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A comparison of innovation capacity at science parks across the Taiwan Strait: the case of Zhangjiang High-Tech Park and Hsinchu Science-based Industrial Park

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Abstract

This paper aims to explore the innovation capacity in two different science parks across the Taiwan Strait. In both Taiwan and China considerable resources are being devoted to science parks as policy instruments aimed at promoting R&D-based as well as innovation activities. For this study, we chose the Zhangjiang High-Tech Park (ZJHP) of China and the Hsinchu Science-based Industrial Park (HSIP) of Taiwan to compare innovation capacity. Based on Porter's (The Competitive Advantage of Nations, Free Press, New York, 1990; Cluster and Competition: New Agendas for Companies, Governments, and Institutions, on Competition, Harvard Business School Press, Boston, MA, 1998; Econ. Develop. Quart. 14 (1990, 1998, 2000) 15) model for the innovation orientation of national industrial cluster, this paper proposes a model to analyze the science parks in innovation capacity across the Taiwan Strait. We found differences in determinants for innovation capacity between the ZJHP and HISP, such as the "basic research infrastructure", "sophisticated and demanding local customer base", and "the presence of clusters instead of isolated industries".

Keywords: Science park; Innovation capacity; Industry migration; Clustering

1. Introduction

Science parks provide an important resource network for new technology-based enterprises. Castells and Hall (1994) listed three motivations for establishing science parks: reindustrialization, regional development, and synergy creation. The first two motivations are straightforward and could be described as science and technology (S&T) development and regional renewal. The third motivation involves the promotion of technology transfers from universities or research institutes to enterprises. At science park's geographic proximity, it could be viewed as "the generation of new and valuable information through human intervention" to the extent that an "innovative milieu", which generates constant innovation, is created and sustained (Castells and Hall, 1994; Phillimore, 1999).

The underlying assumptions and performance involved in the issue of "science park" have been researched. However, the results from these researches have not been unanimous (see Castells and Hall, 1994; Massey et al., 1992; Westhead and Storey, 1995; Vedovello, 1997; Storey and Tether, 1998; Phillimore, 1999). Park to park interaction and differences between parks have not been examined. Many of the determinants and advantages of science park are more different across nations than within a nation. Government policy, legal rules, capital market conditions, factor costs, and many other attributes make these differences important (Porter, 1990). Of particular importance has been the development of free trade zones around the world that allow the increasingly free movement of capital and in some cases, such as the European Union, human resources move across geographical regions (Yeung, 1999; Clement et al., 1999). The increasing factor movement liberalization provides enterprises with greater opportunities for competition across markets differentiated by their characteristics (Arita and McCann, 2002). In this paper, we explore the differences in innovation capacity between science parks across nations.

Taiwan is one of the world's largest manufacturers of high-technology (high-tech) components and products. Taiwan maintains its current long-term competitive position through investment in research and development (R&D) and advanced manufacturing techniques. The Hsinchu

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Science-based Industrial Park (HSIP) is the pivot base in Taiwan. The HSIP model has been used in southern Taiwan as well as in markets outside of Taiwan. Singapore, Shenzhen, and Shanghai all have science parks that beckon high-tech investors with clusters of technical excellence and attractive investment enticements. The China government has engaged in science park establishment as a critical policy for developing high-tech industries. China's goal is to reduce its dependence on high-tech product imports and build its domestic innovation capacity. Through years of investment and effort, several science parks have been developed. The Shanghai Zhangjiang High-Tech Park (ZJHP) has the most potential. In 1998, as the China market boomed, its increasing market share became a magnet attracting Taiwan investors. Taiwanese investors favored electronics and information, precision instruments, base metals, and plastics. To attract further attract, Taiwanese high-tech industries' movement across the strait, the Chinese government has introduced a number of investment incentives and benefits, such as low tariffs and tax exemptions. Taiwan companies that move there enjoy lower production costs and access to a super-sized domestic market. Of the Chinese electronics industry's US $ 25.5 billion in hardware production in 2000, 70% was generated by foreign firms. Seventy percent of the foreign total was generated by Taiwanese enterprises. The migration of Taiwan's high-tech industry to China is further perceived as fueling the growth and prosperity of a dreadful opponent at the expense of Taiwan's own future. The Chinese government declared that ZJHP is primed to develop into a new "Silicon Valley" for the whole of China. That ZJHP will someday rival Taiwan's renowned HSIP is no longer distant. The differences between the science parks in innovation capacity across the Taiwan Strait is a critical subject that lacks sufficient analysis. For this paper we chose ZJHP and HSIP for an empirical study to determine the different innovation capacities between ZJHP and HSIP. In this study, we based our model on Porter's (1990, 1998, 2000) model for the innovation orientation of national industrial cluster innovation. We used published or archived data analyses, questionnaire surveys, and in-depth interviews to explore the different innovation capacities between ZJHP and HSIP (e.g., Hsu et al., 2003).

This paper is organized as follows. Section 2 reviews the relevant literature on science parks and industrial clusters. Section 3 summarizes the situations at ZJHP and HSIP. Model and methodologies applicable to the proposed model is described in Section 4. Section 5 explores the differences between ZJHP and HSIP in innovation capacity through the proposed model. The conclusion is presented in Section 6.

2. Science park

The science park concept was originated in the late 1950s. The idea was, and still is, to provide a technical, logistical, administrative, and financial infrastructure to help young enterprises gain a toehold for their products in an increasingly competitive market. Science parks are usually based around universities and interact continuously with them (Guy, 1996). Monck et al. (1988) argued that funding for science parks generally comes from five sources: universities (including bank borrowing); local authorities; government development agencies; private sector institutions, and the tenant enterprises themselves.

Governments devote considerable resources to science parks as policy instruments aimed at promoting research-based industrial and innovative activity (Löfsten and Lindelöf, 2002). Lorenzoni and Ornati (1988) suggested that enterprises located in "constellations" are more willing to seek information from outside sources such as higher education institutes, consultants, and community entrepreneurs than off-park enterprises. Comparing the differences between science park and off-park enterprises, the observed differences could reflect the motivations of the enterprises as well as the benefits of a science park location (Löfsten and Lindelöf, 2002). Felsenstein (1994) suggests science parks are "enclaves" for innovation. A cluster is defined as groups of related enterprises located in one geographical region or centered at a nation's science-based park (Baptista and Swann, 1998). The clustering and interchange process among industries in the cluster also works best when the industries involved are geographically concentrated. Many of the determinants for innovation capacity are more similar within a nation than across nations. Government policy, legal rules, capital market conditions, factor costs, and many other attributes that are common to a country make these differences important (Porter, 1990).

Porter (1990, 1998, 2000) proposed a model to analyze local clusters using a four-dimensional diamond metaphor that includes "factor conditions", "demand conditions", "related and supporting industries", and "firm strategy, structure and rivalry". This will be described, in detail, in Section 4.

A literature review shows that differences between science parks in innovation capacity from two nations have existed, and cluster drivers might account for some of these differences. There are no developing Asian country cases reported in the literature. This paper proposes a model to explore the different innovation capacities between ZJHP and HSIP.

3. Science parks across the Taiwan Strait

3.1. Zhangjiang Hi-Tech Park: an overview

Lujiazui is the tip of the newly developed Pudong District beyond the Bund. Further out is the Waigaoqiao tax-free zone, the Jinqiao export processing zone, and the Kangqiao Industrial Park. At the center of all this is the ZJHP, a park surrounded by several national R&D institutes and national universities. ZJHP was established in 1992 as a national-level park designed for high-technology development. The Shanghai Municipal Government issued a "Focus on ZhangJiang" policy to accelerate the ZJHP's rate of development. This acceleration included one-stop service for incoming enterprises, venture capital and special funds for entrepreneurs, tax and financial incentives and industry, education, and R&D integration. Through these efforts, the following industries have been developed: integrated circuits (IC), software, information security, biotechnology (biotech), and pharmaceutical industry. In the first 8 years of development, this park became the home to various national-level bases, including the State Bio-Tech and Pharmaceutical Base (Shanghai), the National Information Technology Industry Base, the National Science and Technology Innovation Base, and the National 863 Information Security Industry Base. The park now houses 287 international and domestic enterprises with a total investment of US $ 4.4 billion. Shanghai Jiao Tong University and Fudan University are both advanced academic institutes in Shanghai and national critical universities in China. They provide Shanghai ZJHP with high-quality human resources and on-job training (e.g., EMBA program). These universities generate many start-up enterprises in parks as well. It is helpful for universities to focus their research more closely on the needs of industry. In 2000, the ZJHP's industrial earnings were over 53.38 billion RMB. This clustering effect has been especially successful for biotech/pharmaceutical and IC industries.

3.2. Hsinchu Science-based Industrial Park: an overview

Established in December 1980 to engage high-tech enterprises, develop brand new technological industries, and improve current industrial technologies, the HSIP is located in Hsinchu, Taiwan, stretching over both Hsinchu City and Hsinchu County. Several competent actors support the HSIP: The Industrial Technology Research Institute (ITRI), National Chaio Tung University (NCTU), National Tsing Hua University (NTHU), and three national laboratories. The HSIP was the first high-tech industry development center in Taiwan. This park has achieved a remarkable worldwide reputation. Entirely government oriented, this park was developed using public land, publicly funded infrastructure facilities, efficiently supported one-stop service, automated customs services, on-the-job training, a domestic and international network, investment incentives and benefits.[1] The following industries have been developed and are flourishing: IC, computers and peripherals, telecommunications, opto-electronics, precision machinery, and biotech. With more than US $ 912 million invested by the government in infrastructure over the past 20 years, by the end of 2001, 312 companies in the HSIP employed 96,293 people. ITRI is a national-level, government-sponsored non-profit institute for applied research in Taiwan. From 1986 to 1997, about 7500 ITRI employees moved from ITRI to jobs in the private sector. About 31.9% of these moved to companies in the HSIP, and 15.18% of these former ITRI employees went on to hold positions as CEOs or board members (Hung, 1998). NCTU and NTHU are both advanced S&T academic institutes in Taiwan, especially in electronics and information. They furnish the HSIP with talent enforcement activities, high-quality human resource, and R&D support. The HSIP also houses three national laboratories: the National Center for High-performance Computing, the Synchrotron Radiation Research Center, and the National Space Program Office. The Precision Instrument Development Center, the Chip Implementation Center, and the National Nano Device Laboratories, NCTU, also cooperate closely with HSIP. HSIP enterprises spent US $ 1578 million on R&D in 2000, which represents 5.4% of the total annual sales revenue, but only 1.3% of the overall manufacturing industry in Taiwan. The clustering phenomenon was established at the HSIP.

Both the ZJHP and the HSIP have special characteristics compared to those in other nations. Both parks are attached to higher education and research institute. Both parks are well integrated into the life of a district or city. The central government provides strong policy guidance, financial support, and staffing for both parks. Preferential fiscal and other incentives are present and together with a buoyant economy, help attract considerable foreign investment.

4. Remarks on the model and methodologies

Porter (1990) developed a model enumerating the environmental characteristics of the innovation orientation of a nation's industrial clusters. As several researchers have emphasized, it is important to recognize the dynamics of innovation within clusters, and particularly the role of the dynamic interactions between clusters and specific institutions—from universities to public institutes—within given geographic areas (Porter, 1990, 1998; Niosi, 1991; Carlsson and Stankiewicz, 1991; Audretsch and Stephan, 1996; Mowery and Nelson, 1999). Porter's (1990, 1998, 2000) model encapsulates these forces by identifying four critical drivers (see Fig. 1). The first is the availability of high-quality and specialized innovation inputs. For example, the overall availability of trained scientists and engineers are important for economy-wide innovation potential. The second driver is the nature of the domestic and international demand for cluster producers and services. Demanding customers encourage domestic firms to offer best-in-the world technologies and raise the incentives to pursue globally novel innovations. The third driver is the extent to which the local competitive context is intense

[1] The investment incentives and benefits include tax incentives, protection of investors' rights, governments participation in investment, capitalization of technical expertise, capital raising, low-interest loan, and R&D encouragement.

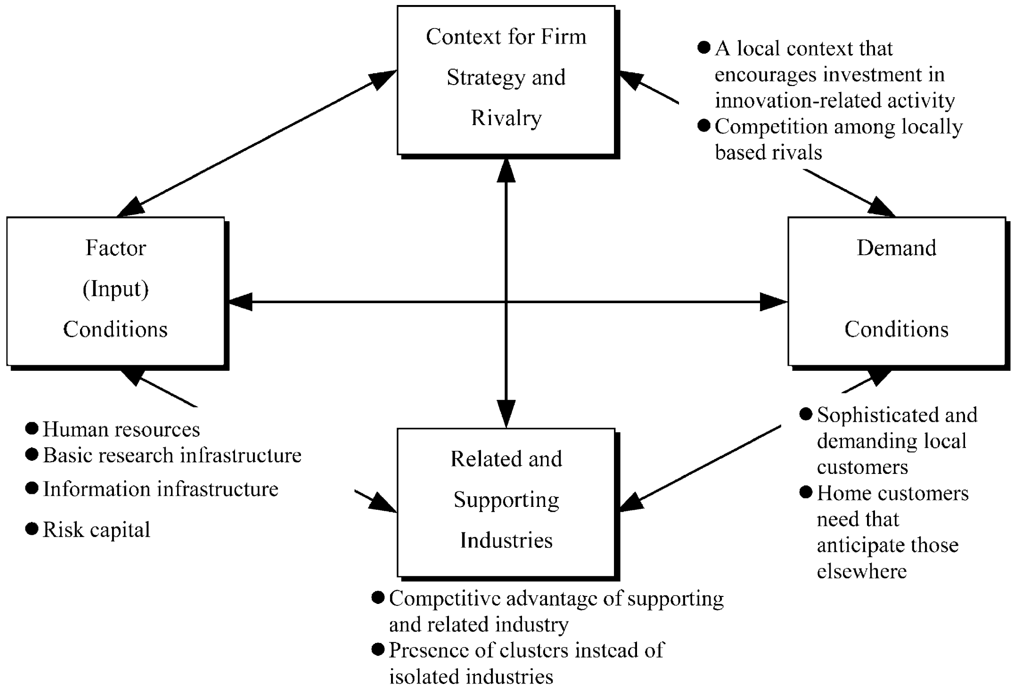

Fig. 1. The innovation orientation of national industry cluster. *Source*: Furman et al. (2002).

and rewards successful innovators. Effects of this depends on general innovation incentives such as intellectual property protection and regulations affecting particular products, consistent pressure from intense local rivalry, and openness to international competition in the cluster (Sakakibara and Porter, 2000). The last driver is the availability, density, and interconnectedness of vertically and horizontally related industries. This combination generates positive externalities both from knowledge spillovers, transactional efficiencies, and cluster-level scale economies, which are enhanced when clusters are concentrated geographically (Furman et al., 2002). In this model, each driver not only interacts with the others but also affects the cluster, and the cluster affects each driver of that cluster correspondingly. This paper proposes this model to explore the differences between the science parks in innovation capacity across the Taiwan Strait. With this model significant differences might be observed, described, and evaluated (Hsu et al., 2003).

To facilitate exploring the different innovation capacities of the science parks across the Taiwan Strait several methodologies will be introduced. Data analysis of published or archived data is widely utilized in the literature as an objective method for corroborating proposed models and hypotheses. The questionnaire survey is a multi-purposed approach capable of measuring either substantial or intangible indicators. The in-depth interview is a judgment-based approach that can help researchers to know the holistic system and the insider operations that are important for identifying critical drivers and inter-relationships (e.g., Hsu et al., 2003).

5. Exploring the differences between science parks in innovation capacity across the Taiwan Strait

5.1. Sample

A questionnaire survey study was selected to provide information about the 10 determinants for the four critical drivers (see Fig. 1) in Porter's (1990, 1998, 2000) model for the innovation orientation of national industrial cluster to explain any disparities in the innovation capacity (ZJHP and HSIP). Stakeholders in each science park were asked to describe their perceptions of the science park impact on the 10 determinants for the four critical drivers using a 5-level scale (1 = significant negative effect, 2 = negative effect, 3 = no effect, 4 = positive effect, 5 = significant positive effect). Of the 500 questionnaires sent out, we collected 263 valid returns, making a 52.6% valid return rate. In this survey, the majority of the respondents were managers at foreign-owned enterprises, locally owned enterprises, R&D institutions, and local government officials at the ZJHP and HSIP. Of the 263 valid questionnaires, 162 were from the ZJHP and 101 were from the HSIP. Table 1 shows the descriptive statistics.

5.2. Empirical results

After the questionnaire collection was completed in April 2003, one-way ANOVA (parametric method) and the Kruskal–Wallis (K–W) test (non-parametric method) were used to examine if both science parks exhibited four critical drivers toward the effect. The results are shown in Table 2.

Table 1
Descriptive statistics for replies

	ZJHP	HSIP
A. Factor conditions[a]	3.527 (0.709)[b]	3.599 (0.573)
A.1. Human resources	3.685 (0.635)	3.693 (0.957)
A.2. Basic research infrastructure	3.747 (0.643)	3.297 (0.901)
A.3. Information infrastructure	3.605 (0.751)	3.951 (0.654)
A.4. Risk capital	3.241 (0.825)	3.455 (0.807)
B. Demand conditions	3.435 (0.543)	3.723 (0.618)
B.1. Sophisticated and demanding local customers	3.118 (0.491)	4.327 (0.602)
B.2. Home customer needs that anticipate those elsewhere	3.560 (0.699)	3.704 (0.787)
C. Related and supporting industries	3.224 (0.709)	4.203 (0.520)
C.1. Competitive advantage of supporting and related industry	3.296 (0.713)	4.020 (0.583)
C.2. Presence of clusters instead of isolated industries	3.358 (0.745)	4.386 (0.616)
D. Context for firm strategy and rivalry	3.563 (0.710)	3.861 (0.605)
D.1. A local context that encourages investment in innovation-related activity	3.562 (0.780)	3.703 (0.867)
D.2. Competition among locally based rivals	3.784 (0.685)	4.020 (0.583)

[a] In each questionnaire, the grades of the determinants in one driver are averaged into the driver's grade.
[b] The number in the bracket is the standard deviation.

Using one-way ANOVA and the K–W test, the means and medians[2] were significantly different for seven determinants for the four drivers at the 0.05 significant levels.

To determine the priority for the two science parks on the 10 determinants for the four critical drivers, we used pairwise comparisons (see Table 3). Results indicated that the ZJHP is significantly superior to the HSIP in "basic research infrastructure". Excluding "human resources", "basic research infrastructure", "home customer needs that anticipate those elsewhere", and "a local context that encourages investment in innovation-related activity", the HSIP was significantly superior to the ZJHP for each determinant for the four drivers.

To produce a rank that indicated the sequence for the four drivers' effects on ZJHP and HSIP respectively, we applied the Tukey multiple comparison test (see Tables 4 and 5). The priority for the four drivers' effects on the ZJHP were ranked as "factor conditions", "demand conditions", "context for firm strategy and rivalry", and "related and supporting industries". However, this was not significantly different from the preceding three drivers. The priority for the four drivers' effects on HSIP were ranked as "related and supporting industries", "context for firm strategy and rivalry", "demand conditions", and "factor conditions". However, the "context for firm strategy and rivalry", and "demand conditions" are not significantly different.

[2] The K–W test is a non-parametric test for the null hypothesis that k samples from possibly different populations actually originate from similar populations, at least as far as their central tendencies or medians are concerned. The test assumes that the variables under consideration have underlying continuous distributions.

Table 2
Results of ANOVA and Kruskal–Wallis test for 10 determinants of four drivers

	Significance levels of ANOVA[b]	Significance levels of K–W test[b]
A. Factor conditions[a]	0.306	0.213
A.1. Human resources	0.936	0.328
A.2. Basic research infrastructure	0.000	0.000
A.3. Information infrastructure	0.000	0.000
A.4. Risk capital	0.039	0.044
B. Demand conditions	0.000	0.000
B.1. Sophisticated and demanding local customers	0.017	0.000
B.2. Home customers need that anticipate those elsewhere	0.170	0.123
C. Related and supporting industries	0.000	0.000
C.1. Competitive advantage of supporting and related industry	0.000	0.000
C.2. Presence of clusters instead of isolated industries	0.000	0.000
D. Context for firm strategy and rivalry	0.000	0.000
D.1. A local context that encourages investment in innovation-related activity	0.172	0.130
D.2. Competition among locally based rivals	0.004	0.004

[a] In each questionnaire, the grades of the determinants in one driver are averaged into the driver's grade.
[b] The difference is significant at the 0.05 level.

5.3. Discussions

Through a series of analyses of the different innovation capacities between ZJHP and HSIP was discussed based on four drivers.

5.3.1. Factor conditions

Results revealed that "human resources" for the two parks was not significantly different. In the last decade, the increase in the Chinese economy and the growing accumulation of industry in China's coastal regions steadily changed the industrial map of Asia. Coastal China has become a "magnet" for human resources for the nations surrounding China and worldwide. Shanghai is one of the most critical gateways to Central China and serves as the premiere high-tech industry area with the highest quality human resources in China. ZJHP even searched outside for talent to fulfill the huge demand for human resources in the high-tech sector.

Previously, Taiwan had accumulated strength in various industries, human talent, capital, and other resources. However, a reduction in already scarce education resources, coupled with an increase in the number of junior colleges has not produced a corresponding increase in instructional quality. With Taiwan's investment in elite education falling

Table 3
Results of pairwise comparisons for two science parks in each determinant

	i-Variable	*j*-Variable[a]	Mean difference (*i*–*j*)	Significance levels of ANOVA[b,c]	Pairwise comparisons[d]
A. Factor conditions	1	2	−0.001	0.306	
A.1. Human resources	1	2	−0.001	0.936	
A.2. Basic research infrastructure	1	2	0.450	0.000	(1, 2)
A.3. Information infrastructure	1	2	−0.346	0.000	(2, 1)
A.4. Risk capital	1	2	−0.215	0.039	(2, 1)
B. Demand conditions	1	2	−0.208	0.000	(2, 1)
B.1. Sophisticated and demanding local customers	1	2	−1.209	0.000	(2, 1)
B.2. Home customer needs that anticipate those elsewhere	1	2	−0.144	0.170	
C. Related and supporting industries	1	2	−0.979	0.000	(2, 1)
C.1. Competitive advantage of supporting and related industry	1	2	−0.724	0.000	(2, 1)
C.2. Presence of clusters instead of isolated industries	1	2	−1.028	0.000	(2, 1)
D. Context for firm strategy and rivalry	1	2	−0.298	0.000	(2, 1)
D.1. A local context that encourages investment in innovation-related activity	1	2	−0.141	0.172	
D.2. Competition among locally based rivals	1	2	−0.236	0.004	(2, 1)

[a] 1: ZJHP; 2: HSIP.
[b] The mean difference is significant at the 0.05 level.
[c] Adjustment for multiple comparisons: Bonferroni.
[d] (1, 2) means that ZJHP has significantly higher grade than HSIP at 0.05 significant level.

in relation to that of neighboring Japan and China and an evident lack of student motivation for higher education, Taiwan is in decline. This phenomenon is leading to stagnation in innovation capacity and industrial development. Furthermore, the outflow of human resources to China leaves the HSIP short of essential technical talent. With the vicissitudes of the Taiwan Strait, "human resources" was found not significantly different. Both the HSIP and the ZJHP should enhance the "education policy", such as technical education, continuing education, and retraining.

Table 4
Results of Tukey test for the ZJHP in four drivers

i-Variable	*j*-Variable[a]	Mean difference (*i*–*j*)	Significance levels of ANOVA[b]	Multiple comparisons[c]
A	B	0.001	0.414	
	C	0.305	0.000	(A, C)
	D	−0.001	0.939	
B	A	−0.001	0.414	
	C	0.212	0.003	(B, C)
	D	−0.128	0.148	
C	A	−0.305	0.000	(A, C)
	B	−0.212	0.003	(B, C)
	D	−0.340	0.000	(D, C)
D	A	0.000	0.939	
	B	0.128	0.148	
	C	0.340	0.000	(D, C)

[a] A: Factor conditions; B: Demand conditions; C: Related and supporting industries; D: Context for firm strategy and rivalry.
[b] The mean difference is significant at the 0.05 level.
[c] (A,B) means that factor conditions has significantly higher grade than demand conditions at 0.05 significant level.

After 20-year's operation, the quality of the infrastructure and living amenities in the HSIP has deteriorated and need renovation. Deficiencies in electrical power, and industrial water resources as well as traffic congestion and conflicts[3] between the HSIP and Hsinchu City have

[3] Although the HSIP contributes to Hsinchu City in terms of extending the development of the service industry, increasing employment opportunities, and income level of the citizens, it also induces a serious negative impact on the surrounding municipality. Problems such as traffic congestion, higher housing prices, and city river contamination from illegal chemical pollution that results from the inadequate sewerage infrastructure at the HSIP. Furthermore, the increase in population also resulted in a shortage of classrooms at elementary schools adjacent to the HSIP. However, since Hsinchu City is the home base of the park, the Taiwan's government upgraded its status with the "Local Autonomy Law" in 2000. Since the enactment the city government has started to manipulate the levers of city planning and development strategies to maintain its regional advantage and to readjust the relationship between the city and the HSIP. The city government's new agenda was finally accepted by the HSIP administration and is nurturing a localized "revolution in merging high-tech industry and urban development". The revolution is aimed at restructuring the city environs by launching development of several satellite Parks extending from the HSIP and by improving the capability of regional infrastructure including a light rail system, a sewerage system, and an e-government investment.

Table 5
Results of Tukey test for the HSIP in four drivers

i-Variable	*j*-Variable[a]	Mean difference (*i*–*j*)	Significance levels of ANOVA[b]	Multiple comparisons[c]
A	B	−0.124	0.428	
	C	−0.604	0.000	(C, A)
	D	−0.262	0.007	(D, A)
B	A	0.124	0.428	
	C	−0.480	0.000	(C, B)
	D	−0.139	0.325	
C	A	0.604	0.000	(C, A)
	B	0.480	0.000	(C, B)
	D	0.342	0.000	(C, D)
D	A	0.262	0.007	(D, A)
	B	0.139	0.325	
	C	−0.342	0.000	(C, D)

[a] A: Factor conditions; B: Demand conditions; C: Related and supporting industries; D: Context for firm strategy and rivalry.
[b] The mean difference is significant at the 0.05 level.
[c] (A, B) means that factor conditions has significantly higher grade than demand conditions at 0.05 significant level.

influenced park development. Satisfaction with the "basic research infrastructure" has fallen compared to the other eight determinants (see Table 1). "Public services policy" should be reinforced in the HSIP, such as construction, transport, maintenance, and supervision as well as innovation in health service.

The central, provincial, and Shanghai governments invested over 25 billion RMB in infrastructure from 1990 to 1995, an investment which included the construction of an expanded utility infrastructure. By 1995, new water plant, gas works, power plant, sewage facilities, and telephone lines had been built in the Pudong District. The second phase of infrastructural investment which began in 1996 included the construction of a new international airport, metro line, light rail line, ring road, information port, and harbor expansion. It was and still is important to lay the necessary groundwork to attract the type of development the ZJHP was planned to attract. Although the government set several goals for the ZJHP for the years leading up to 2010, the ZJHP might draw from the HSIP's.

5.3.2. Demand conditions

The HSIP has been significantly superior to the ZJHP in "supplying sophisticated and demanding local customers"; however, "home customer needs that anticipate those elsewhere" has not been significantly different. The income, consumption, information, and level of education of consumers in Taiwan are higher than those in China. Consequently, local customer sophistication and demand for products and technology are much more complex. To service consumers, Taiwanese high-tech enterprises possess quick response and diversification abilities. A large-scale domestic market, diverse nationality, and a priority for openness have contributed to several disparities among China's regions. Consequently, China has the potential for a very diverse market.

The HSIP with its small to medium-sized technology-based enterprises (insufficient R&D budget) took the lead among developing nations in adopting a technology acquisition and transfer strategy at the beginning of the 1980s. Through these enterprises' efforts in advanced manufacturing techniques and R&D capacity, foreign assemblers often purchased parts and eventually sold them as a part of completed systems to other foreign enterprises. Some essential technologies depend on other leading countries. Domestic enterprises with lower levels of technology are moving out of Taiwan, a development which will not lead to product and technology innovation in the international market. New technology-based enterprises at the ZJHP also confront the same problem. "Procurement policy" might be enforced by the authority of the ZJHP, such as central or local government purchases and contracts, public corporations R&D contracts, and prototype purchases. Government procurement strategy also plays a fundamental role in enlarging their market. Contracts assigned to local businesses can provide them with a suitable and stable market, which is crucial for emerging enterprises. However, with the coming of globalization, deregulation both in taxation and legal regulatory, should be considered in Taiwan-related policy formulation process.

In a domestic market, enterprises can advance when possible and pull back when necessary. They can develop their R&D capacity using the domestic market then expand step-by-step into the international market without the need to rush into uncharted territory. Taiwan high-tech industries found this context attractive and moved across the strait. Through relocation, Taiwanese firms also enjoy lower production costs which enable them to stay ahead of the keen competition.

5.3.3. Related and supporting industries

The HSIP was also significantly superior to the ZJHP in the "presence of clusters instead of isolated industries". The HSIP focuses on fields such as IC, computers and peripherals, telecommunications, opto-electronics, precision machinery, and biotech and forms a complete related industry structure. National-level R&D institutions, laboratories, and advanced academic institutions cooperate closely with HSIP enterprises in R&D in activities such as technology transfers, innovation diffusion, and commercializing technology. Taiwan's government cut budgets for higher education in recent years, forcing universities to adopt the strategy to work actively with industries, to get funding. The resulting research can then be commercialized, which brings in additional funds.

Competent actors in the cluster such as incubators, educational resources, national-level high-tech base, and R&D institutions are present at the ZJHP. However, the industry–university–government relationship should be reinforced to strengthen the clustering effect. There are advantages enjoyed by an enterprise located in a cluster: reduced consumer search costs and information externalities. The supply side benefits are technology spillovers, specialized labor, infrastructure benefits, and information externalities. "Political policy" should be enforced in ZJHP, such as encouragement of mergers of joint consortia and public consultation.

5.3.4. Context for firm strategy and rivalry

Relying upon a nimble fleet of small to medium-sized enterprises, many of which employ fewer than 1000 people, Taiwanese enterprises have carved out a niche in the field of electronic components. Often assemblers purchase these parts and eventually sell them as a part of completed systems. There has been a decided transition from the Taiwanese enterprise traditional position as a leading manufacturer of high-tech products. Many Taiwanese enterprises have inserted themselves in global commodity chains from the simplest original equipment manufacturing contracting arrangements (OEM) to more complex activities: own design and manufacture (ODM) to full-fledged product development. Few of them have "broken through" into own-brand manufacturing (OBM). Increasingly, Chinese enterprises, through cooperative ventures with Taiwanese investors, have become the source of low-cost, efficient, manufacturing capacity. Most high-tech enterprises at the ZJHP and the HSIP are process-improvement oriented firms that offer the value-proposition of "operation excellence" according to Hope and Hope's (1997) definition. This effect contributes no significant difference to "a local context that encourages investment in innovation-related activity". Taiwan has traditionally focused on process-improvement and gained worldwide recognition for its competitive advantage in efficient production. However, with increasing competition from a number of developing countries led by China, Taiwan can no longer take this advantage for granted. To cope with the challenges that lie ahead, the government should put create incentitive programs to encourage investment in R&D, new technology acquisitions, and human resources improvement.

6. Conclusions

This paper chose the HSIP and the ZJHP for an empirical study to explore the different innovation capacities between science parks on both sides of the Taiwan Strait and proposed a model for analyzing them. An analysis series was used to facilitate exploring the different innovation capacity between the science parks across the Taiwan Strait. Through use of the model we were able to recommend improvements for both parks.

There were many coincidences between the findings by this paper and the actual situation. That many of the determinants for science park innovation capacity are different across nations was confirmed. Government policy, legal rules, market conditions, factor conditions, and many other attributes make the differences important. Excluding "human resources", "basic research infrastructure", "sophisticated and demanding local customers", and "a local context that encourages investment in innovation-related activity", the HSIP was significantly preferable to the ZJHP for the four drivers for each determinant. The weakest driver of the ZJHP was "related and supporting industries". However, the strongest and the weakest drivers at the HSIP were "related and supporting industries" and "factor conditions" respectively. This case study contributes to the literature on the differences between science parks by providing a practical case in Asian developing countries, which has so far been neglected in previous researches.

Based on these findings, science park authorities can identify comparative advantages and defects. Related policies for science parks can be initiated that leverage the park's comparative advantages to reinforce R&D-based industrial and innovative activity. Taiwanese new technology-based enterprises might select the most suitable science park to match their strengths and compensate for their weaknesses.

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