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# Innovation strategy, firm survival and relocation: The case of Hong Kong-owned manufacturing in Guangdong Province, China

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## ABSTRACT

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 generate a higher share in new product sales as a percentage of total sales or 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 by investigating the effects of innovation on the survival and relocation of Hong Kong-owned manufacturing firms in Guangdong. The results support policy initiatives that strengthen collaborative ties among key innovation system actors.

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## 1. Introduction

In this paper, we study the relationship between innovation strategies and the decision to stay in, relocate out of, or cease operating altogether in Guangdong Province (hereafter “Guangdong”) on the part of Hong Kong-owned manufacturing firms. Economic trends in the Guangdong-Hong Kong region are significant in the context of the Chinese and East Asian economic zone insofar as investment on a vast scale has flown from Hong Kong to Guangdong over the past three decades, significantly strengthening their economic ties and transforming the region into an economic powerhouse in southern China.<sup>1</sup>

Since the economic reform era began in 1979, many firms in Hong Kong have transformed themselves into service providers, transitioning from manufacturing to trading. They operate as traders in Hong Kong and as proprietors of or partners in plant facilities in Mainland China, particularly in Guangdong. These import/export firms in Hong Kong import goods from their factories in Guangdong, and subsequently re-export those goods to the rest of the world from Hong Kong. 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 Guangdong.<sup>2</sup>

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<sup>1</sup> Of Mainland China's total Foreign Direct Investment (FDI) from 1985 to 2003, 30% went into Guangdong, in large part because of its geographical and cultural proximity to Hong Kong. An overwhelming 90% of FDI in Guangdong was invested by entrepreneurs from Hong Kong in the mid 1980s and, although the ratio decreased steadily after the mid-1990s, even as recently as 2008 as much as 55% of FDI in Guangdong originated in 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 up to half of their Mainland China investments into Guangdong.

<sup>2</sup> 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 was estimated to have ranged between 50,000 and 60,000 in 2002, and these manufacturing firms were estimated to have employed

Although Guangdong is adjacent to Hong Kong, geographical proximity—while extremely important—is not the only advantage Hong Kong enjoys as a business partner with Guangdong. In addition, ethnic (i.e., cultural and linguistic) familiarity, reinforced through investment and encouraged by national, provincial, and local policies, has been the more important factor attracting Hong Kong firms to Guangdong (Womack and Zhao, 1994; Yu, 2005). Within Guangdong, Hong Kong entrepreneurs have established their manufacturing operations primarily in the Pearl River Delta region.<sup>3</sup>

The Guangdong manufacturing environment has, however, been changing dramatically of late. Since mid-2007, Hong Kong manufacturers (as well as other manufacturers operating in Guangdong) have found themselves increasingly forced either to shut down or to move their manufacturing operations 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 regulation requiring exporters to pay a deposit equivalent to half the amount spent on importing almost two thousand raw materials;<sup>4</sup> cancellation or reduction of tax refunds on goods such as metals, plastics, textiles, and furniture;<sup>5</sup> a stronger Yuan; escalating prices for energy and raw materials; stringent pollution control requirements in Guangdong; the introduction of welfare benefits for employees; and the introduction of a labor law stipulating the benefits and responsibilities of both employers and employees, insurance coverage, and overtime pay.<sup>6</sup>

The most damaging of these policies for manufacturers—for instance the introduction of a minimum wage—are applicable to the whole of Guangdong Province, en bloc, where the minimum wage has risen by an average of 18.6% since 1 March 2011.<sup>7</sup> Another example of a policy applicable to all of Guangdong Province is the imposition of stringent pollution control requirements on manufacturing plants across the entire province. (Given these challenging province-wide business conditions we did not, in our study, investigate the relocation of Hong Kong-owned manufacturing firms between cities within Guangdong. This may be regarded as a methodological limitation of our paper insofar as we do not study or compare microeconomic environments across cities within Guangdong—that would have required a very different data-gathering methodology, applied at the city level. Therefore, within-province variation across cities cannot be addressed in this study.)

approximately 447,000 and 11 million workers in Hong Kong and Mainland China, respectively.

<sup>3</sup> The PRD region is named for the Pearl River—a river that is on a par with the Yellow River and the Yangtze River as a major Chinese waterway—which flows just south of Guangzhou and then spreads east and south to form a large estuary between Hong Kong and Macao. The river links the city of Guangzhou to Hong Kong and the South China Sea and is one of China's most important waterways for trade. According to the Hong Kong Trade Development Council (HKTDC), the PRD region covers approximately 60,000 km<sup>2</sup> and extends to (and includes) the areas of the cities Dongguan, Guangzhou, Huizhou, Jiangmen, Shenzhen, Zhaoqing, Zhongshan and Zhuhai.

<sup>4</sup> “Public notice 22”, 4 June 2007, Ministry of Commerce of the People's Republic of China. <http://www.mofcom.gov.cn/aarticle/b/c/200804/20080405462357.html>, accessed 10 April 2008.

<sup>5</sup> “Circular No. 139”, 19 June 2007, Ministry of Commerce of the People's Republic of China. <http://www.mofcom.gov.cn/aarticle/b/e/200706/20070604800599.html&173433629=2827746338>, accessed 10 April 2008.

<sup>6</sup> “Circular No. 139”, 19 June 2007, Ministry of Commerce of the People's Republic of China. <http://www.mofcom.gov.cn/aarticle/b/e/200706/20070604800599.html&173433629=2827746338>, accessed 10 April 2008.

<sup>7</sup> To be sure, within Guangdong Province, minimum wages have been raised differentially. Shenzhen, for example, has raised the minimum pay by 20% to 1320 Yuan from 1 April 2011 onwards, and Dongguan, which has the largest cluster of Hong Kong-owned factories, raised minimum wage by 19.6% to 1100 Yuan from 1 March 2011 onwards (the second increase in 10 months).

These challenges have squeezed thousands of firms operating in labor-intensive, highly polluting industries, most of which have been and continue to be run by Hong Kong-based entrepreneurs. The prevailing sentiment, as expressed by leaders of Hong Kong's manufacturing associations, is that the substantial costs associated with relocation as well as increased operating costs in the new region effectively mean that relocation out of Guangdong is a sub-optimal choice. Our survey data confirm the view that rising cost is the primary reason for a firm's decision not to stay in Guangdong, while attractive conditions in other locations or business expansion are the least important reasons (Fig. 1).

Unless Hong Kong-owned manufacturing firms can develop new strategies—and move up the value chain—they will find it difficult to survive in Guangdong, dramatically undermining Hong Kong's manufacturing-related service-based economy there. Policymakers in Guangdong prefer clean, high value-added industrial activities to these highly polluting and labor-intensive industries. However, any dramatic shake-up in Hong Kong-owned manufacturing activity in Guangdong would have serious repercussions that might be hard to manage. The upshot is that the success or failure of Hong Kong-owned manufacturing firms in Guangdong matters tremendously because their economies are increasingly integrated and their prosperity rests on the health of these firms.

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 the innovation activities of Hong Kong-owned manufacturing firms in Guangdong. Even fewer studies have linked the innovation patterns of these Guangdong-based, Hong Kong-owned manufacturing firms to survival and relocation decisions. Because these activities have 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 fill this gap by conducting an innovation survey, administered from March to September 2008, involving 492 Hong Kong firms with manufacturing operations in Guangdong. The econometric analysis based on the survey data demonstrated that the firms' innovation activities determine their survival and relocation decisions.

The remainder of the paper is structured as follows. In Section 2 we review past studies on the impact of innovative activities on firm survival and relocation. Section 3 introduces the survey and the data. Section 4 presents our econometric analysis and results. Section 5 concludes the paper, suggesting some policy implications.

## 2. Innovation, firm survival and relocation

The view that innovation plays a key role in firm survival owes much to Schumpeter (1942: 84) and has been endorsed by Liemt (1992: 9), who argues that innovation constitutes a clear competitive advantage. Baumol (2002: 1) observes that “innovative activity . . . becomes mandatory, a life-and-death matter for the firm . . . innovation has replaced price as the name of the game.” Lazonick (2004: 273) argues that, at the national level, too, economic development rests on firm capacity to innovate by offering goods and services that elevate quality and lower costs. Defined as such, innovation makes it possible to improve the economic position of already established firms. Studies of firm survival and industry dynamics related to innovative activity (cf. Audretsch, 1991, 1995; Agarwal and Gort, 2002; Klepper and Simons, 1997) suggest that the competitive advantage of innovation is the essence of firm survival (Brüderl et al., 1992). According to Christensen et al. (1998), the combination of technological innovation and market-

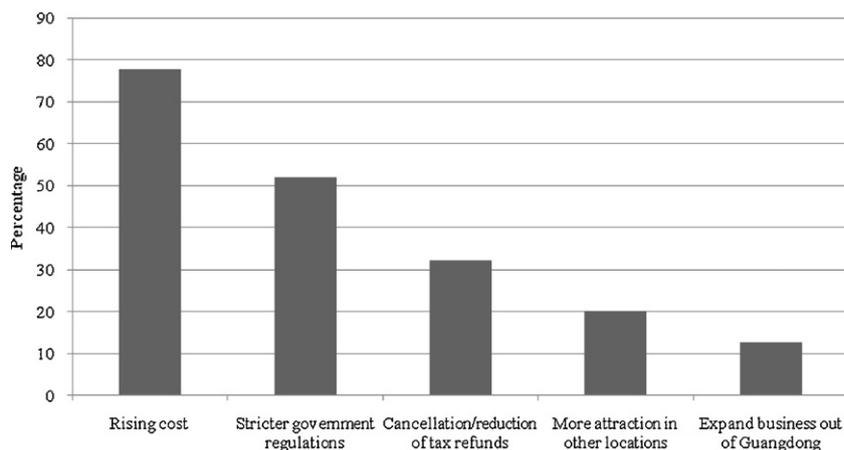


Fig. 1. Percentage of respondents (156 firms) assigning a high degree of importance to various reasons for the not-staying-in-Guangdong decision.

oriented 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% greater than that of a non-innovative firm. Additional studies have found that, while technological change threatens established firms (Utterback and Abernathy, 1975; Gort and Klepper, 1982), innovation activity enables such firms to deal with emerging or “disruptive” technologies while continuously improving existing capabilities (Banbury and Mitchell, 1995; Christensen, 1997).

Relocation provides an additional survival strategy deployed by some firms to weather challenging conditions. Two streams in the economic geography literature—location theory (focusing on “pull” factors, or the attractiveness of a region) and relocation theory (which additionally considers “push” factors or factors that trigger relocation)—are most relevant here. The neo-classical approach to firm relocation employs the concept of “spatial margins to profitability” in differentiating between profitable and unprofitable locations, emphasizing pull factors. However, in reality, because relocation is usually associated with significant cost, and capital inertia discourages firms from leaving established locations, profitable firms are unlikely to relocate. For this reason, a behavioral approach adds to the neo-classical view by accounting for the internal dynamics of firms in the context of imperfect information, uncertainty, and bounded rationality (Cox and Golledge, 1981; Benoit, 1995). This approach seeks to understand the actual behavior of entrepreneurs, and focuses on push factors that trigger the need to relocate.

Yet a third framework within which to conceptualize firm relocation is the institutional approach, which emphasizes the social and cultural context of firm behavior (Martin, 1999). On this approach, a firm’s interaction with its environment in a regional innovation system or in an industrial district (Hayter, 1997) determines the decision to relocate. Compared with the neoclassical view, then, the institutional approach assigns a more important role to government, although Oukarfi and Baslé (2009) found that companies involved in R&D are not likely to be enticed by public financial incentives for business relocation.

As we have indicated, Hong Kong-owned manufacturing firms have found that Guangdong offers them competitive advantages based not only on favorable development policies but also on cultural and linguistic familiarity, which is exceedingly difficult for other provinces in Mainland China to replicate. Each of the three approaches discussed above indicates how difficult relocation out of Guangdong might be in light of the weak pull factors characterizing other provincial economies in Mainland China. In this paper we provide a valuable perspective on economic integration in a

region of rapid industrialization and growing innovation linkages by studying the relationship between, on the one hand, surviving in or relocating out of Guangdong and, on the other hand, innovativeness and R&D or collaborative innovation activities on the part of Hong Kong-owned manufacturing firms in Guangdong. In this way, our paper fills a gap in the empirical and theoretical literature on innovation, firm survival, and firm relocation.

### 3. Survey and data

#### 3.1. Survey methodology

To study the effects of innovation strategies adopted by Hong Kong-owned manufacturing firms in Guangdong on survival or relocation, we conducted an innovation survey by using the questionnaire of the Fourth European Community Innovation Survey (CIS-4).<sup>8</sup> We encountered enormous difficulty in so doing because there is no available registry of Hong Kong-owned manufacturing firms in Guangdong and 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.

Established in 1934, the CMA is one of the oldest and most representative industrial associations in Hong Kong, with over 3700 member-companies from various industry and trade sectors. Ordinary 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 2300 companies from the list that operated 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

<sup>8</sup> The first Community Innovation Survey was conducted 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 conducted in 1997/1998 and 2000/2001, respectively. The CIS-4 was conducted 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.

**Table 1**  
Distribution of sample firms by sector.

Sector	Number of firms	Percentage
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
Community, Social and Personal Services	3	0.6
Total	484	100

Note. The industry sector codes are not available for 8 of the 492 surveyed firms. Therefore, the total number of firms in this table is 484.

comprised 3170 Hong Kong firms with ownership of manufacturing facilities in Guangdong. Through phone-based and face-to-face interviews, we collected 492 valid questionnaires from these firms. The response rate was 15%. 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.

### 3.2. Questionnaire and respondents

Following the CIS-4 questionnaire pattern, 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 financial information. We added two additional questions, which were used to collect information about R&D or collaborative innovation activities in Mainland China and potential plans for closing down or moving manufacturing operations out of Guangdong. These two additional questions were devised and pilot-tested after discussions with senior industry managers.

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

### 3.3. Distribution and representativeness of the sample firms

Seventy-five percent of the firms in our sample fall into the manufacturing sector and 11% belong to the wholesale, retail-import/export trade, and restaurant-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, comprise wearing apparel, textiles, plastic products, fabricated metal products, and electronic parts and components (Table 2).

In order to confirm that our sample was representative of the target population, we identified two bodies of evidence by reference to which we evaluated the quality of our survey exercise. According to both sets of evidence and based on sectoral distri-

butions, we concluded that our survey exercise is representative. The first set of evidence consists of two survey studies sponsored by the Federation of Hong Kong Industries that were conducted in the periods of 2002–2003 and 2005–2006, 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” (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, 5030 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%. 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 point 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 which manufacturing establishments in Hong Kong can be classified into two categories: manufacturing firms and import/export firms that use subcontractors in Mainland China, including their manufacturing-related technical support services. The former accounted for 44% of all establishments engaged in manufacturing, while the latter accounted for 56% (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% fall into the import/export sector. The econometric analysis presented in the next section is performed only on the 389 sample firms that fall into the manufacturing and import/export sectors.<sup>9</sup>

To further confirm the appropriateness of the samples, we also conducted *t*-tests to detect any statistically significant differences 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 tested whether statistically significant differences existed between early and late respondents in terms of variables relevant to the research hypotheses (Armstrong and Overton, 1977). The average values of items from the first 10% of the respondents were compared with those from the last 10%, using *t*-tests. The results indicated no statistically significant differences across the two groups.

## 4. Model and econometric analyses

### 4.1. 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 remain in Guangdong's challenging market environment. We therefore carried out our analysis based on analyzing the following baseline Probit model:

$$y^* = \alpha\beta + \varepsilon, \quad y = 1 \text{ if } y^* > 0, 0 \text{ otherwise,} \quad (1)$$

where  $y^*$  is a latent variable, which is not observed. Instead, we observe only  $y$ .

In Eq. (1), the dependent variable is not staying in Guangdong, which is a binary variable. It is constructed based on the answer to a single question in the survey, that is, whether a firm is expected to close down or cut back its manufacturing operations in Guangdong,

<sup>9</sup> We also conduct the same econometric analysis on the whole sample (456 firms after data cleaning). The results based on the whole sample, which are available upon request, are broadly similar to the ones based on the 389 firms in the manufacturing and import/export sectors.

**Table 2**

Distribution of sample firms by manufacturing sector.

Manufacturing sectors	Number of firms	Sector share as percentage of total (data within parentheses are percentages of the number of firms in the sample of the 2005/2006 survey sponsored by the Federation of Hong Kong Industries, 2007)
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
Total	361	

considered as a proportion of its total manufacturing operations in Mainland China, in the years following the survey (i.e., 2009–2010). Among the sample firms that belong to the manufacturing and import/export sectors, 156 answered “yes” to this question, so the value of the dependent variable is 1 for these firms. Two hundred and thirty-three firms answered no, so the value for them is 0. The key explanatory variables include new product share and R&D or innovation collaboration in Mainland China, which are proxies for innovation activities on the part of Hong Kong-owned manufacturing firms. 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 and new-to-firm products. R&D or innovation collaboration in Mainland China is a binary variable that is constructed on the basis of “yes” or “no” answers given by firms when asked whether or not they had undertaken R&D or innovation collaboration in Mainland China during 2006–2007. Because these two key explanatory variables are highly correlated, they enter regressions separately.

If a Hong Kong-owned manufacturing firm received public financial support for its innovation activities from the governments of Hong Kong, Guangdong, or Mainland China, it would probably choose not to relocate its business elsewhere. We tested this hypothesis by adding two corresponding dummy (control) variables into the equation. We also added six sector dummies to control for the presence of firms in the (1) apparel, (2) textiles, (3) plastic products, (4) fabricated metal products, (5) electronic parts and components, and (6) import/export sectors. Firms in each of the aforementioned six sectors account for over 5% of the total sample share. The definitions of all variables are presented in Table 3.

The estimation of the baseline model shows that innovation activities are indeed associated with decisions to stay on the part of Hong Kong-owned manufacturing firms in Guangdong (columns 1 and 4 in Table 4). The marginal effects of the two innovation proxies are statistically significant and negative. An increase of 1% in new-to-market and new-to-firm product sales as a percentage of total sales will decrease the probability of not staying in Guangdong by 0.0018 (0.18%). Engaging in R&D or innovation collaboration in

**Table 3**

List of variables.

Variables	Definition
Not staying in Guangdong	If a firm expects to close down its manufacturing operations in Guangdong or cut back its manufacturing operations in Guangdong as a proportion of its total manufacturing operations in Mainland China within the next years after the survey was conducted (2009–2010), the value is 1. Otherwise, 0.
New product share	Percentage of total turnover in 2007 from new-to-market and new-to-firm products.
R&D or innovation collaboration in Mainland China	If a firm carried out R&D activities or collaboration for innovation in Mainland China, the value is 1. Otherwise, 0.
Financial support for innovation from Hong Kong or 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.
Financial support for innovation 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.
Firm size	Ln (number of employees in 2007)
Importance of scientific journals and trade/technical publications as source of innovation information (instrumental variable)	If scientific journals and trade/technical publications are ranked 'high' in importance, the value equals 3. The value equals 2 if such sources are ranked 'medium' in importance, 1 if ranked 'low' in importance, and 0 when they are not relevant to the firm.
Dummy variables for apparel, textiles, plastic products, fabricated metal products, electronic parts and components, and import and export	Taking the dummy for the 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 the Hong Kong Standard Industrial Classification version 1.1, available at <http://fec.mofcom.gov.cn/uploadfile/xiangg.pdf>.

**Table 4**  
Probit model, second stage of instrumental variable Probit model and bivariate Probit model.

Independent variables	Dependent variable: not staying in Guangdong (binary variable)				
	Probit model on new product share (marginal effects) (1)	Probit model on predicted new product share (marginal effects) (2)	Instrumental variable Probit model on predicted new product share (coefficients) (3)	Probit model (marginal effects) (4)	Bivariate Probit model (coefficients) (5)
(Predicted) new product share	-.0018(.00093)**	-.0065(.0038)*	-.050(.063)	-	-
R&D or innovation collaboration in Mainland China	-	-	-	-.17(.053)***	-.28(.37)
Financial support for innovation from Hong Kong or Guangdong governments	-.089(.10)	-.12(.095)	-.33(.27)	-.078(.10)	-.25(.29)
Financial support for innovation from central government in Mainland China	-.012(.16)	.15(.16)	.57(.54)	.17(.16)	.37(.42)
Apparel sector	.066(.081)	.0063(.088)	-.33(.70)	.068(.081)	.18(.20)
Textiles sector	.25(.090)***	.22(.091)**	.41(.39)	.25(.090)***	.63(.24)***
Plastic products sector	.090(.10)	.11(.10)	.37(.31)	.076(.10)	.21(.25)
Fabricated metal products sector	.0082(.11)	.090(.12)	.66(.87)	.017(.10)	.026(.28)
Electronic parts and components sector	.11(.090)	.27(.13)**	1.6(1.8)	.14(.091)	.30(.25)
Import and export sector	-.049(.10)	-.14(.10)	-.95(1.1)	-.049(.11)	-.12(.28)
$\rho$	-	-	.23(.45)	-	-.13(.23)
Number of observations	389	389	389	389	389
Chi-square statistic of Wald test of $\rho=0$	-	-	.25	-	-
Chi-square statistic of likelihood-ratio test of $\rho=0$	-	-	-	-	.31

Note. The data between the parentheses are standard deviations.

- \* Significance at the 10% level.
- \*\* Significance at the 5% level.
- \*\*\* Significance at the 1% level.

Mainland China will decrease the probability by 0.17 (17%). However, the probability of not staying in Guangdong for a firm in the textiles sector, in comparison with its counterparts in the reference industry sectors (all sectors not covered by the six sector dummies), is 0.25 (25%) higher. Textiles firms seem to be affected by the challenging business environment more powerfully than firms in the reference group are. Public financial support for innovation from the governments of Hong Kong, Guangdong or Mainland China has no material impact on relocation decisions.

4.2. Endogeneity bias in the baseline model

A careful examination of the two innovation proxies reveals possible endogeneity in the baseline model. A firm might decide not to engage in innovation or R&D and collaborative innovation activities in Mainland China while facing market and environmental pressures because innovative activities are costly and risky. In other words, the not-staying-in-Guangdong decision and the decision about innovation might be jointly determined, which would lead to endogeneity bias. We are able, however, to rule out—to some extent—reverse causality running from the not-staying-in-Guangdong decision to the innovation decision because the former (a dependent variable) depends on a firm’s plans for the 2009–2010 period, while the latter (innovation proxies) cover the observation period of 2006–2007, and the business environment in Guangdong began souring in mid-2007. We nevertheless suspect the presence of endogeneity, provided that our data is cross-sectional.

To correct for such potential endogeneity bias, we estimate an instrumental variable Probit model below:

$$y_1^* = y_2\beta + x_1\gamma + u, \quad y_1 = 1 \text{ if } y_1^* > 0, 0 \text{ otherwise,} \quad (2)$$

$$y_2 = x_1\lambda + x_2\varphi + v, \quad (3)$$

$$\text{corr}(u, v) = \rho, \quad (4)$$

where  $(u, v)$  has a zero mean, bivariate normal distribution and is independent of  $x_1$  and  $x_2$ ,  $y_1^*$  is a latent variable,  $y_2$  is endogenous in Eq. (2),  $x_1$  are the exogenous independent variables, and  $x_2$  are

instrumental variables. The model is estimated by conditional maximum likelihood (Stata, 2007: 21–24). Whether  $y_2$  is exogenous can be tested with the null hypothesis  $\rho=0$  (Wooldridge, 2002: 472–477). If  $\rho=0$ , then  $u$ , and  $v$  are independent and there is no endogeneity problem.

The qualified instrumental variables need to be highly correlated with endogenous variables  $y_2$  but not correlated with the residual of the structural function (Eq. (2))  $u$ . We choose the importance to a firm of scientific journals and trade/technical publications as a source of information for innovation as our instrumental variable. The value of the variable equals 3 if scientific journals and trade/technical publications are ranked ‘high’ in importance by a firm. The value equals 2 if journals and publications are ranked ‘medium’ in importance, 1 if they are ranked ‘low’ in importance, and 0 if they are not relevant. Firms with greater new product share or that engage in R&D or innovation collaboration in Mainland China should source more of the information they rely on from scientific journals and trade/technical publications than their counterparts do. This is confirmed by the results of a first-stage regression of the instrumental variable Probit model (columns 2 and 3 in Table 5). However, the importance of scientific journals and trade/technical publications does not contribute to a firm’s not-staying-in-Guangdong decision, nor does such a decision affect its perception of the importance of journals and publications as sources of information for innovation. As a result, the instrumental variable is not correlated with the residual  $u$ .<sup>10</sup>

<sup>10</sup> In order to confirm that the importance of scientific journals and trade/technical publications is not correlated with the residual  $u$ , we implement an overidentifying restriction test that is based on Newey (1987) and Lee (1992). The Stata command/ado file is programmed by Baum et al. (2000). To perform the test, we include another instrumental variable—the importance of information within the enterprise or enterprise group as an innovation information source, to yield one overidentifying restriction. The variable is defined in the same way as the variable of importance of scientific journals and trade/technical publications. The value of the variable equals 3 if information within the enterprise or enterprise group is ranked ‘high’ in importance by a firm 2 if information within the enterprise or enterprise

**Table 5**  
Tobit model, first stage of the instrumental variable Probit model and bivariate Probit model.

Independent variable	Dependent variable		
	New product share (censored variable) Tobit model (coefficients) (1)	Predicted new product share (continuous variable) First stage of IV Probit model (coefficients) (2)	R&D or innovation collaboration in Mainland China (binary variable) Bivariate Probit model (coefficients) (3)
Importance of scientific journals and trade/technical publications as sources of innovation information (instrumental variable)	–	1.0(.36)***	.59(.078)***
Financial support for innovation from Hong Kong and Guangdong governments	–	–.82(1.4)	.35(.29)
Financial support for innovation from central government in Mainland China	–	5.7(2.1)	.82(.48)*
Firm size	3.9(2.0)**	–	–
Apparel sector	–9.9(11)	–10.2(1.1)***	–.091(.23)
Textiles sector	–5.1(13)	–4.0(1.2)***	–.067(.26)
Plastic products sector	1.5(13)	3.0(1.3)**	–.31(.29)
Fabricated metal products sector	15(14)	13(1.4)***	.18(.30)
Electronic parts and components sector	24(12)**	27(1.2)***	.47(.25)*
Import and export sector	–14(15)	–17(1.4)***	–.16(.31)
Number of observations	389	389	389

Note. The data between the parentheses are standard deviations.

- \* Significance at the 10% level.
- \*\* Significance at the 5% level.
- \*\*\* Significance at the 1% level.

It is difficult to implement the instrumental variable Probit model (Eqs. (2–4)) vis-à-vis our data because new product share is a censored variable and R&D or innovation collaboration in Mainland China is a binary variable. This violates the assumption that  $y_2$  given  $x_1$  and  $x_2$  is normal, because  $v$  is normally distributed. Below we undertake a separate analysis for each potential endogenous variable.

4.2.1. New product share

It is extremely difficult to estimate an instrumental variable Probit model with a censored endogenous variable. We are not able to estimate such a model directly, but we are able to replace the original censored endogenous variable with a new continuous variable that can also measure the ratio of new product sales to total sales. We consider regressing new product share on firm size and the six sector dummies with the following Tobit model,

$$y = 0, \quad \text{if } y^* \leq 0 \tag{5}$$

$$y = y^*, \quad \text{if } 0 < y^* < 100 \tag{6}$$

$$y = 100, \quad \text{if } y^* \geq 100 \tag{7}$$

$$y^* = x\beta + \varepsilon \tag{8}$$

where  $y^*$  is an unobserved latent variable and  $y$  is an observed variable. In contrast to new product share, which is censored at values of 0 and 100, the Tobit model's linear prediction (latent variable)  $y^*$  is normal. In addition,  $y$  and  $y^*$  both indicate share of new product sales in total sales. We can replace the original new product share with its linear prediction in Eqs. (2–3) and implement the instrumental variable Probit model.

group is ranked to be of medium-level importance, 1 if ranked to be of low-level importance and 0 when they are not relevant to the firm. Similarly, the importance of information within the enterprise or enterprise group is highly correlated with the innovation proxies, but does not contribute to the not-staying-in-Guangdong decision. The result is available upon request from the authors. The Chi-square statistic of the test is 0.28 with a  $P$ -value 0.60. The null hypothesis that instrumental variables  $x_2$  are independent of  $u$  is thus not rejected, which confirms the validity of the instrumental variables.

Compared with small firms, large firms are better able to generate funds internally or to raise capital from external sources with which to invest in innovation projects, and larger firms benefit from economies of scale when undertaking innovation activity. Empirical research has consistently found that the probability that a firm pursues innovation increases with firm size (Veugelers and Cassiman, 1999; Bartoloni and Baussola, 2001; Mohnen and Dagenais, 2002; Rammer et al., 2009). We thus include firm size as an explanatory variable in the Tobit model (Eqs. (5)–(8)). Firm size is defined as a logarithm of number of employees in 2007. Its coefficient is statistically significant and positive in the model (column 1, Table 5).

The marginal effects of the predicted new product share are statistically significant and negative in the baseline Probit model (column 2 in Table 4). Exogeneity in the instrumental variable Probit Model (column 3 in Table 4) cannot be rejected by our sample because the null hypothesis,  $\rho = 0$ , is not rejected. Although we did not perform this test on the original new product share construct, given the underlying economic meaning of the linear prediction of new product share from the Tobit model, it suffices for the purpose of testing endogeneity of the innovation proxy in the structural function that models a firm's not-staying-in-Guangdong decision. The result considerably relieves our worry that the estimation of new product share might be biased by endogeneity.

4.2.2. R&D or innovation collaboration in Mainland China

Because R&D or innovation collaboration in Mainland China is a binary variable, we are able to test its exogeneity using the following bivariate Probit model (Wooldridge, 2002: 477–478):

$$y_1^* = y_2\beta + x_1\gamma + u, \quad y_1 = 1 \quad \text{if } y_1^* > 0, 0 \quad \text{otherwise}, \tag{9}$$

$$y_2^* = x_1\lambda + x_2\varphi + v, \quad y_2 = 1 \quad \text{if } y_2^* > 0, 0 \quad \text{otherwise}, \tag{10}$$

$$\text{corr}(u, v) = \rho, \tag{11}$$

where  $(u, v)$  has a zero mean, bivariate normal distribution, is independent of  $x_1$  and  $x_2$ , and each has unit variance. This bivariate Probit model can be understood by comparison to a Seemingly Unrelated Regressions model, which is used to test the not-staying-in-Guangdong decision and innovation decision jointly. If the null

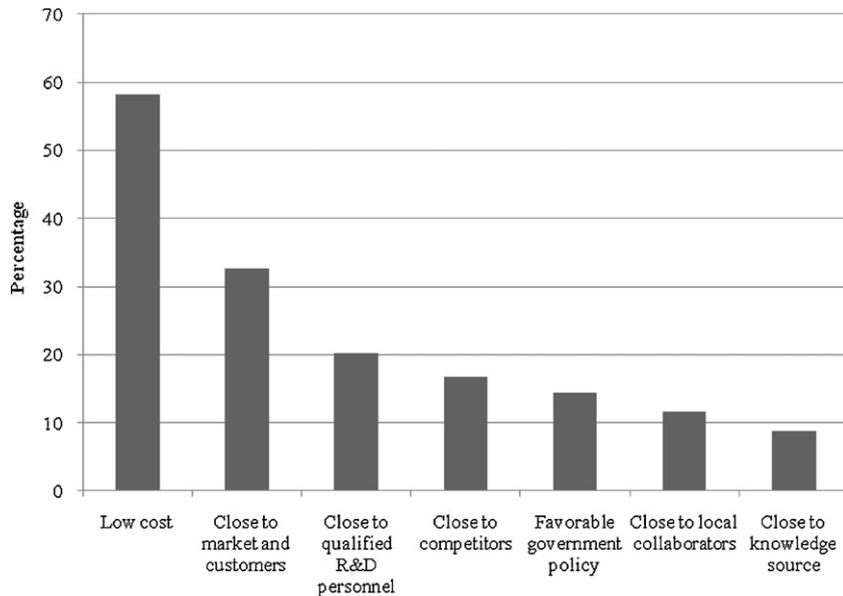


Fig. 2. Percentage of respondents (138 firms) rating R&D and cooperation for innovation activities in Mainland China with a high degree of importance.

hypothesis of  $\rho = 0$  is not rejected, which means that the two decisions are not correlated, the two Probit equations (Eqs. (9) and (10)) can be estimated separately, and the log likelihood of the bivariate Probit model equals the sum of the log likelihoods of the two univariate Probit models. In this case,  $y_2$  is exogenous. In estimating the bivariate Probit model using our data, we performed a likelihood-ratio test and the results show that the null hypothesis of  $\rho = 0$  cannot be rejected (column 5 in Table 5). Therefore, there is insufficient information in the sample to reject the hypothesis that R&D or innovation collaboration in Mainland China is exogenous in the model.

In summary, the econometric analyses of the surveyed data reveal that Hong Kong-owned manufacturing firms in Guangdong whose business strategy included either greater new product share or R&D or innovation collaboration in Mainland China were more likely to weather the challenging market and environmental pressures. R&D and, more broadly, innovation are costly and risky activities requiring firms to obtain internal sources of finance or to raise capital from external sources to purchase laboratory equipment and advanced instruments and to hire qualified personnel. Firms that depend on a greater share of new product sales as a percentage of total sales or undertake R&D or innovation collaboration activities in Mainland China are presumably more competitive and

have sufficient resources to absorb the negative impact of the challenging business environment 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. For such firms, the odds of survival in Guangdong, and of not feeling pressure to relocate elsewhere, would thus be more favorable.

Financial support for innovation from the governments of Hong Kong, Guangdong, or Mainland China has no material impact on the not-staying-in-Guangdong decision and, surprisingly, almost no influence on either new product share or the decision to engage in R&D or innovation cooperation in Mainland China (with one exception in the regression of column 3, Table 5). Perhaps most of the innovation policies in the region, particularly those enacted by the Guangdong or Mainland central governments, have benefited primarily state-owned enterprises or large companies, or have targeted R&D activities in high-technology sectors while overlooking innovative activities in the low- and medium-technology industries. Because a significant proportion of Hong Kong-owned manufacturing firms in Guangdong operate in labor-intensive low- and medium-tech sectors, government sources provide little public financial support for innovation activities in these firms.

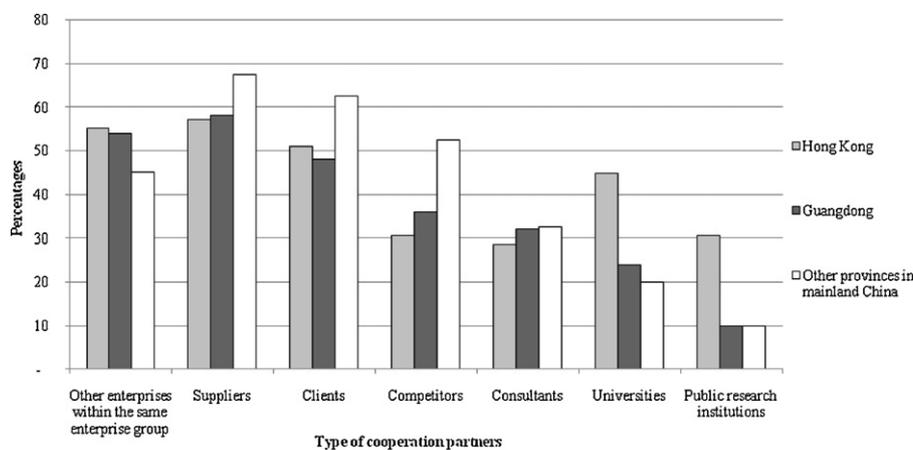


Fig. 3. Percentage of respondents indicating partnerships by type of partner in the area.

#### 4.3. R&D and innovation collaboration on the part of Hong Kong-owned manufacturing firms in Guangdong

A close look of the data generates additional insights on the motivations driving Hong Kong-owned manufacturing firms to undertake R&D or collaborative innovation activities in Mainland China. As shown by Fig. 2, “low cost” and being “close to the market and customers” are the two primary motivations. Nearly 60% of the respondents regard “low cost” and about 30% consider being “close to the market and customer” as highly important reasons for carrying out R&D or collaborative innovation activities in Mainland China.

An analysis of the types of partners that Hong Kong-owned manufacturing firms have chosen for collaborative innovation also supports the above finding pertaining to innovation and the relocation decision (Fig. 3). Regarding collaborating with partners from their own enterprise groups, suppliers, clients, and consultants, 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 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 and public research institutions in Mainland China are not regarded as reliable sources of knowledge for Hong Kong-owned manufacturing firms in Guangdong. Similarly, “close to the knowledge source” is the weakest motivation for Hong Kong-owned manufacturing firms to undertake R&D or collaborative innovation activities in Mainland China.

### 5. Conclusions and discussion

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 decisions of these firms with respect to relocating from Guangdong or ceasing operations altogether. Firms that choose the latter option judge that moving to neighboring provinces is, in actuality, not a viable option insofar as neighboring provinces do not offer the key cultural and geographical affinities that make Guangdong attractive to Hong Kong firms. 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 (cf. Zhang, 2005; Hollows, 1999; Wong, 1988)—but has not considered survival, relocation, or innovation strategies, much less strategies for facing challenging business conditions. Admittedly, 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 Mainland China, as manufacturing activity moves inland to Mainland China's hinterland provinces (such as Jiangxi, Hunan, Shanxi, Guizhou, Henan, Anhui, and Hubei), in which the central government is actively promoting manufacturing activity, not only from the Pearl River Delta region, but also from the Yangtze River Delta region. Such lessons apply both at the firm level and at the provincial government level (cf. Sharif and Tseng, 2011), provided that such governments are indeed keen to exploit this trend in some way (which depends, understandably, on whether the policymak-

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

The findings of this research show that Hong Kong-owned manufacturing firms in Guangdong whose market strategies aim at a higher share in new product sales as a percentage of total sales or who engage in R&D or collaborative innovation activities in Mainland China are more likely to weather the challenging market and environmental pressures they face. Such firms are less likely to close down or to move their business operations out of Guangdong. Furthermore, the data show that “low cost” and “close to the market and customers” are the two primary motivations inducing Hong Kong-owned manufacturing firms in Guangdong to undertake R&D or collaborative innovation activities in Mainland China. Finally, universities and public research institutions in Mainland China are not sources of knowledge for Hong Kong-owned manufacturing firms in Guangdong.

This research yields policy implications for both the Guangdong provincial government and the Hong Kong Special Administrative Region government. While Steinfeld (2004) identifies impediments created by legacies of macro-level Chinese reform style, bottlenecks in the institutional reform process, and inconsistencies in central government policies in China's industrialization, this research identifies by contrast areas that provincial authorities would do well to target for improvement.

In particular, the research points to the need, first, to strengthen links between universities and public research institutes and industry (cf. Sharif and Baark, 2011; Eom and Lee, 2010; Motohashi and Yun, 2007; Berger and Diez, 2006), especially given how much public funding is devoted to the development of such research institutions in both areas (Sharif and Baark, 2009). Not only would this allow Hong Kong-owned manufacturing companies to survive in Guangdong (ensuring the sustainability of Hong Kong's manufacturing-related service-based economy), but it would also increase the likelihood that these companies—operating mostly in labor-intensive low- and medium-tech sectors—would move up the value chain and engage in innovative activities related to the products they manufacture (a major goal for Guangdong's government in instigating the new policy measures). Strengthening links between actors in an innovation system is a particularly important lesson for emerging economies around the world (Lundvall et al., 2006). 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 stage of maturity of actors within an innovation system, such actors forge strong links with 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 (cf. Edquist, 2005).

Second, considering the issues more broadly, this research suggests that it may indeed make sense for policymakers on both sides of the Guangdong/Hong Kong border (and, by extension, policymakers governing activity in other developing regions) to seriously consider the viability of devoting resources to the development of a genuinely regional innovation system, whereby the two regions' strengths and capacities are combined—if the goals of both Hong Kong and Guangdong are to be achieved (HKSAR, 2004). This type of integration is important in a region featuring rapid development and growing innovation linkages. Insofar as the results of our research have shown that government financial support from Hong Kong, Guangdong, or Mainland China has no impact on a firm's decision to engage in innovation, and only a weak impact on its decision to carry out R&D or innovation collaboration in Mainland China, it follows that it would be wiser for policymakers at any level

of government to allocate resources not only exclusively to firms in high-tech sectors in support of their R&D activities, but also to make sure these allocations support broader innovation activities such as acquiring advanced machinery and equipment, implementing advanced training programs, and purchasing or licensing patents or other knowledge-based resources, particularly in the low- and medium-tech sectors. Not only would this allow Hong Kong-owned manufacturing firms to survive and thrive in Guangdong, becoming more deeply integrated into Guangdong's economy by taking advantage of the strengths of Guangdong's innovation system, but it would also allow Guangdong's firms to take advantage of the strengths offered by Hong Kong's innovation system (especially the higher education institutes) in their attempts to move up the value-added chain (Yam et al., 2011).

Such development of innovative capacity, 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 in Guangdong or Hong Kong—in which those strengths may be found (Huang and Sharif, 2009). With their strengths combined, such manufacturing and service firms would be more likely to develop intellectual assets, production skills, modes of serving customers, and products that can be understood as proprietary assets that are irreproducible by other firms in their immediate environment—an achievement that both Hong Kong and Guangdong's policymakers would warmly welcome.

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