that offer R&D to other companies (in-sourcing of R&D projects). The paper investigates characteristics of this product development market in general and analyzes the management and organization of such R&D service firms in detail. The case study of a particular service company, the MR&D-Institute, examined that acquiring external R&D and external support enables firms to get access to highly specialized technology, while the risk associated with the innovation and development process is rapidly reduced. In the meantime, the time needed for the innovation process can be reduced through the aid of external R&D support (Chiesa, Manzini, & Pizzurno, 2004).

More advantages of external R&D are mentioned in an article by Vanhaverbeke, Duysters and Noorderhaven (2002). First of all, adding external R&D enables firms to increase the speed of the technological developments. Second, the costs for research and development can be reduced when having access to external sources, as the initial required investments have been installed. The firm can generally handle the complexity of the technological development in a more efficient way. These advantages of external R&D are actually the disadvantages of internal R&D. Specifically, internal R&D is costly, time-consuming and risky, as the results of internal R&D processes cannot be forecasted accurately. Therefore, having access to multiple resources and capabilities is a big advantage (Leonard, 1995).

The research on the core capabilities of a firm also highlights the advantage of external R&D. A firm can have a stock of R&D that cannot adjust to the changes in its environment. Some capabilities become rigidities (Leonard-Barton, 1992). This problem can be solved by adding external innovation knowledge in order to avoid these rigidities.

2.4. Comparison of the advantages of internal and external R&D

Comparison of the advantages of internal and external R&D	
Advantages of internal R&D	**Advantages of external R&D**
• Internal R&D as a source of sustainable **competitive advantage** *(Chiesa, Manzini, & Pizzurno, 2004; Lei, Hitt, & Bettis, 1996; Zahra & Nielsen, 2002).* • **Intellectual property rights** as an incentive to conduct internal R&D *(Love & Roper, 2002; Veugelers & Cassiman, 1999).* • **Some technological assets cannot be traded** *(Barney, 1999).* • **Independence** (from others) *(Larsson, Bentsson, Henriksoon, & Sparks, 1998).* • **Avoidance of losing own business knowledge** *(Larsson, Bentsson, Henriksoon, & Sparks, 1998).* • **External R&D strategies are riskier than in-house innovation** *(Mata & Woerter, 2013).*	• External R&D enables firms to gain a **competitive advantage** *(Danneels, 2002; McGrath, 2001; Zahra, Sisodia, & Das, 1994).* • Expansion of a firm's **techno-logical capacity** *(Henderson & Cockburn, 1996; Montoya, Zarate, & Martin, 2007).* • Acquisition of external R&D results in a **higher flexibility** of firms *(Zahra & Nielsen, 2002).* • **Access to highly specialized technologies** *(Chiesa, Manzini, & Pizzurno, 2004).* • **Reduction of risk and time** *(Chiesa, Manzini, & Pizzurno, 2004).* • **Reduction of the costs** of technological developments *(Vanhaverbeke, Duysters, & Noorderhaven, 2002).*

Table 3: Comparison of the advantages of internal and external R&D

Table 3 summarizes the key findings about the advantages and disadvantages of internal and external R&D. Juxtaposing them side by side is helpful for comparison. The review reveals that the main tensions in R&D activities are related to some of the input factors, such as time, speed, and costs. One issue is about which brings competitive advantage to the firm – internal R&D or external R&D. Some studies maintain that internal R&D is the true source of competitive advantage for firms, whereas other studies examined that benefiting from external R&D can result in a competitive advantage. My

view is that the advantages of internal and external R&D are strongly situation dependent. Consequently, the question of how to allocate firms' resources between internal R&D and external R&D based on firms' availability of resources has the potential to contribute to the literature. This is the reason why I will investigate four factors that determine a firm's decision to allocate financial resources between internal and external R&D from the RBV.

2.5. Consequences of internal or external R&D

In the following paragraphs I will summarize the results of conducted research that examined different consequences of internal and/or external R&D. A detailed description of the studies can be found in Table 4-1, Table 4-2 and Table 4-3 below.

Drawing on the RBV, Zahra and Nielsen (2002) investigated the relationships between internal and external manufacturing capabilities on technology commercialization (TC) for U.S.-based industries. The study also investigated whether formal and informal integration mechanisms have a moderating effect on the main relationships. The study's main results are that the internal sources are necessary for a successful TC, whereas only some of the external sources have a positive impact on TC.

Nicholls-Nixon and Woo's (2003) study of the U.S. pharmaceutical industry over the period from 1981 to 1991 investigated the effect of internal and external R&D on the firms' output. They examined that internal R&D is positively related with the number of patents, whereas the acquisition of external R&D is positively associated with firms' number of biotechnology-based products. This corresponds with the previous finding about the advantage of internal R&D that the true innovativeness of firms lies in conducting own development, which results in the competitive advantage of a firm. When a technology is protected by a patent, the firm can wholly benefit from it.

Fey and Birkinshaw (2005) investigated three different ways to obtain external R&D – contracting, alliances with other firms and partnering with universities. They examined the effect of these three options on the R&D performance. Their sample consisted of Swedish and British firms. Two of the interesting findings of their study are that partnering with universities is positively related with R&D performance, whereas external contracting is negatively related with R&D performance.

Laursen and Salter (2006) conducted a study to examine how firms' external search strategies regarding R&D are related to their innovative performance. According to their argument, it is easier for firms that are more open to external sources to achieve high levels of innovative performance. This openness allows companies to increase the number of technological opportunities they can benefit from. To test this proposal, Laursen and Salter (2006) distinguished between external search breadth and external search depth and used them as their independent variables. The main finding of this study is that external search depth is associated with radical innovation (one type of the measured innovative performance). Moreover a substitution effect between the openness to external search activities and internal R&D intensity was identified.

Montoya, Zarate, & Martin (2007) examined if the technological sourcing decision has an effect on the firm's productivity, by using panel data of Spanish firms belonging to the high or medium high technology sectors. This technological sourcing decision is characterized and measured as the trade-off between internal R&D stock and external R&D stock. The main result of the study's empirical analysis is that this technological strategy has an effect on the performance of the firm. An important distinction is that firms that decide to invest in small amounts of resources on technological activities obtain a higher performance when they use external R&D. In contrast, the performance of firms

that decide to invest high amounts of resources on technological activities is higher in the case of using internal R&D.

Tsai and Wang (2007) distinguished between internal R&D investment and external technology acquisition as their antecedent variables. To examine their effect on the firm performance, they analyzed a sample of Taiwanese electronics-manufacturing firms. The sample included the years from 1998 to 2002. Their important findings are that internal R&D investment is positively related to firm performance. Moreover the study did not examine a relationship between external technology acquisition and firm performance. However, the combination of internal R&D investment and external technology acquisition enhances the firm performance.

The main research question of another project by Tsai and Wang (2009) was how firms' external technology acquisition approaches impact their innovation performance. In this regard they investigated the impact of four antecedents – internal R&D investment, R&D outsourcing, inward technology licensing and R&D collaboration – on the innovative performance of Taiwanese low- and medium-technology firms. One of their main findings is that internal R&D investment is positively related to innovative performance. Moreover internal R&D investment negatively moderates the relationship between R&D outsourcing and innovation performance. However, there is no relationship examined between inward technology licensing and innovative performance.

The two previously reviewed studies by Tsai and Wang (2007 & 2009) are the only ones that I found about investigating the consequences of internal or external R&D that focus on an emerging market country, as I do with my study about China.

Benson and Ziedonis (2009) investigated which information gained through corporate venture capital (CVC) investing can improve firm performance. Hereby they

analyzed data from the U.S. IT sector. The main result of the study is that this information obtained through CVC investment, which can be considered as a type of external knowledge in the early stage of R&D projects, results in a higher firm performance.

Based on the exploration-exploitation framework, Hoang and Rothaermel (2010) investigated whether external exploitation experience and external exploration experience have an impact on R&D project performance under the moderating role of internal exploration experience and internal exploitation experience. According to their results, the combination of internal exploration and external exploitation improves R&D project performance, whereas the combination of internal exploitation and external exploration reduces the R&D project performance. Therefore, focusing on the consequence of R&D project performance, ambidexterity is advantageous when firms focus on internal exploration combined with external exploitation.

Mata and Woerter (2013) investigated the effect of internal R&D and external R&D on the price cost margin (PCM) of the firm as a measurement for its performance. Moreover they focused on the risk level of the firm as another dependent variable. The data analysis was based on Swiss firms. As I already mentioned in the section about the advantages of internal and external R&D, one of the study's finding is that external innovation strategies are riskier than conducting internal R&D. Moreover the project examined that the positive effect of external R&D on the firm performance is stronger than the effect of internal R&D on firm performance.

Berchicci (2013) investigated the impact of internal and external R&D activities on the innovative performance of Italian firms. The results show that firms that combine internal and external R&D achieve a better innovative performance. However, in case there is a higher share of external R&D compared to internal R&D, the innovative

performance is lower. This corresponds with the claim that internal R&D activities are the true source of the firm's competitive advantage.

Bertrand and Mol (2013) analyzed firms operating in France for the years between 1995 and 2004. They found that firms with high internal R&D intensity do more offshore outsourcing due to their high absorptive capacity, developed through internal R&D. There is a positive relationship between offshore outsourcing and innovation outcome in general.

2.6. Antecedents of internal or external R&D

In the following paragraphs I will summarize the results of conducted research that examined different antecedents of internal and/or external R&D. A detailed description of the studies can be found in Table 5-1, Table 5-2 and Table 5-3 below.

In an early study, Pisano (1990) tried to answer the question whether transaction-cost specific factors influence the firm's decision to either expand its internal R&D or external R&D activities. In this study, external R&D includes the outsourcing of R&D activities. The analysis of biotechnology R&D projects of the leading global pharmaceutical firms revealed that small-numbers-bargaining hazards induce firms to focus on internal R&D. Firm level factors such as R&D experience, location and the dependence on the industry affected by the technological change influence the decision of the firm to outsource more R&D.

Vanhaverbeke, Duysters, and Noorderhaven (2002) examined antecedents of external R&D. They distinguished external R&D between a firm's technology-based strategic alliance and technology-based acquisition and used the choice between the two as the dependent variable in order to examine which factors influence the choice between these two options of getting access to external R&D. Their findings show that a series of

strategic alliances between two partners increases the probability that one will ultimately acquire the other. Whereas previous direct contacts tend to lead to an acquisition. In the case of acquisitions, the firms that are more centrally located in the network of inter-firm alliances tend to be the acquirers, and the firms with a less central position tend to become the acquired.

Love and Roper (2002) measured the productivity of R&D activities by the amount of cost of these activities. The research task was to identify the factors that affect the productivity of internal R&D. Their study on UK manufacturing plants that are engaged in product innovation finds that the size and number of qualified research staff are important factors to achieve economies of scale in internal R&D. Furthermore high market shares of firms in concentrated industrial sectors are achieved through high intensity of internal R&D activities.

Cuervo-Cazzura and Un (2004) examined the relationship between knowledge resources and the degree of investments in R&D for Belgian manufacturing firms. They found that firms with no or less internal knowledge resources tend not to invest in R&D. Firms with both internal and external knowledge resources tend to sometimes invest in R&D, whereas firms with internal knowledge resources but no or less external knowledge resources tend to always invest in R&D (Cuervo-Cazzura & Un, 2004). Therefore it stands to argue that knowledge is a powerful driver for R&D investment decisions and innovativeness in general.

Drawing on the RBV as the theoretical framework, Piga and Vivarelli (2004) investigated several drivers (e.g. ownership style, ownership concentration, R&D intensity,…) of R&D activities in general and of external R&D in specific for Italian manufacturing firms. The dependent variable external R&D included the collaboration of

firms with universities or specialized research centers and the collaboration with other firms. One interesting finding is that firms that are partly or wholly owned by the state are more likely to do external R&D with universities or research centers, but not with other external firms. Another important finding of the study by Piga and Vivarelli (2004) is that firms are more likely to do collaborations with other firms when the firm has a concentrated ownership structure.

Munari, Oriani and Sobrero (2010) focused on examining the relationship between ownership style and R&D investments. They made the distinction between state ownership, family ownership and widely-held firms. Their sample includes a mix of firms from six western European countries (Germany, France, Italy, Norway, Sweden and UK). According to their results, family-owned firms are less likely to invest in R&D than state-owned companies or widely-held firms. The study also investigated differences between countries. Widely-held firms in the UK for example invest less in R&D than firms from the other countries in Western Europe. This shows us that country-specific factors make a huge difference and have to be taken into consideration in our research topic.

Spithoven and Teirlinck (2015) also investigated a number of factors that might influence the decision to outsource R&D. Very interesting are the factors of the firm's internal capabilities regarding R&D, the network resources and the firm's appropriation mechanisms. The results show that internal R&D intensity has a positive effect on R&D outsourcing. Also firms with research cooperations have a higher tendency to outsource R&D. Therefore network resources in general are positively associated with outsourcing. Another interesting result is that formal and informal appropriation mechanisms have a positive effect on R&D outsourcing. This is an interesting result as other research projects

often came to the conclusion that the power of patents encourages firms to do more R&D and innovation by themselves and inside the firm.

Selected Studies on the consequences of internal or external R&D						
Study	**Theoretical Lens**	**Internal or external R&D**	**Consequence**	**Research question**	**Methodology**	**Main findings**
Zahra and Nielsen (2002)	RBV	Internal manufacturing capabilities External manufacturing capabilities	Technology commerciali-zation (TC)	How do firm's different internal and external manufacturing sourcing affect TC? Do formal and informal integration mechanisms have a moderating effect on these relationships?	Mix of two surveys (conducted in 1996 and 1999) and secondary data of 20 U.S.-based industries.	Firms' internal manufacturing sources are important for a successful TC. Some external manufacturing sources promote a successful TC. Formal integration mechanisms strengthen the effect of both internal and external manufacturing sources on TC.
Nicholls-Nixon and Woo (2003)	Absorptive capacity	Internal R&D External R&D (acquisitions)	Output	Investigating relations among the strategies of external linkage of chemical and pharmaceutical firms in the biotechnology business.	Mix of secondary data and primary data (surveys) of U.S. pharmaceutical firms for the years 1981-1991	Internal R&D is positively related to patent output. Acquisition of external R&D is positively related to the number of products. A manifold technology sourcing is important to build the absorptive capacity that is necessary to create new technical output.
Fey and Birkinshaw (2005)	Social capital theory	Contracting Alliances with other firms Partnering with universities	R&D performance	Examination of three different ways to obtain external R&D knowledge (contracting, alliances with other firms, partnering with universities) and their effect on R&D performance of the firm itself.	Analysis of surveys of 107 R&D-intensive firms in Sweden and Great Britain.	Partnering with universities has a positive effect on R&D performance. External contracting has a negative effect on R&D performance.
Laursen and Salter (2006)	Absorptive capacity	External search breadth External search depth	Innovative performance	How are firms' external search strategies (regarding R&D) related to their innovative performance?	Analysis of data from the U.K. innovation survey. Sample includes 2707 manufacturing firms.	External search depth is associated with radical innovation. There exists a substitution effect between the openness to external search activities and internal R&D intensity.

Table 4-1: Consequences of internal or external R&D

Selected Studies on the consequences of internal or external R&D						
Study	**Theoretical Lens**	**Internal or external R&D**	**Consequence**	**Research question**	**Methodology**	**Main findings**
Montoya, Zarate, & Martin (2007)	Transaction cost theory	Technological sourcing decision	Firm performance	Does technological sourcing decision have an effect on the productivity of the firm?	Analysis of panel data of Spanish firms that belong to high or medium high technology sectors The data are from the Survey of Industrial Behavior ESEE for the years 1990-1999.	The technological strategy, which includes the technological sourcing decision, affects productivity. The performance of firms that decide to invest small amounts of resources on technological activities is higher in the case of using external R&D. Firms that decide to invest high amounts of resources on technological activities obtain a higher performance when they do in-house R&D.
Tsai and Wang (2007)	Production function theory	Internal R&D investment External technology acquisition	Firm performance	What is the effect of internal R&D investment, external technology acquisition and internal R&D combined with external technology acquisition on firm performance?	Analysis of a sample of 341 Taiwanese electronics-manufacturing firms for the period from 1998 to 2002.	Internal R&D investment is positively related to firm performance. There is no relationship between external technology acquisition and firm performance. The combination of internal R&D investment and external technology acquisition enhances firm performance.
Tsai and Wang (2009)	KBV	Internal R&D investment R&D outsourcing Inward tech-nology licensing R&D collaboration	Innovative performance	How do firms' external technology acquisition approaches impact their innovation performance?	Analysis of a sample of 753 low- and medium-technology firms from a Taiwanese Technological Innovation Survey.	Internal R&D investment results in a higher innovative performance. Internal R&D investment negatively moderates the relationship between R&D outsourcing and innovation performance. Inward technology licensing does not result in a higher innovative performance.
Benson and Ziedonis (2009)	Organization theory RBV	Information gained through corporate venture capital (CVC) investing	Firm performance	Which information gained through CVC investing can improve firm performance?	Analysis of data from active CVC investors in the U.S. IT sector.	The relationship between CVC investing and acquisition performance critically depends on the acquirer's internal knowledge base: as CVC investments increase relative to an acquirer's total R&D expenditures, acquisition performance improves at a diminishing rate.

Table 4-2: Consequences of internal or external R&D

Selected Studies on the consequences of internal or external R&D						
Study	**Theoretical Lens**	**Internal or external R&D**	**Consequence**	**Research question**	**Methodology**	**Main findings**
Hoang and Rothaermel (2010)	Exploration-exploitation framework of organizational learning	External exploitation experience External exploration experience	R&D project performance	Do external exploration and exploitation experience have an impact on subsequent R&D project performance? Do internal exploration experience and internal exploitation experience have a moderating effect on the main relationships?	Analysis of a sample of 412 R&D projects in biotechnology conducted by 43 large global pharmaceutical firms from 1980 to 2000.	A combination of internal exploration and external exploitation improves R&D project performance. A combination of internal exploitation and external exploration reduces R&D project performance.
Mata and Woerter (2013)	Absorptive capacity	Internal R&D External R&D	Price cost margin (PCM) of the firm Risk	Are there differences in the results of diverse innovation strategies? Are the different innovation strategies accompanied with different degrees of risk?	Quantile regression analysis of a sample of Swiss firms from the Swiss Innovation Survey (SIS) including three periods (1999, 2002, and 2005).	External R&D strategies have a positive effect on the performance of the firm. This effect is greater than the effect of internal R&D activities on the performance. External innovation strategies are riskier than conducting in-house innovation.
Berchicci (2013)	Transaction-cost theory	Internal R&D External R&D	Innovative performance	Investigating the impact of R&D configuration (internal and external R&D activities) on innovative performance under the moderating role of the firm's R&D capacity.	Analysis of five surveys between 1992 and 2004 of R&D intensive Italian firms. 2537 firms are included in the final sample.	Firms that combine internal and external R&D obtain a greater innovative performance. However, firms with a higher share of external R&D activities have a lower innovative performance.
Bertrand and Mol (2013)	Absorptive capacity	Internal R&D	Offshore R&D outsourcing Innovation	What are the differences in the antecedents and performance consequences of domestic and offshore R&D outsourcing?	Analysis of secondary data from two representative databases on firms operating in France for the years 1995 to 2004.	Internal R&D intensity leads to more offshore outsourcing due to absorptive capacity and offshore outsourcing itself results in higher innovation outcomes.

Table 4-3: Consequences of internal or external R&D

Selected Studies on the antecedents of internal or external R&D						
Study	**Theoretical Lens**	**Antecedents**	**Internal or external R&D**	**Research question**	**Methodology**	**Main findings**
Pisano (1990)	Transaction cost theory	Number of R&D suppliers Rivalry Historical R&D capabilities Internal R&D experience Market share	Internal R&D External R&D (outsourcing)	Do transaction-cost specific factors have an influence on a firm's decision to expand its internal R&D into a particular subfield of a new technology or outsource the relevant R&D capabilities?	Analysis of s sample of 92 biotechnology R&D projects of leading pharmaceutical firms.	Small-numbers-bargaining hazards induce firms to focus on internal R&D. The firm's R&D experience, the firm's dependence on the pharmaceutical business and the firm's national origin have an effect on R&D procurement. Firm level factors (R&D experience, dependence on the industry affected by the technological change, and location) influence R&D procurement patterns.
Vanhaver-beke, Duysters, and Noorder-haven (2002)	Transaction cost theory	Prior ties Network distance Intraindustry ties/ Intrasegment ties International ties Alliance history Network centrality	Technology-based strategic alliance Technology-based acquisitions	Which factors influence the choice between technology-based strategic alliances and technology-based acquisitions?	Analysis of a sample of 140 mergers and acquisitions and 145 strategic alliances in the ASIC (application-specific integrated circuits) industry from 1985-1994.	Within the network of interfirm alliances, the firms that are more centrally located tend to be the acquirers, and firms that are less centrally located tend to become acquired. A series of strategic alliances between two firms in the past results in a higher probability that one will completely acquire the other.

Table 5-1: Antecedents of internal or external R&D

Selected Studies on the antecedents of internal or external R&D						
Study	**Theoretical Lens**	**Antecedents**	**Internal or external R&D**	**Research question**	**Methodology**	**Main findings**
Love and Roper (2002)	Transaction cost theory	Scale Market structure conditions	cost of internal R&D cost of external R&D	Which factors determine the productivity of internal R&D and therefore the cost of internal R&D?	Analysis of data of more than 500 UK manufacturing plants which are engaged in product innovation.	To achieve economies of scale in internal R&D, the size of plants has to be above average and a large number of qualified research staff has to be employed. Plants with a relatively high market share are characterized by a high internal R&D capacity.
Cuervo-Cazurra and Un (2004)	Real options theory KBV	Internal knowledge External knowledge resources	Technological options Investment in R&D	How do the knowledge resources of a firm influence the frequency of investing in R&D in order to establish technological options?	Mix of secondary data from Eurostat's Community Innovation Survey (1993) and survey data from Belgian manufacturing firms.	Firms with no or little internal knowledge resources are more likely to never invest in R&D. Firms with both internal and external knowledge resources are more likely to sometimes invest in R&D. Firms with internal knowledge resources but no or little external knowledge resources are more likely to always invest in R&D.
Piga and Vivarelli (2004)	RBV	Diversification in R&D strategy Public ownership Ownership concentration Public subsidies R&D intensity Outsourcing in purchases	External R&D (includes gaining external R&D knowledge from universities, specialized research centers or other firms)	Which factors drive firms to engage in R&D activities in general and to engage in external R&D in terms of collaborating with other firms or external institutions?	Analysis of a sample of Italian manufacturing firms. Data includes balance sheet data from 1989-1997, measurable firm characteristics from 1995-1997, and questionnaire data from a survey conducted in 1998.	Firms that are partly or wholly owned by the state are more likely to do external R&D with universities or research centers, but not with other external firms. The probability that a firm seeks other firms as partners is higher when the firm has a concentrated ownership structure.

Table 5-2: Antecedents of internal or external R&D

Selected Studies on the antecedents of internal or external R&D						
Study	**Theoretical Lens**	**Antecedents**	**Internal or external R&D**	**Research question**	**Methodology**	**Main findings**
Munari, Oriani, and Sobrero (2010)	Agency theory Institutional theory	Ownership style (distinction between state ownership, family ownership and widely-held firms)	R&D investments	Does the ownership style of firms have an influence on the amount of R&D investment?	Analysis of a sample of about 1000 firms from six European countries (Germany, France, Italy, Norway, Sweden, United Kingdom)	Family-owned firms are less likely to invest in R&D than firms of the other ownership styles. Widely-held firms in the UK invest less in R&D than other countries in Continental Europe. Therefore country-specific factors in R&D investment decisions have to be taken into consideration.
Spithoven and Teirlinck (2015)	Transaction cost theory RBV KBV Relational view	Internal R&D intensity Education of the staff Informal knowledge spillovers Formal research cooperation Research cooperation with business Formal appropriation mechanisms Informal appropriation mechanisms	R&D outsourcing	How do a firm's internal capabilities, network resources and appropriation mechanisms, which represent the bundle of resources and capabilities available to the firm, influence R&D outsourcing?	Analysis of data from the Third and Fourth European Community Innovation Surveys for Belgium (CIS3 and CIS4). Both cover the periods 1998-2000 and 2002-2004.	Internal R&D intensity has a positive effect on R&D outsourcing. Firms with research cooperations also have the tendendy to do R&D outsourcing. Therefore network resources in general are positively associated with outsourcing R&D. Also formal and informal appropriation mechanisms have a positive effect on R&D outsourcing.

Table 5-3: Antecedents of internal or external R&D

2.7. Overview of investigated antecedents and consequences

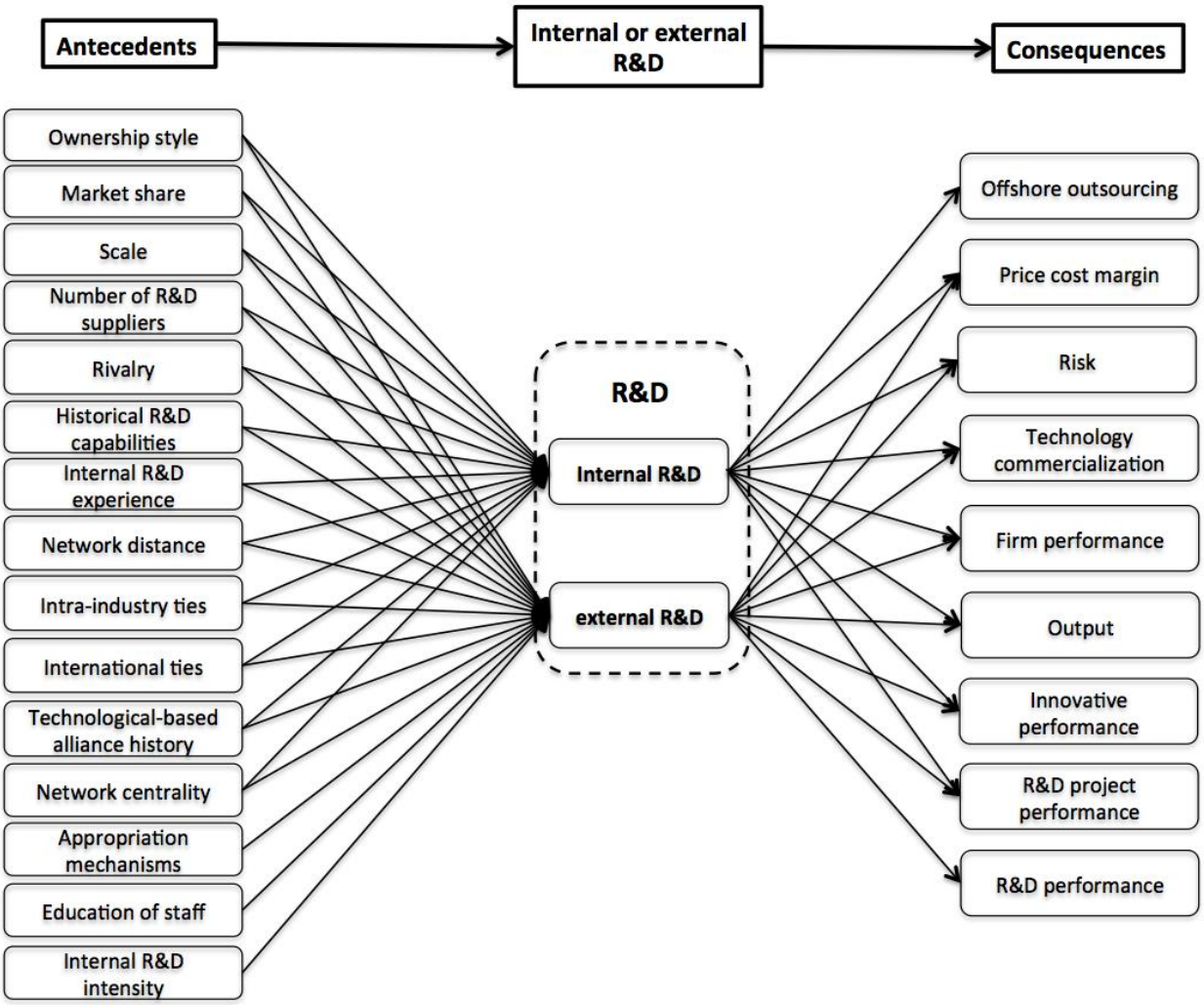

Figure 1: Overview of investigated antecedents and consequences of internal and external R&D

Figure 1 summarizes the antecedents and consequences of internal and external R&D that have already been examined in research projects. In general, the above review leads to the identification of three gaps. First, the antecedents of internal and external R&D mainly focus on situational factors that are located outside of the firm. Little attention

has been paid to the firms' internal factors, which will become one of the tasks of this study. Second, there is no mention of the firms' optimal organization or combination of internal and external R&D activities. The RBV also emphasizes the organization of resources, yet the existent literature did little examination on this point. This gap will also be fulfilled in this study. Third, there is not much investigation of firms' innovation performance in emerging markets, which will become the third task of this study. An emerging market firm's innovation performance is better measured by its international success, which is a demonstration of their true achievement compared with their international counterparts.

3. THEORETICAL BACKGROUND

3.1. Resource-based view (RBV)

Even though the concept of the RBV is established for so many years, the RBV is still one of the prominent and dominant perspectives in the strategic management area (e.g. Lockett, Thompson & Morgenstern, 2009). The main idea of the RBV is to explain the fundamental question of how firms can achieve a sustainable competitive advantage, as the name of this view already indicates, the competitive advantage of a firm is based on its specific resources and capabilities (Amit & Schoemaker, 1993; Barney, 1991; Grant, 1991; Dierickx & Cool, 1989; Peteraf, 1993). In the following I will first briefly introduce the development of the theory and then explain the classification of the resources and its characteristics in order to lay the foundation of my theorization.

3.1.1. Historical background

Many scholars consider Penrose's (1959) work *"The Theory of the Growth of the Firm"* as the intellectual foundation of the modern RBV. Penrose views the firm as a pool of interchangeable resources that are organized within an administrative framework. According to Penrose, firms differ in their resources and capabilities. The growth of the firm is based on the development of its resources and capabilities. She recognizes the importance of individuals' behavior and learning as important functions in the firms' growth process and maintains that managerial limitations are a main constraint to firms' growth rate (Rugman & Verbeke, 2002). Penrose's perspective is in a sharp contrast to the neoclassical theory of the firm, as the neoclassical theory of the firm provides "no notion of an internal process of development leading to cumulative movements in any one direction" (Penrose, 1959, p.1). Penrose (1959) explains that one of the important characteristics of a firm is made by the heterogeneity, not the homogeneity, of its resources. This heterogeneity of resources is the fundamental idea of the RBV.

In his seminal work *"Firm resources and sustained competitive advantage"*, Barney (1991) first suggests the VRIN framework. He argues that firms must acquire and control valuable, rare, inimitable and non-substitutable resources and capabilities in order to achieve a competitive advantage over their competitors. Later on, he added "organization" as another element into the framework (Barney, 1994), pointing out that firms need to have organization in place to absorb and apply those resources. This idea is echoed and supported by several related perspectives such as core competences (Hamel & Prahalad, 1994), dynamic capabilities (Teece, Pisano, & Shuen, 1997) and the knowledge-based view (KBV) (Grant, 1996).

3.1.2. Classification of resources

The fundamental proposition of the RBV is that the resources of the firm are heterogeneous. This heterogeneity is based on resource-market imperfections (Barney, 1991), resource immobility (Barney, 1991) and the fact that firms are unable to change their accumulated stock of resources over time (Carroll, 1993).

According to the RBV, resources are defined as "[…] stocks of available factors that are owned or controlled by the firm […] and are converted into final products or services by using a wider range of other firm assets (Amit & Schoemaker, 1993, p.35)." Capabilities are defined as "[…] a firm's capacity to deploy resources, usually in combination, using organizational processes, to effect a desired end (Amit & Schoemaker, 1993, p.35)." There are some disagreements among scholars whether capabilities can be viewed as a specific and significant type of firm resource or if capabilities have the power to make a group of resources perform the activity or task (Grant, 1991). Black and Boal (1994) and Grant (1991) argue that resources are independent, simple and static, whereas capabilities are collective, complex and dynamic. According to Nelson and Winter (1982), capabilities can be understood as organizational routines. They emerge from the combination and coordination of different resources (Amit & Schoemaker, 1993; Grant, 1996; Prahalad & Hamel, 1990; Teece, Pisano, & Shuen, 1997). Organizational routines are intangible by themselves (Itami & Roehl, 1987; Leonard-Barton, 1992). Considering the different viewpoints regarding resources and capabilities, all researchers agreed that internal resources and capabilities have the potential to generate competitive advantages when strategically identified and used by the firm (Grant, 1991).

In the literature, Barney's (1991) classification of the numerous resources into three categories is highly accepted. These categories are: physical capital resources

(Williamson, 1975), human capital resources (Becker, 1964), and organizational capital resources (Tomer, 1987). Companies' financial resources (Bower, 1986; Noda & Bower, 1996) also play a significant role. Grant (1991) also highlights that commercial and technological resources play a tremendous role.

There is a distinction made between tangible and intangible resources and capabilities (Wernerfelt, 1984). Financial and physical resources, for example, are tangible, whereas human resources such as employees' experiences or organizational resources such as formal reporting structures are intangible resources. Hall (1992,1993) highlights that the organization of intangible resources and not only tangible resources plays an important role in strategic management. These intangible resources are assets such as contracts, patents, copyrights, and reputation, as well as the connecting capabilities with suppliers and distributors (Hall, 1992 & 1993). The corporate culture is considered as an intangible resource, as the corporate culture motivates employees, encourages collaboration between employees and functional areas, and stimulates innovative ideas. These intangible resources help companies to achieve a sustainable competitive advantage. Castells (2001) and Robinson (2001) claim that in today's creative world things like ideas, talent and creative capacities of people have to be classified as intangible resources. Michalisin, Kline, & Smith (2000) argue that especially intangible resources are of a big value for the RBV, as intangible resources are most likely to meet the resource-based criteria of being valuable, rare, difficult to imitate and non-substitutable. Amit and Schoemaker, 1993) and Grant (1991) also confirm that the most strategic assets of a firm are of intangible nature, for example human capital or corporate reputation.

3.1.3. Characteristics of resources

According to the RBV, firms can gain and sustain a competitive advantage when their resources have following attributes: They are valuable, rare, cannot be imitated, and there are no strategically equivalent substitutes available (Barney, 1991). Resources are "valuable" when they help the firm to build and implement a strategy to improve the firm's efficiency and effectiveness (Barney, 1991). The attribute "rarity" refers to the rareness of the resource among the firm's current or potential competitors. If the resources are not rare, the firm cannot build a competitive advantage over competitors, even though the resources might be valuable (Barney, 1991). The attribute of "inimitability" is highly important. Inimitability can be established due to three reasons given by Barney (1991): (1) The owning of a resource can depend on the firm's historical condition; (2) there is a causal ambiguity between the resources of a firm and its sustained competitive advantage; and (3) these resources are socially complex that result in a firm's competitive advantage (Barney, 1991; Dierickx & Cool, 1989). The last criteria, "non-substitutability", can be explained using Barney's (1991) original words: "[…] there cannot be strategically equivalent substitutes for this resource that are valuable but neither rare or imperfectly imitable (Barney, 1991, p.106)".

As we can see, the requirements regarding the attributes of firm's resources according to the RBV are very complex. However, they are a good indicator of the degree to which the resources are heterogeneous and immobile, which is necessary to generate the firm's sustained competitive advantage.

3.2. Application of the theory to the model

The RBV is extended by including that, in order to gain a sustainable competitive advantage, firms need to combine effectively their firm-specific resources (Barney & Education, 1997), which is the newly added item, organization, in the VRIN/O framework (Barney, 1994). Firms have different components of resources, components that are complementary to each other. Those components are called complementary assets (Chi & Seth, 2009). Only when those complementary resources are allocated within the organization in an optimal way to respond to the competition of the market, firms can obtain their competitive advantage. Such an allocation/organization of resources generates ambidexterity for firms, and therefore it is difficult for other firms to perceive and imitate (Barney & Education, 1997), which is why firms gain their competitive advantage. I use the term of the resource allocation here, which carries the same meaning of resource organization in the RBV but fits more in the context of this study, as in my model the allocation of efforts in internal and external R&D is characterized by the internal and external R&D activities. In more detail, this R&D activity is measured by the amount of the available financial resources that the firm uses for its internal R&D and/or external R&D. That's why I also use the term resource allocation for the firm's organization of the financial resources between internal and external R&D.

A dilemma firms face is about making a decision regarding the investment in their R&D activities. As the literature review shows, the firm's major decision lies between using its financial resources for in-house R&D activities or to use financial assets to "buy" external knowledge or technologies. Traditionally, firms focus on their internal R&D in order to develop their unique competitive edge (Lei, Hitt, & Bettis, 1996; Zahra & Nielsen, 2002; Chiesa, Manzini, & Pizzurno, 2004). Yet with the fast development of technology,

new technology development cycles become shorter, leaving firms scramble in catching up with others (Zahra & Nielsen, 2002). Under these conditions making use of external R&D can result in the firm's competitive advantage (Zahra, Sisodia, & Das, 1994; McGrath, 2001; Danneels, 2002). Similarly, I also identified that in some conditions the factor time and speed can be both an advantage and a disadvantage of external R&D (Larsson, Bentsson, Henriksoon, & Sparks, 1998; Chiesa, Manzini, & Pizzurno, 2004). Firms' focus on internal R&D may lead to rigidities (Leonard-Barton, 1992) and further fall in failure traps (March, 1991) because those firms focus too much on one direction but ignore other possibilities, leading to learning myopia (Levinthal & March, 1993). Yet too much external R&D leads to dependence on others, erosion of innovation capability, or loss of business knowledge (Larsson, Bengtsson, Henriksoon, & Sparks, 1998).

As a result, firms face a dilemma when allocating their financial resources between internal and external R&D activities. Therefore, creating the optimal combination between internal and external R&D is on the one hand difficult for a firm to make, but on the other hand very crucial for a profitable performance.

3.3. Research model

The baseline logic of the model is that firms' available resources (types of available resources) determine the resource allocation strategy (reflected as the ratio between internal R&D and the sum of internal and external R&D), which further leads to their performance (international market success). What is original in my model is that the "organization" element, which is presented as one of the characteristics in the VRIN/O framework, is actually the result of a firm's decision-making and thus is an endogenous variable, rather than an exogenous variable as the RBV presents, because organization

of resources is the result of the assessment of available resources with the involvement of managerial processing of basic information about the firm. The second contribution in the model is that whether the allocation of resources will lead to good performance will also be influenced by external environment, an element that is not included in the RBV framework, and was criticized in the literature (e.g. Priem and Burler, 2001a). In my model, the external environment is characterized by the presence of foreign competition in the Chinese market, which is an important factor that influences the Chinese firms' success in the markets (Zhang, Li & Li, 2014).

In the R&D literature, R&D expenditure is considered as a strategic resource variable and has been found to be highly important in strategic management research (Baysinger & Hoskisson, 1989; Baysinger, Kosnik, & Turk, 1991; Franko, 1989; Fryxell, 1990; Harrison, Hitt, Hoskisson, & Ireland, 1991). As I proposed above, the availability of different components of resources determine a firm's resource allocation strategy. In the literature review I summarized the antecedents of internal and/or external R&D that have an influence on the decision of firms to carry out R&D on their own or to use their financial resources to get access to external knowledge. I want to fill a gap in the literature and investigate further variables that have an impact on firms' decision to allocate their financial resources in favor of internal R&D or external R&D. In this regard I consider the four categories of resources according to Barney (1991): human resources, physical resources, financial resources and organizational resources.

In figure 2 I summarized all constituents that make up the RBV as my theoretical framework. The representatives of each resource categories that I will investigate are highlighted in blue in Figure 2. I will focus on two tangible and two intangible resources. As human resources I consider the engineer intensity, defined as the ratio of the number

of engineers over total number of employees. This ratio reflects the availability of high quality technology-associated human resources. As an example of a physical resource I choose the location of the firm because the location represents the availability of high quality information about new technology development (Barney, 1991; Porter, 1980). I will investigate the affiliation level of a firm with the government as an organizational resource. This variable is very characteristic for the Chinese economy. As a characteristic for a financial resource I consider the amount of government funding that firms receive.

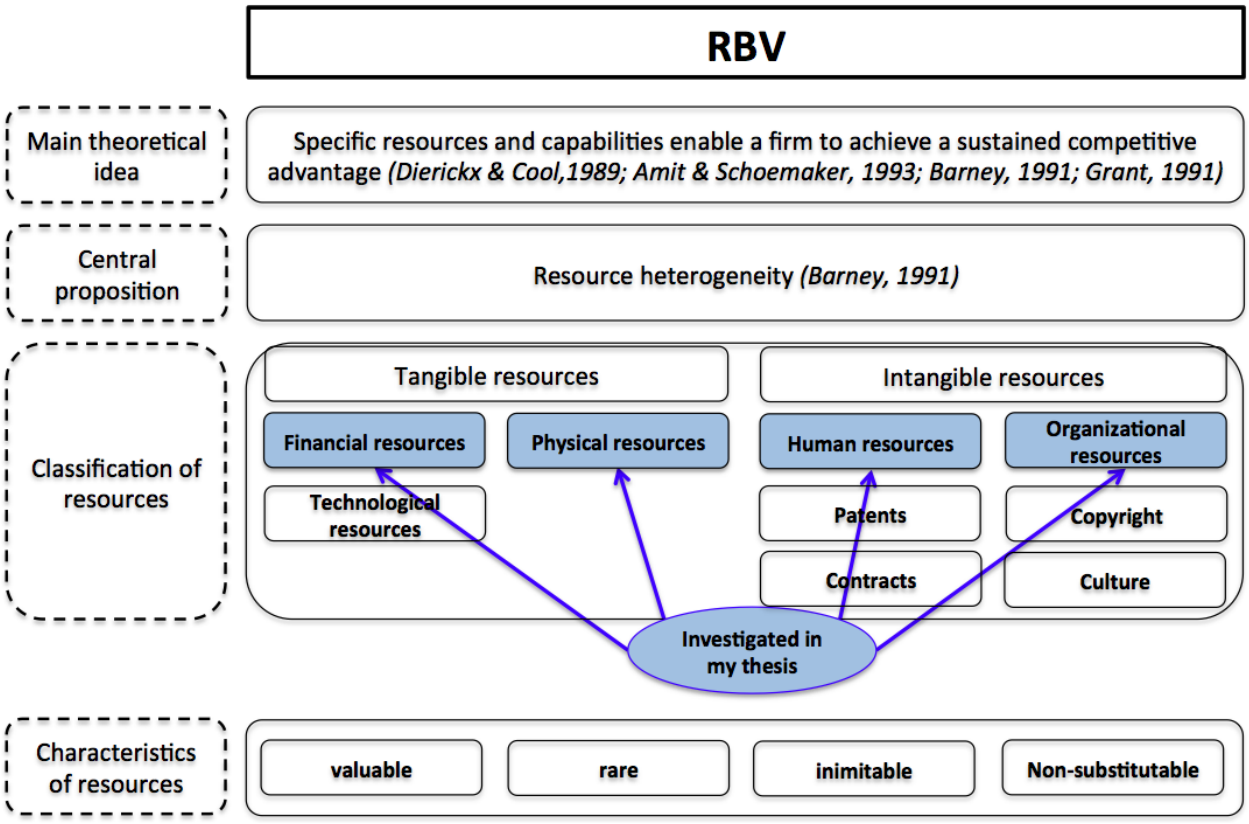

Figure 2: RBV – Overview

The effects of firms' strategic decision to focus on internal R&D or on external R&D are assessed by their performance. In this study, I consider Chinese manufacturing firms'

international market success, when they export their newly developed products in international markets, as a measurement for performance. The main reason to choose this variable is that products that are “new” in international markets can reflect Chinese firms’ “true” success of R&D. Moreover, as my literature review about the consequences of internal or external R&D reveals, this variable as a firm’s performance measurement has not been used in this regard so far. I also consider that the presence of foreign companies in different industries in China will serve as a conditional variable due to their spillover effects (Spencer, 2008). The justification to investigate this moderating variable is also motivated from a practical perspective as more and more foreign firms try to enter China and establish subsidiaries to show local presence in an environment with tremendous economic growth.

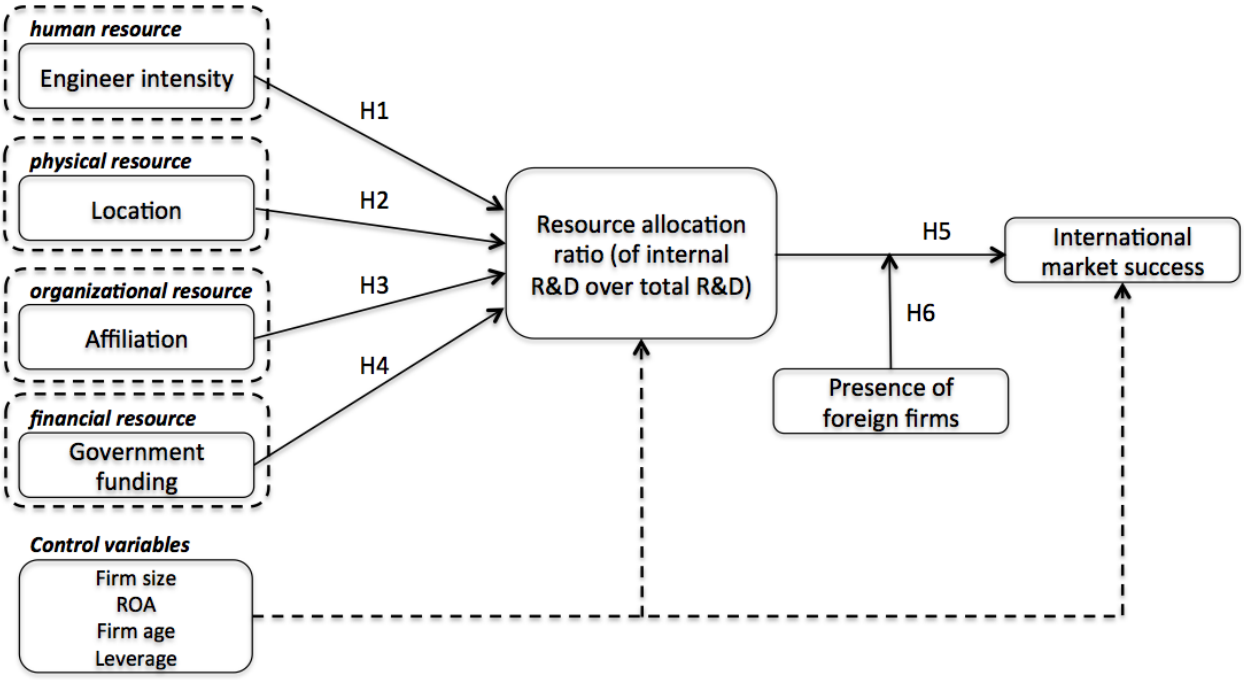

Figure 3: Research Model

4. HYPOTHESES

In the following subsections I will develop the six hypotheses of my model. The development of the hypotheses draws mainly on the RBV. The perspective of spillover effect (Spencer, 2008) will be applied as a supplementary perspective to the RBV in the arguments for the hypotheses development.

4.1. Investigation of the effects of the four factors

Schumpeter argues that innovation is the source of a competitive advantage. In this regard, resources are only valuable when they constitute capabilities which have to be enhanced through innovation and learning for the firm to grow (Nelson & Winter, 1982). The concept of dynamic capabilities also states that the ability to integrate, build and reconfigure resources has a positive effect on firm performance (Teece, Pisano, & Shuen, 1997). The RBV indicates that firms can use their mix of resources to generate new capabilities to achieve a competitive advantage (Barney, 1991). Also Loasby (1998, p.139) highlights that “managing capabilities is itself a capability”. In other words firms continually develop capabilities, that combined generate new capabilities.

Based on the above arguments it is highly interesting to investigate whether the availability of resources has an impact on the organization of other resources or capabilities. Therefore four resource-based variables are incorporated as antecedents in the research model. On the one hand this speaks to the need to investigate the organization of internal and external R&D. On the other hand, other resources might be responsible for this combination. Therefore, in the first step, I will focus on four resource-

based considerations for the firm's decision to either invest in internal R&D or to get access to it from external sources.

Moreover it is not clear so far if these investigated firm resources necessarily result in a higher ability to do internal R&D by the firm itself and inside the firm. In a study of large multinational firms, Patel and Pavitt (1997) examined that these firms have competences across a wide range of technologies. In this regard firms know more than they make (Brusoni, Prencipe, & Pavitt, 2001). Even though they obtain the technological knowhow to conduct R&D by themselves, they often prefer to outsource R&D activities. There are research results that show that firms have resources and capabilities available but they do not make use of them completely. Instead, they even make use of outside technologies. Therefore the four resources as the antecedents will be determined if they have a concrete effect on the firm's decision to focus more on internal R&D or external R&D.

4.1.1. Impact of human resources

Human resources are the critical type of resources that can create a competitive advantage for firms (Barney, 1991). In general, important contributions of human resources to the firm's success include the employees' knowledge, expertise, talents, special skills and creativity (Cohen & Zysman, 1988; Davenport, 2013). Especially the engineers responsible for R&D activities need lots of experience in their job and highly specific knowledge and expertise in order to develop products that can generate a competitive advantage (Lado & Wilson, 1994). This corresponds with the argumentation according to the RBV that highly specialized and educated employees can contribute to the competitive advantage of a firm, as firm-specific and expert knowledge takes years to

develop, so that it is also difficult for other firms to copy the expertise that engineers have (Yeoh & Roth, 1999).

The main question for this hypothesis is how this HR resource affects the firm's decision to carry out more internal R&D or external R&D, a decision that also contributes, together with the strong HR factor, to a competitive advantage of the firm. Engineer intensity refers to the ratio of engineers over total employees. When a firm possesses a high engineer intensity, it can be hypothesized that the firm has the intention to develop its innovation capability by itself in order to stand independently competing against other domestic as well as international competitors that carry out more advanced technology and know-how (Chiesa, Manzini, & Pizzurno, 2004; Lei, Hitt, & Bettis, 1996; Zahra & Nielsen, 2002). Moreover, according to the RBV, firms that have strong HR personnel working in the area of innovation are active in recruiting more well-trained engineers (Ettlie & Vellenga, 1979). Constantly recruiting employees enables firms to be updated with the current skills and knowledge of their employees, so that new employees can be a big asset for the firm as a whole but also for the learning process of older employees as they bring new skills and knowledge to the firm (Ettlie & Vallenga. 1979; Yeoh & Roth, 1999). There are also studies that confirm that skilled employees can reduce the costs of the product development cycle and shorten it (Sanchez, 1995).

Another argument according to the RBV is that firms make use of external R&D knowledge in cases they are not specialized in specific activities so that it would be inefficient for the firm to perform those activities. In case they have the capacity for these specific activities, they perform the R&D activities by themselves (Barney, 1999; Quinn, 2000). Based on this logic, it stands to argue that high engineer intensity enables a firm to be a specialist in R&D activities so that they prefer to perform R&D activities by

themselves rather than to get access to external sources. In order to make use of this human resource, these firms will focus more on internal R&D to receive a competitive advantage as they have the know-how and profit from the advantages of internal R&D in this regard. Hence I hypothesize:

Hypothesis 1: Firms with higher engineer intensity are more likely to allocate more resources in internal R&D than in external R&D.

4.1.2. Impact of physical resources

According to the RBV, geographic location is considered as a physical resource and can therefore result in a firm's competitive advantage (Barney, 1991). In order to investigate how the location in China can result in a competitive advantage for firms, or the firm's decision to invest more in internal or external R&D in the first step, I have to determine how the regions in China differ economically.

Economically, China can be divided in two general areas: the eastern area and the western area. The main difference between these two geographical areas is that, in contrast to the western regions, the eastern area is abundant with multinational companies. Especially the regions around Shanghai, Bejing, Shenzhen, Guangzhou and Suzhou are very popular locations for multinational companies (Von Zedtwitz, Ikeda, Gong, Carpenter, & Hämäläinen, 2007). It can be argued that these international firms increase the competition in the eastern areas, which seems on the first view as a disadvantage for domestic Chinese firms as there are crowding out effects due to the presence of international firms (Spencer, 2008). However, there are benefits for domestic firms because the availability of technological information that spills over from international firms helps local firms to improve their productivity (Badinger, 2007; Kato, 2009; Mnasri &

Ellouze, 2015; Spencer, 2008). The competition drives domestic Chinese firms to organize their resources according to the RBV in a more efficient way in order to respond to the challenges of the international firms, both in their domestic market and in international markets. Chinese firms located in the Western area are not endowed with this condition. The location of international firms in the eastern area generates a spillover effect (Spencer, 2008). In order to absorb the spillovers from multinational firms, Chinese firms of this area tend to invest more in internal R&D. Though external R&D is also an option, available spillover knowledge reduces the need for it. Therefore it can be concluded that local firms in the eastern area tend to allocate more resources in favor of internal R&D than external R&D. Hence, I propose:

Hypothesis 2: Compared to the western area, firms located in the eastern area will allocate more resources in internal R&D than in external R&D.

4.1.3. Impact of organizational resources

The affiliation of a firm is defined as the registration in different levels of government (Buckley et al., 2007; Wang, Hong, Kafouros, & Wright, 2012). According to the RBV, affiliations can be considered as organizational resources (Barney, 1991). In general organizational resources are intangible resources that include rules, norms, routines and the organizational culture (Aaker, 1989; Hall, 1992; 1993; Itami & Roehl, 1987; Prahalad & Hamel, 1990). Firms with strong organizational resources can structure their organizational activity in a very efficient and effective way. This also supports the development of other types of resources (Bueno, Arrien, & Rodriguez, 2003; Bueno-Campos, 1998).

These findings lead to the interesting question how the affiliation level of the firm impacts the strategic decision to carry out more internal or external R&D. In order to understand this relationship, we have to understand the advantages that firms with high affiliation levels enjoy compared to those who are less affiliated with the Chinese government. The higher the level of the affiliation of a firm with the government, the more benefits it enjoys. Firms registered in the central government level, for example, enjoy a lot of financing and taxation benefits such as loans with low interest rates (Wang, 2014). In the meantime, the higher the affiliation level, the more legitimacy in the market the firms receive, legitimacy in terms of brand awareness, quality recognition, and social responsibility credit (Wang, Hong, Kafouros, & Wright, 2012). Generally speaking, firms with higher level of affiliation gain more trust from customers. Such a trust is accompanied with expectations in return, expectations about the firms' advancement of technology and control of product quality. To meet those expectations, those firms will tend to invest more in R&D activities (Chiesa, Manzini, & Pizzurno, 2004; Lei, Hitt, & Bettis, 1996; Zahra & Nielsen, 2002). Making use of R&D from external sources is still an option. Yet endowed with abundant resources, those firms with higher affiliation level can simply hire best engineers, engage in more scientific research, and conduct more experiments to match their status with the expectations from the market. Thus I hypothesize:

Hypothesis 3: The higher the affiliation level of Chinese firms, the more they will allocate resources in their internal R&D than in external R&D.

4.1.4. Impact of financial resources

According to the RBV, government funding is a financial resource (Barney, 1991). It can be derived from the RBV (Barney, 1999; Quinn, 2000) that firms will get access to

external R&D in those areas where they do not have the resources and capabilities to develop innovation by themselves and in-house. According whether necessary resources are available or not it can be derived if a firm is specialized in specific activities or not. In case the firm lacks those resources, it is not capable to perform these by itself so that it is better for the firm to get access to it externally. In order to understand the effect of government funding on the firm's resource allocation decision for innovation strategy, we have to understand the advantages that firms enjoy when receiving this kind of financial asset from the government. Compared to the other sources of funding, such as bank loans or shareholders' capital, government funding in China is characterized with a "soft" budget constraint (Buckley et al., 2007). Government funding is made below market rates and is less strict in asking returns (Buckley, Cross, Tan, Xin, & Voss, 2008). There are two reasons that government funding is more likely to be used for internal R&D than for external R&D. First, internal R&D activities are often accompanied with high levels of risk as there is no guarantee that R&D activities can lead to successful results (Chiesa, Manzini & Pizzurno, 2004; Leonard, 1995). Especially in a highly competitive environment there exists a high risk of failure. Government funding as a soft budget restraint can resolve some of the pressure of high risk. Yet government funding expects firms to conduct internal R&D rather than outsource their R&D. Therefore I can conclude that government funding will more likely lead to internal R&D than external R&D.

Hypothesis 4: The firms that receive government funding will allocate more resources in internal R&D than in external R&D.

4.2. Impact of the R&D strategy on international market success

One of the significant differences between internal R&D and external R&D that I identified in my literature review is the speed of responses to the changing environment (e.g. Chiesa, Manzini, & Pizzurno, 2004). Firms have total control of internal R&D in terms of the direction of research activities and the schedule of research activities (Larsson, Bentsson, Henriksoon, & Sparks, 1998). While external R&D has lower uncertainty as the results have been approved by external sources of research, firms do have control on whether the internal R&D has quickly responded to the demand of the changing environment. In terms of swiftness in response to the change in the environment, external R&D has its limitations, as it has to be arranged beforehand in agreements between firms. The change of the markets can go beyond the predictions in those agreements. Whereas for internal R&D, firms conduct research independently, and therefore can quickly respond to the fast change of the markets (Larsson, Bentsson, Henriksoon, & Sparks, 1998).

Competing in international markets requires strong technological competitiveness and quick response to the changing demand of the markets. Firms conducting internal R&D have the flexibility and complete control to respond to the changing environment than engaging in external R&D. It can be predicted that firms with a focus on internal R&D can have better opportunities to successfully compete in the international markets with their products commercialized from new technologies. While external R&D can provide firms with reliable technologies, those technologies can become relatively old though more mature and therefore have less competitive advantage in competing in international markets. As a result, it stands to reason that internal R&D contributes more to international market success than external R&D. This corresponds with another argumentation that can be logically derived from to the nature of the performance variable

– the international market success. In hypothesis 2 I discussed Chinese economic issues regarding the increasing presence of foreign firms in some parts of the Chinese market. Therefore external R&D that Chinese domestic firms could use does not only have to come from other Chinese domestic firms, but also from international firms. As we measure the success in foreign markets, these external R&Ds might be already established in these foreign markets and thus are not completely new so that Chinese firms cannot obtain a competitive advantage. Thus I formulate following hypothesis:

Hypothesis 5: Chinese firms with their firm-specific combination of internal R&D and external R&D will receive better performance in accessing international markets.

4.3. Moderating role of the presence of foreign companies

The presence of foreign firms in a certain industry means spillover effect to the local market, so that Chinese firms have better access to advanced knowledge to learn from and to adopt for their own research and development processes. Spillover from multinational corporations is different from external R&D in the way that spillover provides examples but not detailed inside knowledge of the technologies (Spencer, 2008). Inspired by those examples, local firms have a good sense of direction in their internal research. Sometimes, local firms do reverse engineering with prototypes that are available in the local markets. Therefore, the presence of foreign firms in the local markets makes firms' internal R&D more effective and efficient as spillovers work as free inputs for local firms.

In addition to spillovers, the presence of foreign firms also brings about competitive pressure in the local markets. Such a pressure induces Chinese firms to work more diligently in their R&D activities so that their R&D efforts can generate new technologies,

new technologies that can be comparable to those of multinational corporations. The annual increase in Chinese firms' new product export (UNCTAD World Investment Report, 2014) footnotes the following hypothesis:

Hypothesis 6: The effect of the firm-specific combination regarding R&D activities on the international market success will be enhanced by the presence of foreign firms in the industries to which the firms belong.

5. METHODOLOGY

This section contains four sub-sections. First I will introduce the dataset that I used to test my model. Afterwards I will explain how the variables are operationalized and present the data analysis techniques. Finally the results are reported and discussed.

5.1. Data source

I used the Annual Industrial Survey Database, which is provided by the Chinese National Bureau of Statistics (CNBS), to test my hypotheses. A big advantage of this database is that it contains very extensive information about Chinese companies. The reason is that all companies, both local and foreign, are required by law to submit their annual financial information and demographic information to CNBS (Chang & Xu, 2008). Chow (1993) verified the high accuracy and consistency of the data so that the CNBS statistics can be used as secondary data for further empirical analysis. Therefore, data from the CNBS database has already been used in several studies in the area of international business (Buckley, Clegg, & Wang, 1999; Park, Li, & David, 2006; Tian, 2007; Chang & Xu, 2008; Zhang, Li, Li, & Zhou, 2010; Zhang, Li, & Li, 2014).

To test my model, I used panel data from 2001 to 2007. I included the seven years because 2001 is the year the CNBS has the most complete collection of the data from Chinese firms and 2007 is that last year that I can obtain. There is a change of policies from CNBS that no more firm-level data can be offered after 2007. One advantage of having the data from 2001 to 2007 and not from later years is that the worldwide financial crisis in 2008 and several years after 2008 may have some effect on firms' decision making. In 2008 China's yearly increase in its GDP was tremendously interrupted[6]. I do not have good control variables to control such effect except for the year control. I also deleted observations with missing data. As the study focuses on Chinese domestic firms, I excluded from the sample all foreign subsidiaries and international joint ventures. Eventually there are 13,708 firm-year observations, with 7,169 firms across 360 manufacturing sectors at the four-digit industry level included in testing my model.

5.2. Measurement

Dependent variables. As I used the two-stage regression model to test my hypotheses, there are two dependent variables – the *resource allocation ratio (of internal R&D over total R&D)* in the first step, and *international market success* in the next step. The resource allocation ratio is measured by the ratio of internal R&D over the sum of internal R&D and external R&D. The measure is adopted from Bönte (2003) and is based on an econometric specification proposed by Griliches (1986). According to Griliches (1986), the R&D capital of the firm consists of the two types, internal R&D capital and external R&D capital. Therefore the whole R&D capital stock can be expressed as the sum of internal R&D and external R&D. This justifies using the ratio as explained for the

[6] http://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG

operationalization of the decision between the two options. This operationalization has also been applied in other studies (e.g. Montoya, Zarate, & Martin, 2007). Internal R&D itself is the expenditure in internal R&D activities while external R&D is the expenditure in purchasing technology from external sources. *International market success* is measured by the ratio of the value of new product sales in international markets over total sales. I explicitly chose new products' success in the international market rather than in the domestic market because new products in a domestic market can come from an original equipment manufacturer (OEM) and thus are not the result of the firms' own innovation. Thus, international market success can truly measure Chinese firms' success as a result of their own research and development of products.

Independent variables. *Engineer intensity* is measured as the ratio of the number of engineers over the total number of employees. *Location* is a dichotomous variable with two values: 0 and 1. If the firm is located in the eastern area, it is assigned with the value of "1". Otherwise the location is assigned with "0". The definition of the area can be found on the CNBS website[7]. *Affiliation* refers to the level government at which the firm is registered. There are five levels of government. "1" represents the village, or street level of government; "2" the county level; "3" the district level; "4" the provincial level; and "5" the central government level. *Government funding* is measured by the grant from all levels of government divided by total sales. So this fourth independent variable is another intensity variable.

Moderating variable. In my model there is one moderator – the *presence of foreign companies* in industries. It is measured as the ratio of total assets of foreign companies

[7] www.stats.gov.cn

in the industry over the total assets of domestic firms in the industry. There are 378 industrial sectors included in the data at the four-digit industry level.

Control variables. I included four firm level control variables. *Firm size* is measured by the logged number of employees. It is included because the size of a firm may reflect the availability of slack resources and thereby might have some influence on the allocation of financial resources between internal and external R&D. *ROA* (return on assets) is measured as the ratio of profit over total assets of that year and is included because it represents the availability of financial resources. *Firm age* is included because the firm's age may reflect an inertia when making resource allocation decisions. *Leverage* is measured by the ratio of debt over total assets and is included as it may represent the risk-taking attitude of the firm when making resource allocation decisions.

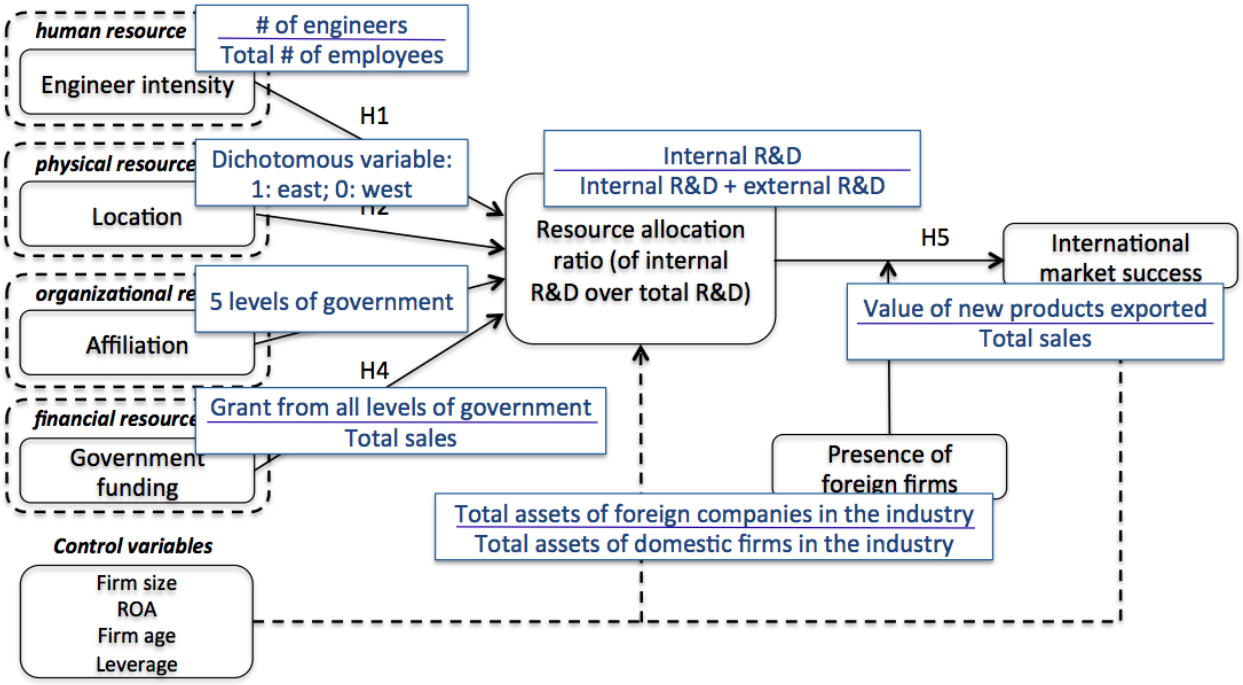

Figure 4: Operationalization of the variables

5.3. Data analysis

I used Heckman's (1979) two-staged model to test the hypotheses. In the first stage, the dependent variable is the resource allocation ratio while the independent variables are engineer intensity, location, affiliation, and government funding. In the second stage, the dependent variable is the international market success while the independent variable is the resource allocation ratio and the moderator is the presence of foreign companies in different industries. As my data is panel data, I used the panel data method instead of the least squares approach to test my models (Woolridge, 2002). In the second stage regression, I also considered the time effect on the performance. The dependent variable, international market success, is forwarded by one year.

5.4. Results

Table 6 presents the variable statistics and the correlation matrix. All the absolute values of the correlation coefficients are lower than 0.356. I also conducted a variance inflation factor (VIF) test and the results show that all the VIF values are lower than 1.25. Thus, multicollinearity is not a problem in the regression analysis (Chatterjee, Hadi, & Price, 2000). The variables are also mean-centered when the interaction effect is tested (Aiken & West, 1991).

	1	2	3	4	5	6	7	8	9	10	11
1. Intextratio											
2. Firm size	-0.058										
3. ROA	-0.040	0.176									
4. Firm age	-0.042	0.013	-0.103								
5. Leverage	0.056	-0.082	-0.356	0.062							
6. Engineer intensity	-0.028	0.078	0.057	0.005	-0.078						
7. Location	0.062	0.043	0.063	-0.013	0.008	0.004					
8. Affiliation	0.049	-0.109	0.213	-0.310	-0.011	-0.088	0.179				
9. Government funding	-0.049	-0.066	-0.017	0.041	-0.034	0.120	-0.052	-0.084			
10. International market success	0.036	0.033	0.034	-0.053	0.010	0.027	0.111	0.109	-0.006		
11. Presence of foreign firms	0.111	-0.048	0.057	-0.138	-0.048	0.031	0.118	0.163	0.007	0.143	
Mean	0.926	12.466	0.053	2.639	0.609	0.137	0.806	3.766	0.041	0.050	0.318
S.D.	0.140	1.300	0.081	0.936	0.210	0.174	0.395	1.345	0.122	0.128	0.178

N=13,708

Table 6: Variable statistics and correlations

Table 7 reports the regression results. In model 1 and 2, the dependent variable is the resource allocation ratio, measured as the ratio between internal R&D and internal R&D plus external R&D. For models 3 to 5, the dependent variable is the international market success. In the first stage of the regression, Model 1 includes all control variables while Model 2 adds the four main effects. In the second stage of regression, Model 3 includes the control variables and the four antecedent variables, Model 4 includes the control variables and the two main effects and Model 5 reports the full model, including the interaction effect. In Hypothesis 1, I proposed that engineer intensity is positively related to the resource allocation ratio (i.e., more internal R&D than external R&D). This hypothesis is not supported (Model 2). Probably the quality of engineers differs between firms, while there is no measure to capture the quality of engineers. It should also be the quality of engineers that contributes to the decision of internal versus external R&D investment and not only the number of engineers. This insignificant result leads to the future research direction on the operationalization of human resources. That is, the quality of such resources should be considered. Hypothesis 2 predicts that firms located in the eastern area are more likely to invest more in internal R&D than in external R&D. This hypothesis is also supported (b=0.019, p<0.001, Model 2). Hypothesis 3 proposes that Chinese firms with a higher affiliation level with the government are more likely to invest in internal R&D than in external R&D. This hypothesis is supported too (b=0.003, p<0.01, Model 2). Hypothesis 4 predicts a positive relationship between government funding and the preference to conduct R&D internally. This hypothesis is not supported (b=-0.042, p<0.001, Model 2). This result actually can lead to an interesting finding. Government funding, rather than promoting more risk-taking exploration behavior, leads to negative cause to resource allocation towards internal R&D. The reason probably lies in the agency

effect that the more a firm can receive government support, the less the firm is interested in enhancing its competitive advantage as there is always support from the government, which is a type of moral hazard described in the agency theory (Jensen & Meckling, 1976). Hypothesis 5 proposes that a higher share of internal R&D compared to external R&D results in a better international market success. This hypothesis is supported (b=0.009, p<0.001, Model 5). In the last hypothesis, I proposed that the presence of foreign firms in an industry enhances the effect of the R&D allocation strategy on international market success. This hypothesis is supported as well (b=0.113, p<0.001, Model 5). Figure 5 shows the plot of the interaction effect. As high presence of foreign firms makes the line higher and steeper, it enhances the relationship between the R&D allocation strategy and international market success.

Model 3 of Table 7 also shows us some interesting results regarding direct effects of the antecedent variables on the performance variable, the international market success. Engineer intensity has a positive effect on the international market success (b=0.012, p<0.1, Model 3). Even though the study did not confirm an effect of engineer intensity on the resource allocation decision between internal and external R&D, engineer intensity generally has a positive effect on international performance. The location of Chinese firms has a positive and statistically significant effect on the international market success (b=0.028, p<0.001, Model 3). Hence, Chinese firms located in the eastern area have a better performance abroad compared to firms located in the western regions of China. The reason for this result might be that the firms in the eastern area are more familiar with the market conditions abroad due to the high presence of foreign firms and the resulting spillover effect and the condition of increased competition. Moreover the affiliation level of the firm with the government has a positive and statistically significant effect on the firm's

international market success (b=0.008, p<0.001, Model 3). This finding lies in the fact that firms with high levels of affiliation enjoy a lot of benefits (Wang, 2014) as discussed in the hypothesis development. These benefits also give the firms an advantage to be more successful abroad. Finally government funding has a positive effect on the international market success (b=0.019, p<0.05, Model 3). Corresponding to the argumentation of the positive effect of the affiliation level on the performance abroad, the benefits that government funding provides for firms also result in the advantage to be more successful abroad for those firms.

	Model 1 DV: intextratio	Model 2 DV: intextratio	Model 3 DV: International market success	Model 4 DV: International market success	Model 5 DV: International market success
Firm size	-0.006***	-0.006***	0.006***	0.006***	0.007***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
ROA	0.001	-0.013	-0.007	0.013	0.013
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
Firm age (log)	-0.005***	-0.004*	-0.003*	-0.004**	-0.004**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Leverage	0.030***	0.026***	0.015*	0.019***	0.019***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Engineer intensity		-0.004	0.012+		
		(0.00)	(0.01)		
Location		0.019***	0.028***		
		(0.00)	(0.00)		
Affiliation		0.003**	0.008***		
		(0.00)	(0.00)		
Government funding		-0.042***	0.019*		
		(0.01)	(0.01)		
Intextratio				0.006**	0.009***
				(0.00)	(0.00)
Presence of foreign firms				0.097***	0.113***
				(0.01)	(0.01)
Intextratio X presence					0.028*
					(0.01)
Constant	0.997***	0.970***	-0.087***	-0.026+	-0.025+
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
R square (all)	0.430	0.440	0.568	0.573	0.577
N	13,708	13,708	13,708	13,708	13,708

1.Standard errors in parentheses

2. + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Table 7: Two stage regression results

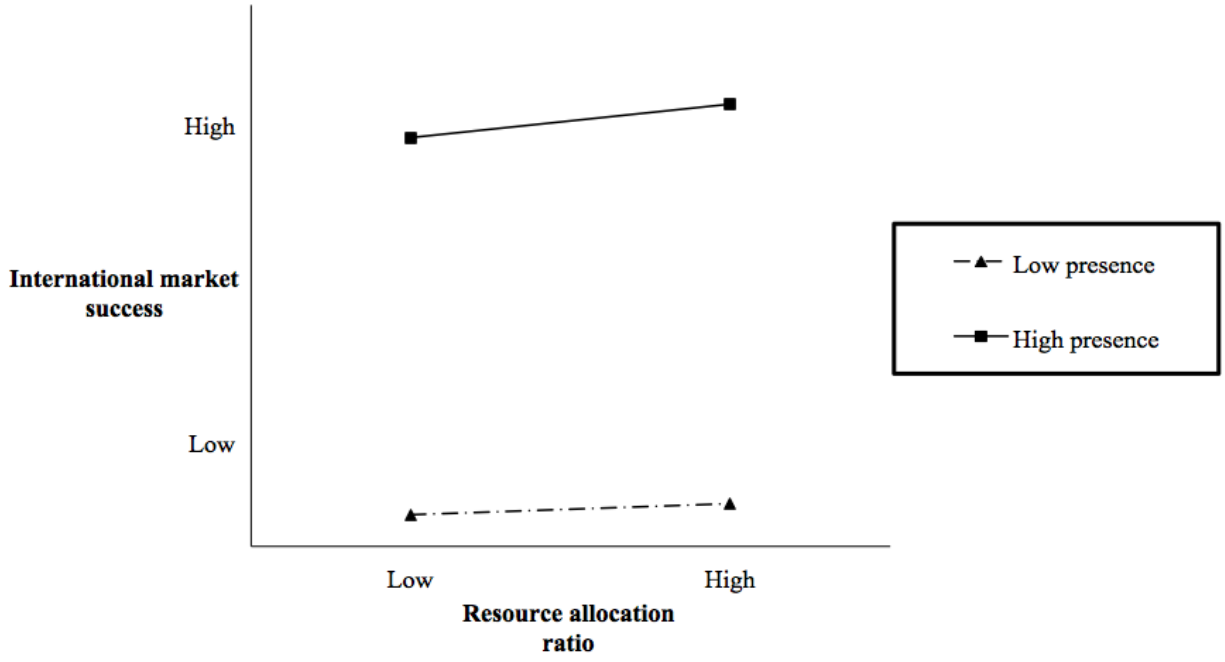

Figure 5: The moderating effect of presence of foreign firms

6. DISCUSSION

6.1. Theoretical Contribution

This study aims to reveal the factors that determine Chinese firms' resource allocation strategies in terms of the combination of investment in internal R&D and external R&D and to understand the consequence of such strategies. The contribution of this study is fourfold. The RBV is one of the most accepted and cited theories of strategic management (Lockett, Thompson & Morgenstern, 2009; Powell, 2001; Priem & Butler, 2001a; Rouse & Daellenbach, 2002). Nevertheless, less empirical tests have been conducted to support this theory (Newbert, 2007). The thesis' study empirically tests the RBV. Given the framework, the study's results reveal that firm resources that have the characteristics to be valuable, rare, inimitable and non-substitutable result, combined with

the strategy of the firm, in a competitive advantage and consequently in a higher performance in terms of a successful performance in foreign markets. Moreover there is a discussion in the literature regarding how to measure the competitive advantage firms can obtain through the availability and organization of their resources. According to Barney (1991, p.102), a firm can obtain a competitive advantage "[…] when it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors". Based on this definition, a firm has a current competitive advantage when it has a better performance compared to some or all of its rivals (Barney, 1991; Peteraf, 1993; Teece, Pisano, & Shuen, 1997; Wernerfelt, 1984). A meta-analysis conducted by Garengo, Biazzo, and Bititci (2005) shows that sustainable competitive advantage relevant for the RBV has been mainly measured either by financial performance variables or process performance variables. I also make a contribution to this by using a performance variable in the global context to emphasize firm's obtained competitive advantage in the global market. Second, I extended the explanation of the last dimension of "VRIO" (Barney & Hesterly, 2010) - "organization". Organization of resources refers to an effective combination of resources that create competitive advantage. Yet it is not extensively applied, nor empirically tested. My study looks into this dimension and empirically tested how effectively the combination of resources (e.g., internal R&D and external R&D) leads to international market success. Third, the issue of internal R&D and external R&D has been examined in existing literature (Hagedoorn & Wang, 2012). However, the literature focused on discussing the complementary and substitute effects between the two. My thesis looks into the important issue of the determinants of the two R&D strategies and fills the gap in this way. Fourth, there is an extensive literature on learning from exporting (e.g. Damijan & Kostevc, 2006; Salomon &

Shaver, 2005), which investigates that firms involved in exporting can learn from international markets. My thesis looks differently from this literature and examines that indigenous firms learn from the multinational firms in indigenous firms' domestic markets, which complements this literature.

6.2. Managerial Contribution

I also have some managerial implications. First, my hypotheses mainly seem to focus on the effects of internal R&D. Yet, external R&D is an inseparable component of R&D strategy. My hypotheses actually imply that, for example, when the location is a disadvantage for firms to quickly access critical technological information, external R&D is an effective alternative. Same for firms that do not enjoy the benefits associated with a high government affiliation. Second, regarding where to have the external R&D, the literature has pointed to institutions and other firms (Hagedoorn & Wang, 2012). Yet another important source of external R&D, particularly for Chinese firms, is the multinational corporations. As my Hypothesis 6 reveals, the presence of foreign firms can enhance the effect of Chinese firms' R&D strategy on exporting their new products successfully. Such an enhancing effect may also include the transfer of technology from multinational corporations to indigenous Chinese firms. Thus, external R&D from multinational corporations is a critical option for Chinese firms. All in all one can derive from the findings of the study that Chinese firms should focus more on internal R&D activities as they provide better solutions that can result in an advantage abroad. This is in contrast to the current trend as Chinese firms are more interested in attracting external R&D solutions so that they overall put much more focus on this option.

6.3. Limitations and Future Research

All studies, including the one carried out in my thesis, have limitations. Some of the limitations of my study lead to future research directions. I mentioned that I made an empirical test of the RBV. My model is based on the assumption that the antecedent variables are classified as resources according to the RBV. However, the reason why concrete empirical tests of the RBV are missing in the literature is that the characteristics of the resources to be valuable, rare, inimitable and non-substitutable are difficult to measure. There are also scholars that question the empirical testability of the RBV, as the theory's assertions are true by definition, which means that the constructs are defined in a tautological way and therefore not empirically testable (Armstrong & Shimizu, 2007; Priem & Butler, 2001b). A perfect resource according to the RBV has been empirically tested by Markman, Espina and Phan (2004). Pharmaceutical patents are tested to have the attributes to be valuable, rare, inimitable and non-substitutable. They also highlight in their paper that they made a review of top-tiered management journals and did not identify any empirical study in which a resource was operationalized as valuable, rare, inimitable, and non-substitutable. However, Barney (2001) counters that scholars also face problems regarding testing other theories, such as transaction cost economics or agency theory. He also highlights that one cannot state that the RBV is not testable, but difficult to test. All in all it can be summarized and stated that the measurement of the resources characteristics of value, rarity, inimitability, and non-substitutability are difficult to design.

The second limitation is that my model measures the allocation of financial resources between internal R&D and external R&D, but fails to include other resources. In future research, other resource categories such as allocations of talents or time should

be included in the measurement, such that the measures of resource allocation are more precise in capturing firms' R&D strategies.

Third, my study uses China as the context to investigate R&D strategies. The resources available to firms, which are expressed as my antecedent variables, can be considered as Chinese specific to some extent. For example the importance of the affiliation level of firms with the government is very specific for the Chinese economy and society (Buckley et al., 2007; Wang, Hong, Kafouros, & Wright, 2012; Wang, 2014). It is obvious that emerging market countries differ economically from developed westernized countries, so that it can be concluded that they have many things in common. However, there are of course also smaller differences between emerging market countries, for example between China and India, regarding the availability of resources and the firms' endogenous organization of these resources. Therefore there is the open question whether the findings can be generalized to other emerging markets, which can be an option for another future study.

Last there is a limitation in the model regarding the factors that are investigated. Only one specific resource is picked from each category of resources listed by Barney (1991). Other relevant factors have to be included in future studies as well. In general, more theoretical and empirical work has to be done to clarify the relationship between resource configuration and company profit or companies' international market success.

REFERENCES

Aaker, D. A. (1989). Managing assets and skills: the key to a sustainable competitive advantage. *California Management Review*, *31*(2), 91-106.

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Thousand Oaks: Sage Publications.

Amit, R., & Schoemaker, P. J. (1993). Strategic assets and organizational rent. *Strategic Management Journal*, *14*(1), 33-46.

Armstrong, C. E., & Shimizu, K. (2007). A Review of Approaches to Empirical Research on the Resource-Based View of the Firm†. *Journal of Management*, *33*(6), 959-986.

Arora, A., & Gambardella, A. (1990). Complementarity and external linkages: the strategies of the large firms in biotechnology. *The Journal of Industrial Economics*, *38*(4), 361-379.

Badinger, H. (2007). Market size, trade, competition and productivity: evidence from OECD manufacturing industries. *Applied Economics*, *39*(17), 2143-2157.

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99-120.

Barney, J. B. (1994). Bringing managers back in: a resource-based analysis of the role of managers in creating and sustaining competitive advantages for firms. *Does management matter*, 1-36.

Barney, J. B., & Education, P. (1997). *Gaining and sustaining competitive advantage*: Addison-Wesley Reading, MA.

Barney, J. B. (1999). How a firm's capabilities affect boundary decisions. *Sloan Management Review*, *40*(3), 137-145.

Barney, J. B. (2001). Is the resource-based “view” a useful perspective for strategic management research? Yes. *Academy of Management Review*, *26*(1), 41-56.

Barney, J.B., & Hesterly, W. (2010). VRIO framework. In *Strategic management and competitive advantage* (pp. 68-86). New Jersey: Pearson.

Baysinger, B., & Hoskisson, R. E. (1989). Diversification strategy and R&D intensity in multiproduct firms. *Academy of Management Journal*, *32*(2), 310-332.

Baysinger, B. D., Kosnik, R. D., & Turk, T. A. (1991). Effects of board and ownership structure on corporate R&D strategy. *Academy of Management Journal*, *34*(1), 205-214.

Becker, G. S. (1964*). Human Capital.* New York: National Bureau of Economic Research.

Benson, D., & Ziedonis, R. H. (2009). Corporate venture capital as a window on new technologies: Implications for the performance of corporate investors when acquiring startups. *Organization Science*, *20*(2), 329-351.

Berchicci, L. (2013). Towards an open R&D system: Internal R&D investment, external knowledge acquisition and innovative performance. *Research Policy*, *42*(1), 117-127.

Bertrand, O., & Mol, M. J. (2013). The antecedents and innovation effects of domestic and offshore R&D outsourcing: The contingent impact of cognitive distance and absorptive capacity. *Strategic Management Journal*, *34*(6), 751-760.

Black, J. A., & Boal, K. B. (1994). Strategic resources: Traits, configurations and paths to sustainable competitive advantage. *Strategic Management Journal*, *15*, 131-148.

Bower, J. L. (1986). *Managing the resource allocation process: A study of corporate planning and investment* (Vol. 3). Harvard Business Press.

Bönte, W. (2003). R&D and productivity: Internal vs. external R&D-evidence from west german manufacturing industries. *Economics of Innovation and New Technology*, *12*(4), 343-360.

Brusoni, S., Prencipe, A., & Pavitt, K. (2001). Knowledge specialization, organizational coupling, and the boundaries of the firm: why do firms know more than they make?. *Administrative Science Quarterly*, *46*(4), 597-621.

Buckley, P. J., Clegg, J., & Wang, C. (2002). The impact of inward FDI on the performance of Chinese manufacturing firms. *Journal Of International Business Studies*, *33*(4), 637-655.

Buckley, P. J., Clegg, L. J., Cross, A. R., Liu, X., Voss, H., & Zheng, P. (2007). The determinants of Chinese outward foreign direct investment. *Journal of International Business Studies, 38*, 499-518.

Buckley, P. J., Cross, A. R., Tan, H., Xin, L., & Voss, H. (2008). Historic and emergent trends in Chinese outward direct investment. *Management International Review, 48*(6), 715-748.

Bueno Campos, E. (1998). El capital intangible como clave estratégica en la competencia actual. *Boletín de estudios económicos*, *53*(164), 207-229.

Bueno, E., Arrien, M., & Rodríguez, O. (2003). Modelo Intellectus: medición y gestión del capital intelectual. *Documentos intellectus*, *5*, 1-175.

Carroll, G. R. (1993). A sociological view on why firms differ. *Strategic Management Journal*, *14*(4), 237-249.

Casciaro, T., & Piskorski, M. J. (2005). Power imbalance, mutual dependence, and constraint absorption: A closer look at resource dependence theory. *Administrative Science Quarterly*, *50*(2), 167-199.

Cassiman, B., & Veugelers, R. (2006). In search of complementarity in innovation strategy: Internal R&D and external knowledge acquisition. *Management Science*, *52*(1), 68-82.

Castells, M. (2001). *The Internet galaxy: Reflections on the Internet, business, and society*. Oxford University Press.

Chang, S. J., & Xu, D. (2008). Spillovers and competition among foreign and local firms in China. *Strategic Management Journal*, *29*(5), 495-518.

Chatterjee, S., Hadi, A. S., & Price, B. (2000). *Regression Analysis by Example*. New York: Wiley.

Chi, T., & Seth, A. (2009). A dynamic model of the choice of mode for exploiting complementary capabilities. *Journal of International Business Studies, 40*, 365-387.

Chiesa, V., Manzini, R., & Pizzurno, E. (2004). The externalisation of R&D activities and the growing market of product development services. *R&D Management*, *34*(1), 65-75.

Chow, G. C. (1993). Capital formation and economic growth in China. *Quarterly Journal Of Economics*, *108*(3), 809-842.

Christensen, C. (2013). *The innovator's dilemma: when new technologies cause great firms to fail*. Harvard Business Review Press.

Coe, D. T., & Helpman, E. (1995). International R&D spillovers. *European Economic Review*, *39*(5), 859-887.

Cohen SS, Zysman J. (1988). Manufacturing innovation and American industrial competitiveness. *Science 239*(4845), 1110–1115.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, *35*(1), 128-152.

Cuervo-Cazurra, A., & Annique Un, C. (2010). Why some firms never invest in formal R&D. *Strategic Management Journal*, *31*(7), 759-779.

Damijan, J. P., & Kostevc, C. (2006). Learning-by-exporting: Continuous productivity improvements or capacity utilization effects? evidence from Slovenian firms. *Review of World Economics, 142*(3), 599-614.

Danneels, E. (2002). The dynamics of product innovation and firm competences. *Strategic Management Journal*, *23*(12), 1095-1121.

D'Aveni, R. A. (2010). *Hypercompetition*. Free Press: New York.

Davenport, T. H. (2013). *Process innovation: reengineering work through information technology*. Harvard Business Press.

Dierickx, I., & Cool, K. (1989). Asset stock accumulation and sustainability of competitive advantage. *Management Science*, *35*(12), 1504-1511.

Ennen, E., & Richter, A. (2010). The whole is more than the sum of its parts—or is it? A review of the empirical literature on complementarities in organizations. *Journal of Management*, *36*(1), 207-233.

Ettlie, J. E., & Vellenga, D. B. (1979). The adoption time period for some transportation innovations. *Management Science*, *25*(5), 429-443.

Fey, C. F., & Birkinshaw, J. (2005). External sources of knowledge, governance mode, and R&D performance. *Journal of Management*, *31*(4), 597-621.

Foss, N. J. (1997). *Equilibrium vs Evolution in the Resource-Based Perspective The Conflicting Legacies of Demsetz and Penrose* (No. 97-10). DRUID, Copenhagen Business School, Department of Industrial Economics and Strategy/Aalborg University, Department of Business Studies.

Foster, R., & Kaplan, S. (2011). *Creative Destruction: Why Companies That Are Built to Last Underperform the Market--And How to Success fully Transform Them*. Crown Business.

Franko, L. G. (1989). Global corporate competition: Who's winning, who's losing, and the R&D factor as one reason why. *Strategic Management Journal*, *10*(5), 449-474.

Fryxell, G. E. (1990). Multiple outcomes from product R&D: profitability under different strategic orientations. *Journal of Management*, *16*(3), 633-646.

Garengo, P., Biazzo, S., & Bititci, U. S. (2005). Performance measurement systems in SMEs: a review for a research agenda. *International Journal of Management Reviews*, *7*(1), 25-47.

Grant, R. M. (1991). The resource-based theory of competitive advantage: implications for strategy formulation. *California Management Review*, *33*(3), 3-23.

Grant, R. M. (1996). Toward a knowledge- based theory of the firm. *Strategic Management Journal*, *17*(S2), 114-135.

Griliches, Z. (1986). Productivity, R&D, and basic research at the firm level in the 1970s. *American Economic Review, 76,* 141-154.

Grimpe, C., Kaiser, U., 2010. Balancing internal and external knowledge acquisition: the gains and pains from R&D outsourcing. *Journal of Management Studies 47* (8), 1483–1509.

Hagedoorn, J., & Wang, N. (2012). Is there complementarity or substitutability between internal and external R&D strategies? *Research Policy, 41*, 1072-1083.

Hall, R. (1992). The strategic analysis of intangible resources. *Strategic Management Journal*, *13*(2), 135-144.

Hall, R. (1993). A framework linking intangible resources and capabilities to sustainable competitive advantage. *Strategic Management Journal*, *14*(8), 607-618.

Harrigan, K.R., 1983. *Strategies for Vertical Integration.* Blackwell, Oxford.

Harrison, J. S., Hitt, M. A., Hoskisson, R. E., & Ireland, R. D. (1991). Synergies and post-acquisition performance: Differences versus similarities in resource allocations. *Journal of Management*, *17*(1), 173-190.

Heckman, J. J. (1979). Sample Selection Bias as a Specification Error. *Econometrica, 47*(1), 153-161.

Henderson, R., & Cockburn, I. (1996). Scale, scope, and spillovers: The determinants of research productivity in drug discovery. *RAND Journal Of Economics*, *27*(1), 32-59.

Hoang, H. A., & Rothaermel, F. T. (2010). Leveraging internal and external experience: exploration, exploitation, and R&D project performance. *Strategic Management Journal*, *31*(7), 734-758.

Holcomb, T. R., & Hitt, M. A. (2007). Toward a model of strategic outsourcing. *Journal of Operations Management*, *25*(2), 464-481.

Howells, J., Gagliardi, D., & Malik, K. (2008). The growth and management of R&D outsourcing: evidence from UK pharmaceuticals. *R&D Management*, *38*(2), 205-219.

Huang, Y., Chung, H., Lin, C., 2009. R&D sourcing strategies: determinants and consequences. *Technovation 29* (3), 155–169.

Hitt, M. A., Hoskisson, R. E., & Harrison, J. S. (1991). Strategic competitiveness in the 1990s: Challenges and opportunities for U.S. executives. *Academy of Management Executive, 5*(2), 7-22.

Itami, H., & Roehl, T. W. (1987). *Mobilizing invisible assets*. Harvard University Press.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics*, *3*(4), 305-360.

Kato, A. (2009). Product Market Competition and Productivity in the Indian Manufacturing Industry. *The Journal of Development Studies*, *45*(10), 1579-1593.

Kumar, N., Scheer, L. K., & Steenkamp, J. B. E. (1995). The effects of perceived interdependence on dealer attitudes. *Journal of Marketing Research*, 348-356.

Lado, A. A., & Wilson, M. C. (1994). Human resource systems and sustained competitive advantage: A competency-based perspective. *Academy of Management Review*, *19*(4), 699-727.

Larsson, R., Bengtsson, L., Henriksson, K., & Sparks, J. (1998). The interorganizational learning dilemma: Collective knowledge development in strategic alliances. *Organization Science*, *9*(3), 285-305.

Laursen, K., & Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among UK manufacturing firms. *Strategic Management Journal*, *27*(2), 131-150.

Lei, D., Hitt, M. A., & Bettis, R. (1996). Dynamic core competences through meta-learning and strategic context. *Journal of Management*, *22*(4), 549-569.

Leonard, D. (1995). Wellspring of knowledge. *Boston: Harvard Business School*.

Leonard-Barton, D. (1992). Core capabilities and core rigidities: a paradox in managing new product development. *Strategic Management Journal*, *13*(1), 111-125.

Levinthal, D. A., & March, J. G. (1993). The myopia of learning. *Strategic Management Journal, 14*(Winter SI), 95-112.

Loasby, B. J. (1998). The organisation of capabilities. *Journal of Economic Behavior & Organization*, *35*(2), 139-160.

Lockett, A., Thompson, S., & Morgenstern, U. (2009). The development of the resource-based view of the firm: A critical appraisal. *International Journal of Management Reviews*, *11*(1), 9-28.

Love, J. H., & Roper, S. (2002). Internal versus external R&D: a study of R&D choice with sample selection. *International Journal of the Economics of Business*, *9*(2), 239-255.

March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science, 2*(1), 71-87.

Markman, G. D., Espina, M. I., & Phan, P. H. (2004). Patents as surrogates for inimitable and non-substitutable resources. *Journal of Management*, *30*(4), 529-544.

Mata, J., & Woerter, M. (2013). Risky innovation: The impact of internal and external R&D strategies upon the distribution of returns. *Research Policy*, *42*(2), 495-501.

Mazzanti, M., Montresor, S., & Pini, P. (2009). What drives (or hampers) outsourcing? Evidence for a local production system in Emilia Romagna. *Industry and Innovation*, *16*(3), 331-365.

McGrath, R. G. (2001). Exploratory learning, innovative capacity, and managerial oversight. *Academy of Management Journal*, *44*(1), 118-131.

Michalisin, M. D., Kline, D. M., & Smith, R. D. (2000). Intangible strategic assets and firm performance: a multi industry study of the resource based view. *Journal of Business Strategies*, *17*(2).

Mnasri, K., & Ellouze, D. (2015). Ownership structure, product market competition and productivity: Evidence from Tunisia. *Management Decision*, *53*(8), 1771-1805.

Montoya, P. V., Zárate, R. S., & Martín, L. Á. G. (2007). Does the technological sourcing decision matter? Evidence from Spanish panel data. *R&D Management*, *37*(2), 161-172.

Munari, F., Oriani, R., & Sobrero, M. (2010). The effects of owner identity and external governance systems on R&D investments: A study of Western European firms. *Research Policy*, *39*(8), 1093-1104.

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

Newbert, S. L. (2007). Empirical research on the resource- based view of the firm: an assessment and suggestions for future research. *Strategic Management Journal*, *28*(2), 121-146.

Nicholls- Nixon, C. L., & Woo, C. Y. (2003). Technology sourcing and output of established firms in a regime of encompassing technological change. *Strategic Management Journal*, *24*(7), 651-666.

Noda, T., & Bower, J. L. (1996). Strategy making as iterated processes of resource allocation. *Strategic Management Journal, 17*, 159-192.

Odagiri, H., 2003. Transaction costs and capabilities as determinants of the R&D boundaries of the firm: a case study of the ten largest pharmaceutical firms in Japan. *Managerial and Decision Economics 24*(2–3), 187–211.

Papaconstantinou, G. (1997). Technology and industrial performance. *OECD Observer*, *204*, 6-10.

Park, S. H., Li, S., & David, K. T. (2006). Market liberalization and firm performance during China's economic transition. *Journal of International Business Studies*, *37*(1), 127-147.

Patel, P., & Pavitt, K. (1997). The technological competencies of the world's largest firms: complex and path-dependent, but not much variety. *Research Policy*, *26*(2), 141-156.

Penner-Hahn, J., & Shaver, J. M. (2005). Does international research and development increase patent output? An analysis of Japanese pharmaceutical firms. *Strategic Management Journal*, *26*(2), 121-140.

Penrose, E. T. (1959). *The Theory of the Growth of the Firm*. Oxford university press.

Peteraf, M. A. (1993). The cornerstones of competitive advantage: a resource- based view. *Strategic Management Journal*, *14*(3), 179-191.

Piga, C. A., & Vivarelli, M. (2004). Internal and External R&D: A Sample Selection Approach*. *Oxford Bulletin of Economics and Statistics*, *66*(4), 457-482.

Pisano, G. P. (1990). The R&D boundaries of the firm: an empirical analysis. *Administrative Science Quarterly*, 153-176.

Porter, M. E. (1980). *Competitive strategy: techniques for analyzing industries and competitors*. New York: The Free Press.

Powell, T. C. (2001). Competitive advantage: logical and philosophical considerations. *Strategic Management Journal*, *22*(9), 875-888.

Priem, R. L., & Butler, J. E. (2001a). Is the resource-based "view" a useful perspective for strategic management research?. *Academy of Management Review*, *26*(1), 22-40.

Priem, R. L., & Butler, J. E. (2001b). Tautology in the resource-based view and the implications of externally determined resource value: Further comments. *Academy of Management Review*, *26*(1), 57-66.

Quinn, J. (2000). Outsourcing innovation: the new engine of growth. *Sloan Management Review, 41*(4), 13-28.

Hamel, G., & Prahalad, C. K. (1990). The core competence of the corporation. *Harvard Business Review*, *68*(3), 79-91.

Robinson, K. (2011). *Out of our minds: Learning to be creative*. John Wiley & Sons.

Rouse, M. J., & Daellenbach, U. S. (2002). More thinking on research methods for the resource- based perspective. *Strategic Management Journal*, *23*(10), 963-967.

Priem, R. L., & Butler, J. E. (2001). Tautology in the resource-based view and the implications of externally determined resource value: Further comments. *Academy of Management Review*, *26*(1), 57-66.

Rugman, A. M., & Verbeke, A. (2002). Edith Penrose's contribution to the resource-based view of strategic management. *Strategic Management Journal*, *23*(8), 769-780.

Salomon, R. M., & Shaver, J. M. (2005). Learning by exporting: New insights from examining firm innovation. *Journal of Economics & Management Strategy, 14*(2), 431-460.

Salomon, R., & Jin, B. (2010). Do leading or lagging firms learn more from exporting?. *Strategic Management Journal*, *31*(10), 1088-1113.

Sanchez, R. (1995). Strategic flexibility in product competition. *Strategic Management Journal*, *16*(S1), 135-159.

Schendel, D., & Hofer, C. W. (1978). *Strategy Formulation: Analytical Concepts.* St. Paul, MN: West Publishing.

Spencer, J. W. (2008). The impact of multinational enterprise strategy on indigenous enterprises: Horizontal spillovers and crowding out in developing countries. *Academy of Management Review, 33*(2), in press.

Spithoven, A., & Teirlinck, P. (2015). Internal capabilities, network resources and appropriation mechanisms as determinants of R&D outsourcing. *Research Policy*, *44*(3), 711-725.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509-533.

Tian, X. (2007). Accounting for sources of FDI technology spillovers: evidence from China. *Journal of International Business Studies*, *38*(1), 147-159.

Tiwana, A., Keil, M., 2007. Does peripheral knowledge complement control? An empirical test in technology outsourcing alliances. *Strategic Management Journal 28* (6), 623–634.

Tomer, J. F. (1987). *Organizational capital: The path to higher productivity and wellbeing*. New York: Praeger.

Tsai, K. H., & Wang, J. C. (2007). A longitudinal examination of performance of two ways on innovation in Taiwan: internal R&D investment and external technology aquisition. *International Journal of Technology Management*, *39*(3-4), 235-247.

Tsai, K. H., & Wang, J. C. (2009). External technology sourcing and innovation performance in LMT sectors: An analysis based on the Taiwanese Technological Innovation Survey. *Research Policy*, *38*(3), 518-526.

Vanhaverbeke, W., Duysters, G., & Noorderhaven, N. (2002). External technology sourcing through alliances or acquisitions: An analysis of the application-specific integrated circuits industry. *Organization Science*, *13*(6), 714- 733.

Veugelers, R., & Cassiman, B. (1999). Make and buy in innovation strategies: evidence from Belgian manufacturing firms. *Research Policy*, *28*(1), 63-80.

Von Zedtwitz, M., Ikeda, T., Gong, L., Carpenter, R., & Hämäläinen, S. (2007). Managing foreign R&D in China. *Research Technology Management*, *50*(3), 19-27.

Wang, C., Hong, J., Kafouros, M., & Wright, M. (2012). Exploring the role of government involvement in outward FDI from emerging economies. *Journal of International Business Studies, 43*, 655-676.

Wang, S. (2014). A comparison of financing utilization efficiency among stated owned, private and FDI enterprises. *Management & Engineering,* (15), 31-36.

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, *5*(2), 171-180.

Williamson, O. E. (1975). *Markets and Hierarchies: Analysis and Antitrust Implications.* New York: Free Press.

Winter, S. G. (1987). Knowledge and competence as strategic assets. In D. J. Teece (Ed.), *The Competitive Challenge*: Ballinger Publishing, Cambridge, MA.

Wooldridge, J. M. (2002). *Econometric analysis of cross section and panel data*. Cambridge, MA: MIT Press.

Wu, L. Y. (2010). Applicability of the resource-based and dynamic-capability views under environmental volatility. *Journal of Business Research*, *63*(1), 27-31.

Yeoh, P. L., & Roth, K. (1999). An empirical analysis of sustained advantage in the US pharmaceutical industry: Impact of firm resources and capabilities. *Strategic Management Journal*, *20*(7), 637-653.

Zahra, S. A., Sisodia, R. S., & Das, S. R. (1994). Technological choices within competitive strategy types: a conceptual integration. *International Journal of Technology Management*, *9*(2), 172-195.

Zahra, S. A., & Nielsen, A. P. (2002). Sources of capabilities, integration and technology commercialization. *Strategic Management Journal*, *23*(5), 377-398.

Zhang, Y., Li, H., Li, Y., & Zhou, L. (2010). FDI spillovers in an emerging market: the role of foreign firms' country origin diversity and domestic firms' absorptive capacity. *Strategic Management Journal*, *31*(9), 969-989.

Zhang, Y. A., Li, Y., & Li, H. (2014). FDI spillovers over time in an emerging market: the roles of entry tenure and barriers to imitation. *Academy of Management Journal, 57*(3), 698-722.