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External technology base, absorptive capability and innovation performance of technological acquisition among Chinese firms

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External technology base, absorptive capability and innovation performance of technological acquisition among Chinese firms

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Abstract: This paper examines the impact of the acquired knowledge base on the subsequent innovation performance of acquiring firms in the domestic technological acquisition in China. This study provides and tests a framework relating the acquired knowledge base and absorptive capacity of firm innovation performance. Based on Poisson regression with 39 cases' data, the result shows that both the absolute size and relative size of acquired technology are positively affected innovation performance. In addition, the absorptive capacity measured by the size of acquiring technology base and R&D input density have the positive impacting trend to the relationship between acquired technology and innovation performance.

Key words: Technology base, Technological acquisition

1 Introduction

Over the past few years, acquiring external technology has been become a central part of a firm's overall strategy and has received increasing attention in the literature (*Van De Vrande*, 2013), because even the largest innovative organizations cannot rely solely on internal sourcing, also require technology from external sourcing in high-tech industries with the increasing cost, speed, and complexity (Cohen and Levinthal, 1989, 1990; Harrison et al. 2001; Mytelka 1991; Porter and Fuller, 1986; Teece, 1992; Chesbrough and Crowther, 2006; Rigby and Zook, 2002). Technological acquisition is a new type of strategy to access external resources to strengthen their innovative capabilities and achieve specific strategic goals through buy technology enterprises or technological resources embedded in an organization.

The study in technology acquisition has typically focused on the existence and the motivation in the developed countries since 1980s (see Granstrand & Jacobsson, 1983; Jacobsson, 1984; Hagedoorn & Duysters, 2002; Vermeulen & Brekema, 2001; Carayannopoulos & Auste, 2009, etc), where developed countries are major research background, such as Sweden, Cananda, Japan, United State and European countries. However, the technological acquisition influencing technology upgrading is growing in developed, emerging and developing countries alike. Developing country as research background is a supplementary to currently research on technological acquisition, and China, the world's the second-biggest economy, is a very important study field for the research due to the fact that Chinese firms are growing new power in technology acquisition.

It is worthwhile to note that some enterprises, especially medium-sized and small enterprises often cannot acquire technology sources in the worldwide for their limited sources and capabilities.

For some firms in developing countries with less advanced technology, the domestic technological acquisition is an important step to establish technological foundation to absorb, utilize and explore advanced technology worldwide. For example, many Chinese firms firstly acquire the external technology sources from a Chinese technology enterprise in the Chinese domestic market. The high-profile Chinese companies undertaking domestic technology acquisition include Chongqing Zongshen Power Machinery Co.,Ltd, Jiangzhong Pharmaceutical Co.,Ltd, Guodian Nanjing Automation Co.,Ltd and so on.

The strategic objective of this study is explores how the external technology base influences the innovation performance of technological acquisition among Chinese firms. This paper designs to explore two questions. First, the relationship between the sizes of acquired knowledge base and innovation performance in technological acquisition. Second, how the absorptive capability moderates the above relationship in technological acquisition among Chinese firms.

Using a Poisson regression based on multiple cases of 39 Chinese firms undertaking domestic technological acquisition from 2003 to 2008, the study answers the above two research questions and deepens the study of technological acquisition. This study provides a sharp insight for the study of technological acquisition. First, the impact of internal sources interact with external sources to innovation performance of technology acquisition is explored, it is a remarkable progress to the prior study on influencing factor of technological acquisition almost has been provided through internal and external sources separately(Vega-Jurado et al., 2009; Ahuja and Katila, 2001). In addition, this study extends the main research perspective of technology acquisition from developed countries to developing countries. This study also pushes the methodology relating to the technological acquisition by Chinese firms into empirical analysis from case study.

This paper is organized in five sections. Section 1 is the introduction, which raises the question. Section 2 summarizes classical literature with respect to external technology sources, and constructs the assumptions on this basis; the methodology including the model set, data and variable measures is presented in section 3. The descriptive analysis and empirical results were represented in section 4. The final section discussion concludes with the findings, management implications and discussions about studies in the future.

2 Literature Reviews and Hypotheses

2.1 Technological acquisition relating developed countries

In recent years, some scholars studied technological acquisition in developed countries. Classic research on technological acquisition in developed countries background include the existence, motives, influencing factors and integration, see table 1.

[INSERT TABLE 1 HERE]

There are three limitations in research on technological acquisition. Firstly, the existence of technological acquisition (Granstrand & Jacobsson, 1983; Jacobsson, 1984; Hagedoorn & Duysters, 2002; Puranam, Singh & Zollo, 2003), motives (Vermeulen & Brekema, 2001; Mar ń,

2006; Vega-Jurado,etc, 2009; Carayannopoulos & Auste, 2009) and integration (Puranam, Singh and Zollo, 2003; Puranam, etc.,2009; Ernst & Vitt, 2000; Al-Laham, etc., 2009) have been extensively studied, but research on influencing factors are rare (eg. Granstrand, etc,1992; Ahuja & Katila, 2001; Al-Laham etc.,2009).

What's more, the influencing factors of technology acquisition performance almost have been provided through internal and external sources separately (Vega-Jurado et al., 2009; Ahuja and Katila, 2001). In fact, companies have increased their use the combination of internal and external sources striving for a competitive advantage, and the firm will benefit more from external technological knowledge when is having more internal technology sources (Cohen and Levinthal, 1990; Lane and Lubatkin, 1998; Kim, 1998), so the study on impacts of internal sources interact with external sources to innovation performance of technology acquisition is a useful complement to previous studies.

In addition, interestingly, while studies on technological acquisition in advanced countries have been studied extensively, relatively little research has focus on the developing countries. Developing country as research background is a supplementary to currently research on technological acquisition, and China, as the world's the second-biggest economy, is an important study field. Chinese firms are growing new power to undertake technology acquisition in the international market and domestic market. They also play an irreplaceable role in technology exchanges and upgrading both at home and abroad. For example, Lenovo acquired IBM PC, Dalian Machine Tool merged Ingersoll manufacturing company and Ingersoll crankshaft Production Systems of the U.S., and Geely bought Volvo.

2.2 Technological acquisition of Chinese firms

Although relatively little research has focus on the developing countries, as China becomes the world's second-biggest economy, Chinese firms' technological acquisitions are growing and increasingly influential. At present, technological acquisition of Chinese firms have been paid attentions by scholars and business circles. The studies of Chinese firms' technological acquisitions are presented in Table 2.

[INSERT TABLE 2 HERE]

The differences of study on technological acquisition in different research backgrounds deserve scholars' attention. First, it is a strange phenomenon that research idea of technological acquisition comes from the growing literature on Resources-Based View (RBV) and Knowledge-Based View (KBV), but it was neglected to examine influencing factors of technological acquisition in developing countries. In general, most of the literature relating technology acquisitions in Chinese firms are focused on motives of cross border technological acquisition (Deng, 2010; Lin et al.,2009; Rui and Yip, 2008) and the important of government behaviors (Deng,2009). Second, research respective on technology acquisition in developed background is the focus on resources and capacities while all of the researches relating Chinese firms' technology acquisitions are focused on the effect of government's intervene, such as Deng(2009, 2010; Rui and Yip, 2008). However, the first motivation of technological acquisition is technology upgrading hence the factors relating to technology ought to consider firstly in the

research. Third, with respect to the study approach, most of the studies relating technology acquisitions of Chinese firms are based on case studies(such as Rui & Yip, 2008; Liu, 2007; Deng, 2007; XIE, 2000) and lack statistical analysis as developed countries background did (such as Ahuaj & Katila, 2001). Fourth, no comprehensive study of the technological acquisition from the perspective of domestic firms has yet been made. All study about technological acquisition by Chinese enterprises is based on oversea background (such as Rui & Yip, 2008; Liu, 2007; Deng, 2007, 2009, 2010; XIE, 2000 etc.).

This paper analyzes how the external technology base influences the innovation performance in technological acquisition. Using a Poisson regression based on multiple cases from 39 Chinese firms undertaking technological acquisition from 2003 to 2008, the paper deepens the research methodology from case study into empirical analysis and extended the main research background of technology acquisition from developed countries into developing countries. The study also answers two questions what is the relationship between the size of acquired knowledge base and innovation performance of technological acquisition and how absorptive capability moderates the above relationship in technological acquisition among Chinese firms.

2.3 Hypotheses

Based on literature review, the study proposes hypotheses model of external technology base, absorptive capacity and innovation performance of technological acquisition (Figure 1). According to the RBV and KBV, a firms' competitive advantage dates from exploring, exploiting, and integrating different specialized knowledge areas through both internal and external technology sourcing (Grant, 1996). External technology source allows a firm to increase its technological knowledge input, access cutting-edge technology, remain flexible and hence improve innovation performance. From this, size of acquired technology means the size of new technology input and the relative size of acquired technology refers for the potential of technology progress hence they all should be positively relate to innovation performance (Grant, 1996) (H1 and H2). However, the importance of external technology on technological competitiveness and innovation capability is depends on whether the recipient firms has related prior knowledge or absorptive capacity to understand and exploit technological opportunities, hence these firms undertaking technological acquisition with higher absorptive capability may get better innovative performance (H3).

[INSERT FIGURE 1 HERE]

The external technology base

For RBV, a steady growth in utilizing external sources to acquire and develop technological capabilities is well documented in the literature (Roberts,1995; Chatterji,1996; Chatterji and Manuel,1993; Wolff,1992; Granstrand et al.,1992; Jonash, 1996; Granstrand and Oskarsson 1994; Contractor and Narayanan, 1990; Magee, 1992; MacLachlan, 1995). External technology sourcing does not preclude the commitment to continue developing technical capabilities internally, undertaking in-house, also may be seen as a means of complementing and leveraging internal capabilities (Granstrand et al. 1992; Roberts,1995; Jonash, 1996; Chatterji, 1996).

While studying influential factors for innovation performance of technological acquisitions,

scholars such as Cohen and Levin(1990), Ahuja and Katila(2001), Ranft and Lord (2002), Cloodt et al.(2006)etc, especially focus on the importance of knowledge scale. It is generally considered that the important of acquired absolute size is very amazing based on at least two mechanisms. First, the technological acquisition provides the opportunities for achieve scale, scope, and recombination benefits on innovation output. According to the study of innovation performance in the U.S chemicals industry, Ahuja and Katila (2001) argued that the technological acquisition expands the acquiring firm's knowledge base, provides a series of benefits including scale effect, scope effect, and recombination, and has a significant impact to firm innovation output. Henderson and Cockburn(1996) and Fleming(1999) also point out that through combined knowledge base of the acquired firms, the acquiring firms improves its technological inputs, therefore, it is possible that technological acquisition leads the expansion of acquiring firms' knowledge bases and induces scale, scope, and recombination effect. From the perspective of absorptive capability, some scholars point out that as a firm expands its knowledge base and technological capability through buy the technologies outside, it also enhances its ability to absorb and utilize external knowledge (Cohen and Levinthal, 1989; Cohen and Levinthal, 1990). Accordingly this study presents the following hypothesis:

H1：The greater the absolute size of the acquired technology base, the greater the subsequent innovation performance of the acquiring firm.

The relative size of the acquired technology base also has similar impacts to the subsequent innovation performance of acquiring firms. First, technological acquisitions can rebuild the existing organizational routines relating to the innovation arena or the technological subsystem in the firm. In which, the relative size of acquired firms means the possibility to change existing organizational routines and create new innovative organizational mechanism and hence generate a positive impact on the innovation output of the acquiring firm.

Second, the more relative scale between both acquiring and acquired firms also means the bigger gap and more potentiality to achieve inventive recombination through the combination of elements of both internal and external knowledge. In general, the relative larger size of acquired firms stands for more technology scale, scope and hence provides the more opportunities to achieve scale, scope and recombination benefits on innovation output. Hence, this study hypothesizes:

H2: The greater the relative size of the acquired technology base, the greater the subsequent innovation performance of the acquiring firm.

The moderating role of absorptive capability

The absorptive capacity literature highlights the importance of taking in external knowledge, combining it with internal knowledge and absorbing it for commercial use (Cohen and Levinthal, 1990; Lane et al., 2006; Zahra and George, 2002). The study of Zahra & George (2002) divides absorptive capacity into four stages of acquisition, assimilation, transfer and use. Cohen and Levinthal (1990) argue that the importance of external technology on technological competitiveness and innovation capability depends on whether recipient firms have related prior knowledge or absorptive capacity to understand and exploit technological opportunities.

Several empirical studies support that firms are more successful in using both internal

research and development efforts and external available information (Tilton,1971; Allen,1977; Mowery, 1983). Using 2900 panel data in Mannheim innovative manufacturing firm which is collected in Germany in 1993, Becker and Peters (2000) prove that there is a positive correlation between absorption capacity and innovation performance. Tu et al.(2006), Escribano et al.(2009), Liao et al.(2010), Mariano and Pilar (2005) and Cepeda et al.(2010) also have similar perspectives. Based on a national survey about 2334 industrial enterprises, Guan et al.(2006)argue that technological progress orbit of "imitation-innovation" is composed by acquisition, absorptive and technology improvement. This orbit is successful for technology-catching up countries. For example, Japan changed into the world second largest economy from a minor-economy (Narin,1989) and South Korea has become an emerging prosper industrialized country from an agricultural economy(Kim,1997). Logically, firms with a higher level of absorptive capability should be better able to integrate technologies acquired externally, thus leading to higher innovation performance. Therefore, the third theoretical prediction in this study is as follows:

H3: The greater the level of a firm's absorptive capability before acquisition, the stronger the positive effect of external technology acquisition on a firm's performance.

3 Methodology

3.1 Model selection

A Poisson regression is appropriate for the data in this study (Hausman, Hall and Griliches, 1984; Henderson and Cockburn, 1996; Ahuja and Katila, 2001). Since innovation output is measured by patent data, this variable is a nonnegative and discrete integer. Both homogeneity of the linear model assumptions and normal distribution of errors do not comply.

In Poisson regression, $\mathbf{P_{i,t}}$ is the number of patents, t is the number of patents obtained by firm i in year t, the study specifies the density function:

$\mathbf{P(P_{i,t})} = \frac{\lambda(i,t)^{p_{i,t}} e^{-\lambda_{i,t}}}{p_{i,t}!}$, where λ is the distribution parameter, E($\mathbf{P_{i,t}}$)=Var($\mathbf{P_{i,t}}$)= $\boldsymbol{\lambda_{i,t}}$

To further discuss the relationship between some explanatory variables and patent application number, conditional expectation should be considered. The conditional distribution is specified:

$\mathbf{P(P_{i,t} \mid X_{i,t})} = \frac{\lambda(X_{i,t})^{p_{i,t}} e^{-\lambda(X_{i,t})}}{P_{i,t}!}$, where $\mathbf{X_{i,t}}$ are explanatory variables.

Ahuja and Ktila (2001) suggest that a distributed lag analysis was used to identify the effects of an acquisition on innovation performance in the 5 years succeeding the acquisition. Since the total impact of an acquisition is likely to be distributed over several periods following the acquisition, in this paper all, variables relating to innovation was selected the mean of patent quantities of 5-years preceding the acquisition. Specifically, the fundamental model was defined as following:

$$\mathbf{P = exp(\alpha X + \beta industry + \delta time + \varepsilon logprice + \eta capital)}$$

$$\mathbf{P = exp(\alpha X + \beta industry + \delta time + \varepsilon logprice + \eta capital + absorptive\ capability)}$$

Where P, dependent variable, stands for post-acquisition innovation output; X is the set of explanative variables including the absolute and relative size of acquired technology and absorptive capability measured by the number of employee and ante-acquisition R&D investment density. Control variables include event time, industry of acquiring firms, transaction price and firm's size.

Model specification and variables have four implications. First, this model specification implies that the number of patents obtained by a firm is randomly distributed following a Poisson process, where the coefficients of X determine the mean of this process, and thus changes in the value of coefficients will affect patenting frequency. Second, the study applied a Poisson model with distributed lag factors for up to the 5 years because the impact of an acquisition is likely to be felt over a number of years, rather than entirely in any one year (Judge et al., 1988). Third, this paper uses the acquirer firms' patent counts relating to the data in 5 years before and after the acquisition to measure innovation performance and technology base since a patent represents an element of knowledge and innovation foundation. Fourth, for the sake of intensive study, technology base and R&D input density to measure absorptive capability.

There are four steps in Poisson regression. First, test whether the likelihood ratio test statistic obey chi-square distribution. It is obverted that the overall model presented in this paper are highly significant, and considered the possibility of over dispersion, we utilize Poisson regression with VCE robust test. Second, according to specific parameter estimation, determine explanatory variable's impact on the dependent variable to be explained. Third, test good-of-fit after Poisson regression with deviance and statistics and Pearson good-of-fit test was provided. Last, test the sensitivity of the results by negative binominal regression.

3.2 Variables definitions and measures

Dependent variable

The variables used in the analyses are defined as shown in table 3. Innovation performance, the dependent variable, is measured by the patent application quantity because the main purpose for a firm to acquire external technology is to improve innovation capability through technological acquisition, which is identical to researches by Ahuja and Katila (2001). Since acquisition's impact on innovation performance is likely to be for many years, not just a 1 year (Judge et al., 1988), this paper uses the 5-year value after the acquisition to enhance credibility. The resource of a patent application number (P) is from the website of STATE INTELECTUAL PROPERTY OFFICE OF P.R.C (http://www.sipo.gov.cn).

[INSERT TABLE 3 HERE]

Independent variables

Referring to studies by Ahuja and Katila(2001) and to highlight total acquired knowledge size, this paper uses the applied patent counts in the 5 years prior to the acquisition to measure the absolute and relative size of knowledge in acquired firms and the absolute size of acquiring firms (Cohen and Levin,1990; Tsai, 2001; Griffith et al., 2006).

The absorptive capacity can be divided into four stages including acquisition, assimilation, transfer and utilization (Zahra & George, 2002). The absorptive capability requires learning capability and develops problem-solving skills and a lot scholars measured absorptive capability

by prior knowledge base and the intensity of effort (Kim, 1995, 1997; Matusik & Heeley, 2001; Wijk, Bosch, & Volberda, 2001). Accordingly, the absorptive capability is measured by the applied patent counts in the 5 years prior to the acquisition and ante-acquisition R&D investment density in this study.

Control variables

Firm size, industry, transaction price and event time are control variables. Firm size is measured by the natural log of capital size of acquiring firm in the event year. Control variable of the transaction price stand for acquisition's size.

According to the standards of high-, med-and low-technology in the manufacturing industry (OECD, 2003), control variable of the industry is divided into three groups including high-, med- and low-tech, they are 3, 2 and 1 respectively.

Considering that technology acquisitions are distributed in more than one year, regressions bring in variable of time to eliminate the influence of time. Control variable of time is discrete, and value of 3-8 stands for the acquisition took palace in 2003-2008, respectively.

3.3 Sample and data

Technological acquisition, is a kind of acquisition to gains technological inputs for the acquiring firm (Ahuja & Katila, 2001), also an important approach for firms to obtain technological know-how and upgrade technological capabilities (Hobday, 1995). Three criteria can distinguish technological acquisitions from all other merger and acquisitions (M&As). First, the paper examines the announcements of the M&As if the acquiring firm argued technology as a motivation for the acquisition or if the technology was a part of the transferred resources. The paper classifies the acquisition as technological if either of these conditions was met. Second, the study classifies the acquisition as technological if the acquired firm had any patenting activity in the 5 years preceding the acquisition. Third, the study also deletes technological acquisition from the sample set if the acquired firm had been sold in 5 years or the deals happened because of government intervention. Two approaches were used to collect data. First, detailed acquisition announcement and news are obtained on the web and listed companies' annual reports. Second, all patents data are searched on the website of STATE INTELECTUAL PROPERTY OFFICE OF P.R.C, http://www.sipo.gov.cn). Third, China Statistical Yearbook of Science and Technology provided basic information. Finally, this study got 39 cases information for further study.

These 39 technological acquisitions spread out evenly into the 6 years from 2003 to 2008, see figure 2. In these events, most of the acquiring firms belong to med- and high-tech industry. Some acquiring firms are technology-relating firms, include North Navigation Control Technology Co.,Ltd., Hongfa Technology Co., Ltd., Jiangsu Changjiang Electronics Technology Co.,Ltd., BGRIMM Materials & Techology Co.,Ltd., Tsinghua Tongfang Co.,Ltd , NARI Technology Development Limited Company, Shanghai Baosight Software Co.,Ltd., and Henan Ancai Hi-Tech Co.,Ltd. The industry of Electric and Automation is also happened more technological acquisition, such as Anhui Sun-Create Electronics Co.,Ltd, Taiyuan Heavy Industry Co.,Ltd., Huayi Electric Company Limited, Chongqing Zongshen Power Machinery Co.,Ltd, Guodian Nanjing Automation Co.,Ltd, Guangxi Liugong Machinery Co.,Ltd and so on. And some acquiring firms are Pharmaceutical Companies including Apeloa, Zhejiang Hisun, Zhejiang CONBA, Jiangzhong and so on.

[INSERT FIGURE 2 HERE]

4. RESULTS

Table 4 provides descriptive statistics and spearman correlations. The table indicates the diversity of firms included in the sample. The variables reflecting the hypothesized effects are not very highly correlated among themselves or with the control variables. The correlation between innovation performance and the size of firm's technology base is 0.51, but the test of good-of-fit after Poisson regression and the robust check indicates that the results on the hypothesized effects were strong and unaffected by this high correlation.

[INSERT TABLE 4 HERE]

4.1 Poisson regression results

Table 5 provides results for all models using Poisson regression with the VCE (robust) option. In the model 1 and M2, the study found that all the coefficient of the natural logarithm of the absolute size and relative size of the acquired knowledge base is positive and significant, supporting H1 and H2. That is to say that the relationship between the absolute size and relative size of the acquired knowledge base and the post technological acquisition innovation output of the acquiring firms is positive.

[INSERT TABLE 5 HERE]

From model 3 to model 6, this study tests the impacts of absorptive capability based on sequential enter variables including the size of acquiring technology base, the science and technology level and their cross-term variables with the size of acquired technology base respectively.

The result shows that the coefficient of the natural logarithm of the absolute size of acquiring technology base is positive and significant in the model 3. When the interaction of the natural logarithm of the absolute size of acquiring technology base and the natural logarithm of the absolute size of acquired technology base entered model 4, even the coefficient of the natural logarithm of the absolute size of acquired technology base is not significant, it goes up to 32% changed the coefficient from 0.234 to 0.309. Therefore, the absorptive capacity measured by the size of acquiring technology base has the positive impacting trend to the relationship between acquired technology and innovation performance.

Similarly, when the interaction of the science and technology level of acquiring technology and the natural logarithm of the absolute size of acquired technology base entered model 4, the coefficient of the natural logarithm of the absolute size of acquired technology base is significantly rising from 0.253 to 0.315, change ratio up to 25%. Therefore, the absorptive capacity measured by the science and technology level has the positive impacting to the relationship between acquired technology and innovation performance.

In this group of models, the impact of the control variable of the firm size is significant in all models, and the control variable of the industry and the event time are positive and partly significant. However, the transaction price has not a significant impact to post-acquisition innovative performance of acquiring firms in these models.

4.2 Sensitive test

This study also runs a sensitive test with another research method of negative binominal regression (see table 6). In this study, the patent data exhibits over dispersion, a simple solution is to simply use Poisson with the VCE (robust) option. Another commonly used method is the negative binomial model (Schilling and Phelps, 2007) to solve this problem. The negative binomial model is a generalization of the Poisson model and allows for over dispersion by incorporating an individual, unobserved effect into the conditional mean (Hausman et al. 1984).

Overall, the robust analysis supports the results. The results of these analyses are presented in table 6. Most of variables in the robust test play the same roles as they did in the Poisson regression. The impacts of absolute size and relative size of the acquired knowledge base are positive, they all are significant, and results are still support the H1 and H2. The paper also founds the absolute size of acquiring technology base has a positive influence to innovation performance, and when their interaction entered into the model, the coefficient of the size of acquired technology base become bigger obviously. The science and technology level and its cross variable play similar roles in the model 5 and model 6. Therefore, absorptive capacity measured by the size of acquiring technology base and the science and technology level have the positive impacting trend to the relationship between acquired technology and innovation performance.

5 Conclusion and Discussion

5.1 Implications for theory

This study provides and tests a framework relating the acquired knowledge base and absorptive capacity to firm innovation performance based on Poisson regression with 39 cases' data. The study found some interesting results. First, both the absolute size and relative size of acquired technology are positively affecting innovation performance. In addition, the size of acquiring technology base has a positive influence to innovative performance of acquiring acquisition and absorptive capacity measured by it has the positive impacting trend to the relationship between acquired technology and innovation performance. More interesting, although the science and technology level has not positive influence to innovation performance, the absorptive capacity measured by it has the positive impacting trend to the relationship between acquired technology and innovation performance.

This study is a helpful answer to the question about obtaining resources and competitive advantages under RBV in the background of China. An important challenge for RBV researcher is to answer enough how questions-How can obtain the resources? How and in which contexts does it contribute to competitive advantage? How does it interact/compare with other resources? (Priem and Butler, 2001). Acquisition and exploitation of knowledge are predominantly business processes of redeploying resources and knowledge into more productive uses (Anand and Singh, 1997; Capron, Dussauge, and Mitchell, 1998; Kogut and Zander, 1992, Yli-Renko, Autio and

Sapienza, 2000). This paper examines how the acquired knowledge affects innovative performance of technological acquisition in Chinese firm and improves the efficiency of this asset-matching and combining process and provides evidence and deepens the answer two questions relating to RBV. On one hand, technological acquisition is the answer how can the resource be obtained as a new kind of method to access external technological resources with the intent to access technologies or resources for strengthen their innovative capabilities. On the other hand, this paper examines how the acquired knowledge affects innovative performance, which is the answer how the resources interact/compare with other resources.

It is an obvious progress to previous studies to explore the relationship among the size of acquired knowledge base, absorptive capacity and innovation performance of acquiring firms. Scholar point out that some companies have strived for a competitive advantage through increased their use of internal and external sources (Zahra and Nielsen, 2002), and they will benefit more from the external technology with stronger absorptive capability. However, research on influencing factors of performance lack of comprehensive factors including both sides, for example, Ahuja & Katila (2001) developed influencing factors of innovation performance of technology acquisition from the side of acquired firms, and Al-Laham etc (2009) explored the impacts of experience and similarity of acquiring firms to the patent application.

Developing country as research background is a supplementary to currently research on technological acquisition, and China, as the world's the second-biggest economy, is an awful important study field for the research. In recent years, more and more firms in both developed and developing countries are trying to enhance technological capabilities through technological acquisition. However, some scholars studied technological acquisition in developed countries but ignored developing countries (eg.Granstrand & SjÖlander, 1990; Ahuja & Katila, 2001). This study verifies the research on technological acquisition with research background extends from advanced countries to developing countries.

Methodology of technological acquisition in Chinese firms is deepens into statistical analysis from case study. Current methodology of study on technological acquisition under took by Chinese firms are mainly case studies (Deng, 2007, 2009, 2010). Although these case studies research increase the understanding of how technological acquisition work in China and enables us to identify important phenomena, it is necessary to build and test relationship models by quantitative studies involving samples to determine the relative importance of influencing factors and understand innovative performance.

5.2 Management implications

This study investigated the impact of acquired technology base to innovation performance in China, based on Poisson regression using 39 case firms undertaking technological acquisition from 2003 to 2008. This study has some important implications for managers.

Who should be a target firm in technological acquisition?

Both absolute size and relative size of acquired technology are positively related to innovation performance of the technological acquisition by Chinese firms. This result is similar to previous work, knowledge scale is important influential factors for innovation performance of technological acquisitions (Cohen and Levin, 1990; Ahuja and Katila, 2001; Ranft and Lord, 2002; Cloodt et al., 2006 etc.) and it has a direct good effect on firm financial, product, and market

measures of performance (Kotabe and Murray 1990; Kotabe and Omura 1989; Kotabe and Swan 1994).

The absolute size and relative size of acquired technology generate innovation performance based on two ways at least as has been discussed before. First, the acquired technology base increase the technology input and the possibility to change existing organizational routines and create new innovative organizational mechanism, and hence generate a positive impact on the innovation output of the acquiring firm. Second, the more relative scale between both acquiring and acquired firms also means the bigger potential to inventive recombination through the combination of elements of both internal and external knowledge, and hence generates the scale, scope, and recombination benefits on innovation output.

Never neglect absorptive capability

Influencing factors of technology acquisition almost have been provided through internal and external sources separately (Vega-Jurado et al., 2009; Ahuja and Katila, 2001), have scarcely examined impacts of internal sources interact with external sources to innovation performance of technology acquisition. Companies have increased their use of internal and external sources strive for a competitive advantage (Zahra and Nielsen, 2002), and firms with stronger absorptive capability will create more benefit when they use external technological knowledge (Cohen and Levinthal, 1990; Lane and Lubatkin, 1998; Kim, 1999). Therefore, this study made an obvious progress to previous studies through developed a framework about the size of external knowledge base, internal absorptive capacity and innovation performance in technological acquisition by Chinese firms.

Results showed that absorptive capacity measured by the size of acquiring technology base and science and technology level have the positive impacting trend to the relationship between acquired technology and innovation performance. Prior studies pointed out that Chinese multinationals influenced by absorptive capacity (Deng, 2010; Buckley et al., 2004). Therefore, firms should not only pin their hope on “purchased technologies”, they also need to focus on accumulation of their own technology capabilities. Enhancement of acquiring technology relies on two aspects of technology capabilities and technology talents. On one hand, if the acquiring firms lack effective technology capabilities, effective digestion and utilization of the acquired technology resources would be difficult, in particular the paucity of relatedness of technology resources of the two sides (Wang, Wang and Wang, 2009); on the other hand, in acquisitions relating high-tech fields, technology capabilities relied on fully trained technical staff with respect to physical assets have long-term positive effect, some firms damaged initial target as a result of emphasized too much on physical assets (Chaudhuri and Tabrizi,1999).

The enterprise foundation plays an especially important role

Enterprises’ fundamentals including the size of technology base and the size of firm’s capital are pretty important to innovation performance based on above regression results. Both the size of technology base and the size of firm’s capital are playing positive and significant impacts to innovation performance of acquiring firms in all regression models. What’s more, two coefficients are second-largest and third-largest respectively in the model 3 and model 4. That is to say, enterprises’ fundamentals play an especially important role in the technological acquisition. These results are similar to prior studies. Some scholars point out that knowledge scale of acquiring firm is an important influential factor for innovation performance of technological acquisitions (Cohen

and Levin, 1990; Ahuja and Katila, 2001; Ranft and Lord, 2002; Cloodt et al., 2006 etc.). At the same time, the more capital, employee and technology capacity exist, the more resources allocate. Therefore, internal resources not only have a direct good effect on firm performance (Kotabe and Murray 1990; Kotabe and Omura 1989; Kotabe and Swan 1994), but also they are important signals to recognize, assimilate and apply the new technology and capability (Cohen and Levinthal 1990: 128).

This is an important research implication to Chinese firms wishing to acquire external technologies. In recent years, many Chinese companies are using cross-border M&As to obtain strategic assets so as to address their competitive disadvantage, but in average-level absorptive capability, Chinese firms cannot done well in understand and exploit technological opportunities. Therefore, Chinese acquiring firms just bought applied technology and mainly improved design patent, cannot advance the invention innovation capability in acquiring firms (Guan, 2006). Therefore,

Therefore, *without the diamond, do not embrace the chinaware to live*. With respect to technology and patents of acquired firms, the important element, to decide the acquiring firms ’profit level is accumulation base of acquiring firms’ technology capability and firm size. Firms should not only pin their hope on “purchased technologies”, they also need to focus on accumulation of their own technology enterprises’ foundation.

5.3 Limitations and future research

The restriction of the sample to Chinese firms undertaking technological acquisition reinforces the need for conducting the study on technology strategy. Additionally, the relevance and utility of the patent-based measures of technology are likely to be limited to the validity of the result. For instance, patent applications data is often used to represent innovation performance, a single indicator inevitably lacks persuasive; third, due to research target limitations, sample size in this paper is not large enough. Moreover, there is a problem of incomplete data with regard to obtain of specific indicator data. Research can be further improved regarding the sample data, study influential factors for changes of technology acquisition capacity, and provide firms with practical guidance.

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Table 1. Classical Research on Technological Acquisition in Developed Countries

Areas	Authors	Background	Key questions
Existence	Granstrand & Jacobsson(1983); Jacobsson(1984)	Sweden	Phenomena, motivations and critical influence factors
	Hagedoorn & Duysters(2002)	United states, Cananda, and European countries	Balanced the gap between technological acquisition and technological alliance
	Puranam, Singh & Zollo(2003)	United states	The important role of technological acquisition
Motivation	Vermeulen & Brekema(2001)	Netherlands	The influences from invest and M&As
	Mar ń(2006)	Spainish	M&As and internationalization
	Vega-Jurado,etc(2009)	Spainish	The impact of external knowledge to innovation
	Carayannopoulos & Auste(2009)	North America	Weighted technological acquisition and technological alliance
Influencing factors	Granstrand, etc(1992)	United States, Japan, European	To explore the relationship between strategy and diversity in technology and productions
	Ahuja & Katila(2001)	United States	They named the technological acquisition and developed influencing factors of innovation performance of technology acquisition.
	Al-Laham etc.(2009)	United States	The impacts of experience and similarity to the quantity of the patent application
Integration	Puranam,Singh and Zollo(2003)	United States	The Effect of integration to enterprises long-term performance and short-term performance
	Puranam, Singh and Chaudhuri (2009)	United States	Structural integration
	Ernst & Vitt(2000)	German	Key technician and innovation
	Al-Laham, etc.(2009)	United States	Experience and similarity

Source: References

Table 2. Research on Technological Acquisitions of Chinese Firms

Scholar	Topic	Approach	Conclusions
Deng(2010)	Absorptive capacity and the failure of multinational acquisitions	Case study	The study explains Chinese firms' failure of obtaining know-how and international acquisition of strategic assets under the perspective of absorptive capacity based on case study.
Deng(2009)	Why Chinese firms tend to obtaining strategic resources through international expansion	Case study	Given institutional theory to present the resource-driven motive in the context of the Chinese firms' acquisitions, the approach of Chinese firms to obtain strategic assets through overseas acquisitions is consistent with the logic within the special institutional background in China.
Yang et.al(2009)	Comparison study of internalization of Chinese and Japanese firms	Case study	Comparative analysis of the similarities and differences between China and Japan from three-level international theories (institution, industry and enterprise) based on case studies.
He, Lyles (2008)	China's direct investments	Case study	Use small case to examine the China's foreign direct investment, multinational history and the challenges of Chinese firms operating in the U.S. Strategic advices also were proposed.
Rui, Yip. (2008)	Foreign acquisitions of Chinese firms：a strategic intent perspective	Case study	From strategic intent perspective (SIP) to analyze Chinese firms' overseas acquisitions.
Liu (2007)	Lenovo: a case of Chinese firm's globalization	Case study	Lenovo's international achievement and its way to success.
Deng (2007)	Investments of strategic resources and the rationality：case study of Chinese firms' foreign direct invests	Case study	Chinese MNCs are mainly driven by demands of strategic resources and capabilities, and strategic needs are the potential root cause of this kind of asset-seeking FDI.
XIE (2000)	Acquisition of technical capacity through Special Economic Zone	Case study	Investigate characteristics of technological capacity acquisition and determinant of success in the Shenzhen Special Economic Zone

Resources：References

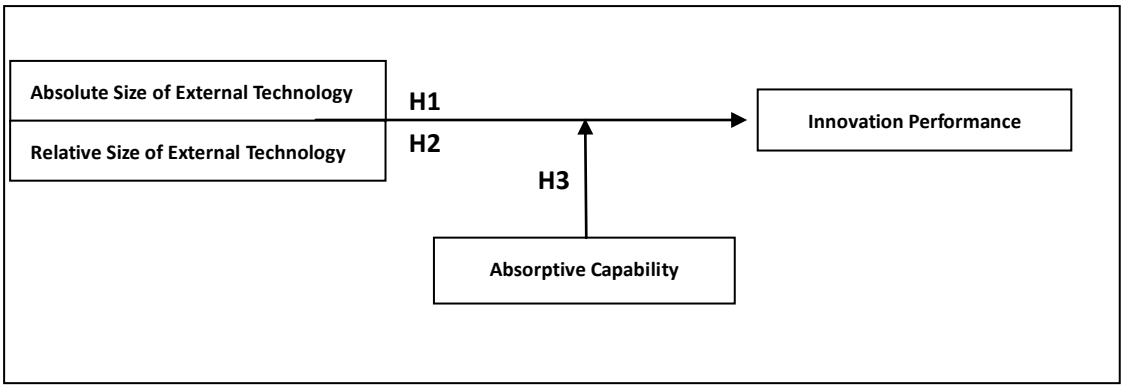

Figure 1. External Technology, Absorptive Capability and Innovation Performance

Table 3. Construct Measures and Sources

Variable	Calculation methods	Research basis
Innovation performance	The mean of acquirer firms' patent counts for 5 years succeeding the acquisition(look up to integer)	Ahuja and Katila(2001);Acs and Audretsch(1988);Liu and White,(1997);Stock et al(2001)
Acquired technology base	The mean of acquired firms' patent counts in the 5 years preceding the acquisition(look up to integer)	
Acquiring technology base	The mean of acquirer firms' patent counts for 5 years preceding the acquisition(look up to integer)	
S&T level	Science and technology level , the ratio of intangible asset to total asset	Guo & Liu (2011)
Event time	Value of 3-8 stands for the acquisition took place in 2003-2008	Stock et al.(2001)
Industry	Industry of acquiring firms, industries are divided into three groups including high-, med- and low-tech, they are 3, 2 and 1 respectively.	OECD (2003)
Transaction price	Natural log of the transaction price in the acquisition	Kaplan and Weisbach (1992)
Firm size	Natural log of firm's capital in acquisition-year	

Note: patent data source from STATE INTELECTUAL PROPERTY OFFICE OF P.R.C(http://www.sipo.gov.cn), other data source from Wind information database, CSMAR solution database and M&As announcement.

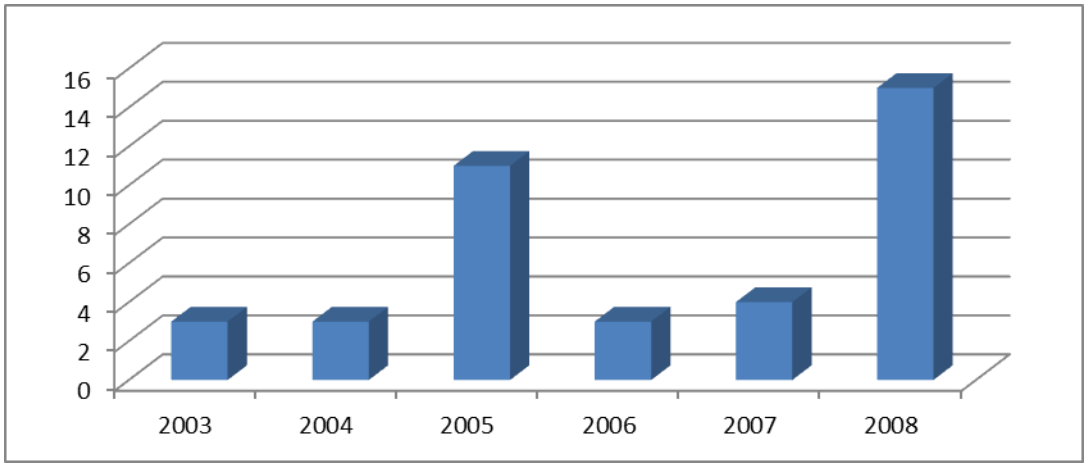

Figure 2. Technology Acquisition Cases by Chinese Firms

Table 4. Descriptive Statistics and Correlations

Variable	Mean	Std.Dev.	Innovation performance	**Firm size**	Event time	Transaction price	Industry	Acquired technology base	Relative size of acquired technology base	Acquiring technology base	S&T level
Innovation performance	25.92	43.56	1								
Firm size	6.78	1.06	0.47	1							
Event time	6.15	1.84	0.21	0.00	1						
Transaction price	8.76	2.37	0.06	0.00	0.33	1					
Industry	2.07	0.50	-0.01	-0.14	-0.15	-0.05	1				
Acquired technology base	0.86	1.82	0.31	0.07	0.19	0.18	-0.19	1			
Relative size of acquired technology base	0.34	0.28	-0.03	-0.35	-0.33	0.19	0.17	-0.11	1		
Acquiring technology base	1.39	1.21	0.51	0.27	0.18	-0.07	-0.03	0.23	-0.17	1	
S&T level	0.04	0.05	0.13	0.17	0.09	0.38	-0.08	-0.11	0.26	-0.07	1

Table 5. Results of Poisson Regressions with Robust Check

	M1	M2	M3	M4	M5	M6
Acquired technology base	0.236**	0.248***	0.234***	0.309	0.253***	0.315*
Relative size of acquired technology base		1.677**	1.477***	1.659***	1.637***	1.533*
Acquiring technology base			0.331***	0.393***		
Acquiring technology base*Acquired technology base				-0.037		
S&T level					0.662	1.294
S&T level *Acquired technology base						-0.891
Firm size	0.886***	1.05***	0.773***	0.773***	1.036***	0.999***
Event time	0.147	0.199*	0.152*	0.149*	0.200*	0.188
Transaction price	-0.044	-0.047	0.002	-0.011	-0.055	-0.073
Industry	0.395	0.288	0.498*	0.509	0.295	0.343
_cons	-4.551*	-6.357***	-5.446***	-5.495***	-6.234***	-5.888***

Note: ˙ p<0.1, *p<0.05; **p<0.01; ***p<0.001

Table 6. Results of Negative Binominal Regressions with Robust Check

	M1	M2	M3	M4	M5	M6
Acquired technology base	0.280**	0.251**	0.218***	0.269*	0.240**	0.254˙
Relative size of acquired technology base		1.276*	1.114	1.189*	1.340*	1.330*
Acquiring technology base			0.343***	0.392**		
Acquiring technology base*Acquired technology base				-0.034		
S&T level					-1.970	-1.832
S&T level*Acquired technology base						-0.264
Firm size	0.652***	0.809***	0.576***	0.557***	0.853***	0.842***
Event time	0.084	0.165	0.154	0.152	0.169	0.170
Transaction price	0.013	-0.034	-0.033	-0.044	-0.014	-0.019
Industry	0.943	0.886	0.594*	0.591*	0.853	0.865
_cons	-4.196*	-5.666**	-3.851*	-3.691	-6.014**	-5.943*

Note: ˙ p<0.1, *p<0.05; **p<0.01; ***p<0.001