

Cross-Regional Patenting A Signal of Enhancement for Innovation Competence or Market Entry?

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Abstract:

- Patenting at home country or foreign countries affects firm performance. Treating cross-regional patenting as a signal of innovation enhancement and a signal for multi-market competition, we investigate the impact of cross-regional patenting on a firm's overall performance and performance in a specific foreign market (the US).
- To meet the research purposes, this research collected a wide range of primary and secondary data of 164 Taiwan's manufacturing firms in the information and communication technology (ICT) sector.
- The findings suggest that if a firm has domestic and overseas patenting simultaneously (i.e., in Taiwan and the US), this cross-regional patenting can increase a firm's overall market performance but decrease its US market performance.
- This result implies that though cross-regional patenting may send a signal of multi-market competition in one overseas market, it also sends another signal of greater innovation competence to global vendors, which leads to a better overall market performance. This research also enriches current multi-market competition research by introducing the competition in factor markets.

Keywords: Cross-regional patenting · Technology protection · Firm market performance · Multi-point competition

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Introduction

Innovation has become increasingly important to international marketing academics and practitioners since firms tend to operate in a larger number of markets in recent years. The ability of multinational corporations (MNCs) to coordinate geographically diversified activities including research and development (R&D) or manufacturing activities has become an important issue in international business research (Cantwell 1995; Dunning 1993). This trend of specialization offers MNCs alternatives to outsourcing some of their products to manufacturing-oriented suppliers in other countries which enjoy lower production costs. However, MNCs normally request their contracting suppliers to patent their technologies or components for the end products in the MNCs' home countries or major markets (Blind et al. 2006; Harabi 1995; Levin et al. 1987). Thus, cross-regional patenting, a signal of enhancement for innovation competence, becomes an important criterion for supplier selection by MNCs.

However, once a supplier patents its technologies or components in a MNC's major market, it means that this supplier can produce the products for all MNCs in this market, which may intensify market competition. The increasing globalization of supply chain intensifies the need for cross-regional patenting activities. Thus, MNCs should be aware of whether the cross-regional patenting of their suppliers is requested by other competitors. This implies that perceiving the signal of cross-regional patenting by suppliers becomes increasingly important for MNCs to prevent potential competition from rivals.

Earlier studies regarding international competition mainly focus on how a firm with a multinational (Ghoshal and Bartlett 1990) or a global concern (Yip 1995) competes in international markets. The international competition strategy of a MNC is to leverage the firm's position or resources in one particular market to help gain advantage in other regional markets (Kogut 1985; Yip 1995). The MNC not only enjoys competitive advantage in global economy of scale in terms of manufacturing, supply procurement, or distribution, but also cross-subsidizes its operations in a wider range of regional markets. This stream of studies treats the multiple markets where the MNC participates in as an interrelated competitive arena (Ma 1998). However, these studies do not distinguish competition between firms in the developed countries and the emerging countries. Entry mode studies, another important stream of international business literatures, emphasize how competitive advantages (e.g., proprietary technological knowledge or a brand) originating in one country (normally in a developed country) can be efficiently exploited in other countries (normally in developed and/or emerging countries) (Dunning 1998). If the competitive assets or resources can be easily replicated internally by the MNC or acquired externally through arm-length markets locally, the MNC opts to internalize its operation in this host country. On the contrary, MNCs are inclined to conduct joint ventures or strategic alliances to acquire complementary assets, such as low-cost manufacturing capabilities, held by local business partners (Anderson and Gatignon 1986; Hennart 1988) if assets or resources are difficult replicated internally or acquired externally in the local market. However, this stream of studies implicitly assumes that the MNCs from the developed countries can compete in the emerging markets by leveraging competitive advantage developed in their home countries. Relative few studies pay attention to how the firms from emerging countries initiate the international competition in the developed

countries. In the past decade, an increasing number of firms from the emerging countries, such as Taiwan and China, have entered the markets in developed countries such as the US and Japan. For instance, Acer Computer Inc. and ASUSTek Computer Inc., two firms in Taiwan, have successfully transformed their businesses from manufacturing PCs for foreign branding clients to marketing their own branded products (i.e., Acer and Asus) in the home markets of their clients or in new foreign markets. Because these incumbent MNCs have already established strong market positions in their home markets, how can these Taiwanese firms overcome the challenges of building brand image in a final product in these countries (mainly developed countries)? We propose in the paper that investing in factor markets by these firms may offer an explanation on how firms from emerging countries can compete in developed countries.

Discussion regarding competition between firms in factor and product markets can be traced back to the concept of 'strategic factor market' introduced by Barney (1986). Barney (1986) argues that firms can obtain abnormal returns only if the cost of acquiring strategic resources is lower than the created economic value of those resources which are used to implement product market strategies. If a firm can access valuable resources in factor markets at lower costs than its competitor, the firm can sustain its competitive advantage. Prahalad and Hamel (1990) further assert that firms not only should compete with their rivals in final product markets but also in core products or core competences, which are composed of resources and skills. More recently, enhancing the theory of internalization, Chen (2005) assesses the importance of two factor markets (technology and manufacture markets) on the choice of governance structure by MNCs in foreign markets. He argues that the competition between firms in the technology market and manufacturing market may influence competition in a final product market. In fact, there is an increasing trend that international competition takes place between firms in the final product markets and the factor markets, particularly in intellectual property market. For instance, in 2006, the second largest LCD maker in the world, Korea's LG Display, accused the third largest LCD maker, a Taiwan's firm—AU Optronics Corp. (AUO), for patent infringement in the US. Few months later, AUO also accused LG Display for patent infringement. More recently, in March of 2010, Apple accused the largest Taiwan's smart phone maker HTC, for infringing patents in the US. Three months later, HTC also accused Apple for infringing patents. As can be seen in international business, an increasing number of competition takes place in factor markets instead of in product markets. The lawsuit of patent infringement is regarded as a weapon to delay or to restrict a rival's market entry or expansion. Therefore, there is an urgent need to investigate the cross-regional competition between firms in the factor markets (such as patented technologies).

This paper extends the existing multi-market competition studies by asserting that firms should be aware not only of the competition for the locations of marketing activities but also be aware of the locations of patenting activities. Firms should consider cross-regional patenting as a signal of market entry. Sociology and economics scholars have recognized the behaviors of firms in any single market as affected by the extent to which they meet competitors in other markets (Edwards, 1955; Simmel 1950). A majority of multi-market competition studies focus on the multiple geographic markets in a country (Chen 1996; Haveman and Nonnemaker 2000), on product markets (Klemperer 1992), and on international markets (Chen and Stucker 1997; Ma 1998; Watson 1982). Most of

the above studies emphasize the multi-market competition in terms of marketing activities (i.e., in product markets) instead of patenting activities (i.e., in factor markets). Thus, this paper will examine whether cross-regional patenting represents a signal of multi-market competition.

To meet the research purposes, this research collected a wide range of primary and secondary data of 164 Taiwan's manufacturing firms in the information and communication technology (ICT) sector. The empirical results show that if a firm has domestic and overseas patenting simultaneously (i.e., in Taiwan and the US), this cross-regional patenting can increase a firm's overall market performance but decrease its US market performance. The result implies that although cross-regional patenting sends a signal of market entry which leads to a decreasing sales in the market where the firm files patents, cross-regional patenting in a technology-leading market can send another signal that the firm has the ability to utilize new technologies or develop new products internationally, which in turn helps to increase a firm's overall market performance. Thus, firms can expand overseas by showing their enhancement for innovation competence in terms of cross-regional patenting even though this behaviour can generate operation risks because of the implication of multi-market competition in a specific foreign market.

After the introduction, we discuss the research hypotheses in section two. Section three describes the research methodology and section four shows the empirical findings. Section five discusses the findings and the last section concludes the paper.

Theoretical Background and Hypothesis Development

Cross-Regional Patenting and the Signal of Enhancement for Innovation Competence

International business studies regarding MNCs and innovation research focus on how geographical agglomeration of innovative activities take places globally (Almeida and Kogut 1997; Cantwell 1991; Feldman 1993) and how MNCs diversify their technological activities geographically (Almeida 1996; Cantwell 1995; Dunning 1993, 1996). Although some prior international business studies distinguish international patenting from domestic patenting, the majority of them evaluate how domestic patenting and international patenting affect the level of a country's innovation system and economic development (Eduardo Albuquerque 2000), a nation's foreign direct investment activities (Kondo and Scherer 1995; Penrose 1973), or MNCs' innovation activities (Almeida 1996; Cantwell 1995; Dunning 1993, 1996). For instance, Eduardo Albuquerque (2000) suggests that domestic patents can provide better explanations for innovation activities than can international patents by comparing Brazilian patents and US patents. Other international economic studies explore how patenting relates to productivity growth by investigating the source (domestic or foreign) of patent applications (Eaton and Kortum 1996; McCalman 2001). Although these studies suggests that domestic or international patenting may have different impacts on a national innovation system or national economic productivity in both developing or developed countries, none of them examine how patenting affects a firm's economic gains or market performance. In addition, these studies rarely investigate whether the impact differs for cross-regional patenting on a firm's performance in a host

market and on a firm's overall performance. In this paper, we address this issue by comparing the impact of domestic patenting and international patenting.

Domestic patenting can protect a firm's innovative technologies or products from its domestic competitors, which in turn protects its domestic market. Particularly, when a country retains a comparative advantage in production, domestic patenting can protect a firm's superior products or efficient production process from imitation by local competitors. As a result, firms with domestic patenting have a stronger competitive advantage either in differentiated products (production innovation) or in lower cost production (process innovation) over local competitors, which leads to increasing sales or market shares due to their abilities to offer attractive features and functions of products or lower prices to clients.

Hypothesis 1: The level of domestic patenting has a positive association with a firm's overall market performance.

While domestic patenting protects a firm's innovative technologies or products from its domestic competitors, cross-regional patenting may assist its entry to foreign markets. The main purpose of cross-regional patenting by firms is to protect the markets or licensing rights for the products and processes protected by patents (Penrose 1973). If a firm has less patent protection in a country, it would be easier for competitors to serve this country either by producing locally or importing from other countries. Moreover, protected technologies allow firms to enter markets in which require firms to have patented technologies or components in the end products (Blind et al. 2006; Harabi 1995; Levin et al. 1987). Thus, to protect their own interests, firms need to patent their products or processes in the countries which are either their major markets or their major production sites. As a result, a firm with more cross-regional patents has more opportunities to manufacture and sell its products globally, leading to higher levels of performance.

Hypothesis 2: The level of cross-regional patenting has a positive association with a firm's overall market performance.

Cross-Regional Patenting and the Signal of Multi-Market Competition

Nevertheless, the above research neglects a potential negative effect of international patenting from the perspective of multi-market competition (MMC) on firm market performance. Research in sociology and economics has shown that the extent to which firms meet competitors in any single market affects the behavior of the firms in other markets. Edwards (1955) proposes that multi-point contact among firms is conducive to mutual forbearance. While Edwards emphasizes that MMC can deter aggression, Simmel (1950) acknowledges that multi-point competition promotes the tit-for-tat exchange of dominance. This nature of competition covers a number of issues, such as 'linked oligopoly' (Bulow et al. 1985; Martinez 1990), 'fate interdependence' (Hughes and Oughton 1993), 'spheres-of-interest' agreements (Kantarelis and Veendorp 1988), 'mutual footholds' of rival firms, and 'mutual hostage' (Karnarni and Wernerfelt 1985). Previous research regarding multi-market competition mainly focuses on the multiple geographic markets in a country, such as in the airline industry (Chen 1996) and saving and loan industry (Have-

man and Nonnemaker 2000), on product markets (Klemperer 1992), and on international markets (Watson 1982; Chen and Stucker 1997; Ma 1998). However, these MMC studies in the context of international business mainly focus on explaining how international geographic market competition occurs (i.e., in product markets). None of the above studies attempt to analyze the multi-market competition in terms of location of patenting activities (i.e., in factor markets). Thus, this paper attempts to investigate whether activities in factor markets, specifically cross-regional patenting, can be a signal of MMC.

Mutual forbearance depends on an implicit assumption of familiarity among rivals (Jayachandran et al. 1999) as well as on the ability of firms to sense the market properly, recognizing who their competitors are and what competitor initiatives would likely be undertaken in response (Li and Greenwood 2004). Therefore, multi-market contact can raise tacit collusion among firms, if and only if firms can decode the messages embedded in each other's behaviors (Jayachandran et al. 1999). In this study, since Taiwanese information and communication technology firms are mainly suppliers of MNCs through OEM contracts, the familiarity between these Taiwanese firms and MNCs is relatively high. Thus, if a supplier attempts to patent its products or processes in an MNC's (its client) major market, this patenting activity sends a signal to the MNC that a potential competitive rivalry may arise due to potential new entrants supported by a new supplier (i.e., the MNC's supplier may offer its service to other firms intending to compete with the MNC in the market and this can be regarded as a competition in a factor markets), or even worse, the supplier may compete with the MNC directly in a product market (i.e., the supplier's own brand competes with the MNC's brand). As a result, cross-regional patenting by a firm sends a signal of market entry, which leads to MMC perceived by its clients, mainly MNCs.

Competitive rivalry research has differentiated two actions, strategic and tactical (Chen and Miller 1994; Ferrier 2001). Firms take tactical actions quickly and can change market shares while strategic actions take a longer time to carry out and have the ability to change the nature of the entire market development. In the context of this research, because most Taiwanese manufacturing firms are suppliers of MNCs, MNCs may tactically transfer their orders from the suppliers conducting cross-regional patenting to other firms. In addition, these MNCs enjoy higher bargaining power and incur lower switching costs because there are several alternative suppliers in Taiwan. The majority of MNCs also adopt a second-source policy which reduces their switching costs and risks if they would like to switch suppliers. As a result, MNCs in the ICT industry tend to stipulate a short period of time (normally less than a year) in supplying contracts since they can switch to other suppliers easily. Therefore, firms with cross-regional patents may lose orders from MNCs, especially for the orders in the countries important to these MNCs.

Based on the above discussion, though domestic patenting of a supplier reflects its improved capabilities to serve its multinational clients, cross-regional patenting is a signal of MMC to MNCs. Viewing by an MNC, the patenting behaviour of a supplier in a foreign country implies that the supplier may enter this particular country either by serving the competitors of the MNC or by marketing the supplier's products with its own brand name. This may lead to the cancellation of some orders by the MNC and thus lower

the performance of the supplier in this market. Therefore, we can derive two hypotheses related to cross-regional patenting and the market where the cross-regional patenting takes place as follows:

Hypothesis 3: The level of domestic patenting has a positive association with a firm's market performance in the overseas market where the firm files patents.

Hypothesis 4: The level of cross-regional patenting has a negative association with a firm's market performance in the overseas market where the firm files patents.

Research Method

Sample and Data Collection

The data used in the analysis were composed of primary and secondary data. The sample firms of this research were Taiwanese manufacturing firms in the information and communication technology (ICT) sector during 1996–2002. We chose the period because many Taiwanese ICT firms served MNCs by OEM contracts (Chen 2005) as well as the US market was the major market where these Taiwanese ICT firms served to these MNCs (Ministry of Economic Affairs 2010). We selected sample firms on the basis of the stock code compiled by the Taiwan Stock Exchange Corporation (TSEC) and the Over-The-Counter (OTC). The codes included 23, 24, and 30 in the TSEC and 53, 54, 61 and 80 in the OTC. In total 165 out of 415 firms replied to the survey and, after excluding one with incomplete data, the number of useable responses was 164, representing a 40% response rate.

The questionnaire was semi-structured, including both open and closed questions. The questionnaire asked respondents about the size of a firm, in terms of the total assets, and industry competition on a five-point Likert scale. For other variables, such as patent number, sales, and R&D intensity, we collected data from government publications by Ministry of Economic Affairs, Taiwan, R.O.C. and the United States Patent and Trademark Office (USPTO), as well as corporate financial statements released by firms gathered by the Securities & Futures Institute (SFI).

Construct Measurement

Independent Variables: Domestic Patenting and Cross-Regional Patenting

In this research, there are two independent variables, domestic patenting and cross-regional patenting. Domestic patenting was measured by the number of Taiwanese patent while cross-regional patenting was measured by the number of US patent. We chose patenting in the US instead of other regions in the world as our focused overseas market because the US firms held leading positions in the global ICT industry in the 1990s and early 2000s and the majority of Taiwanese firms, known as OEM suppliers, mainly sold

their products to these US firms. Focusing on a major overseas market also helped us to simplify the research design and to obtain more clear results from our research. Further, Taiwanese firms prefer to file patents in the US, the largest market in the world. Our data showed that, out of the 164 firms examined, 58 and 19 firms had patents in the US and Europe, respectively. Thus, we chose the US market as the major overseas market in this research. This research used the total number of applied patents between 1996 and 2002 as an indicator of patenting. Following the suggestion by Almeida and Phene (2004), we calculated the number of patents based on the application date rather than on the issue date since firms may have used such filed technologies or products in production as firms file the application for patents.

Dependent Variables

Traditionally, researchers use sales and market share to measure a firm's market performance (Amato and Wilder 2004; Grewal et al. 2001; Ravenscraft 1983; Rumelt 1991; Slade 2004). These two indicators highly correlate to each other and prior researchers have used them interchangeably. In this study, it was difficult to calculate market share for each idiosyncratic firm since firms varied from sector to sector. Thus, we used sales as an indicator of a firm's market performance. Considering a time lag between patenting activities and market performance, we set a one-year difference between the dependent variable and independent variables (or control variables). This research used the natural logarithm of a firm's two-year averaged sales during 2003 and 2004 to measure its overall market performance (164 observations) and the sales in the US to measure its overseas market performance (137 observations). The Kolmogorov-Smirnov tests suggested that the two dependent variables were normally distributed and multiple regression models were appropriate for our analysis.

Control Variable: Firm Size

Empirically, firm size has a positive impact on a firm's market performance (Amato and Wilder 2004; Freeman 1982; Henderson and Cockburn 1996; Porter 1980; Said et al. 2003). Therefore, we controlled firm size in this study. Economics and management studies use sales, total assets, or the number of employees interchangeably for measuring firm size (Shalit and Sankar 1977). In this study, we used a firm's total assets (the natural logarithm form) in 2002 to measure firm size (Hansen and Wernerfelt 1989). In order to avoid huge variance of the variable, we standardized it when using in the regression models.

Control Variable: Firm Innovation Capability

Because firm heterogeneity might have an impact on firm performance, we also controlled firm heterogeneity by using a firm's innovation capability. Innovation capability varies from one firm to another and has impact on a firm's leadership in the market (Fan 2006). To investigate the net effect of a patenting mechanism on market performance, we also controlled the effect of firm innovation capability on firm market performance. Hill

et al. (1992) suggest that the multiple-year average can smooth out annual fluctuations in the accounting data, such R&D intensity. Therefore, the measure of R&D intensity should be averaged over a multiple-year period, and in this study, a seven-year average, which was consistent with our sample selection, was employed. We used the seven-year average of R&D intensity (R&D expenditures as a percentage of sales) between 1996 and 2002 to measure a firm's innovation capability.

Control Variable: Industry Competition

Industrial competition, defined as the level of competitive intensity in an industry, is an important factor influencing a firm's market performance in prior studies (Porter 1980). An industry's competitive intensity may also affect a firm's innovative activity (such as patenting) (Aghion et al. 2006). Particularly, the extent of competitive rivalry in an industry may affect the degree of multi-market competition where a firm faces. Therefore, to test our hypotheses, controlling the impact of industrial competition is needed. The measurement was modified from Baker and Sinkula (1999) and Huang (2011). Industry competition was measured by a five-point Likert scale question, "Competition is intense in our product markets" with 1 indicating strongly disagree and 5 indicating strongly agree.

Analysis and Research Approach

Since R&D intensity (used as a proxy for firm innovation capability) typically influences patenting activity, both in the domestic market and international markets, leading to an issue of endogeneity and a bias in the coefficients on patenting in our analysis, we used a common econometric procedure proposed by Heckman (1978, 1979) to control this potential endogeneity bias. A two-stage Heckman procedure was employed to remedy the model misspecification. This approach re-estimates regression coefficients by introducing an adjustment term, named the inverse Mills ratios to the market performance model. We first estimated a first-stage probit model to specify a selection equation and then calculated the inverse Mills ratio, which was used as a control variable in the second-stage performance model (Leiblein et al. 2002; Shaver 1998). In this study, a control variable in the first-stage model, firm innovation capability, was used to predicting outcome variable, *any patenting action*, which was a dummy variable indicating whether the firm undertook any action of patenting (i.e., domestic patenting or cross-national patenting). Then, we entered the inverse Mills ratio into the second-stage regression model to remove any bias in the coefficients by accounting for endogeneity. An appropriate proxy of the inverse Mills ration requires that a variable is correlated with the first-stage probit model's outcome (i.e., any patenting action), but not with the second-stage performance model's outcome (i.e., market performance). Therefore, firm innovation capability was the instrumental variable entered in the first-stage model but not in the second-stage model.

In the second-stage regression model, there were one base model and three additional models in our multiple regression method. The base model was a baseline against which the added contribution of the variable could be estimated. We used the first base model to examine the relationship between market performance and control variables¹, includ-

ing firm size and industry competition, while used the second model to examine whether domestic patenting has an impact on firm market performance. We then used the third model to test whether domestic patenting and cross-regional patenting exert different impact on firm market performance.

Results

Descriptive Statistics and Correlations

Table 1 summarizes the descriptive statistics and correlation coefficients for our data set. We used Variance Inflation Factor (VIF) to examine whether multicollinearity was a problem in model estimation. Myers (1990) and Bowerman and O’Connell (1990) suggest that if the largest VIF is greater than 10 then there is cause for concern. In all of the models examined, the values of VIF for all independent variables are less than 10, suggesting that correlations among independent variables would not cause problems in our analysis.

As shown in Table 2, firm size is positively correlated to firm performance in all models. As for the impact of industry competition on firm performance, our findings were not in line with those of prior studies One possible explanation is that, due to confidential agreements between Taiwanese firms, as suppliers, and MNCs, as buyers, in OEM con-

Table 1: Descriptive statistics and correlation matrix

	Mean	S.D.	1	2	3	4	5	6	7
1. Overall market performance (2003–2004 averaged sales)	5,099,311	11,639,170	1.00						
2. US market performance (2003–2004 averaged sales)	1,782,434	7,330,450	0.77**	1.00					
3. Firm size (total assets in 2002)	8,123,693	18,926,357	0.81**	0.54**	1.00				
4. Firm innovation capability	5.31	8.08	-0.09	-0.10	-0.05	1.00			
5. Industry competition	2.88	0.75	-0.03	-0.08	-0.06	0.09	1.00		
6. Domestic patenting (number of taiwan patents, 1996–2002)	21.75	77.75	0.67**	0.57**	0.46**	-0.02	0.01	1.00	
7. Cross-regional patenting (number of US patents, 1996–2002)	3.29	12.09	0.53**	0.40**	0.51**	0.02	0.03	0.82**	1.00

N= 164

*p<0.05; **p<0.01; Correlations were examined by standardized variables. Means and variances were presented as the original figures of the variables

Table 2: Regression results: overall market performance^a

Exogenous variable	First-stage probit estimate of taking patenting action		Second-stage regression estimate of market performance					
	<i>Model 1</i>		<i>Model 2</i>		<i>Model 3</i>		<i>Model 4</i>	
<i>Control variables</i>								
Constant	2.44*** (26.16)							
Firm size	1.29*** (7.54)		0.61*** (9.74)		0.52*** (8.77)		0.52*** (8.93)	
Firm innovation capability	4.21*** (16.30)							
Industry competition	0.15 (0.44)		-0.06 (-0.96)		-0.07 (-1.18)		-0.07 (-1.24)	
LAMBDA (inverse Mills ratio)			0.01 (0.22)		0.02 (0.27)		0.01 (0.24)	
<i>Independent variables</i>								
Domestic patenting					0.34*** (5.68)		0.18* (1.79)	
Cross-regional patenting							0.19* (1.88)	
X or F-Value	142.55*** 32.326***		37.056***				30.817***	
Adjusted R ²	0.366		0.469				0.478	
			Δ0.103***				Δ0.009*	
			(Against Model 2)				(Against Model 3)	

*p<0.10; **p<0.05; ***p<0.01

^aDependent variable: Overall market performance (natural log of 2003–2004 averaged sales)

tracts, Taiwanese firms were not able to assess industry competition easily and clearly. Our survey result seemed to confirm this observation—the mean of industry competition was only 2.88 (out of 5)—suggesting that the sample firms in our research perceived relatively gentle industry competition and thus might be less concerned with competition which led to no impact of industry competition on firm market performance.

Cross-Regional Patenting and Firm Overall Market Performance

Model 1 presents the results of the first-stage probit model while Models 2, 3, and 4, show the second-stage estimation results (Table 2). LAMBDA in Models 2, 3, and 4 represents the inverse Mills ratio. Model 2 explains 36.6% of the variance (Adjusted R²=0.366) in firm overall market performance and Model 3 explains 46.9% of the variance. The additional explanatory power of Model 3 (ΔR²=0.103, p<0.01) suggests the significant

contribution of the added independent variable in explaining firm performance. As predicted, domestic patenting has a positive association with firm overall market performance ($b=0.34, p<0.01$).

Model 4 explains 47.8% of the variance in firm overall market performance and the change of R^2 between Models 3 and 4 is significant (ΔR^2 is 0.009, $p<0.10$). Consistent with Hypotheses 1 and 2, domestic patenting has a positive correlation with overall market performance ($b=0.18, p<0.10$) and cross-regional patenting also has a positive association with firm overall market performance ($b=0.19, p<0.10$). These results suggest that patenting in the home market (Taiwan in this study) and a foreign market (the US market in this study) help firms to increase overall market performance. The above findings imply that a firm's domestic patenting and cross-regional patenting are signals of competence enhancement to MNCs, which lead to suppliers' better overall market performance.

Cross-Regional Patenting and US Market Performance

To further investigate whether cross-regional patenting of Taiwanese firms in the US has an impact on a firm's US market performance, this study employed the same multiple regression approach except that the dependent variable was a firm's US market performance. Model 5 presents the results of the first-stage probit model while Models 6, 7, and 8, show the second-stage estimation results (Table 3). LAMBDA in Models 6, 7, and 8 represents the inverse Mills ratio. Model 6 explains 10.4% of the variance (Adjusted $R^2=0.104$) in US market performance and Model 7 explains 30.7% of the variance. The additional explanatory power of Model 7 ($\Delta R^2=0.203, p<0.01$) and Model 8 (ΔR^2 is 0.023, $p<0.05$) suggests the significant contribution of the added independent variable in explaining US market performance. Model 8 shows that, when evaluated simultaneously, domestic patenting illustrates a positive relationship with the US market performance ($b=0.71, p<0.01$) and cross-regional patenting a negative relationship with the US market performance ($b=-0.30, p<0.05$). The findings support both Hypotheses 3 and 4 and imply that MMC was perceived by MNCs in the US market.

Discussion

Patenting is a critical source of a firm's performance. Previous studies have concluded that the level of a technology protection mechanism has a positive association with firm market performance (Ernst 2001; Rivette and Kline 2000). The result of this research is also consistent with previous findings, suggesting that the extent to which firms successfully deliver new products to the market may have a significant impact on firm performance (De Carolis and Deeds 1999; Roberts 1999). If innovating firms do not adopt any protection for their innovated products or technologies, then their monopoly position may diminish as competitors imitate. With better protection, firms are able to sustain their competitive position and appropriate the rents from innovative products or technologies.

The findings in this research suggest that cross-regional patenting not only can protect the markets or licensing rights for the products and processes protected by the patents

Table 3: Regression results: US market performance^a

Exogenous variable	First-stage probit estimate of taking patenting action		Second-stage regression estimate of market performance					
	<i>Model 5</i>		<i>Model 6</i>		<i>Model 7</i>		<i>Model 8</i>	
<i>Control variables</i>								
Constant	2.44*** (26.16)							
Firm size	1.29**	(7.54)	0.34***	(4.28)	0.22***	(3.08)	0.22***	(3.09)
Firm innovation capability	4.21*** (16.30)							
Industry competition	0.15	(0.44)	-0.05	(-0.52)	-0.05	(-0.76)	-0.05	(-0.67)
LAMBDA (inverse Mills ratio)			-0.01	(-0.07)	-0.00	(-0.04)	0.00	(0.02)
<i>Independent variables</i>								
Domestic patenting					0.47***	(6.45)	0.71***	(5.75)
Cross-regional patenting							-0.30**	(-2.41)
X or F-Value	142.55***		6.484***		16.700***		14.993***	
Adjusted R ²			0.104		0.307		0.330	
					Δ0.203***		Δ0.023**	
					(Against Model 6)		(Against Model 7)	

N= 137

*p<0.10; **p<0.05; ***p<0.01

^aDependent variable: US market performance (natural log of 2003–2004 averaged sales)

(Penrose 1973) but also can allow firms to enter more markets which require firms to have patented technologies or components for the end products (Blind et al. 2006; Harabi 1995; Levin et al. 1987). When firms expand into foreign markets, cross-regional patenting provides the protection of their new technologies or products, which in turn helps to increase their performance; with the possession of patents in a foreign market, firms are more likely to acquire the procurement orders from MNCs intending to serve the foreign market. Therefore, the positive effect of cross-regional patenting, just like that of domestic patenting, may represent a signal of enhancement for innovation competence which increases a firm’s overall market performance.

Furthermore, the findings of this research also support that there is a negative effect of cross-regional patenting on a firm’s market performance in their foreign buyers’ major markets. If a Taiwanese firm patents its products or technologies in the US, this behaviour may send a signal to its clients, which usually are MNCs with operations in the US, that a potential competitive rivalry may arise in the US due to new entrants supported by this Taiwanese suppliers or the Taiwanese firm’s own market entry. When these MNCs sense

the cross-regional patenting actions by its Taiwanese suppliers, they may take competitive responses, such as cancelling some orders to the supplier (Jayachandran et al. 1999; Li and Greenwood 2004). As a result, cross-regional patenting by Taiwanese firms represents a signal of market entry, which leads to MMC perceived by MNCs. This means that if Taiwan's manufacturing firms extend their patenting activity to the US, they may provoke competitive responses from some MNCs (Chen and Miller 1994; Ferrier 2001), such as reducing the procurements to these Taiwanese firms. Thus, cross-regional patenting, seen as a signal of market entry, may decrease a firm's market performance in MNCs' major markets due to MMC. The above discussion also brings in a context issue—we were looking at firms from an emerging country, which file patents (i.e., a factor) in a developed country, and this behaviour has MMC implications for their clients (MNCs) with operations in this developed country.

International multi-market competition (MMC), defined as that firms from both developed countries and emerging countries compete their products at each others' markets, has been well studied by prior research (Watson 1982; Chen and Stucker 1997; Ma 1998). However, these studies mainly focus on how MNCs attack each other's markets in the developed countries, but rarely reflect the fact that an increasing number of multinational firms from emerging countries, such as Acer from Taiwan, enter the markets in developed countries. Thus, our results provide insights for the international business researchers that international MMC should be taken into consideration of both factor markets and product markets among MNCs from both developed and emerging countries.

To summarize, from the perspective of clients, MMC does exist in the US market if their suppliers file patents in the US. Our finding supplements the MMC research by adding competition on factor markets. The signal of possible entry in the factor market will also result in responses by competitors, suggesting that MMC takes place not only in geographic markets or product markets but also in factor markets.

Our findings imply that though cross-regional patenting decreases a firm's US market performance due to MMC, cross-regional patenting perceived as innovation competence enhancement can also increase a firm's overall market performance. Because the signal of enhancement for innovation competence by cross-regional patenting is more critical than the signal of MMC, firms should file patents in major markets where either their potential clients or they are thinking of entering. We thus postulate that efforts devoted to factor markets may be a possible answer to explain why firms from emerging countries can compete with their incumbent rivals in developed countries.

Conclusion

This study helps us to revisit the theories of cross-regional patenting, innovation competence, and multi-market competition, and provides empirical evidences for examining such concepts. Prior multi-market competition studies mainly focus on multiple geographic markets in a country (Chen 1996; Haveman and Nonnemaker 2000), on product markets (Klemperer 1992), and on international markets (Chen and Stucker 1997; Ma 1998; Watson 1982). This research suggests the multi-market competition also exist in

factor markets, such as patents in this study. This paper augments existing multi-point competition studies by asserting that MNCs not only should be aware of the competition for the locations of product markets but also be aware of the suppliers' patenting (a factor) locations. When suppliers engage in cross-regional patenting, they should be aware that this can be regarded as a significant signal of market entry, which may negatively affect their market performance in where they file patents. However, firms should not overlook the drawbacks of cross-regional patenting. Functioning as a signal of enhancement for innovation competence, cross-regional patenting exerts a positive impact on a firm's overall market performance though a negative impact in the country where it file patents. This suggests that when a firm expands into foreign markets, cross-regional patenting does provide the mechanism of innovation appropriability leading to improved overall performance.

For business practitioners, this paper provides some implications. First, multiple-market competition not only arises in product markets but also in factor markets, such as patents. When assessing threats from competitors, firms not only need to monitor their activities in product markets and geographical markets, but also in factor markets. Their suppliers' cross-regional patenting activities, for examples, may be evaluated from the perspective of MMC. Second, for a supplier, though there is a risk for losing market share in a host market where it files patents, the signal of its innovative capability will eventually lead to better performance in global markets. Finally, patenting, either at home country or abroad, positively affects firm performance and firms should devote resources to R & D activities in light of the increasing challenging in international business arena.

One limitation of this research is the measure for patenting. To examine the effect of patenting on performance, we should compare the effect of patenting on performance for a given piece of patented technology with that on performance for a given piece of technology without patenting. However, emphasizing a piece of technology has some difficulties. Since each firm has its unique development of technologies, it is difficult to compare a large number of sample firms for a given type of technology. Thus, we used the number of patents as a proxy for patent protection. Moreover, there is a possible causality issue between domestic patenting and cross-regional patenting decisions. Patenting in the domestic market may influence the decision of patenting in foreign markets. However, as shown in Table 1, the mean of the number of domestic patents was five times more than that of the number of cross-regional patents. This means that not every firm with domestic patents applies for patents abroad, possibly due to high costs for filing international patents². Moreover, our data show that 33.5% firms (55 out of 164) had patents in the domestic market and foreign markets³. The relatively low percentage of the sample firms having both domestic and cross-regional patents deserves investigation in future studies.

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Endnotes

- 1 Since the samples in our research were mainly manufacturing firms (i.e., OEM suppliers), the manufacturing-oriented characteristic makes them conducting less marketing/advertising expenses. Thus, we held the assumption that the sales of manufacturing firms may not be influenced by marketing/advertising expenses. However, for clarifying this point, we still ran the regression models by controlling marketing/advertising expenses as a percentage of sales between 1996 and 2002. The results were almost identical for controlling and not controlling marketing/advertising expenses. Moreover, the marketing/advertising expenses were not significantly correlated to a firm's market performance. This supports our assumption that marketing/advertising expenses do not have direct impact on a manufacturing-oriented firm's sales. Thus, we did not add this control variable (i.e., marketing/advertising expenses) into this research.
- 2 According to USPTO and Taiwan PTO, the file fees for innovation patent are US\$ 1,000 for one US patent and US\$ 380 for one Taiwan's patent.
- 3 In our study, 39.7% of the sample firms applied patents only in one region (either in Taiwan or in the US) while 26.8% of the firms did not apply patents in both regions.

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