INNOVATION STRATEGY AND FIRM SURVIVAL: THE CASE OF HONG KONG-OWNED MANUFACTURING IN GUANGDONG PROVINCE, CHINA

by

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Based on a survey adapted from the Fourth European Community Innovation Survey (CIS-4), this study finds that, in the changing manufacturing environment of Guangdong province in China, Hong Kong-owned businesses that engage in R&D or collaborative innovation activities in China are more likely to survive and remain in Guangdong. The study fills a gap in the literature as the first to study the effects of innovation on survival of Hong Kong-invested firms in the emerging economy of Guangdong, and the results support policy initiatives that strengthen collaborative ties among key innovation system actors.

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1. Introduction

Among developing countries, The People's Republic of China (hereinafter "Mainland China") indisputably has attracted the most Foreign Direct Investment (FDI) over the past two decades. Of Mainland China's total FDI over the 1985–2003 period, 30 percent went into Guangdong Province (hereafter "Guangdong") in southern China, in large part because of its geographical and cultural proximity to Hong Kong. An overwhelming 90 percent of FDI in Guangdong was invested by entrepreneurs from Hong Kong in 1985 and, although the ratio fluctuated in the second half of the 1980s and decreased steadily after the mid 1990s, even as recently as 2008 as much as 55 percent of FDI in Guangdong still came from Hong Kong. From Hong Kong's perspective, then, Guangdong is the most important investment destination in Mainland China. Since the mid 1990s, Hong Kong-based entrepreneurs have channeled as much as half of their total investments in Mainland China into Guangdong.

In the 1980s and 1990s, many firms in Hong Kong shifted from manufacturing to trading, turning manufacturing firms into service providers. Many entrepreneurs in Hong Kong in fact do both: They operate as traders in Hong Kong and as proprietors of or partners in plant facilities in Mainland China. The import/export firms in Hong Kong operated by these entrepreneurs import goods from their factories in Mainland China and subsequently re-export those goods to the rest of the world. Following this business model, Hong Kong entrepreneurs have successfully reduced their manufacturing costs by leveraging their access to the abundant, and relatively cheaper, labor and land resources in Mainland China. According to Hong Kong Census and Statistics Department figures (2007), there were 12,535 manufacturing firms registered in Hong Kong in 2007, but 15,798 import/export firms in Hong Kong

engaged in manufacturing-related activities using subcontractors in Mainland China. In a study by the Federation of Hong Kong Industries (2003), the number of companies in Mainland China owned and controlled by Hong Kong businesses is estimated to range between 50,000 and 60,000 in 2002, and these manufacturing firms are estimated to employ approximately 447,000 and 11 million workers in Hong Kong and Mainland China, respectively.

The Guangdong manufacturing environment has, however, been changing dramatically of late. This has affected both Hong Kong manufacturing firms and indigenous Guangdong firms. Since mid-2007, Hong Kong manufacturers have found themselves increasingly forced either to shut down or to move their production plants out of Guangdong. This shakeup in industrial activity has been caused by the combined effects of unfavorable central government policies that have penalized low-end and low-cost manufacturing, a stronger Yuan, escalating raw materials prices, stringent pollution control requirements in Guangdong, cancellation and reduction of tax refunds for low-end processed exports (tax rebate cuts), and the introduction of welfare benefits for employees (such as annual leave and medical coverage). These challenging business conditions have squeezed thousands of firms operating in typically labor-intensive, highly polluting industries—such as leather tanning, shoe making, and textile and garment production—most of which have been and continue to be run by Hong Kong-based entrepreneurs. Unless these entrepreneurs, who control a sizeable portion of low-end manufacturing in Guangdong, can develop new strategies—to somehow move up the value chain—they will find it difficult to survive, dramatically undermining Hong Kong's manufacturing-related service-based economy.

In such a changing environment, innovation is often the key to success. In this paper, then, we study the relationship between innovation activities and the decision to stay or move out on the part of Hong Kong-owned manufacturing firms in Guangdong. We tested this relationship by conducting an innovation survey, administered from March to September 2008, to 492 Hong Kong firms with manufacturing operations in Guangdong. The survey instrument was adapted from the Fourth European Community Innovation Survey (CIS-4), which itself conforms to the Organization for Economic Co-operation and Development's (OECD) Oslo Manual and provides the analytical framework for our study.

The remainder of the paper is structured as follows. In sections 2 and 3 we review past studies on cross-border investment between Hong Kong and Guangdong that examine the impact of innovative activities on firm survival. Section 4 introduces the survey and the data. Section 5 presents our econometric analysis and results. Section 6 concludes the paper, suggesting some policy implications.

2. Cross-border Investment Between Hong Kong and Guangdong

The roots of Hong Kong manufacturing can be traced to the opportunistic exploitation of a geographic area by Mainland Chinese immigrants, particularly textile barons from Shanghai (fleeing the Communist regime), who transferred start-up capital and managerial expertise to the territory (Wong, 1988; Hollows, 1999). Over time, however, as Hong Kong manufacturers faced limits on low-cost manufacturing in the 1970s, they found an escape route for their manufacturing industries in the opening-up of Mainland China that began in 1979 (leading to cheaper land and labor resource costs).

Guangdong attracted FDI, particularly from Hong Kong, because it offered several competitive advantages. First, several areas within Guangdong were designated as Special Economic Zones, in which the province exercised substantial legal and economic authority to manage FDI and trade, and in which it could provide incentives and supporting facilities to attract and encourage investment in the area (Zhang, 1994). Second, Mainland Chinese economic reforms provided Guangdong with strong incentives to encourage export-driven development. Among these incentives, the province was allowed to retain a much higher percentage of earnings resulting from exports, as opposed to non-export driven earnings, from which Guangdong had to send a significant portion of its tax revenue to the central government. Third, Guangdong was given greater leeway in managing its own macroeconomic policy, as a result of which it was able to set wages and prices, operate organizations in foreign countries to attract investment, and determine local banking regulations.

Feenstra and Hanson (2004) contended that Hong Kong import and export firms with manufacturing-related operations enjoyed an information advantage in trade between Mainland China and the rest of the world by specializing in finding Mainland Chinese producers who could meet foreign quality standards and in locating buyers for Mainland Chinese goods. Naughton (1999) suggested that Hong Kong firms enjoyed a similar advantage in "property rights arbitrage": They used their specific knowledge of business conditions in Mainland China and the security of property rights in Hong Kong to broker deals with agents who seek access to Mainland China's market and are wary about the security of its property rights regime.

Although Guangdong is adjacent to Hong Kong, geographical proximity per se is not the major element in Guangdong's border advantage for Hong Kong; other

provinces are not far away. Rather, ethnic (i.e., cultural and linguistic) familiarity, reinforced through investment and encouraged by national, provincial, and local policies, has been the more important feature attracting Hong Kong firms to Guangdong (Womack & Zhao, 1994). The Guangdong people, influenced heavily in terms of consumer tastes, orientation, and outlook by Hong Kong, sits between two former empires—Britain and Mainland China—and at the center of an increasingly transnational and diasporic world economy. Hong Kong offers those in Guangdong a model of how to be both Chinese and modern, a model that many in Guangdong adopt with relish (Smart & Smart, 1998, 1999).

The close relationship between Hong Kong and Guangdong includes the creation through investment by Hong Kong firms in Guangdong of an integrated manufacturing sector (Sit, 1999; Chen and Ho, 1994; Enright, et al, 2005; Goodman & Feng, 1994; Johnson, 1994, 1997; Shen, 2003; Sung, 1991; Tsang & Ma, 2000). As observed by Enright et al. (2005), such manufacturing integration is facilitated by the large number of Hong Kong-owned manufacturing companies in the province and the aforementioned cultural affinities between Hong Kong and Guangdong. Such integration is also supported by an industrial market for inputs, materials, and capital goods, a major market for transportation and trade-related services, rapid urbanization, burgeoning city populations, an influx of just over one-third of the total foreign direct investment to Mainland China, a transportation and logistics hub, and a highly attractive consumer market.[1]

Despite an extensive body of literature on economic linkages and cross-border investment between Mainland China and Hong Kong, very few studies—including two undertaken by the Federation of Hong Kong Industries (2003, 2007) and another by Huang and Sharif (2009)—focus on innovation activities of Hong Kong-owned

manufacturing firms in Guangdong. Even fewer studies have linked the innovation patterns of these Hong Kong-owned manufacturing firms to their survival and development across the border. Because this activity has helped to forge strong economic ties between Mainland China and Hong Kong and transform the region into a manufacturing powerhouse in Southern China, this is a noteworthy gap in the literature. This study attempts to close this gap by surveying Hong Kong-owned manufacturing firms in Guangdong to analyze their innovation and business strategy and investigate the impact of innovation on their survival and development in Mainland China.

3. Innovation as a Pre-Requisite for Firm Survival

Schumpeter (1942: 84) argued that innovation plays a key role in firm survival by "[striking] not at the margins of the profits and the outputs of the existing firms but at their foundations and their very lives." This view has been endorsed more recently by Baumol (2002: 1): "Under capitalism, innovative activity . . . becomes mandatory, a life-and-death matter for the firm . . . innovation has replaced price as the name of the game in a number of important industries." Given the importance of innovation, there have been many studies of firm survival and industry dynamics related to innovative activity (cf. Audretsch, 1991, 1995; Agarwal & Gort 2002; Klepper & Simons 1997). Such studies suggest that innovation is the essence of firm survival since only firms that innovate successfully establish and maintain a competitive advantage in the marketplace (Bruderl et al. 1992). Christensen et al. (1998) showed that the combination of technological and market strategies is an important predictor of firm survival, while Cefis and Marsili (2005) found an *innovation premium* in

virtue of which the expected survival time of an innovative firm is about 11 percent higher than that of a non-innovative firm.

Additional studies have found that innovation can play an important role in shaping firm survival that varies with time of market entry. Innovation may increase the survival chances for new firms by providing successful niche strategies. Technological change threatens established firms (Utterback & Abernathy 1975, Gort & Kelpper 1982), but innovation activity enables such firms to deal with emerging or 'disruptive' technologies while continuously improving existing capabilities (Banbury & Mitchell 1995; Christensen 1997).

Studies linking survival and innovation have often focused on innovation inputs such as R&D investment (Perez et al. 2004; Lin & Huang, 2008; Fontana and Nesta, 2009) and technology use (Doms et al., 1995). Perez et al. (2004), Lin and Huang (2008), and Fontana and Nesta (2009) all suggested that higher R&D intensity implies higher innovation opportunity, thus improving the survival prospects for new firms. Doms et al. (1995) indicated that manufacturing plants employing more advanced technologies grow faster and are less likely to fail. Innovation output such as patents also affect firm survival; Wagner and Cockburn (2010) found that recent internet-related IPO firms were more likely to survive if they held registered patents, after controlling for age, sales, venture-capital backing, financial characteristics and so on.

In this paper we add a valuable perspective on the activities of foreign-owned firms in emerging economies to this stream in the literature with our focus on Hong Kong-owned manufacturing firms in Guangdong. Using the CIS-4 survey questionnaire, we differentiate the role of product innovation in firm survival from that of process, organization, and marketing innovation. We also link the odds of

surviving in a host region (here, Guangdong) to R&D and collaborative innovation activities on the part of foreign firms (here, Hong Kong-owned manufacturing firms in Mainland China). We consider such activities as indicative of the integration of foreign firms into a local economy, as we demonstrate the extent to which such integration determines firm survival rates in Guangdong.

4. Survey and Data

To study the effects of innovation strategies adopted by Hong Kong-owned manufacturing firms in Guangdong on their survival under challenging market and environmental pressures, we conducted an innovation survey by using the questionnaire of the Fourth European Community Innovation Survey (CIS-4).[2] We encountered enormous difficulty in so doing because there is no available registry of Hong Kong-owned manufacturing firms in Guangdong. It is therefore impossible to conduct a random sampling of the population, let alone employ more sophisticated stratified sampling techniques. Moreover, it is difficult to convince Hong Kong companies to disclose sensitive information such as annual turnover, employment numbers, and R&D expenditures in a privately run survey. Nevertheless, with the assistance of the Chinese Manufacturers' Association (CMA) of Hong Kong, we surveyed the members of the Association (as well as other firms) between March and September 2008 through phone-based and face-to-face interviews.

Established in 1934, the CMA is one of the oldest and most representative industrial associations in Hong Kong, with over 3,700 member-companies from various industry and trade sectors. The ordinary members of the CMA members either are registered as factories in Hong Kong or operate factories outside of Hong Kong. The directory provided detailed information, including every company's contacts and

major product lines as well as ownership/organization status, which greatly assisted our identification of target companies. We selected 2,300 companies from the list that operated both offices in Hong Kong and manufacturing facilities in Guangdong. To broaden the sampling frame, we also used personal networks to identify an additional 870 Hong Kong firms with manufacturing facilities in Guangdong. The sampling frame therefore ultimately comprised 3,170 Hong Kong firms with ownership of manufacturing facilities in Guangdong. We collected 492 valid questionnaires from these firms. The response rate was 15 percent. All survey respondents were required to state the addresses of their offices in Hong Kong and their manufacturing facilities in Guangdong, to verify the authenticity of the responses.

With 98 percent of firms in Hong Kong classified as small-to-medium-sized enterprises (SMEs), senior management not only centralizes decision-making when deploying design and productive resources for new product lines, but also manages all product development processes (Berger & Lester, 1997; Enright et al., 1997; HKTDC, 1998). For this reason, the targeted respondents most likely to be knowledgeable enough to be able to fill out the questionnaires in this study were presidents, general managers, or other senior managers. Indeed, 86 percent of the respondents were high-ranking managers whose titles were “manager,” “director,” “CEO,” “member of the board,” etc.

As per the CIS-4 questionnaire, the firms were asked questions about product and process innovation, innovation activities and expenditures, ongoing and abandoned innovation activities, sources of information and co-operation related to innovation activities, intellectual property rights, organizational and marketing innovations, and basic economic information. We added two additional questions, which were used to collect information about the firms’ R&D or collaborative

innovation activities in Mainland China and their plans for moving manufacturing operations out of Guangdong (if such plans exist). These two additional questions were devised and pilot-tested after discussions with senior industry managers.

Seventy-five percent of the firms in our sample fall into the manufacturing sector and 11 percent belong to the wholesale, retail and import/export trade, and restaurant and hotel sectors (Table 1). A further breakdown of the manufacturing firms shows that the top five manufacturing sectors, to which more than half of the firms in the sample belong, are wearing apparel, textiles, plastic products, fabricated metal products, and electronic parts and components (Table 2). About half of the surveyed firms in our sample employed more than 250 staff in Hong Kong and Guangdong combined (Table 3). These are labor-intensive operations, reflecting the motivation for Hong Kong-owned manufacturing firms to move and expand their manufacturing operations to Guangdong to take advantage of the low cost of labor and land there.

[Insert Table 1 here]
[Insert Table 2 here]
[Insert Table 3 here]

We identified two bodies of evidence by reference to which we evaluated the quality of our survey exercise. The first, which is similar to ours, consists of two survey studies sponsored by the Federation of Hong Kong Industries and conducted in the periods of 2002–2003 and 2005–2006, respectively, which resulted in two reports published under the titles “Made in PRD—The Changing Face of HK Manufacturers” and “Made in PRD—Challenges and Opportunities for HK Industry,” respectively (Federation of Hong Kong, 2003 and 2007). In the 2005–2006 study, the survey was conducted by the Guangdong Bureau of Statistics. In that survey, 5,030 Hong Kong-

owned manufacturing firms and Guangdong domestic companies whose shares were partially held by Hong Kong-owned manufacturing firms were contacted. The response rate was 75 percent. The shares of the top 10 sectors measured by the number of firms in the survey sample are very similar to the corresponding shares in our sample (Table 2).

The second reference is the *Report on the 2007 Annual Survey of Industrial Production* published by the Census and Statistics Department of the Hong Kong government (Census and Statistics Department, 2007). According to the Census and Statistics Department, manufacturing establishments in Hong Kong can be classified into two categories: manufacturing firms and import/export firms which use subcontractors in Mainland China, including their manufacturing-related technical support services. The former accounted for 44 percent of all establishments engaged in manufacturing, while the latter accounted for 56 percent (Census and Statistics Department, 2007, Table 2). This information explains why, in our sample of Hong Kong-owned firms with manufacturing activities in Guangdong, 11 percent fall into the import/export sector.

To further verify the appropriateness of the samples, we also conducted t-tests to verify that there was no statistically significant difference between the samples obtained from the CMA directory and those obtained from our personal network in terms of company profile, modes of innovation, innovation activities, and turnover. We also conducted a test to determine if significant differences existed between early and late respondents in terms of variables relevant to the research hypotheses (Armstrong & Overton, 1977). The average values of items from the first 10 percent of the respondents were compared with those from the last 10 percent, using t-tests.

The results indicated that the means for the items across the two groups are not statistically significantly different.

5. Model and Econometric Analyses

5.1 Baseline model

The central research question in this study is whether innovation activities undertaken by Hong Kong-owned manufacturing firms would help them survive and thrive in the challenging market environment of Guangdong. We therefore carried out our analysis based on analyzing the following baseline model:

(1) *(Moving out of Guangdong) = f {[(R&D or innovation collaboration in Mainland China) or (New product share)], (Firm growth), (Public financial support for innovation activities from Hong Kong and Guangdong governments), (Public financial support for innovation activities from central government in Mainland China), (Sector dummies)}*

In equation (1), moving out of Guangdong is a binary variable that indicates whether a firm expected cut back its manufacturing operations in Guangdong, considered as a proportion of its total manufacturing operations in Mainland China, decrease in the two years following the survey (i.e., 2009–2010). R&D or innovation collaboration in Mainland China is a binary variable that is constructed based on "yes" or "no" answers to the question whether or not a firm had undertaken R&D or innovation collaboration in Mainland China during 2006–2007. New product share is a censored variable whose value ranges from 0 to 100. It is defined as the percentage of a firm's total turnover in 2007 in new-to-market or new-to-firm products. These two variables—R&D or innovation collaboration in Mainland China and new product share—are proxies for innovation activities on the part of Hong Kong-owned manufacturing firms. Because the dependent variable depended on a firm's plan for the 2009–2010 period, while the innovation proxies cover the observation period of

2006–2007, we were able to rule out, to a great extent, reverse causality running from the dependent variable to the independent variables. In other words, we avoided a case in which a firm undertakes no R&D or innovation collaboration in Mainland China because of plans to relocate its operations out of Guangdong.

Following Cefis and Marsili (2005) and Audretsch (1991, 1995), we suspect that, if a firm achieved rapid growth in the observation period, it would be unlikely to move its operations out of Guangdong or to close down those operations. Moreover, if a Hong Kong-owned manufacturing firm received public financial support for its innovation activities from the Guangdong government or the central government in Mainland China, it would probably choose not to relocate its business elsewhere. We test these hypotheses by adding three corresponding control variables into the equation. We also add seven sector dummies to control for the presence of firms in the apparel, textiles, plastic products, fabricated metal products, electronic parts and components, import/export, and business service sectors. The firms that belong to each of these seven sectors account for over 5 percent of the total sample share. The definitions of all variables are presented in Table 4.

[Insert Table 4 here]

The estimation of the baseline model shows that the innovation activities of Hong Kong-owned manufacturing firms in Guangdong contributed to their decisions not to relocate (Table 5). The coefficients of the two innovation proxies are statistically significant and negative. Firm growth and public financial support for innovation from the Guangdong provincial or central government in Mainland China has no material impact on relocation decisions. The coefficients of the sector dummies demonstrate that firms in the textile sector are more likely than other types

of firms to move their operations out of Guangdong. Because textiles is a labor-intensive industry, it would be most heavily affected by the challenging market and environmental pressures in Guangdong, such as rising costs, a stronger Yuan, escalating raw materials prices, and so on. The results shows that, in contrast, firms in the business service sector are the least likely to move operations out of Guangdong.

5.2 Endogeneity bias in the baseline model

A careful examination of the two innovation proxies reveals that they are likely to be endogenous in the baseline model. For instance, a firm's managerial capability might simultaneously determine both its decision to move out of Guangdong and its decision to engage in R&D or innovation collaboration in Mainland China. In other words, if a firm is not optimally managed, it would find it difficult to engage in R&D or collaborative innovation activities in Mainland China while at the same time surviving against the steep odds posed by challenging market and environmental pressures. However, there is no variable in the baseline model to control for managerial capability. Its possible impact would thus be measured in the residual, which is accordingly correlated with the innovation proxies. This leads to endogeneity bias.

To correct such endogeneity bias, we estimate a recursive two-equation system below:

(2) $y_{1i} = x_{1i}\beta + x_{2i}\gamma + u_{1i}$,

(3) $y_{2i} = y_{1i}\lambda + x_{1i}\varphi + u_{2i}$,

where y_{1i} is endogenous in Equation (3), x_{1i} are the exogenous independent variables, and x_{2i} can be considered instrumental variables. The estimation is

implemented in a two-step process. We first estimate Equation (2), and then replace y_{1i} by its predicted value $\hat{y}_{1i}$ in Equation (3).

We use the regression, including R&D or innovation collaboration in Mainland China as an example, to illustrate the equation system. The first equation of the system (Equation (2)) is constructed as

(4) (R&D or innovation collaboration in Mainland China) = f {(Firm size), (Firm growth), (Supply to Hong Kong and Guangdong market), (Supply to Hong Kong and Mainland China market), (Supply to international market), (Public financial support for innovation activities from Hong Kong and Guangdong governments), (Public financial support for innovation activities from central government in Mainland China), (Sector dummies)}.

Compared with small firms, large firms are substantially better able to generate funds internally for investment in risky R&D projects, and larger firms benefit from economies of scale when undertaking R&D activity. Empirical research has consistently found that the prevalence of in-house R&D increases with firm size, although the relationship between the amount invested in R&D as a share of total revenues (R&D intensity) and firm size can be complex. For instance, Cohen et al. (1987) found that the relationship between firm size and R&D intensity varies by sector. In a recent study, Lee and Sung (2005) contended that size influences firm-specific technological competencies that can be of value to both R&D and other methods of innovating. Rammer et al. (2009), based on the results of an analysis of innovation survey data for Germany, identified several reasons that large firms possess greater internal capabilities than small firms do and are thus more likely to engage in R&D. First, R&D often requires heavy initial investments in laboratory equipment and advanced instruments with large fixed costs over time. Small firms are less likely to be able to marshal internal sources of finance to cover both the initial

costs (creating an entry barrier) and the fixed costs over time. Small firms may also face barriers to raising capital from external sources because of low collateral and weak records of past successful R&D projects. R&D projects are also inherently risky, with many failing. Small firms generally lack the financial resources to maintain a portfolio of several R&D projects to hedge against the risk of failure. We thus include firm size and firm growth as control variables in Equation (2).

In a study of R&D centers maintained by multinational companies in Beijing, Chen (2008) argued that foreign firms are motivated to integrate their R&D, production, and marketing departments in Mainland China in order to compete effectively and maintain market share in the Mainland market. In line with this argument, Hong Kong-owned manufacturing firms that supply the Mainland Chinese market are expected to be more likely to carry out R&D or collaborative innovation activities there. We thus construct three variables—supply to Hong Kong and Guangdong market, supply to Hong Kong and Mainland China market, and supply to international market—to study the relationship between the geographical markets of Hong Kong-owned manufacturing firms and innovation strategy in Mainland China. In addition to these control variables, we include binary variables—intramural R&D, public financial support for innovation activities from the Hong Kong and Guangdong governments and the central government in Mainland China, and sector dummies—in the regression.

The second equation of the system (Equation (3)) is accordingly constructed as

(5) (Moving out of Guangdong) = f {(Predicted value of R&D or innovation collaboration in Mainland China), (Firm growth), (Public financial support for innovation activities from Hong Kong and Guangdong governments), (Public financial support for innovation activities from central government in Mainland China), (Sector dummies)}.

The estimation of the second equation (Equation (3)) is presented in Table 5. After correcting the potential endogeneity bias, we find that the coefficient of new product share bears the same sign as in the result obtained from the baseline model, but it is no longer statistically significant. To the contrary, the significance of the coefficient of R&D or innovation collaboration in Mainland China is preserved, which provides robust evidence for the argument that, if Hong Kong-owned manufacturing firms in Guangdong engage in R&D or innovation collaboration in Mainland China, they are not likely to relocate out of Guangdong.

[Insert Table 5 here]

Table 6 demonstrates the estimation results of the first equation of the system (Equation (2)). The regression, which includes R&D or innovation collaboration in Mainland China as a dependent variable, is estimated by a Probit model, and the one including new product share is estimated by a Tobit model. Larger firms are more likely to engage in R&D or innovation collaboration in Mainland China, but are not more likely to carry out product innovation (Table 6). If a Hong Kong-owned manufacturing firm grew in 2006–2007, it would be likely to engage in R&D or innovation collaboration in Mainland China or to earn a larger proportion of its revenue from new products.

[Insert Table 6 here]

The coefficient of supply to international market is invariably significant in the three regressions, which shows that Hong Kong-owned manufacturing firms that sell to international markets are more innovative than their counterparts that sell only to Hong Kong and the Mainland Chinese market. This finding is consistent with those of

empirical studies that demonstrate that exporters are, on average, more active in innovation than non-exporters are, own more patents, and declare greater R&D expenditures (Tomiura, 2007). This result implies that firms are unlikely to export goods and services unless they have sufficient capabilities in organizational learning and innovation to enter and compete in foreign markets where they lack experience. Exporters need to adapt products to local market conditions, offer customized applications, and take advantage of new market opportunities through rapid new product development (Filatotchev & Piesse, 2009). Export activities can also directly influence how firms innovate through feedback effects. Exposure to a wider range of technologies than those available in domestic markets can give exporting firms an edge over domestic rivals, encouraging them to invest in R&D activities (Girma et al., 2008; Harris & Li, 2009).

Again, public financial support from Hong Kong, Guangdong or the central government in Mainland China has no material impact on a firm's decision to carry out R&D or innovation collaboration in Mainland China. However, public financial support for innovation from the Hong Kong and Guangdong governments contributed to new product share for the sample firms. Firms in the electronic parts and components sector are more likely to engage in R&D or innovation collaboration in Mainland China.

5.3 Sample selection bias in the baseline model

In addition to endogeneity bias, we acknowledge that the results for the baseline model may be affected by sample selection bias. As the questionnaire dictates, any firm that answers the question regarding R&D or innovation collaboration activities in Mainland China must at least have ongoing or past innovation activities. Such a firm

has actually made two sequential decisions. The first is whether to innovate in the first place. Only a firm that innovates will have to decide whether or not to engage in R&D or innovation collaboration in Mainland China. The decision process for such a firm can be modeled by the following probit model with sample selection.

(6) $y_{1i}^{*} = x_i\beta + u_{1i}$

y_{1i}^{*} is a latent variable and we observe only the binary outcome $y_{1i} = (y_{1i}^{*} > 0)$. y_{1i} is observed only when

(7) $y_{2i} = z_i\gamma + u_{2i} > 0$,
where

(8) $u_{1i} \sim N(0, 1)$
(9) $u_{2i} \sim N(0, 1)$
(10) $\text{corr}(u_{1i}, u_{2i}) = \rho$.

Equation (6) is an outcome equation (whether or not to engage in R&D or innovation collaboration in Mainland China) and Equation (7) is a selection equation (whether to innovate). The log likelihood function of the estimator can be found at StataCorp (2007: 575). When ρ=0, an estimation of the outcome equation (Equation (6)) by a standard Probit model will not yield a biased result. The outcome equation can thus be estimated by a standard Probit model.[3] The estimation results of the sample selection models are presented in the Appendix. The null hypothesis (ρ=0) cannot be rejected at the 10 percent confidence level in the two regressions, which implies that the outcome equation can be estimated by a standard Probit model or a standard Tobit model. The results obtained in Tables 5 and 6 are thus not biased. It is worth mentioning that, in the selection equation of the sample selection models, the coefficient of the variable of supply to international markets is invariably significant, providing further evidence that Hong Kong-owned manufacturing firms in Guangdong that sell to international markets are more innovative. The coefficient of the variable for public financial

support for innovation from the Hong Kong or Guangdong governments is not significant in the model with new product share as the dependent variable, failing to confirm the robustness of the estimation result of the first equation in the recursive equation system (Table 6).

In summary, the econometric analyses of the surveyed data reveal that Hong Kong-owned manufacturing firms in Guangdong that had engaged in R&D or innovation collaboration in Mainland China are more likely to weather the challenging market and environmental pressures. Product innovation alone, which is measured by new product share, is not sufficient to help Hong Kong-owned manufacturing firms survive in Guangdong. R&D and, in a broad sense, innovation is a costly and risky activity. Firms need to have internal sources of finance or raise capital from external sources to purchase laboratory equipment and advanced instruments and to hire qualified personnel. Firms that undertake R&D or innovation collaboration activities in Mainland China are presumably more competitive and have sufficient resources to absorb the costs of R&D or innovation collaboration over time. In addition, such firms identify and collaborate with partners in Mainland China, which means that they have built up networks locally or are more deeply integrated into Mainland China's innovation system. The odds of survival for such firms would thus be greater. In contrast, new product launch does not indicate competitiveness on the part of Hong Kong-owned manufacturing firms in Guangdong. As firms may produce new products that are developed mainly by other firms or new products that are not so novel in the sense that they are not new to a market but only new to the firm itself, Hong Kong-owned manufacturing firms that take a greater share of new product sales do not show a greater tendency to stay in Guangdong.

We also find consistent evidence that Hong Kong-owned manufacturing firms that sell to international markets are more innovative than their counterparts that sell only to Hong Kong and Mainland Chinese markets. The econometric results indicate that public financial support from the Hong Kong, Guangdong, or Mainland Chinese governments has no material impact on a firm's decision with regard to carrying out R&D or innovation collaboration in Mainland China.

5.4 R&D and innovation collaboration of Hong Kong-owned manufacturing firms in Guangdong

The econometric analyses of the surveyed data shows that if Hong Kong-owned manufacturing firms are more strongly committed to the Mainland China market, or more deeply integrated into Mainland China's innovation system, as demonstrated by their R&D or collaborative innovation activities in Mainland China, they are unlikely to relocate their businesses. As shown by the data, "low cost" and "close to market and customers" are the two primary motivations for Hong Kong-owned manufacturing firms to undertake R&D or collaborative innovation activities in Mainland China (Figure 1). Over 60 percent of the respondents regard "low cost" and about 35 percent consider "close to market and customer" as highly important reasons for carrying out R&D or collaborative innovation activities in Mainland China.

This finding contradicts the results of a similar survey of 250 multinationals from the US and Western Europe that was intended to examine their motivation for offshoring R&D (Thursby & Thursby, 2006). Thursby and Thursby found that, among multinational companies that locate their R&D activities in emerging economies, the most important attraction was the growth potential in the market, followed by the

quality of R&D personnel. Tied for third-most important reason were costs (net of tax breaks), the expertise of available university faculty, and the ease of collaborating with universities. Our explanation for this discrepancy is that firms surveyed by Thursby and Thursby are large multinationals with large-scale R&D investments and strong technological capabilities. Cost reduction is not their primary interest. On the contrary, the competitiveness of Hong Kong-owned manufacturing firms in Guangdong is not based on advanced technology that they could invent and develop but on their competence in manufacturing with a thin profit margin in Mainland China. For Hong Kong-owned manufacturing firms in Guangdong, cost reduction and better knowledge of markets and customers are keys to survival and success. It is important to differentiate these two types of multinationals and their diverse motivations for offshoring R&D activities to emerging economies.

[Insert Figure 1 here]

An analysis of the types of partners that Hong Kong-owned manufacturing firms will choose for collaborative innovation also supports the above finding. Regarding collaborating with partners from their own enterprise groups, suppliers, clients, and competitors, Hong Kong-owned manufacturing firms do not discriminate among partners from distinct locations. Almost an equal percentage of the partners of the four types are from Guangdong, other provinces in Mainland China, or Hong Kong. However, when considering collaborating with consultants, universities, and public research institutions, a much higher percentage of Hong Kong-owned manufacturing firms choose partners located in Hong Kong. This finding indicates that universities, public research institutions and, to a greater extent, consultants in Mainland China are not regarded as reliable sources of knowledge for Hong Kong-

owned manufacturing firms in Guangdong. Similarly, "close to knowledge source" is the weakest motivation for Hong Kong-owned manufacturing firms to undertake R&D or collaborative innovation activities in Mainland China.

[Insert Figure 2 here]

6. Conclusions

Based on a survey of 492 Hong Kong-owned manufacturing firms in Guangdong administered from March to September 2008, this paper investigates the innovation strategies and survival rate of these firms with respect to deciding whether to move out of Guangdong or cease operations altogether. The study makes a unique contribution to the literature in that there have been no previous scholarly studies on such decisions on the part of Hong Kong-owned manufacturing firms. Indeed, previous research on Hong Kong-owned manufacturing firms clearly identifies the reasons for these firms' success (lower factor input costs) but has not considered survival or innovation strategies. To be sure, the challenges faced by Hong Kong-owned manufacturing firms in Guangdong are themselves of relatively recent origin (since 2007), a factor that may explain the absence of such studies. Additionally, as other coastal regions in Mainland China increasingly upgrade their regional economies, this research provides lessons for understanding the relocation of manufacturing within China, as manufacturing activity (in this case Hong Kong-owned manufacturing activity) moves inland to Mainland China's hinterland, not only from the Pearl River Delta region, but also (to name just one other region) the Yangtze River Delta region. Such lessons are applicable both at the firm level as well as at the provincial governmental level, provided that such governments are indeed keen to exploit this trend in some way (depending on whether the policymakers come

from the region out of which manufacturing is moving or from the region into which it is moving).

By employing the CIS-4 survey questionnaire, this research has been able to differentiate product innovation from innovation in general and investigate its role in firm survival. Indeed, the data analyses show that new product innovation alone is insufficient to ensure the survival of Hong Kong-owned manufacturing firms in Guangdong. Rather, Hong Kong-owned manufacturing firms in Guangdong that engage in R&D or collaborative innovation activities with other actors (such as universities, public research institutions, etc.) in the innovation system that are located in Mainland China are more likely to weather the challenging market and environmental pressures imposed upon them. Such firms are less likely to close down or relocate their business operations out of Guangdong.

Furthermore, the survey data shows that "low cost" and "close to market and customers" indicate the two primary motivations for Hong Kong-owned manufacturing firms in Guangdong to undertake R&D or collaborative innovation activities in Mainland China. Finally, universities, public research institutions, and consultants in Mainland China are not sources of knowledge for Hong Kong-owned manufacturing firms in Guangdong. In this connection, Hong Kong-owned manufacturing firms in Guangdong that sell to international markets (i.e., outside of Mainland China and Hong Kong) are more innovative as compared with their counterpart firms that sell only to Mainland China's or Hong Kong's markets.

This research yields policy implications for both the Guangdong provincial government as well as the Hong Kong Special Administrative Region government. In particular, the research points to the need, on the one hand, to strengthen links between universities and public research institutes and industry, especially given how

much public funding is devoted to the development of both these actors in both areas. This is a particularly important lesson for emerging economies around the world. Where much attention may be devoted to the development of strong actors—universities, public research institutes, industry associations, etc.—within an economy's innovation system, simply pouring in resources dedicated to the development of such strong actors alone is insufficient. Rather, it is just as or perhaps more important to ensure or find ways of ensuring that, regardless of the maturity of the other actors within the innovation system, they are strongly linked to one another. Within any given innovation system, isolated islands of strength are of little value unless their contributions permeate the broader innovation system in any given economy.

On the other hand, at a more aggregate level, this research suggests that it may indeed make sense for policymakers on both sides of the Guangdong/Hong Kong border to seriously consider the viability of developing a genuinely regional innovation system, whereby the two regions' strengths and capacities are combined. This would allow Hong Kong-owned manufacturing firms to take advantage of the strengths offered by Guangdong's innovation system (mostly in terms of public research institutes) and similarly allow Guangdong's firms and public research institutions to take advantage of the strengths offered by Hong Kong's innovation system (especially the higher education institutes). Such a development, if executed intelligently, could lead to the emergence of an even stronger region in which manufacturing firms as well as service firms are both deeply integrated into and are able to exploit the strengths of the regional innovation system irrespective of location—whether Guangdong or Hong Kong—in which those strengths may be found.

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Appendix

Table A-1: The Sample Selection Models

Independent variable	Dependent variable			
	R&D or innovation cooperation in Mainland China (binary variable)	Innovation dummy (binary variable)	New product share (censored variable)	New product dummy (binary variable)
	Outcome equation	Selection equation	Outcome equation	Selection equation
Firm size	.068(.046)	.11(.042)***	-.21(1.1)	-.040(.039)
Firm growth	.35(.22)	-	2.3(4.9)	.15(.16)
Intramural R&D	-	-	-3.9(10.0)	1.4(.15)***
Supply to Hong Kong and Guangdong market	.29(.19)	.11(.18)	-4.8(4.7)	-.033(.17)
Supply to Hong Kong and Mainland China market	.13(.19)	-.033(.17)	2.2(4.7)	-.089(.17)
Supply to international market	.44(.20)**	.34(.16)**	-6.7(5.8)	.41(.17)**
Public financial support for innovation activities from Hong Kong and Guangdong governments	.19(.24)	-	2.9(6.2)	-
Public financial support for innovation activities from central government in Mainland China	.18(.38)	-	8.9(8.7)	-
Organizational innovation	-	.73(.15)***	-	.17(.15)
Marketing innovation	-	.63(.15)***	-	.30(.14)**
Apparel sector	-.031(.26)	-.33(.21)	6.0(7.7)	-.47(.22)**
Textiles sector	.044(.31)	-.17(.24)	9.1(8.0)	-.11(.26)
Plastic products sector	-.13(.31)	.057(.30)	5.6(8.6)	-.22(.28)
Fabricated metal products sector	.26(.33)	.29(.32)	4.0(9.2)	-.46(.28)
Electronic parts and components sector	.60(.28)**	.010(.28)	8.5(6.5)	.030(.27)
Import and export sector	-.29(.33)	.53(.34)	-11(11)	-.48(.29)*
Business service sector	.51(.42)	-.18(.36)	-5.0(9.7)	-.23(.32)
Number of observations	441	441	465	465
P	-.086(.32)		-.34(.32)	
Chi-square statistic in the likelihood-ratio test of no correlation between the residuals in the outcome and the selection equations (ρ=0):	0.07		0.55	

Note: The data between the parentheses are standard deviation. *** denotes significance at 1% level, ** denotes significance at 5% level, * denotes significance at 10% level.

Table 1: Distribution of the Sample Firms by Sector

Sector	Number of firms	Percentage in total
Agriculture and Fishing	1	0.2
Manufacturing	361	74.6
Electricity, Gas and Water	8	1.7
Construction	12	2.5
Wholesale, Retail and Import/Export Trades, Restaurants and Hotels	53	11.0
Transport, Storage and Communication	14	2.9
Finance, Insurance, Real Estate and Business Services	32	6.6

Table 2: Distribution of the Sample Firms by Manufacturing Sector

Manufacturing sectors	Number of firms	Share of the firms from the sector in total (data within parentheses are percentage of number of firms in the sample of the 2005/2006 survey sponsored by the Federation of Hong Kong Industries, 2007) (Percentage)
Food	6	1.7
Beverage	2	0.6
Wearing apparel	57	15.8 (13.6)
Leather and leather	9	2.5 (7.7)
Footwear	4	1.1
Textiles	36	10.0 (6.4)
Wood and cork products	4	1.1
Furniture and fixtures	10	2.8
Paper and paper products	10	2.8 (3.3)
Printing and publishing	20	5.5 (3.6)
Chemicals	13	3.6 (3.4)
Rubber products	6	1.7
Plastic products	30	8.3 (9)
Non-metallic mineral	6	1.7
Basic metal	9	2.5
Fabricated metal products	25	6.9 (10.5)
Office, accounting and computing machinery	1	0.3
Radio, television & communications equipment and apparatus	7	1.9
Electronic parts and components	40	11.1 (17.4)
Electrical appliances & houseware and electronic toys	16	4.4 (5.4)
Machinery, equipment, apparatus, parts and components	21	5.8
Professional & scientific, measuring & controlling equipment and photographic & optical goods	13	3.6
Manufacturing industries, not elsewhere classified	16	4.4

Table 3: Distribution of the Sample Firms by Size

Firm Size (Eurostat's definition)	Number of firms	Share in total sample firms (Percentage)
Small firms (1-49 employees)	79	17
Medium firms (50-249 employees)	148	32
Large firms (250 or more employees)	241	51
Firm Size (National Statistics Bureau of China's definition)	**Number of firms**	**Share in total sample firms (Percentage)**
Small firms (1-299 employees)	273	54
Medium firms (300-1999 employees)	145	31
Large firms (2000 or more employees)	66	15

Table 4: List of Variables

Variables	Definition
Moving out of Guangdong	If a firm expected that its manufacturing operations in Guangdong as a proportion of its total manufacturing operations in Mainland China decreases within the next two years after the survey was implemented (2009-2010), the value is 1. Otherwise, 0.
R&D or innovation cooperation in Mainland China	If a firm had R&D activities or cooperation for innovation in Mainland China, the value is 1. Otherwise, 0.
New product share	Percentage of the total turnover in 2007 from the product which was new to the market or new to the firm
New product dummy	If a firm introduced product which was either new to the market or new to the firm, the value is 1. Otherwise, 0.
Innovation dummy	If a firm introduced product or process innovation or had abandoned or on-going innovation, the value is 1. Otherwise, 0.
Firm size	Ln(number of employees in 2007)
Firm growth	(number of employees in 2007-number of employees in 2006)/number of employees in 2006
Intramural R&D	If a firm performs intramural R&D, the value is 1. Otherwise, 0.
Public financial support for innovation activities from Hong Kong and Guangdong governments	If a firm received public financial support for innovation activities from the Hong Kong or Guangdong authorities, the value is 1. Otherwise, 0.
Public financial support for innovation activities from central government in Mainland China	If a firm received public financial support for innovation activities from the central government in Mainland China, the value is 1. Otherwise, 0.
Supply to Hong Kong and Guangdong market	If a firm sold goods or services to Hong Kong and Guangdong market, the value is 1. Otherwise, 0.
Supply to Hong Kong and Mainland China market	If a firm sold goods or services to Hong Kong and Mainland China market, the value is 1. Otherwise, 0.
Supply to international market	If a firm sold goods or services to other countries/regions except Mainland China and Hong Kong, the value is 1. Otherwise, 0.
Organizational innovation	If a firm introduced organizational innovation, the value is 1. Otherwise, 0.
Marketing innovation	If a firm introduced marketing innovation, the value is 1. Otherwise, 0.
Dummy variables for apparel, textiles, plastic products, fabricated metal products, electronic parts and components, import and export, and business service sector	Take the dummy for apparel sector as an example, if a firm falls into the sector (industry code 320-322), the value for the apparel sector dummy is 1. Otherwise, 0. The dummy variables for other sectors are defined in a similar fashion.

Note: The industry code is from Hong Kong Standard Industrial Classification version 1.1, available at http://fec.mofcom.gov.cn/uploadfile/xiangg.pdf.

Table 5: Baseline Probit Model and the Second Equation of the Recursive Equation System (Probit model and endogeneity bias corrected)

Independent variables	Dependent variable: Moving out of Guangdong (binary variable)			
	Baseline Probit Model		The second equation of the recursive equation system (endogeneity bias corrected)	
R&D or innovation cooperation in Mainland China	-.37(.15)**	-	-1.2(.67)*	-
New product share	-	-.0044(.0023)**	-	-.0077(.011)
Firm growth	-.11(.18)	-.14(.15)	.020(.21)	-.14(.15)
Public financial support for innovation activities from Hong Kong and Guangdong governments	.052(.24)	.023(.23)	.14(.25)	-.017(.24)
Public financial support for innovation activities from central government in Mainland China	-.032(.37)	-.040(.36)	.055(.38)	-.037(.37)
Apparel sector	.062(.26)	.15(.20)	.020(.26)	.13(.20)
Textiles sector	.42(.29)	.60(.23)***	.44(.30)	.59(.23)***
Plastic products sector	.25(.31)	.21(.25)	.19(.31)	.21(.25)
Fabricated metal products sector	.059(.32)	.013(.27)	.16(.32)	.015(.27)
Electronic parts and components sector	.33(.25)	.28(.22)	.55(.30)*	.27(.23)
Import and export sector	-.23(.32)	-.15(.28)	-.34(.33)	-.14(.28)
Business service sector	-.94(.52)**	-.94(.39)**	-.79(.53)	-.93(.40)**
Number of observations[2]	310	456	310	456
Log likelihood	-195.9	-291.3	-197.0	-293.9

Note:
1.The data between the parentheses are standard deviation. *** denotes significance at 1% level, ** denotes significance at 5% level, * denotes significance at 10% level.
2. As the questionnaire dictates, only 68% of the surveyed firms answer the question whether they have R&D or innovation cooperation in Mainland China. The firms which do not answer the question are the ones that have no product or process innovations or innovation activities during the observation period. That is the reason that the number of observations of the regression with the variable of R&D or innovation cooperation in Mainland China is smaller than that of the regression with the variable of new product share.

Table 6: The First Equation of the Recursive Equation System

Independent variable	Dependent variable	
	R&D or innovation cooperation in Mainland China (binary variable)	New product share (censored variable)
	Probit Model	Tobit Model
Firm size	.079(.042)*	-2.4(1.6)
Firm growth	.37(.21)*	15(6.7)**
Intramural R&D	-	50(6.4)***
Supply to Hong Kong and Guangdong market	.33(.19)*	-1.8(7.2)
Supply to Hong Kong and Mainland China market	.074(.18)	1.5(6.9)
Supply to international market	.45(.18)**	13(7.1)*
Public financial support for innovation activities from Hong Kong and Guangdong governments	.23(.24)	18(9.7)*
Public financial support for innovation activities from central government in Mainland China	.22(.38)	19(14)
Apparel sector	-.053(.25)	-17(9.9)*
Textiles sector	.050(.30)	-.17(11)
Plastic products sector	-.11(.31)	5.8(12)
Fabricated metal products sector	.19(.32)	-2.7(12)
Electronic parts and components sector	.56(.27)**	14(10)
Import and export sector	-.28(.32)	-14(13)
Business service sector	.39(.39)	-13(14)
Number of observations	316	465
Log likelihood	-200.5	-1165.4

Note: The data between the parentheses are standard deviation. *** denotes significance at 1% level, ** denotes significance at 5% level, * denotes significance at 10% level.

Figure 1: Percentage of Respondents Regarding the Motivation as High Degree of Importance to their R&D and Cooperation for Innovation Activities in Mainland China

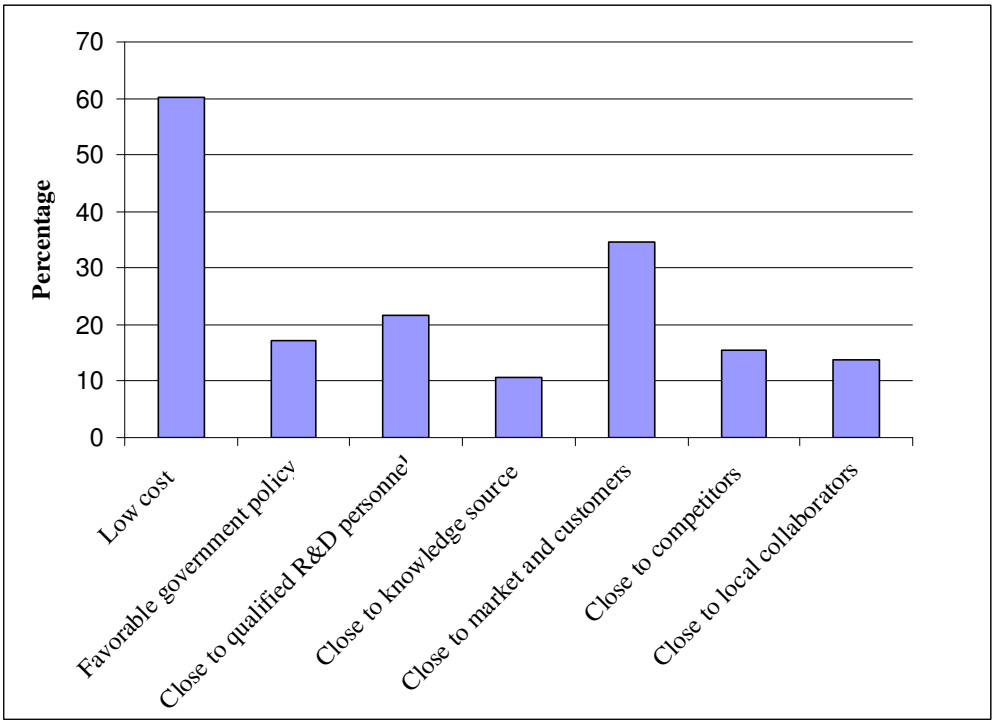
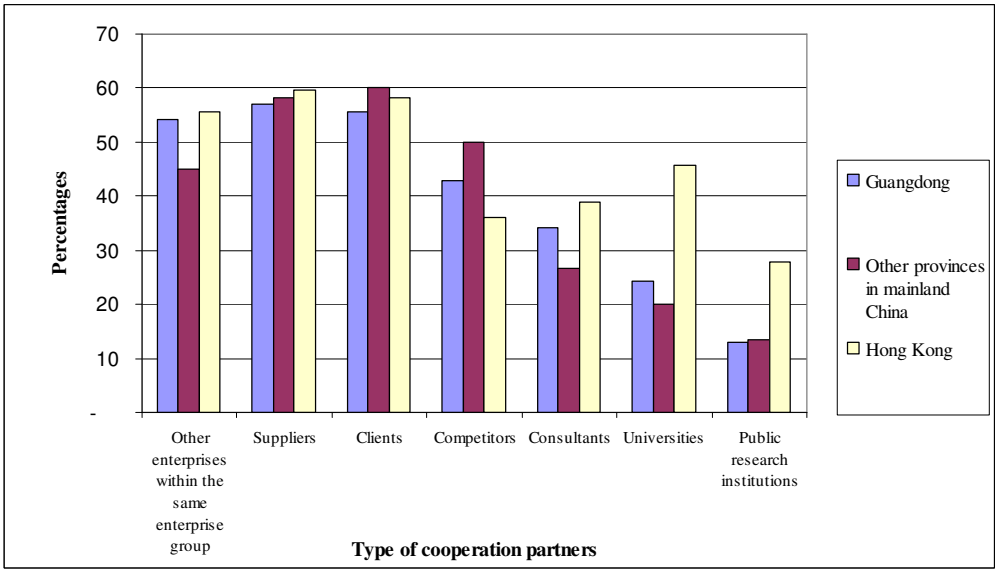


Figure 2: Percentage of Respondents Indicating that They Have the Type of the Partners in the Area



[1] According to the Guangdong Statistics Bureau (2009), Guangdong was the home of 95.4 million people in 2008 and the Gross Domestic Product per capita there has been growing substantially in recent years, to RMB37,589 (US$5,527) in 2008. Consumer expenditures have risen as well.

[2] The first Community Innovation Survey was carried out in European countries in 1993. It is the first survey on innovation implemented simultaneously in multiple countries on the basis of a harmonized questionnaire. The second and third surveys were implemented in 1997/1998 and 2000/2001, respectively. The CIS-4 was implemented in 2004. After the previous three exercises, the questionnaire

was improved to enhance the clarity and usefulness of the questions. Moreover, the length of the questionnaire was shortened significantly.

[3] The sample selection model that has new product share (a censored variable) as the dependent variable in the outcome equation is called a Heckman sample selection model. It should be estimated differently from the sample selection Probit model. The Heckman sample selection model is described as follows. $y_i = x_i\beta + u_{1i}$, and y_i is observed only when $z_i = 1$, where $z_i = 1$ if $z_i^* = w_i\gamma + u_{2i} > 0$ and 0 otherwise, where $u_{1i} \sim N(0, \sigma^2_{u_{1i}})$; $u_{2i} \sim N(0, 1)$; $\text{corr}(u_{1i}, u_{2i}) = \rho$. The log likelihood function can be read in StataCorp (2007: 561). Similarly, if the null hypothesis (ρ=0) is not be rejected, the outcome equation of the Heckman sample selection model can be estimated by a standard Tobit model without bias.