# AN EVENT STUDY OF HOME AND HOST COUNTRY PATENT GENERATION IN CHINESE MNES UNDERTAKING STRATEGIC ASSET ACQUISITIONS IN DEVELOPED MARKETS

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## ABSTRACT

We use event study methodologies to analyze trends in home and host country patent applications of Chinese MNEs that acquire strategic asset-rich developed market businesses. Our results show the domestic market patents of Chinese MNEs rise significantly in the wake of such acquisitions, while those of the acquired target do not significantly change. These results hold for different ownership classes. In light of current theoretical debates, we discuss the possible motivations for such acquisitions by Chinese MNEs and the reasons for the observed patenting performance in both domestic and target businesses. We argue acquisition of codified strategic assets (such as patents) for the purpose of imitation and exploitation in the domestic Chinese market context provides one plausible explanation for our results.

*Keywords*: Chinese outward foreign direct investment, innovation, event study, strategic asset seeking

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# An Event Study of Home and Host Country Patent Generation in Chinese MNEs Undertaking Strategic Asset Acquisitions in Developed Markets

## 1. Introduction

At last count there were over 138 articles on Chinese MNEs (Deng, 2013) and considerably more looking at emerging market (EM) MNEs as a whole (Cuervo-Cazurra, 2012; Hennart, 2012; Ramamurti, 2012). Within this literature, a growing number of papers argue that EM MNEs, including Chinese MNEs, use FDI to acquire brands, technology, and management expertise in psychically distant developed markets via aggressive strategic-asset-seeking (SAS) acquisitions (Deng, 2009, 2012; Luo & Tung, 2007; Mathews, 2006; Rui & Yip, 2008).[1] This trend is considered somewhat unusual and unique, as it contrasts with the more incremental and risk-averse strategies observed in developed market (DM) MNEs in earlier periods of history: 'there are significant peculiar traits characterizing present-day EM MNEs that merit the development of a new framework specific to these firms' (Luo & Tung, 2007). As such, it has also been suggested that existing theories 'need an overhaul since the locational determinants of Chinese companies generally do not follow mainstream literature' (Ramasamy, Yeung, & Laforet, 2012).

We investigate a side of the SAS debate which has received less attention to date. Many past studies consider whether Chinese MNEs acquire strategic-assets via FDI (Deng, 2013), often finding in the affirmative (Alon, 2010; Deng, 2009; Ramasamy et al., 2012). However, some previous research has expressed reservations about EM MNEs' ability to integrate acquired

[1] Strategic assets refer to critical resources or capabilities, including, for example, R&D capacity, proprietary technology, design facilities, brands and reputation, and distribution and production networks which give firms competitive advantages over others (Teece, Pisano, & Shuen, 1997). Strategic asset seeking therefore implies acquiring critical assets that one does not already possess: 'to primarily enhance a firm's critical competencies rather than to exploit existing assets' (Deng, 2009, p. 83).

strategic assets (Rugman & Li, 2007). Our study pushes this debate further by investigating the impacts of international SAS related acquisitions on intangible asset creation in both target and parent firms. Are Chinese MNEs able to absorb and exploit acquired foreign strategic assets? If so, how does this manifest itself in subsidiary and parent innovation performance?

We use event study methodology, focusing on Chinese acquisitions of innovative DM firms in the US, Japan and Europe, to investigate these questions. We find measures of domestic innovative performance in China significantly improve in the wake of these acquisitions. The innovative activity in the acquired DM firms, however, does not significantly change. We critically explore how these findings are best explained in light of recent research, noting the relevance of explanations that emphasize the domestic market exploitation of acquired strategic assets (Hennart, 2012), 'light-touch' post-acquisition integration strategies in knowledge rich target firms (Liu & Woywode, 2013; Schüler-Zhou & Schüller, 2013), as well as knowledge accessing FDI strategies (Awate, Larsen, & Mudambi, 2014).

## 2. Innovation performance in the home and host market

Despite the finding that SAS is a major motivation for outward FDI in Chinese MNEs, surprisingly the literature on whether they can actually absorb acquired strategic assets is rather thin.[2] This contrasts with the significant interest that has been shown in how acquisitions of developed market MNEs may feed back into innovation performance (Cloodt, Hagedoorn, & Van Kranenburg, 2006; Van de Vrande, Vanhaverbeke, & Duysters, 2011).

[2] See Awate, Larsen & Mudambi (2014); Deng (2010); Liu and Woywode (2013) and Tan and Mathews (2014) for some exceptions.

*2.1 Innovative performance in newly acquired developed market subsidiaries*

Despite a dearth of empirical evidence, three schools of thought exist on the likely outcomes of an acquisition on the innovative performance of the developed market target firm. The first argues Chinese MNEs may struggle to integrate and productively harness strategic asset-rich Western businesses (Rugman & Li, 2007; Rugman, 2009). Identifying, transferring and integrating such assets, it argues, is difficult. Indeed, experience shows that such deals often fail for DM acquirers (Ahuja & Katila, 2001; Cassiman, Colombo, Garrone, & Veugelers, 2005). In contrast to DM MNEs, EM MNEs often lack experience in post-acquisition integration. They also have comparatively weaker firm-specific ownership advantages for the absorption and productive harnessing of such foreign acquisitions.

In theory, acquisitions allow for the acquisition of ready-made networks, technologies, managerial skills and other valuable intangible assets. In practice, however, it has been argued this route has 'limited' applicability to most EM MNEs (Narula, 2012). Outside knowledge, it is argued, is often highly specific to the originating firm, since it has a partly tacit nature. The extent to which a firm may exploit these external sources of knowledge is determined by its absorptive capacity, or the 'ability of a firm to recognize the value of new, external information and assimilate it and apply it to commercial ends' (Cohen & Levinthal, 1990, p. 128). This in turn is in part a function of acquiring firms' research and development (R&D) capabilities, the complexity of the acquired knowledge and the extent to which the acquired outside knowledge corresponds to that needed by the firm. Thus, it is argued that most EM MNEs lack the considerable innovative and absorptive capacity required to positively exploit externally acquired sources of knowledge. They are, therefore, 'unlikely to be able to integrate acquired assets successfully' (Narula, 2012, p. 195).

By contrast, a second school of thought acknowledges the issues stated above, with regards to lack of absorptive capacity, relevant experience, and cultural differences, but also argues that Chinese MNEs are cognizant of their weaknesses and adopt suitable strategies to mitigate them. One response, it is argued, is that Chinese MNEs often give acquired firms considerable autonomy in the post-acquisition stage (Estrin & Meyer, 2011; Liu & Woywode, 2013; Rui & Yip, 2008). Recent empirical work has shown, for example, that Chinese MNEs generally take a 'light-touch' approach to the post-merger integration management of their foreign strategic-asset related acquisitions. This approach is aimed at minimizing disturbances in the acquired firm. Chinese MNEs, for example, typically keep the existing management in position after the acquisition, who often enjoys considerable autonomy. The parent is only passively involved in the operation of the company, creating a management style which appears 'extremely inactive in comparison to traditional M&A transactions' (Liu & Woywode, 2013, p. 477).

Other research investigating decision-making autonomy in newly acquired, asset-rich developed market Chinese subsidiaries also illustrates that as the extent of knowledge transfer from the foreign subsidiary grows, this 'exerts a strong and positive influence' on its autonomy (Schüler-Zhou & Schüller, 2013, p. 321). This is because a subsidiary rich in strategic assets exercises greater power, according to resource-dependence theory, over its knowledge-inferior parent. The Chinese parent, therefore, must tread carefully when trying to coax knowledge transfer from a knowledge-superior subsidiary (Schüler-Zhou & Schüller, 2013). This finding is also supported by evidence from Indian MNEs (Awate, Larsen & Mudambi, 2014). On the grounds of both resource-dependence (Schüler-Zhou & Schüller, 2013) and the 'light-touch' integration strategy (Liu & Woywode, 2013), it is argued the acquired subsidiaries, including their innovative capabilities, remain relatively unaffected.

A third possibility is that Chinese MNEs successfully integrate and learn from their strategic-asset related acquisitions (Awate, Larsen & Mudambi, 2014; Luo & Tung, 2007; Mathews, 2006; Rui & Yip, 2008; Tan & Mathews, 2014). Mathews (2006) discusses how Asian 'dragon multinationals' learn from foreign competition by linking, leveraging and then learning (the 'LLL' framework). Further, Tan and Mathews (2014) discuss Chinese MNEs engagement in rapid internationalization, linking multiple times with foreign technology rich companies, leveraging that technology, and learning from each acquisition. There may be mechanisms whereby such alliances also lead to improvements in the innovative performance of the acquired strategic asset-rich developed market target. Linking with EM MNEs, for example, facilitates greater access to their fast growing markets (Buckley, Elia, & Kafouros, 2014), which in turn drives profits and the further flow of investment into R&D in the acquired foreign target. Incentives to innovate are expanded as opportunities increase (Hennart, 2012). Chinese MNEs, moreover, may also exploit certain firm-specific advantages (FSAs) they have developed within their home market, such as those related to incremental manufacturing process innovation, or the ability to produce low cost but high quality products that meet the needs of many large emerging markets. For these reasons, Chinese MNEs can be seen to offer useful FSAs to their acquisitions (Ramamurti, 2012). These factors may potentially feed into the post-acquisition integration and exploitation of their targets. Deng (2010) has shown that in some instances Chinese MNEs have had the requisite combinative capabilities to integrate new acquisitions successfully.

In summary, there are three possibilities regarding the impact of a Chinese acquisition on the innovative performance of the acquired subsidiary. In light of the limited empirical evidence and the conflicting theoretical predictions, we rely upon the most detailed evidence available on post-acquisition integration to develop our first hypothesis. This literature shows that in general

Chinese MNEs use a 'light-touch' approach (Liu & Woywode, 2013), allowing acquired targets to continue with a large degree of autonomy. This autonomy is intensified in the case of technology rich, 'knowledge-superior' subsidiaries (Awate, Larsen & Mudambi, 2014; Schüler-Zhou & Schüller, 2013). In this case we expect Chinese developed market acquisitions to have neither a negative nor positive impact on post-acquisition innovation performance.

> **Hypothesis 1:** The post-acquisition innovation performance of developed market, strategic asset-related acquisition targets of Chinese MNEs neither improves nor deteriorates.

### *2.2 Domestic innovation and developed market strategic asset related acquisitions*

Attention has also been given to the idea that Chinese MNEs may pursue developed market acquisitions primarily to repatriate intangible strategic assets to their home markets (Child & Rodrigues, 2005; Luo & Tung, 2007; Ramamurti, 2012; Rui & Yip, 2008). In this scenario they are not always initially looking to directly compete in international markets (Hennart, 2012) or develop the necessary cutting-edge R&D capabilities to do so (Awate, Larsen, & Mudambi, 2012). Rather, FDI may lead to reverse knowledge transfers of technologies that can be rapidly put into production in the domestic market. A recent World Bank report, for example, suggests a focal reason for Chinese support for outward FDI is so that its MNEs can 'absorb foreign technology and use it to improve domestic production' (The World Bank, 2013). Indeed, the idea EM MNEs use 'knowledge accessing' strategies, in which they look to repatriate the strategic assets of DM MNEs so that they can be imitated using lower cost production techniques, has recently received some support (Awate, Larsen & Mudambi., 2012).

While intuitively appealing, Hennart (2012) has questioned this line of argument, noting it does not fully explain why DM MNEs that own intangible strategic assets willingly choose to sell

them to EM MNE competitors. It may be true that acquired strategic assets create synergies for EM MNEs, which often compete primarily on the basis of mass-manufacturing cost advantages (Luo & Tung, 2007), but it is not entirely clear why DM MNEs would not choose to exploit these proprietary intangibles themselves, availing of the freely available emerging market country specific advantages. The 'bundling model' is one persuasive response to this argument. Hennart (2012) argues current theory tends to overlook a range of market imperfections associated with accessing host country 'locational advantages'. Preferential access to local resources for domestic firms in turn allows them to enjoy advantages over foreign competitors. These 'complementary local resources' (CLRs) are assets which allow for the effective deployment of knowledge (i.e. ownership advantages) in a given market, such as distribution channels, after-sales services or complementary technology (Hennart, 2009; Teece, 1986). In this way, strategic assets are 'bundled' with CLRs for deployment in a given market (Hennart, 2012).

CLRs allow for rents appropriable only by domestic firms. While CLRs can also be achieved via, for example, participation in domestic business groups and strong state-business relationships, those that may be deemed rent-appropriable also include 'the knowledge of how to incorporate these intangibles into products that meet the needs and tastes of local consumers, the logistics necessary to put products within their reach, and all the other inputs necessary for local production' (Hennart, 2012). Better access to CLRs, combined with growing and ever more competitive markets for technology, strengthens the bargaining power of EM MNEs and makes the option for DM MNEs to sell their intangible assets a more logical choice. In turn, these CLRs may facilitate further cross-subsidization of foreign SAS-related FDI, as only EM MNEs are able to generate rents associated with the bundling of intangible strategic assets with CLRs. As CLRs are only available to EM MNEs in their home markets, strong incentives exist for them to

acquire intangible strategic assets from foreign markets exclusively for domestic exploitation (i.e. they are not initially interested in developing internationally). These same barriers and market imperfections (including weak intellectual property rights protection and enforcement) also deter foreign MNEs from successfully entering and competing in emerging markets (Hennart, 2012). The remaining option for a DM MNE – outright sale of their intangible assets – therefore starts to look more logical. An implication of the bundling model is, therefore, that EM MNEs will look, at least initially, to use the acquired intangible assets in their domestic market.

One potentially important explanation for EM MNEs undertaking SAS-related FDI, therefore, is not to develop firm-specific advantages for international competition. Rather, FDI is seen as a means of transferring various capabilities, expertise and technologies back to the domestic market which are used to compete against the DM MNEs domestically (Hennart, 2012; Ramamurti, 2012; Luo & Tung). As DM MNEs are also reluctant in some cases to introduce their most advanced products and technologies to emerging markets because of concerns about losing intellectual property, EM MNEs are also forced to search in foreign markets for such assets. For large emerging markets such as China, developing stronger domestic market positions could be considered an important driver of such asset-seeking behaviour (Hennart, 2012; Ramamurti, 2012; Luo & Tung).

> **Hypothesis 2:** The domestic innovation performance of Chinese MNEs which undertake foreign strategic asset-related acquisitions improves in the post-acquisition period.

### *2.3 Firm-level and institutional determinants of innovation performance in emerging markets*

Numerous factors determine an MNE's capability to not only acquire foreign strategic assets but also, more importantly, to absorb and harness such assets. Firm-level organization (such as

business group membership), industry level effects and previous experience with foreign MNEs, for example, may influence absorptive capacity. According to Cuervo-Cazurra (2012) the key distinguishing feature of EM MNEs that justifies the creation of dedicated theory relates to how the domestic institutional environment influences their FDI decisions. Xu and Meyer (2012), in their detailed review of the EM MNE strategy literature, conclude the most common theoretical frameworks are institutions-based perspectives, as institutions bring context to firm-level behaviours. Indeed, recognizing that EM MNE international expansion is institutionally embedded points to the importance of exploration beyond firm boundaries (Wang et al., 2012). In the case of Chinese MNEs, a great deal of recent research has considered how state ownership and government involvement may influence Chinese MNE FDI behaviour (Buckley et al., 2007; Cui & Jiang, 2012; Luo, Xue, & Han, 2010; Wang et al., 2012).

It has been argued that state actors at different levels supply Chinese MNEs with numerous resources (Li, Cui, & Lu, 2014; Wang et al., 2012), such as access to capital, domestic market monopolies, information and streamlined administrative procedures (Deng, 2009; Luo et al., 2010). Further, it is noted that Chinese governmental institutions tend to work in the interests of state-owned firms in comparison to those from the private sector (Buckley et al., 2007; Cui & Jiang, 2012; Xu & Meyer, 2012). It is suggested the Chinese government has significant influence on the international expansion strategies of its MNEs, especially those which are state owned (Li et al., 2014; Liang, Ren, & Sun, 2014; Wang et al., 2012). In this light it is also interesting that some studies find that strategic-asset-seeking is more common among Chinese state-owned enterprises (SOEs) than private sector businesses (Alon, 2010; Ramasamy et al., 2012).

While Chinese SOEs groups may have better access to capital than privately owned firms some argue SOEs are not as productive with these funds as private firms (Morck, Yeung, & Zhao, 2008). An arguably more important factor determining the target's post-acquisition innovation performance, however, as well as the reverse knowledge transfers flowing from it to the rest of the MNE, are levels of absorptive capacity (Deng, 2010). These are generally believed to be shaped by, among other things, R&D capability and previous experience (Cohen & Levinthal, 1990; Schüler-Zhou & Schüller, 2013). Following from China's 'grasp the large, let go of the small' strategy of state sector reform, state-owned businesses have become increasingly concentrated in a small number of large state-supported business groups, referred to as the 'national team' (Sutherland, 2009; Yiu 2011). These groups are privy to a range of preferential policies, involving both institutional transformation and direct support measures. Many of these groups have been strongly encouraged, for example, to setup R&D centers and to concentrate their group-wide resources for the purposes of technological catch-up (Guest & Sutherland, 2010; Yiu, 2011). Their R&D expenditures have been growing at an explosive rate, in excess of 35% per annum, for example, in the 2002-2008 period (State Statistical Bureau, 2009). These groups also have access to state-funded R&D findings and patents (Wang et al., 2012) and have become the most important R&D powerhouses in China (Yiu, 2011). China's large state-owned businesses groups therefore have considerably higher levels of absorptive capacity than non-supported private sector businesses and groups. Additionally, in terms of learning via experience, these groups have to date been responsible for a large share of China's outward FDI (Sutherland, 2009) giving them greater opportunities to perfect their post-integration management strategies via experiential learning. Coupled with increased absorptive capacity this potentially gives them

advantages over their less experienced private sector counterparts in managing strategic asset-rich acquisitions.

> **Hypothesis 3a**: The post-acquisition innovation performance of strategic asset related foreign acquisitions acquired by Chinese state-owned MNEs is superior to that of private sector Chinese MNE targets.

Higher levels of absorptive capacity also facilitate overcoming the challenges associated with 'multiple-embeddedness', including that related to internal embeddedness (Meyer, Mudambi, & Narula, 2011). Managing internal embeddedness involves promoting connectivity via experiential learning within the MNC network so as to transfer knowledge internally (whereas external embeddedness involves cooperative learning with outside partners, involving assimilation of local culture, norms and conventions). Internal knowledge transfers in EM MNEs, it has been argued, primarily involves knowledge flows from the developed market target to the home market headquarters as they look to access more advanced technological markets and thereby rapidly catch up with DM NMEs (Awate, Larsen & Mudambi, 2014; Buckley et al., 2014). It is argued EM MNEs in this regard are fundamentally different to DM MNEs, where knowledge generally flows from headquarters to subsidiaries. The literature on EM MNEs, internal embeddedness and reverse knowledge transfers, however, is still limited. Nonetheless, it has been suggested that absorptive capacity is again an important determinant of such flows (Awate, Larsen & Mudambi, 2014; Deng, 2010). On this basis we expect SOEs to be more capable of managing internal knowledge flows. Moreover, following from Hennart's (2012) bundling model, state owned groups likely have better access to CLRs. This creates stronger incentives, in the form of potentially larger domestic market shares, to engage in such technology transfers. On this basis we expect also to see greater evidence of increased domestic patenting

activity in state-owned firms in the wake of a developed market acquisition when compared to private firms.

> **Hypothesis 3b**: The post-acquisition innovation performance of the domestic operations of Chinese state-owned MNEs undertaking strategic asset related foreign acquisitions is superior to that of private sector MNEs.

## 3. Data and methodology

Event Study methodology provides a dynamic, longitudinal approach to understanding the trajectory of EM MNE outward FDI and international expansion strategies, potentially helping address identified lacunae in the current EM MNE literature (Ahern, 2009; Corrado, 2011; Fortanier & Tulder, 2009). The approach was initially developed to measure the effect of an event on stock prices (Binder, 1998; Dodd & Warner, 1983) and subsequently determine whether the event was beneficial or harmful to the organization's stakeholders (McWilliams & McWilliams, 2011). It was originally based on the premise that the discounted value of an organization is representative of its future profits. Referring to the impact of an event (i.e. merger, leadership change, new product announcement, etc.) on stock prices, (Duso, Gugler, & Yurtoglu, 2010) note, 'when observing a stock market reaction to the announcement of a particular event, the change in the equity value of firms affected by this event can then be taken as a measure of the additional profits that they are expected to accrue as a consequence of the event' (p. 187). They proceed to discuss the importance of a 'counterfactual' (i.e. had the event not taken place what would have occurred) in analyzing the significance of a given event. Counterfactuals generally take the form of either mean estimated or market estimated activity (McWilliams & Siegel, 1997). In this way, the approach allows for analysis of the effect of a

specific event on a defined stream of data, commonly stock prices.[3] The methodology has also been used, however, in many non-stock market-related studies, such as: the impact of professional sport franchises on local US economies (Lertwachara & Cochran, 2007); institutional impacts of currency crises (Shimpalee & Breuer, 2006); and the aftermath of civil war (Chen, Loayza, & Reynal-Querol, 2008).

Here we adapt the event study approach to measure the effect of an acquisition of an innovative developed market firm by a Chinese MNE on the patent registrations of both the parent and subsidiary of the Chinese MNE. According to a recent review of the innovation literature, innovation as an outcome 'is usually the key dependent variable in empirical studies related to innovation' (Crossan & Apaydin, 2010, p. 1169). Research expenditures are sometimes used as proxies for SAS (Chung & Alcácer, 2002; Halvorsen, 2012; Kornecki & Ekanayake, 2011). These, however, measure inputs into innovation, not outputs. For this reason, it has been argued that patents are a superior indicator of strategic asset availability (Beule & Bulcke, 2012; Pradhan, 2009).

Acquisitions, as opposed to greenfield investments, are generally considered the primary mechanism for acquiring strategic assets by EM MNEs (Deng, 2009; Luo & Tung, 2007; Rui & Yip, 2008). In this study, we concentrate on Chinese acquisitions in the three markets where strategic assets are most abundant: Europe[4], the United States and Japan. We use Thomson One Banker as our acquisition source. This triad constitutes the largest repository of strategic assets

[3] It has been used, for example, to understand how EM MNE acquisitions of developed market firms impact their share prices (Aybar & Ficici, 2009).
[4] Our definition of European is taken from the European Patent Office. See epo.org for more details.

globally, with the vast majority of patents granted worldwide during our period of study: 1998 to 2012 (WIPO, 2012). Our sample includes only acquisitions of firms which have been granted at least one patent either before or after being acquired by a Chinese firm. We searched for historical patenting activity for each developed market company in its respective domestic patenting authority[5]. An initial search for Chinese acquisitions in the US, for example, yielded 268 deals, of which only 241 acquisitions were actually completed with post acquisition ownership levels exceeding 10%. Of these 241, 32 observations could not be used and in 161 acquisitions the target (i.e. US firm) did not register any patents either before or after the acquisition. This left 47 usable observations in the US to analyze hypothesis one. Identical processes were performed for acquisitions of Chinese MNEs in the EU and Japan, yielding 23 and 13 observations, respectively.[6]

To test hypothesis two we gathered domestic patenting activity for these Chinese MNEs. In many cases the Chinese acquirer was a member of a larger group. We assume the technological capability acquired by the Chinese MNE may be diffused among group members. In some cases the recorded acquirer was also incorporated in a tax haven with little substantive activity. In light of this, domestic patenting activity data were gathered for the entire business group of each observation[7]. Gathering data for extremely large business groups (i.e. Huawei, TCL, COSCO, Geely, China National Agrochemical), however, was in some cases impractical. Although having

[5] The patenting authority of the US is the United States Patenting and Trademark Office (uspto.gov); EU is European Patent Office (epo.org); JP is Japan Patent Office (jpo.go.jp).

[6] The number of patents registered by a given target company ranged from a single patent, for example, in China-based Alibaba.com's acquisition of Vendio Services (a US-based ecommerce software developer) in 2010 to 313 patents when China-based Shanggong purchased Duerkopp Adler (a German-based sewing machine manufacturer) in 2004.

[7] The patenting authority of China is the State Intellectual Property Office of the P.R.C. (sipo.gov.cn)

purchased a DM innovative firm, some Chinese firms (i.e. China Travel International Investment) did not engage in patenting activity in either the pre or post acquisition periods and were thus excluded. Excluding firms that did not register any patents as well as excluding those with supra-copious patents allowed us to normalize our sample. In doing so we were left with 50 usable observations.

### *3.1 The Model*

Our approach estimates pre-acquisition (i.e. estimation window) patenting activity for each sample firm and then calculates abnormal patenting activity in the post-acquisition period (i.e. event window). In this commonly used interpretation of event study methodology, abnormal patents are assumed to reflect the firm's reaction to the acquisition (i.e. event) (A. McWilliams & Siegel, 1997). Timing is as follows: time $t = 0$ is the quarter in which the acquisition occurred, time $t = 1$ is the first quarter after the acquisition, time $t = -1$ is the quarter directly proceeding the acquisition and so forth. The event window runs from time $T1$ to $T2$ and spans time $T = T2 - T1 + 1$ total time units. Furthermore, the estimation window spans time $T0$ to $T1 - j$ quarters, or $T_{est} = T1 - j - T0 + 1$ total quarters when an event will not influence patents.

Abnormal patenting activity is defined here as:

$$AP_{it} = P_{it} - P_{bt}$$

where:

$AP_{it}$ is patents generated during the event window that are unexplained by normal patenting activity

$P_{it}$ is the number of patents granted to company $i$ at time $t$

$P_{bt}$ is the expected normal number of patents granted if a firm did not undergo a merger (i.e. the counterfactual number of patents post-merger).

We use two methods to calculate $P_{bt}$. The first way is the mean average returns method which is the average number of patents granted during the estimation window. $P_{bt}$ is then a constant in this method and is mathematically expressed as:

$$P_{bt} = \frac{1}{T_{est}} \sum_{t=T0}^{T1-j} P_{it}$$ [8]

The second method to calculate $P_{bt}$ is the market return method, where $P_{bt}$ is estimated using an ordinary least squares (OLS) regression of how a firm typically reacts to a market variable. In this paper it is expressed as:

$$P_{bt} = \hat{a}_i + \hat{b}_i P_{mt}$$

Where $P_{mt}$ is the market number of patents, $\hat{a}_i$ and $\hat{b}_i$ are the OLS coefficient estimates of firms *i*s regression of $P_{it}$ on $P_{mt}$ during the estimation window. Market patent numbers come from WIPO and contain only patents granted in the same country (or region for the EU) as $P_{it}$. This method incorporates how a firm may be procyclical or countercyclical to a market in the absence

[8] Abnormal returns are most commonly estimated by the residual from a regression of $P_{it}$on a constant and some 'market return' such as the S&P500 Index return for stock prices. Ideally, a 'market patents granted' variable would be generated equal to the average number of patents granted to a company by taking the total number of patents granted divided by the number of companies that were granted said patents. This type of estimation is impossible, however, owing to data limitations. The USPTO only tracks granted patents by year, not quarter, and does not keep any record of how many companies are granted those patents.

of an event occurring and then compares this predicted number of patents to the actual number of patents the firm generated during the event window.

Under this interpretation, if significant, $AP_{it}$ represents the change in real (count) patents caused by an acquisition. This shift can be either positive or negative, where a negative $AP_{it}$ value denotes diminished patenting activity after an acquisition compared to normal patent generation behavior. Every abnormal patent granted for a given firm ($AP_{it}$) during the event window is then tested for significance using t-statistics generated by the square root of the variance during the estimation window, defined as:

$$VAR(AP_i) = \frac{1}{T_{est} - 2} \sum_{t=T0}^{T1-j} AP_{it}^2$$

As is typical in the literature, the focus then shifts to the average abnormal patents over a defined number of time periods after an acquisition has occurred (McWilliams & Siegel, 1997). In this way, rather than investigating companies' abnormal returns on a firm-by-firm basis we are able to effectively average the results of the sample firms to analyze whether a significant number of companies experience a significant patenting pattern in the post-acquisition period. The average abnormal patents, *AAP*, is the average of all *N* companies' abnormal patents at time *t* where significance is calculated using:

$$AAP_t = \frac{1}{N} \sum_{i=1}^{N} AP_{it}$$

$$VAR(AAP) = \frac{1}{N^2} \sum_{i=1}^{N} VAR(AP_i)$$

Beyond evaluating if an acquisition significantly impacted patents at a specific point in time, a potentially more interesting question is whether that acquisition had permanent effects on innovation over several time periods. While most event studies run abnormal returns tests, these tests do not provide insights into whether the event was significant on the whole. To answer this question, cumulative abnormal patents, $CAP_{it}$, are estimated. The cumulative abnormal patents are the sum of all abnormal patents from the beginning of the event window, $T1$, to time $t$. Each event can be tested for significance in its entirety using the square root of the variance, expressed as:

$$CAP_{it} = \sum_{s=T1}^{t} AP_{is}$$

$$VAR(CAP_{it}) = (t - T1 + 1)VAR(AP_i)$$

However, while finding the number of significant events is an important step, calculating the cumulative average abnormal patents, $CAAP_t$, is a fundamentally important measure in event study methodology: it is used to examine whether the aggregated acquisitions of a sample experience significant abnormal patents. This is tested using the square root of the variance, expressed as:

$$CAAP_t = \frac{1}{N}\sum_{i-1}^{N} CAP_{it}$$

$$VAR(CAAP_t) = \frac{1}{N^2}\sum_{i=1}^{N} VAR(CAP_{it})$$

To determine the cogency of the *CAAP* measurement, the generalized sign test is typically used (Cowan, 1992). Rather than assuming a one-half probability for a positive or negative abnormal patents under the null hypothesis (as was the case for the sign test used for average abnormal patents results), the generalized sign test estimates the proportion of negative abnormal returns during the estimation window, denoted as $\hat{p}$, and compares that to the number of negative cumulative abnormal returns during the event window, denoted as $w$[9]. The generalized sign test statistic, $\theta_t^{GS}$, is computed as:

$$\theta_t^{GS} = \frac{w - N\hat{p}}{\sqrt{N\hat{p}(1-\hat{p})}}$$

We also use two additional nonparametric tests to give further support to the tests described above. The first tests whether the number of positive CAPs is significantly different from the number of negative CAPs (Doukas & Travlos, 1988). The test-statistic is found using:

$$Z_t = \frac{m - pn}{\sqrt{p(1-p)n}}$$

where $p$ is the probability under the null hypothesis that a CAP is either positive or negative (0.50), $n$ is the number of positive plus negative CAPs, and $m$ is the number of positive (or negative) CAPs.

The second test determines whether the number of statistically significant positive or negative CAPs is statistically different than the number given by the probability of a type I error (Doukas & Travlos, 1988). This test statistic is expressed as:

[9] Again, the generalized sign test can just as easily be used to test for positive cumulative abnormal returns by denoting $\hat{p}$ and $w$ as the proportion of positive abnormal returns during the estimation window and the number of positive cumulative abnormal returns during the event window, respectively.

$$Z_t = \frac{s - qr}{\sqrt{q(1-q)r}}$$

where $q$ is the probability of a type I error (0.05), $s$ is the number of statistically significant positive/negative CAPs at the 95% level, and $r$ is the total number of CAPs. Finally, if significant cumulative average abnormal patents are detected, the natural extension is to attempt to explain the factors that would cause the event to be significant. This is typically done using ordinary least squares to regress a number of firm-level explanatory variables against individual firms' cumulative abnormal patents. Unfortunately, the number of firms with firm-level data available (i.e. annual reports) brought the sample size down to 37. Unlike event study methodology, however, running regressions on such a small sample would have limited explanatory power.

In lieu of regressing cumulative abnormal patents against firm-level determinants, we disaggregated our sample into groups, such as ownership (state owned and private), and estimated one-way analysis of variance (Anova) models to aid in understanding differences between groups. Essentially, Anova models calculate and compare variability in order to determine whether the means between two or more groups are different. This is generally expressed as:

$$\sum_{j=1}^{n} \left(x_j - \bar{x}\right)^2$$

where $x_j$ is the value of observation $x$ in group $j$ and $\bar{x}$ is the mean of all observations in the list (i.e. all groups). This is termed the variability of the data, or otherwise known as the sum of squares (SS).

We partition the total variability[10] into two parts: 1) between group variability[11] (experimental variance) and 2) within group variability[12] (error variance). The ratio of the two parts is then taken (i.e. experimental variance divided by error variance) to determine the total SS. The degrees of freedom are noted and, subsequently, the mean square is calculated as the SS divided by degrees of freedom. The F ratio (i.e. mean square between groups divided by mean square within groups) is then determined and significance is subsequently reported. If the F ratio = 1 there is no difference between groups. If variation between groups is greater than variation within groups the F ratio will be greater than 1 and there may be differences between groups. Significance of the F ratio indicates there are differences between the mean cumulative abnormal returns of two or more groups (i.e. ownership structures). This analysis simply indicates the presence of differences between groups but does not specify where the differences occur. If results are significant, a post-hoc test can be run to determine where the differences lie. The most commonly used post hoc tests are Scheffe and Games-Howell. If variances are homogeneous, Scheffe tests are most appropriate. If, however, variances are heterogeneous, Games-Howell tests are superior.

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[10] Total variability is defined as: $\sum_{i=1}^{k} \sum_{j=1}^{n,} \left(x_{ij} - \bar{x}_{ij}\right)^2$

[11] Between group variability is defined as: $\sum_{i=1}^{k} n_i \left(\bar{x}_i - \bar{x}_{ij}\right)^2$

[12] Within group variability is defined as: $\sum_{i=1}^{k} \sum_{j=1}^{n,} \left(x_{ij} - \bar{x}_{ij}\right)^2$

*CAAP* were analyzed using two sets of estimation and event windows for granted patents. Granted patents are used rather than applied patents as 1) we measure innovation as an outcome and 2) issue dates are not readily available for Japanese patent data. For the target firms (EU, US and Japan) an estimation window of twelve quarters prior to and including the quarter in which the acquisition took place is used. The target firms' event window spans from eleven quarters after an event to fifteen quarters after an event. For the acquirer firms (Chinese), an estimation window of twelve quarters prior to and including the acquisition period and an event window of four to eight quarters after the acquisition took place is used.

No previous studies have used event study methodology to analyze patenting activity. We therefore use descriptive statistics as the basis for determining the length of our estimation and event windows (see Table 1). We determined the best approach for determining the estimation windows was to calculate the minimum number of days it took a given patent to proceed from 'applied' to 'granted' status. In our sample, the minimum number of days between application and granted patent was 60. In other words, it took less than one quarter for some patents in the sample to be granted after the initial application. As a result, time zero (i.e. the time period in which the acquisition took place) should be included in the estimation window. Starting the estimation window at twelve quarters prior to an acquisition was a decision based on testing several different estimation windows without finding any significant changes in results. The starting quarter for the event window was determined using the mean and median amounts of time between patent application and award. In the case of Chinese patenting activity in the sample, the mean number of days is 463 and the median is 344. This indicates the event window

should start at 463/90 = 5.14 quarters or 344/90 = 3.82 quarters. In this case, we chose to use four quarters after an acquisition as the beginning of our event window as this allows us to lengthen the total time period of the event window without dropping the most recent observations in the sample.[13]

The end of the event window was determined by the availability of data for the most recent observations. If the event window spans to eight quarters past the acquisition only 49 observations were usable.[14] If the event window was expanded to 12 periods, only 36 observations were available. Extending to 16 quarters allowed only 28 usable observations. For this sample, in no cases did model results which ended the event window either 8 or 16 periods after an event change signs or significance (see Appendix A). We, therefore, use the longest event window possible which does not drop a significant number of observations. Identical methodology was used in the case of determining estimation and event windows of foreign patents: the median time between application to acceptance for U.S. patents in our data was 959 days=10.65 quarters. We would then use quarters 11 to 15 in our event window. Doing this, however, resulted in a decrease in measurable events (due to the fact that many mergers happened less than 15 quarters before 2012:Q4; the end of the data sample) from 70 to 37. Even though using quarters 11-15 is theoretically consistent with the Chinese event window, we opt for more observations and choose an event window from quarters 4 to 8 which includes 70 events. This change in the event window does not change the event study results, as can be seen in Appendix B.

[13] This allows us to use acquisitions up to the fourth quarter of 2010, lag the start date of the event window four quarters and still make use of market data to the end of 2012 (i.e. leaving an adequately long event window).
[14] This is because the most recent observations are excluded due to the event window moving into time periods which do not have data.

Finally, two companies (Shanghai Electric and Suntech) made acquisitions in two or more different regions in overlapping event windows. Including overlapping data such as these can potentially skew results. We estimated event study models both including and excluding the overlapping observations. The results remained robust across all models for both domestic and foreign models when including and excluding these observations (see Appendix C for a comparison of results). Those reported here include all observations.

*Table 1: Descriptive Statistics of Patents Granted by Quarter*

| Foreign Target Patents | | | | | |
|---|---|---|---|---|---|
| Type | Obs | Mean | Std. Dev. | Min | Max |
| All | 1470 | 0.408 | 1.264 | 0 | 14 |
| SOE | 609 | 0.432 | 1.273 | 0 | 14 |
| Non-SOE | 861 | 0.391 | 1.258 | 0 | 14 |
| **Chinese Acquiror Patents** | | | | | |
| Type | Obs | Mean | Std. Dev. | Min | Max |
| All | 1029 | 7.601 | 15.46 | 0 | 113 |
| SOE | 378 | 9.349 | 17.51 | 0 | 113 |
| Non-SOE | 651 | 6.585 | 14.04 | 0 | 88 |

*All data described above is from the beginning of the estimation window, 12 quarters before the merger, to the end of the event window we use throughout the rest of the paper, 8 quarters after merger.*

## 4. Results

The innovative activity of the acquired foreign firms does not significantly change after acquisition by a Chinese firm (see Table 2). These results are confirmed by the generalized sign test (a non-parametric measure). The ratio of positive to negative CAPs indicates far more firms experience a decline in patenting activity. The results, however, are significant for only a small

minority of firms. Overall, patents are on average estimated to decrease by less than one patent over the event window. The results using mean estimated or market estimated abnormal patents are analogous and those for percentage change in patents (rather than frequency count) are very similar (see Appendix D). This indicates robustness across event study techniques. The innovative performance of foreign strategic asset acquisitions of Chinese MNEs does not significantly improve or deteriorate after acquisition. Hypothesis one is therefore supported.

*Table 2: Event Study Results for Foreign Patents*

| **Foreign Target Results** | | | | | | |
|---|---|---|---|---|---|---|
| Quarters[@] | CAAP | (t-stat) | GS+ | GS-[#] | Pos:Neg | 95% Sig^ |
| Abnormal Patents Estimated using Mean Estimated Return--70 Events | | | | | | |
| 4 | -0.23 | (-0.43) | -2.18** | 1.70* | 5:39*** | 2:1 |
| 4-5 | -0.26 | (-0.35) | -1.23 | 1.22 | 8:37*** | 5*:3 |
| 4-6 | -0.47 | (-0.50) | -0.91 | 0.98 | 9:36*** | 3:3 |
| 4-7 | -0.71 | (-0.66) | -1.23 | 1.46 | 8:38*** | 3:3 |
| 4-8 | -0.79 | (-0.65) | -0.59 | 0.98 | 10:36*** | 3:6** |
| Abnormal Patents Estimated Using Market Estimated Return (WIPO Data)--47 Events | | | | | | |
| 4 | -0.30 | (-0.65) | -0.82 | 0.67 | 7:20** | 2:2 |
| 4-5 | -0.51 | (-0.79) | -0.08 | 0.37 | 9:19* | 2:5*** |
| 4-6 | -0.81 | (-1.03) | -0.08 | 0.37 | 9:19* | 2:6*** |
| 4-7 | -1.13 | (-1.24) | -0.45 | 0.97 | 8:21** | 3:6*** |
| 4-8 | -1.30 | (-1.28) | 0.28 | 0.37 | 10:19 | 3:8*** |

****=p<.01 ; **=p<.05; *=p<.10*

*Estimation window ranges 0 to 12 quarters before merger*

*@ The event window begins 4 quarters after an event. 4-7 indicates the cumulative abnormal patents from 4quarters to 7 quarters after a merger is announced.*

*# A negative t-statistic on the generalized sign test indicates the opposite of the sign in question. A negative t-statistic for the negative generalized sign test indicates that significantly less negative CAPs were observe than predicted—this indicates there were significantly more positive CAPs than predicted.*

*^ Denotes the number of events that are significant at the 95% level; both positive and negative (Positive:Negative)*

The *CAAP* results for the acquirer home country (China) indicate patenting activity was significantly enhanced in the post-acquisition period (see Table 3). Supporting non-parametric tests confirm the *CAAP* results. The mean estimated CAAP models show an average increase of

nearly 40 patents per firm over and above the number of normal patents generated eight periods after the acquisition. This number drops slightly, to around 27 patents, when taking into account the upward market trend of Chinese patenting activity generally, yet remains highly significant. This provides strong evidence that the domestic innovative performance of Chinese MNEs that undertake foreign strategic asset related acquisitions improves over time, supporting hypothesis two.

*Table 3: Event Study Results for Chinese Patents*

| **Chinese Aquiror Results** | | | | | | |
|---|---|---|---|---|---|---|
| Quarters[@] | CAAP | (t-stat) | GS+ | GS-[#] | Pos:Neg | 95% Sig^ |
| Abnormal Patents Estimated using Mean Estimated Return--49 Events | | | | | | |
| 4 | 8.69* | (1.81) | 5.98*** | -4.26*** | 30:10*** | 15***:0 |
| 4-5 | 15.84** | (2.34) | 7.31*** | -5.41*** | 34:6*** | 20***:1 |
| 4-6 | 25.27*** | (3.04) | 7.97*** | -5.41*** | 36:6*** | 26***:1 |
| 4-7 | 32.61*** | (3.4) | 7.97*** | -5.41*** | 36:6*** | 27***:0 |
| 4-8 | 39.95*** | (3.73) | 8.97*** | -5.69*** | 39:5*** | 28***:0 |
| Abnormal Patents Estimated Using Market Estimated Return (WIPO Data)--35 Events | | | | | | |
| 4 | 5.81* | (1.7) | 3.56*** | -2.92*** | 20:8** | 9***:0 |
| 4-5 | 11.22** | (2.33) | 4.3*** | -3.59*** | 22:6*** | 14***:2 |
| 4-6 | 18.59*** | (3.15) | 5.04*** | -3.59*** | 24:6*** | 16***:1 |
| 4-7 | 22.45*** | (3.29) | 4.67*** | -3.25*** | 23:7*** | 17***:2 |
| 4-8 | 27.21*** | (3.57) | 5.78*** | -3.93*** | 26:5*** | 17***:2 |

****=p<.01 ; **=p<.05; *=p<.10*

*Estimation window ranges 0 to 12 quarters before merger*

*@ The event window begins 4 quarters after an event; the median time between application and approval for patents in China in our data. 4-7 indicates the cumulative abnormal patents from 4 quarters to 7 quarters after a merger is announced.*

*# A negative t-statistic on the generalized sign test indicates the opposite of the sign in question. A negative t-statistic for the negative generalized sign test indicates that significantly less negative CAPs were observe than predicted—this indicates there were significantly more positive CAPs than predicted.*

*^ Denotes the number of events that are significant at the 95% level; both positive and negative (Positive:Negative)*

To test the impact of ownership on innovative capability (hypotheses 3a and 3b), the sample is first disaggregated by ownership (state and non-state) and run as separate event study models. CAAP results for both private and state-owned models closely mirrored results for the overall

sample, and thus each other (see Tables 4 and 5). This gave preliminary evidence differences between groups may not exist. After validating Anova methodology was appropriate for these data, models were run for individual firms' CAP in both groups. No statistically significant differences were found between Chinese firms in either acquirer (China) or target (foreign) firms for the two groups (see Table 6). Thus, hypotheses 3a and b are not supported.

*Table 4: Event Study Results for State Owned Enterprise Acquirers*

| **Foreign Target Results** | | | | | | |
|---|---|---|---|---|---|---|
| Quarters | CAAP | (t-stat) | GS+ | GS-[#] | Pos:Neg | 95% Sig^ |
| Abnormal Patents Estimated using Mean Estimated Return--29 Events | | | | | | |
| 4 | -0.35 | (-0.56) | -1.64 | 1.29 | 2:18*** | 1:0 |
| 4-5 | -0.42 | (-0.48) | -0.22 | 0.54 | 5:16** | 4***:1 |
| 4-6 | -0.71 | (-0.66) | 0.26 | 0.17 | 6:15* | 2:2 |
| 4-7 | -1.19 | (-0.96) | -0.22 | 0.54 | 5:16** | 2:2 |
| 4-8 | -1.58 | (-1.14) | -0.22 | 0.54 | 5:16** | 2:2 |
| **Chinese Acquiror Results** | | | | | | |
| Quarters | CAAP | (t-stat) | GS+ | GS- | Pos:Neg | 95% Sig |
| Abnormal Patents Estimated using Mean Estimated Return--18 Events | | | | | | |
| 4 | 8.78** | -2.86 | 2.60** | -2.43** | 9:2** | 4***:0 |
| 4-5 | 11.88** | -2.73 | 2.03** | -1.90** | 8:3* | 5***:2** |
| 4-6 | 18.60*** | -3.49 | 3.18*** | -1.90** | 10:3** | 7***:1 |
| 4-7 | 21.15*** | -3.44 | 2.60** | -1.36* | 9:4* | 6***:2* |
| 4-8 | 25.36*** | -3.69 | 2.60** | -1.36* | 9:4* | 6***:2* |

****=p<.01 ; **=p<.05; *=p<.10*

*Estimation window ranges 0 to 12 quarters before merger*

*# A negative t-statistic on the generalized sign test indicates the opposite of the sign in question. A negative t-statistic for the negative generalized sign test indicates that significantly less negative CAPs were observe than predicted—this indicates there were significantly more positive CAPs than predicted.*

*^ Denotes the number of events that are significant at the 95% level; both positive and negative (Positive:Negative)*

*Table 5: Event Study Results for Non-State Owned Enterprise Acquirers*

| **Foreign Target Results** | | | | | | |
|---|---|---|---|---|---|---|
| Quarters | CAAP | (t-stat) | GS+ | GS-[#] | Pos:Neg | 95% Sig^ |
| Abnormal Patents Estimated using Mean Estimated Return--41 Events | | | | | | |
| 4 | -0.15 | (-0.31) | -1.46 | 1.14 | 3:21*** | 1:1 |
| 4-5 | -0.15 | (-0.22) | -1.46 | 1.14 | 3:21*** | 1:1 |
| 4-6 | -0.3 | (-0.36) | -1.46 | 1.14 | 3:21*** | 1:1 |
| 4-7 | -0.37 | (-0.39) | -1.46 | 1.46 | 3:22*** | 1:1 |
| 4-8 | -0.23 | (-0.21) | -0.6 | 0.83 | 5:20*** | 1:3 |
| **Chinese Acquiror Results** | | | | | | |
| Quarters | CAAP | (t-stat) | GS+ | GS- | Pos:Neg | 95% Sig |
| Abnormal Patents Estimated using Mean Estimated Return--31 Events | | | | | | |
| 4 | 8.19* | -1.86 | 5.22*** | -3.12*** | 18:7** | 8***:0 |
| 4-5 | 16.42** | -2.64 | 6.55*** | -4.20*** | 21:4*** | 12***:0 |
| 4-6 | 27.10*** | -3.56 | 6.55*** | -4.20*** | 21:4*** | 16***:0 |
| 4-7 | 33.65*** | -3.83 | 7.00*** | -4.56*** | 22:3*** | 17***:0 |
| 4-8 | 40.45*** | -4.12 | 8.34*** | -4.92*** | 25:2*** | 18***:0 |

****=p<.01 ; **=p<.05; *=p<.10*

*Estimation window ranges 0 to 12 quarters before merger*

*# A negative t-statistic on the generalized sign test indicates the opposite of the sign in question. A negative t-statistic for the negative generalized sign test indicates that significantly less negative CAPs were observe than predicted—this indicates there were significantly more positive CAPs than predicted.*

*^ Denotes the number of events that are significant at the 95% level; both positive and negative (Positive:Negative)*

*Table 6: One-Way ANOVA Results for State Owned and Non-State Owned Chinese (Acquirer) Firms*

| **Foreign Target Results** | | | | |
|---|---|---|---|---|
| Quarters | SOE | Non-SOE | F-Statistic | p-value |
| Abnormal Patents Estimated using Mean Estimated Return | | | | |
| 4 | -0.35 | -0.15 | 0.54 | 0.467 |
| 4-5 | -0.42 | -0.15 | 0.20 | 0.654 |
| 4-6 | -0.71 | -0.3 | 0.25 | 0.616 |
| 4-7 | -1.19 | -0.37 | 0.55 | 0.462 |
| 4-8 | -1.58 | -0.23 | 0.87 | 0.354 |
| **Chinese Acquiror Results** | | | | |
| Quarters | SOE | Non-SOE | F-Statistic | p-value |
| Abnormal Patents Estimated using Mean Estimated Return | | | | |
| 4 | 8.78 | 8.19 | 0.07 | 0.791 |
| 4-5 | 11.88 | 16.42 | 0.04 | 0.843 |
| 4-6 | 18.60 | 27.10 | 0.19 | 0.661 |
| 4-7 | 21.15 | 33.65 | 0.04 | 0.835 |
| 4-8 | 25.36 | 40.45 | 0.01 | 0.936 |

****=p<.01 ; **=p<.05; *=p<.10*

*Estimation window ranges 0 to 12 quarters before merger*

## 5. Discussion

### *5.1 Explaining the innovative performance of developed market acquisitions*

Most research to date analyzing the impact of acquisitions on innovative performance in both targets and acquirers has focused on DM MNEs (Ahuja & Katila, 2001; Cloodt, Hagedoorn, & Van Kranenburg, 2006). Research in these areas regarding Chinese MNEs remains limited, making it hard to generalize about their requisite absorptive capacity or their ability to successfully integrate strategic asset rich targets (Deng, 2010; Liu & Woywode, 2013; Schüler-Zhou & Schüller, 2013).[15] We find that acquired foreign strategic asset rich targets exhibit no

[15]Other related empirical evidence considers the possible impacts on other performance indicators (i.e. not only innovation) of foreign acquisitions. For EM MNEs more generally, for example, Aybar & Ficici (2009) examined the stock prices associated with 433 international M&A deals in 58 EM MNEs during 1991–2004. It was found these cross-border expansions did not create value, rather they destroyed value more than half of the time. Ning,

statistically significant upward or downward trend in their post-acquisition activity, which is consistent with the argument that Chinese MNEs generally take a 'light-touch' approach to post-acquisition integration (Liu & Woywode, 2013; Rui & Yip, 2008). In this scenario Chinese firms may be acquiring advanced economy firms capable of generating cutting edge innovation. They do so, however, with a view to only gradually embed them into their existing organizational frameworks. They recognize that the challenge of achieving 'external embeddedness' in foreign subsidiaries, which requires cooperative learning, assimilation of local culture, norms and conventions, is best left to the target firm (Meyer, Mudambi & Narula, 2011). Interventions, therefore, are minimal. They may, for example, simply support the non-manufacturing portion of the subsidiary at arms-length through, for example, cash injections and other forms of financing (Rui & Yip, 2008) with limited direct management intervention.

This finding is also consistent with the resource-dependence theory perspective, namely that strategic asset rich subsidiaries enjoy superior bargaining power over their 'knowledge-inferior' parents (Awate, Larsen & Mudambi, 2014; Schüler-Zhou & Schüller, 2013). Recent empirical research, for example, has shown how the management autonomy in the acquired targets of Chinese MNEs is directly related to their technological intensity and knowledge superiority over the Chinese parent firm (Schüler-Zhou & Schüller, 2013). Similar results have also been found in the developed market acquisitions of Indian MNEs. These also continue to preserve considerable autonomy owing to their stronger bargaining position *vis* a *vis* the parent (Awate, Larsen & Mudambi, 2014). Our findings are therefore supportive of the 'light-touch' post-acquisition integration strategy in Chinese MNEs (Liu & Woywode, 2013), as well as the resource-

Kuo, Strange, & Wang (2014), by contrast, looked specifically at the stock price reactions to international M&A announcements (over the period 1991–2010) of Chinese MNEs and found a positive average reaction. Buckley, Elia, & Kafouros (2014), focusing explicitly on target performance, also have found evidence that EM MNE acquisitions can improve target performance under certain conditions.

dependence perspective that argues technology superior subsidiaries of Chinese MNEs enjoy greater autonomy (Schüler-Zhou & Schüller, 2013).

Research on the impacts of EM MNE acquisitions on the general performance (i.e. also financial and productivity performance) of the target firms remains in its infancy. To date, moreover, extant studies have tended to focus on performance impacts in only the acquiring or target firm and not both simultaneously (Aybar & Ficici, 2009; Buckley, Elia & Kaforous, 2014; Ning et al., 2014). Only one study, to our knowledge, has looked specifically at the performance impacts in the target firm following an EM MNE acquisition. It also finds no evidence of a negative impact (on financial performance). Rather, it finds some positive impacts, particularly in cases where EM MNEs have greater international experience and plentiful tangible resources in their domestic markets (i.e. large domestic markets with relatively low levels of competition, government support and cheap capital) (Buckley, Elia & Kaforous, 2014). Others, therefore, have also found that EM MNEs do not always have a negative impact on their acquired units.

### *5.2 Reverse knowledge flows and the exploitation of acquired strategic assets domestically*

Following from this, our findings can also be interpreted to support the stream of literature arguing EM MNEs actively engage in international acquisitions for the purpose of catching-up and reverse knowledge transfer (Awate, Larsen & Mudambi, 2014; Child & Rodrigues, 2005; Luo & Tung, 2007; Tan & Mathews, 2014). As their innovative developed market acquisitions continue their innovation activities unimpeded, Chinese MNE parents may allow their developed market strategic asset rich acquisitions to continue pushing the world-leading technological thresholds (Grossman & Hart, 1986; Meyer & Estrin, 2001; Morck, Yeung & Zhao., 2008). Once these innovations have been codified via patenting, moreover, the innovation can potentially be

transferred back to the domestic market for exploitation (Dhanaraj et al., 2004). This is particularly so when the MNEs' capabilities to orchestrate intra-MNE knowledge flows (i.e. 'internal embeddedness') are high (Meyer, Mudambi & Narula, 2011) and the knowledge produced is easily codified. This facilitates a steady stream of products, processes and services patented in the most stringent of patenting environments (i.e. US, EU and Japan) to the home market, China. In the two years following acquisitions we found an average increase of 27 patents per year in the domestic market in our sample Chinese MNEs. This is a large rise.

As comparative newcomers, some argue EM MNEs may struggle with the challenges of 'multiple-embeddedness' that international innovation entails. This is because MNEs must deploy internal networks, interconnecting the innovation activities of a growing number of acquired R&D subsidiaries, as well as external networks (through which these R&D affiliates link with foreign firms and institutions to gain access to local innovation systems) (Meyer et al., 2011). The ability of an MNE to manage and exploit these international innovation networks relies on various factors, including initial firm endowments (i.e. FSAs) as well as the home and host country location advantages (Zhou & Guillén, 2014). Some traditional frameworks, such as the ownership-location-internalization paradigm, predict that the ownership advantages of EM MNEs and DM MNEs differ because of the features of the location conditions of the country of origin (Cuervo-Cazurra, 2012; Hennart, 2012). Some argue these are not favorable for promoting the required organizational and transaction-type ownership assets, including high levels of absorptive capacity, for managing both internal and external networks in EM MNEs (Narula, 2012). Nonetheless, our findings suggest Chinese MNEs are capable of exploiting knowledge flows via internal MNE networks. One possible reason for this finding is that we focus on patents as our measure of intangible strategic asset in this study. These are highly codified forms

of intangible strategic assets and less tacit in nature than other forms of intangible asset, potentially making them more easily transferable.

The significant improvement in the domestic patenting performance of Chinese MNEs in the wake of international SAS related acquisitions lends support to the idea they undertake FDI to access advanced technologies for use in their domestic market. Recent research has highlighted the importance of the domestic market as a driver of SAS related outward FDI (Awate, Larsen & Mudambi, 2014; Buckley, Elia & Kaforous, 2014; Hennart, 2012). With strong domestic market positions, which in general remain by far their largest sources of revenue (Morck, Yeung & Zhao, 2008; Rugman & Li, 2007; Sutherland & Ning, 2010), Chinese MNEs may exploit the acquired foreign strategic assets in their domestic markets. Rugman and Li (2007), for example, note that most of China's largest MNEs have comparatively limited international exposure: 'none of these companies are truly internationalized…. [with] well over 95% of their sales within China' (Rugman & Li, 2007, p. 337). This is also reflected in their comparatively low 'trans-nationality indexes' (i.e. the average non-domestic asset, employment and sales shares). Foreign acquisitions designed to leverage their strong domestic market positions are entirely rationale. This is in line with the reasoning behind Hennart's (2012) bundling model, which explores the conceptual relationship between strategic-asset-seeking and domestic market exploitation. The premise that location advantages are freely available to all, therefore, may not hold in emerging markets such as China (Hennart, 2012). If EM MNEs do indeed have privileged access to CLRs, from which they can derive rents, there are strong incentives to engage in the international transfer of strategic assets to the Chinese market.

To further illustrate both the reverse knowledge transfer process and imitation and bundling model strategies employed in Chinese MNEs it is instructive to consider the example of ZJF

Group, taken from our sample. ZJF Group is a Chinese MNE which manufactures optical fiber. In terms of CLRs, many provincial governments have classified fiber optics as a major infrastructure development priority, preferentially granting contracts to indigenous Chinese firms (Firecomms, 2010). Although ZJF Group possessed mass manufacturing capabilities it originally had few firm-specific technological advantages. It therefore purchased Firecomms Ltd in late 2010, a European fiber-optics firm. Firecomms, unlike ZJF, did not have access to government infrastructure projects (i.e. CLRs in China) (Firecomms, 2010). It did, however, have strong innovative capabilities, including a steady stream of European fiber-optics patents. This made it an attractive target for ZJF, which acquired it and subsequently commercialized many of its patents in China, leveraging local CLRs available to it. The acquisition of Firecomms by ZJF Group illustrates how a Chinese group acquired a European firm in order to gain access to its technology for exploitation in its home market, facilitated by CLRs. ZJF, moreover, appears at present to have little intention of competing outside of China, suggesting this international acquisitions was driven primarily by domestic market concerns (Firecomms, 2010).

While this example is useful in illustrating why Chinese MNEs may have strong incentives to acquire foreign technologies, further research is required to ascertain the full extent to which access to CLRs motivates the international acquisitions of Chinese MNEs. Nonetheless, an increasing body of research shows EM MNEs pursue foreign developed market acquisitions with a view to imitating their technologies, often initially with a production focused orientation in their domestic market (Awate, Larsen & Mudambi, 2012; Hennart, 2012). As such, it has also been argued that such acquisitions do not immediately facilitate improved domestic R&D capabilities. Indeed, such capabilities require firms to know 'more than the technology of the final product' that they acquire in the acquisition (i.e. of patents). This includes fundamental

knowledge related to the overall technology and 'architectural innovation', which is necessary to facilitate break through innovations (Awate, Larsen & Mudambi, 2012, p. 220). In this regard, it is argued EM MNE foreign acquisitions in the first instance are often related to catch-up of output, rather than innovation capabilities, which may only later follow. Using again the example of ZJF Group found in our sample, many of the exact patents granted in Europe to Firecomms were applied for and subsequently granted to ZJF Group in China.[16] Further research looking at backward patent citations may shed more light on the extent to which Chinese MNEs look to imitate the DM MNE patents they acquire through acquisitions.

### *5.3 State ownership, absorptive capacity and reverse knowledge flows*

Little research has yet considered how ownership considerations and associated institutional forces may affect absorptive capacity, or what preferential state support or policies are used to shape Chinese MNE absorptive capacity and foreign technology acquisition. The question of whether state-owned Chinese MNEs may more affectively absorb strategic assets and how they use them (i.e. for domestic use or otherwise) remains largely unanswered. Our final hypothesis was concerned with exploring what factors influence the absorption of strategic assets, with a specific emphasis on ownership. Empirically it has been found that strategic asset seeking in Chinese MNEs 'finds more support among state-owned firms' (Ramasamy et al., 2012, p. 24). Others also note that 'among the various institutional dimensions… the role of governments may

[16] Many of the exact patents granted in Europe to Firecomms were applied for in China by ZJF Group and subsequently granted. A typical example is the patent for an 'optical connector'. This innovation was patented in both Europe and China and was attributed to two European inventors in both cases. This patent was granted in Europe prior to ZFJ's purchase of Firecomms but well after the acquisition in China. The patent descriptions are identical. It is notable, moreover, that prior to acquiring Firecomms, ZFJ Group had registered no plastic optical fiber patents. After the purchase of Firecomms the only patents registered to ZFJ affiliates were patents Firecomms had previously been granted in Europe.

be of paramount importance in mid-range emerging economies' (Hoskisson et al.,2013, p. 1306). Our results, however, suggest that even if SOEs are given more support to target strategic-assets, they are not necessarily more (or less) capable of absorbing such assets than private sector MNEs.

We hypothesized superior R&D budgets and greater experience would lead to greater absorptive capacity in SOEs, in turn creating superior innovation performance in the target. Our finding for target innovation performance, however, is consistent with the limited research yet undertaken on post-acquisition integration management in Chinese MNEs acquiring strategic asset rich targets. This finds no noticeable difference in the degree of autonomy afforded to private and state sector targets, implying differences in post-acquisition integration strategies may be minimal (Schüler-Zhou & Schüller, 2013). We can only speculate, however, as to why this is the case. It may be that SOEs R&D expenditures are poorly invested or that private sector firms outperform in this regard. Alternatively, it may be that opportunities for acquiring suitable technologies in their target firms are more restricted for SOEs. As regards domestic innovation performance, a further interpretation is that in terms of access to CLRs, both state and non-state sectors have equal access, meaning there are not necessarily stronger incentives for SOEs to repatriate acquired intangibles to use domestically.

Future research could look to further explore not only the role of ownership and, more generally, domestic market institutions in driving SAS, but also their role in aiding absorption. For it is still unclear how governments may promote or retard absorptive capacity in MNEs. From a catch-up perspective, our findings are interesting as they suggest both private and state sectors may be charting relatively similar courses and are equally capable of rapid catch-up. There is no

evidence, for example, that one ownership class outperforms the other in the case of technology related acquisitions in developed markets.

## 6. Concluding comments

The question of whether EM MNEs aggressively acquire strategic assets in psychically distant developed markets to nurture the firm-specific advantages they lack is central to current conceptual discussion and empirical investigation of EM MNE FDI strategies (Cuervo-Cazurra, 2012; Hennart, 2012; Narula, 2012; Ramamurti, 2012). It is hypothesized EM MNEs try to move quickly to the technological frontier, using non-incremental learning processes by directly acquiring cutting-edge capabilities from their developed market counterparts to 'catch-up' (Luo & Tung, 2007). Some argue this behaviour seems at odds with traditional theories, which start from the premise that firms internationalize using firm-specific ownership advantages (Hennart, 2012; Mathews, 2006; Ramamurti, 2012). The empirical finding that EM MNEs target strategic assets via FDI, however, is also puzzling as it is not clear how they are able to harness, absorb and exploit such assets (Narula, 2012). Some, for example, have questioned whether EM MNEs have sufficient capabilities to properly exploit their SAS-related acquisitions (De Beule & Duanmu, 2012; Rugman & Li, 2007).

We have shown that the acquisition of DM firms by Chinese MNEs has little impact on the innovation performance in the target when measured using patent counts. It does, however, have significant and positive impacts on the patent counts in the domestic Chinese parent group. These findings are consistent with a growing body of work arguing EM MNEs engage in international acquisitions for the purposes of accessing foreign technology which they exploit, at

least initially, in their domestic markets (Hennart, 2012; Awate, Larsen & Mudambi, 2012; Buckley, Elia & Kaforous, 2014; Luo & Wang, 2012).

There are naturally limitations and gaps in our study. Future research, for example, is required probe in finer detail the extent to which Chinese MNEs, like those in our sample, really benefit from CLRs. The question of whether the increased patent counts in China are directly a result of the foreign acquisitions could be analyzed by exploring backward patenting citations in greater detail. Our use of registered patents is also a somewhat restricted definition of strategic asset seeking (less codified intangible assets such as brands and management expertise, for example, are also desirable strategic assets for Chinese MNEs). A broader measure of strategic assets could be considered in future empirical analysis. The real value of the acquired strategic assets to the organization, moreover, is also not analyzed here. Future research may also do more to isolate specific firm-level and institutional determinants of the patenting activities, such as the impact of ownership, employing multiple regression analysis on the event study results. Additionally, our sample could also be enlarged further, using MNEs from both emerging and developed markets and over different periods which will allow for greater comparative analysis.

### *6.1 Managerial relevance*

To rapidly strengthen their domestic market position, managers in Chinese state-owned and private businesses may look to acquire innovative, advanced economy firms, particularly those with existing codified technologies, such as those embodied in patents. In cases where local Chinese businesses can bundle foreign strategic assets with preferential access to CLRs, the strategy has a strong internal logic. Post-acquisition integration strategies that give foreign targets considerable autonomy (i.e. a ‘light-touch’ approach), moreover, can complement

reverse-knowledge flows when strategic assets are codified in patent form. For owners and managers of DM firms which have codified intangible assets that can be used in the Chinese market, outright sale of part or all of the firm to a Chinese company may also make financial sense. This may particularly be the case for sectors or regions where access to local resources is severely restricted for these technologies. Finally, when a DM firm is acquired, innovation at the firms in those countries is not significantly affected. Access to markets in China via CLRs, however, may be gained. This may, therefore, benefit shareholders by allowing their companies to attain increased returns and higher market valuations.

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## Appendix

*Appendix A: Extending the Chinese Patent Event Window to 16 Quarters*

| Chinese Acquiror Results | | | | | | |
|---|---|---|---|---|---|---|
| Quarters | CAAP | (t-stat) | GS+ | GS- | Pos:Neg | 95% Sig |
| Abnormal Patents Estimated using Mean Estimated Return--28 Events | | | | | | |
| 4 | 5.99* | (1.71) | 3.31*** | -2.88*** | 15:6* | 8***:0 |
| 4-5 | 13.63*** | (2.76) | 4.60*** | -4.01*** | 18:3*** | 11***:0 |
| 4-6 | 20.88*** | (3.45) | 5.03*** | -4.01*** | 19:3*** | 16***:0 |
| 4-7 | 26.26*** | (3.75) | 5.03*** | -4.01*** | 19:3*** | 16***:0 |
| 4-8 | 32.76*** | (4.19) | 5.89*** | -4.39*** | 21:2*** | 16***:0 |
| 4-9 | 40.72*** | (4.75) | 5.89*** | -4.39*** | 21:2*** | 16***:0 |
| 4-10 | 44.78*** | (4.84) | 6.32*** | -4.77*** | 22:1*** | 16***:0 |
| 4-11 | 52.31*** | (5.29) | 6.32*** | -4.39*** | 22:2*** | 16***:0 |
| 4-12 | 59.02*** | (5.62) | 6.75*** | -4.39*** | 23:2*** | 16***:0 |
| 4-13 | 65.12*** | (5.89) | 6.75*** | -4.39*** | 23:2*** | 16***:0 |
| 4-14 | 70.94*** | (6.11) | 6.75*** | -4.39*** | 23:2*** | 16***:0 |
| 4-15 | 76.93*** | (6.35) | 6.75*** | -4.39*** | 23:2*** | 17***:0 |
| 4-16 | 84.04*** | (6.66) | 6.75*** | -4.39*** | 23:2*** | 17***:0 |

****=p<.01 ; **=p<.05; *=p<.10*

*Estimation window ranges 0 to 12 quarters before merger*

*Appendix B: Event Study Results using Varying Event Windows for Foreign Patents*

| Foreign Target Results | | | | | | |
|---|---|---|---|---|---|---|
| Quarters | CAAP | (t-stat) | GS+ | GS-[#] | Pos:Neg | 95% Sig^ |
| Quarters 4 to 8 in Event Window--70 Events | | | | | | |
| 4 | -0.23 | (-0.43) | -2.18** | 1.70* | 5:39*** | 2:1 |
| 4-5 | -0.26 | (-0.35) | -1.23 | 1.22 | 8:37*** | 5*:3 |
| 4-6 | -0.47 | (-0.5) | -0.91 | 0.98 | 9:36*** | 3:3 |
| 4-7 | -0.71 | (-0.66) | -1.23 | 1.46 | 8:38*** | 3:3 |
| 4-8 | -0.79 | (-0.65) | -0.59 | 0.98 | 10:36*** | 3:6** |
| Quarters 6 to 10 in Event Window--58 Events | | | | | | |
| 6 | -0.27 | (-0.49) | -2.24** | 1.71* | 3:32*** | 1:00 |
| 6-7 | -0.50 | (-0.65) | -1.16 | 1.18 | 6:30*** | 1:02 |
| 6-8 | -0.53 | (-0.56) | -0.44 | 0.92 | 8:29*** | 1:04 |
| 6-9 | -0.65 | (-0.59) | -0.44 | 1.18 | 8:30*** | 1:5** |
| 6-10 | -0.95 | (-0.78) | -0.80 | 1.44 | 7:31*** | 1:6*** |
| Abnormal Patents Estimated using Mean Estimated Return--37 Events | | | | | | |
| 11 | -0.15 | (-0.40) | -0.90 | 0.94 | 3:20*** | 1:0 |
| 11-12 | -0.30 | (-0.57) | -0.41 | 0.61 | 4:19*** | 2:1 |
| 11-13 | -0.40 | (-0.62) | -0.41 | 0.61 | 4:19*** | 1:1 |
| 11-14 | -0.63 | (-0.85) | -0.41 | 0.61 | 4:19*** | 1:3* |
| 11-15 | -0.81 | (-0.97) | -0.41 | 0.61 | 4:19*** | 1:3* |

****=p<.01 ; **=p<.05; *=p<.10*

*Estimation window ranges 0 to 12 quarters before merger*

*# A negative t-statistic on the generalized sign test indicates the opposite of the sign in question. A negative t-statistic for the negative generalized sign test indicates that significantly less negative CAPs were observe than predicted—this indicates there were significantly more positive CAPs than predicted.*

*^ Denotes the number of events that are significant at the 95% level; both positive and negative (Positive:Negative)*

*Appendix C: Event Study Results Dropping Events in which Chinese Companies Acquired Multiple Firms*

| **Chinese Acquiror Results Keeping Multiple Event Companies** | | | | | | |
|---|---|---|---|---|---|---|
| Quarters[@] | CAAP | (t-stat) | GS+ | GS-[#] | Pos:Neg | 95% Sig^ |
| Abnormal Patents Estimated using Mean Estimated Return--49 Events | | | | | | |
| 4 | 8.69* | (1.81) | 5.98*** | -4.26*** | 30:10*** | 15***:0 |
| 4-5 | 15.84** | (2.34) | 7.31*** | -5.41*** | 34:6*** | 20***:1 |
| 4-6 | 25.27*** | (3.04) | 7.97*** | -5.41*** | 36:6*** | 26***:1 |
| 4-7 | 32.61*** | (3.4) | 7.97*** | -5.41*** | 36:6*** | 27***:0 |
| 4-8 | 39.95*** | (3.73) | 8.97*** | -5.69*** | 39:5*** | 28***:0 |
| **Chinese Aquiror Results Dropping Multiple Event Companies** | | | | | | |
| Quarters | CAAP | (t-stat) | GS+ | GS- | Pos:Neg | 95% Sig |
| Abnormal Patents Estimated using Mean Estimated Return--44 Events | | | | | | |
| 4 | 7.22* | (1.8) | 5.63*** | -3.83*** | 26:9*** | 13***:0 |
| 4-5 | 14.56** | (2.57) | 6.7*** | -4.73*** | 29:6*** | 18***:1 |
| 4-6 | 24.01*** | (3.46) | 7.41*** | -4.73*** | 31:6*** | 23***:1 |
| 4-7 | 30.87*** | (3.85) | 7.41*** | -4.73*** | 31:6*** | 23***:0 |
| 4-8 | 37.55*** | (4.19) | 8.48*** | -5.03*** | 34:5*** | 24***:0 |

****=p<.01 ; **=p<.05; *=p<.10*

*Estimation Window Rangers 0 to 12 quarters before merger*

*@ The event window begins 4 quarters after an event; the median time between application and approval for patents in China in our data. 4-7 indicates the cumulative abnormal patents from 4 quarters to 7 quarters after a merger is announced.*

*# A negative t-statistic on the generalized sign test indicates the opposite of the sign in question. A negative t-statistic for the negative generalized sign test indicates that significantly less negative CAPs were observe than predicted—this indicates there were significantly more positive CAPs than predicted.*

*^ Denotes the number of events that are significant at the 95% level; both positive and negative (Positive:Negative)*

*Appendix D: Event Study Results using Percentage Change in Patents*

| Foreign Target Results | | | | | | |
|---|---|---|---|---|---|---|
| Quarters[@] | CAAP | (t-stat) | GS+ | GS-[#] | Pos:Neg | 95% Sig^ |
| Abnormal Patents Estimated using Mean Estimated Return--70 Events | | | | | | |
| 4 | -0.12 | (-0.26) | -1.7* | 1.25 | 6:39*** | 1:0 |
| 4-5 | -0.05 | (-0.08) | 0.25 | 0.06 | 12:34*** | 4:0 |
| 4-6 | -0.17 | (-0.22) | 0.25 | 0.06 | 12:34*** | 0:0 |
| 4-7 | -0.27 | (-0.29) | -0.08 | 0.53 | 11:36*** | 1:0 |
| 4-8 | -0.25 | (-0.24) | 0.9 | -0.18 | 14:33*** | 0:0 |
| **Chinese Acquiror Results** | | | | | | |
| Quarters | CAAP | (t-stat) | GS+ | GS- | Pos:Neg | 95% Sig |
| Abnormal Patents Estimated using Mean Estimated Return--49 Events | | | | | | |
| 4 | -0.03 | (-0.02) | 1.96* | -1.08 | 17:22 | 3:01 |
| 4-5 | -0.05 | (-0.03) | 1.96* | -0.51 | 17:24 | 3:02 |
| 4-6 | 0.35 | -0.16 | 2.64** | -0.51 | 19:24 | 3:00 |
| 4-7 | 0.24 | -0.09 | 2.64** | -0.51 | 19:24 | 4:00 |
| 4-8 | 0.01 | 0 | 3.66*** | -0.79 | 22:23 | 3:00 |

****=p<.01 ; **=p<.05; *=p<.10*

*Estimation Window Rangers 0 to 12 quarters before merger*

*@ The event window begins 4 quarters after an event; the median time between application and approval for patents in China in our data. 4-7 indicates the cumulative abnormal patents from 4 quarters to 7 quarters after a merger is announced.*

*# A negative t-statistic on the generalized sign test indicates the opposite of the sign in question. A negative t-statistic for the negative generalized sign test indicates that significantly less negative CAPs were observe than predicted—this indicates there were significantly more positive CAPs than predicted.*

*^ Denotes the number of events that are significant at the 95% level; both positive and negative (Positive:Negative)*