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Contents

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Towards a Late-Industrial District: The Construction of Learning Networks in Hsinchu–Taipei Corridor, Taiwan

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Abstract: This research examines the late-industrialisation paradigm by exploring high-technology development in Taiwan. In contrast to the South Korean case, where researchers have argued that latecomer advantage is constructed on the basis of learning and strong state intervention, Taiwan's high technology industry demonstrates a different story of late-industrialisation, despite having being praised as a model of the developmental statist paradigm to be compared with South Korea. The industrial system in Taiwan features vertical disintegration, learning networks and redundant institutional embeddedness. Taiwan's high-technology industries reveal the advantage of flexible specialisation and collaborative learning in the globalisation process. In particular, the connection between the social and professional communities in Taiwan and Silicon Valley have provided the bridge for technological co-operation, and have enhanced the learning capabilities of latecomer firms. In other words, the central agent of Taiwan's story is the technical community, rather than the large conglomerates (*chaebol*) in the South Korean case.

Keywords: Taiwan, late-industrial district, developmental state, network learning, globalisation, cross-border technical community.

Introduction

In the final decades of the twentieth century, a number of East Asian countries and territories—Japan, Taiwan, South Korea, Hong Kong and Singapore —developed the world's most dynamic and successful economies. Their success has drawn the attention of scholars from contradictory theoretical positions (e.g. Galenson, 1982; Henderson, 1993). Thus, the East Asian experience has constituted an empirical field for the testing of rival theories, and has spawned debates over the reasons for the rise of this region. While neo-liberals attribute the spectacular development to minimum state distortion of the market mechanism

(World Bank, 1993), developmental statists give credit to the market-bending efforts of interventionist governments (Deyo, 1987). In addition, the phenomenal success of East Asian development raises the issue of globalisation versus localisation. Whereas some scholars like Whitley (1993) believe that locally embedded[1] institutions and interpersonal relationships generate the dynamics of the industrial system, other scholars like Hobday (1995, 2001) emphasise the roles played by global buyers and the global production networks.

While neo-liberals argue that the market mechanism will naturally lead to the efficient exploitation of comparative advantage, the statists believe that government policies will influence the behaviour of firms and market allocation in such a way as to create competitive advantage. In fact, both arguments are partly accurate in their descriptions of the interaction between the market mechanism and state activity in the East Asian experience. It is the dynamic relationship between government intervention and the strategies of firms that have allowed the East Asian economies to undergo industrial transformation (Wade, 1990).

Moreover, little of the existing literature about East Asia takes technological change seriously. Neo-liberals minimise the influence of technology, treating it as a dependent variable induced by correct outward-looking policies, while statists recognise the critical role of state technology policy but ignore company technology strategies. For their part, localisation theorists emphasise information flows among social networks, rather than actual production techniques, while globalisation theorists assume that foreign technologies simply overwhelm local technical contributions.

Therefore, a theory of late-development comprising the issues of technological learning, institution building, and the dialectic of scalar organisation is urgently needed to decode the myths about the East Asian Miracles. Some recent studies by Amsden (1989), Wade (1990) and Evans (1995) have tried to fill the theoretical gap. As will be shown, however, their theories need to be pushed further if they are to provide a foundation solid enough for a paradigm of late industrialisation in East Asia. Most of the empirical data used by these studies, with some exceptions, is based on the Japanese and South Korean cases, two countries where relatively large business groups have played a leading role in economic development. It is highly doubtful whether such models can be successfully applied to Taiwan, where small specialist firms constitute the majority of economic actors (Buck, 2000).

Rethinking the developmental state

The developmental statists propose that the impressive development of East Asia's Newly Industrialising Countries (NICs) should be understood as a process in which the states play a strategic role in taming domestic and international market forces and harnessing them to national ends. Fundamental to the East Asian success is an insistence on industrialisation, rather than on following current comparative advantage. In other words, market allocation rationality is subjected to the priority of industrialisation, which usually means employing new technologies to increase capital accumulation (Storper and Walker, 1989). A key to the process of industrialisation is that the state lends directional thrust to the operations of the market mechanism.

Among the protagonists of developmental state theory, Wade (1990) carefully distinguishes state-leadership from market-leadership in order to allow theorisation of the complexity of state-market interactions. Based on an empirical study of Taiwan's industrialisation process before 1980, Wade concentrates on the synergetic relationships between state activities and market allocation in each industrial sector. He provides a vivid example of how state intervention, under certain historical conditions, can help start up industrialisation and create economic space in which the market mechanism can function. But Wade does not consider the issue of technological change, apart from some consideration of the role of public laboratories. In fact, technology can be the critical area where the state and the market (private sector) interact.

Evans (1995) directly targets the development of high-technology industries in South Korea, Brazil and India. Through a comparative study, he demonstrates that states vary in the way they are organised and tied to society, and thus play different roles in different countries.[2] More importantly, these roles evolve along with the unfolding of industrial transformation. Moving up in the international division of labour in high-technology sectors usually requires the state to play a role different than that required by traditional industries, since the informatics sectors are characterised by rapidly changing product cycles and requiring agile adjustment to stay competitive. Evans offers solid evidence to show that, under certain state structures and state-society relationships, the government is able to meet the demands that are assumed away by the neo-liberals. In this sense, Evans provides valuable clues to understanding industrial transformation in East Asia, above all South Korea. But for him the research problematic revolves around the interaction of a triple alliance of the state, local industries, and multinationals. Evans generally ignores the issues of firm structure and inter-firm relations. In fact, a comparative study of the development of the informatics industries of South Korea and Taiwan finds that the difference in firm structure and industrial system, as well as in state-industry relations, leads to different roles and strategies adopted by the national governments (Levy and Kuo, 1991; Mathews, 1997).

Amsden's paradigm of late-industrialisation

Although Wade and Evans provide strong arguments against the neo-liberal thesis, their theoretical foci do not adequately address the topics of the (dis)advantage of the latecomer. In contrast, Amsden proposes a theory of 'late-industrialisation' to elaborate on the different developmental trajectories of the East Asian latecomers and their European (and American) forerunners. In her paradigm, technological learning is the central factor in both state behaviour and firm structure in late-industrialising countries. While based on an empirical study of the South Korean industrialisation process, Amsden (1992) argues that this paradigm can be extended to cover other late-industrialising countries such as Japan, Taiwan, and Brazil. Since all of these countries started their industrialisation process by technological borrowing and learning, it follows that they share certain tendencies.

Basically, the growth path of late-industrialisation is defined by an absence of pioneering technology, even in leading enterprises. Whereas the driving force behind the First and Second Industrial Revolutions was the innovation of radically new products and processes, no major technological breakthrough has been associated with late twentieth-century peripheral industrialisation. Thus, learning from others, and realising lower costs, higher productivity, and better quality in already maturing industries by means of incremental improvements, are all imperative for the latecomer to survive in international competition.

According to Amsden (1992), the late-industrialisation paradigm has three major aspects. First, since even the leading enterprises of the late-industrialising countries had no proprietary technology and could not compete in maturing industries against more experienced firms from advanced economies on the basis of low wages alone, their governments had to be more interventionist and developmental. Second, because process improvements constituted their core competitive strategy, manufacturing capabilities on the shopfloor became the critical focus. Third, because individual enterprises did not possess any core proprietary technology, they grew by integrating and diversifying into unrelated industries. As a result, diversified conglomerates, such as *chaebol*（財閥）in South Korea, dominate the economic landscape. In short, three pillars constitute the paradigm of late-industrialisation: shopfloor learning, a developmental state and diversified corporations.

However, some issues concerning Amsden's arguments regarding the construction of a late-industrialisation paradigm should be elaborated further. As the domestic state policy rendered the formation of latecomer firms possible by the fiat system, how would it handle the evolution of the high-technology industrial system, which features a short product cycle, high technological uncertainty and broad transnational scope, and thus needs excessive spontaneous flexibility? Moreover, while shopfloor learning helped the latecomer firms gain grounds at the initial stage of catching-up, how would the firms take advantage of the recent global technology regime, which emphasised the external and collective learning by building up dense social networks? Finally, as South Korean *chaebol*, with their well-established corporate structure, had played the central role in the late-development by the hierarchical governance mechanism, how would other latecomers with decentralised industrial systems participate in the industrialising process? In sum, although Amsden's paradigm provided explanations for the late-industrialising South Korean *chaebol* to catch up by the shopfloor learning strategies, which were fostered by the developmental state, her paradigm did not comprise a comprehensive theory which could cover the issues of the divergent governance systems, industrial structures and learning regimes, as found in another key late-industrialising country, Taiwan (Gereffi, 1990).

The following sections will deal with the development of Taiwan's high-technology district by analysing its decentralised industrial system, its state policy, and the cross-border technical community, all three of which contributed to the transformation of the late-industrial district. It will demonstrate that the key to the late-industrialisation process in Taiwan was not only the big push from the local developmental state at the beginning, but also the existence of the global socio-technical connection that continuously upgraded the local technological level in the global learning economy. In addition, instead of focusing on the individual firm or business group as Amsden proposed, this research argues that late-industrialisation studies should focus on the social network (Dicken *et al.*, 2001). Finally, the relativisation of geographical scales, the dynamic embeddedness between the local and the global, which was ignored by Amsden, will be analysed in the globalisation process. Thus, the research will be able to provide a complementary case for Amsden's late-industrialisation model.

Taiwan's late-industrial district: towards another paradigm?

The Historical Development of Taiwan's Integrated Circuits (IC) Industry

Taiwan's IC industry consists overwhelmingly of specialised small- to medium-sized enterprises. Unlike huge vertically integrated conglomerates, IC firms in Taiwan operate around a finely detailed division of labour. By 2001, Taiwan hosted more than 230 IC firms, including 124 design houses, five in mask making, 21 fabrication firms, 42 in packaging and 33 in testing. Total revenues reached around US$26 billion, comprising a 68.7 percent annual growth rate. Almost all of the important firms, including the top ten design houses, and all of the fabrication and mask making firms, are located in the Hsinchu (新竹) —Taipei (台北) Corridor, a region of 60 mile wide (ITRI, 工業技術研究院, 2000). The largest one is the Taiwan Semiconductor Manufacturing Corporation (TSMC, 台灣積體電路製造公司) whose

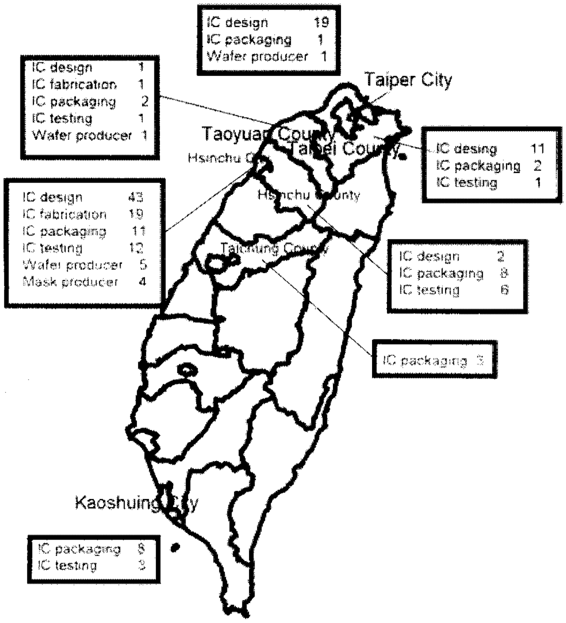

Figure 5.1: The map of IC industry in Taiwan, 1999
Source: MOEA (1999)

initial funding, partly from government initiatives, was US$145 million. Its sales revenues reached US$1.6 billion in 1998 and US$2.4 billion in 1999. By 2000, TSMC employed 14,000 people (including overseas operation), had reached 127 percent annual growth rate, and had become the largest foundry service provider in the world.

As Hsu (1997) shows, Taiwan's IC industry was incubated by the government's initiative. Under the advice of a group of Chinese-American engineers, the government established the Electronic Research Service Organisation (ERSO, 電子工業研究所) to transfer IC design and fabrication technologies from RCA, a leading electronics company. After mastering the borrowed technologies, ERSO consequently spun off new local IC firms, United Microelectronics Corporation (UMC, 聯華電子) and TSMC. Besides these major achievements, ERSO also set up the IC design centre, and allowed its engineers to start up their own companies. The government also established the Hsinchu Science-based Industrial Park (HSIP, 新竹科學工業園區) to host these new firms, and provided financial and tax incentives to allure the risky investments. HSIP eventually became the major base of Taiwan's IC industry. As a result, over 85 percent of Taiwan's IC firms were concentrated in the Park (see Figure 5.1). Through a series of projects, the state successfully fostered the local IC industry so that it could take root (see Table 5.1).

However, in the early 1990s, the government's role changed as the local industrial sector matured. On the one hand, due to the example of government-aided initiatives, the private sector recognised that the IC industry could be profitable, and started to exploit new product opportunities and invest substantial amounts of capital. In particular, the Personal Computer industry, which formed an agglomeration in the Hsinchu—Taipei corridor, grew rapidly in the late 1980s, and many IC firms took advantage of this to obtain IC components locally. More than dozen new firms were started up by Silicon Valley returnees in the early 1990s to take advantage of the booming PC related market, and of the qualified foundry service

Table 5.1: Public R&D projects for IC industry

	EIDP-I	EIDP-II	VLSI Project	ULSI Project
Timeframe	1976-79	1979-83	1983-88	1990-94
Expenditure (NT$m)	489	796	2,921	5,500
Objectives	*IC design and mfg tech acquisition *Establish pilot operation	*Improve pilot CMOS facility *Acquire mask tech	*Establish VLSI process tech *Acquire CAD for VLSI ICs	*Acquire submicron process tech *Establish ULSI pilot plant
Major features	*pilot plant *tech acquisition and transfer *personnel training	*pilot plant improved *LSI chips *mask shop	*VLSI chips *VLSI pilot plant	*ULSI chips *ULSI pilot plant
Tech capability	7.0-micron CMOS	3.5micron CMOS	1.0micron CMOS	0.5micron CMOS
Spin-offs		UMC, Syntek（太欣）, Holtek（和泰）	TSMC, TMC, Winbond	VISC（世界先進）

Source: adapted from Liu (1993: 303)

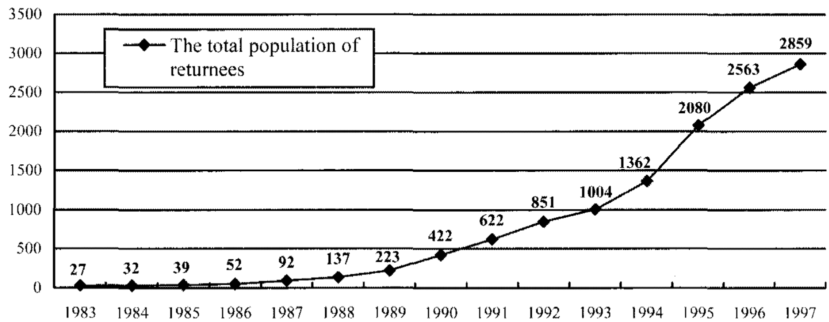

Figure 5.2: Total population of returnees in the HSIP

Note: Returning entrepreneurs have started 97 companies in the Park, or 40 percent of the total.

Source: HSIP Administration, 1998

provided by local IC manufacturing companies.[3] The number of returnees increased rapidly after mid-1990s, as shown in Figure 5.2. The key roles played by the returnee entrepreneurs in the evolution of Taiwan's late-industrial district were particularly notable in that they diversified the technological trajectories in the region. Whereas the ERSO spin-offs were good at low-end consumer electronics design, such as electronic watches, toys, and even monitors, it was the Silicon Valley returnees who started up new IC firms specialising in PC-related products, such as chipsets, flash memory, and audio/video chips.[4] Without doubt, the diversification of technological paths gained a district competitive edge in the global knowledge-based economy (Dedrick and Kraemer, 1998).

On the other hand, those firms producing spin-offs from ERSO began to look for technological collaboration with foreign firms, and no longer relied on ERSO as the sole source of new technology (see Table 5.2). As these offspring firms grew up, they confronted ERSO about the issue as to whether new spin-off projects should be continued. Under the siege from these established interest, as well as from political opposition forces, ERSO agreed not to breed new firms and to change its leading role.

This brief review paints a pattern of Taiwan's high technology development that diverges from

Table 5.2: Joint development agreements between Taiwan's IC firms and foreign companies

Company	Foreign partner	Process/ product
UMC	Unicorn	VLSI technology
	Meridian Semiconductor	CPU
	Tidalwave Microtech Inc.	Portable PC chipsets
Winbond（華邦）	Silicon Storage Technology	Low-voltage EPROM chips
	NCR-MPD	ASICs
	C-Cube Microsystems	Image-compression ICs
MXIC（旺宏）	NKK	Mask ROMs, EPROMs
Hualon Microelectronics（華隆微電子）	Burr-Brown	Mixed-signal ICs
	Seeq Technology	Flash memories, EPROMs

Amsden's paradigm. Several key issues should be re-thought to explain Taiwan's story. First, Taiwan's high-technology industry comprised a cluster of SMEs (Small and Medium sized Enterprises), without the dominance of diversified business group as *chaebols* in South Korea. What such different industrial systems would lead to different firm strategies needed be attacked. Secondly, as being lack of technological and financial resources, Taiwan's SMEs demonstrated unexpectedly strong innovative capabilities (Dedrick and Kraemer, 1998), even stronger than their South Korean rivalries, how could the cat look at the King? Thirdly, as the globalisation imperative raised concerns about the end of the state (Ohame, 1995), how would the global transformation of Taiwan's high technology industrial system lead to change in the embedded institutions? In the following sections, I will respond to these issues by developing the idea of the late-industrial district from the aspects of learning model, district formation and global connection respectively.

Organising for interactive learning

In contrast to their South Korean counterparts, Taiwan's IC SMEs compete in the world market by a vertically disintegrated industrial system. The scale disadvantage limits Taiwan's IC firms to resorting to their own resources, financially and technologically, and leads them to rely on the external partners in the production process. In the circumstances, a refined model of learning is necessary in order to understand Taiwan's decentralised IC industrial system. The patterns of learning should be broad enough to include not only the practical mastering of borrowed technologies in the single firm, but also the constant combination of product ideas and human skills in extensive production systems (Amendola and Gaffard, 1988; Lundvall, 1992). Firms have to be open to their customers, suppliers and partners in order to discuss and negotiate the possible paths of product development. They benefit by learning from external resources, in addition to the internal resources drawn by the coupling of R&D, production and design functions (Malecki, 1991). They can learn from suppliers, customers, and rivals (Saxenian, 1994).

Taiwan's IC firms, in a vertically disintegrated industrial system, have to co-operate in order to get jobs done. Moreover, firms collaborate not only to materialise ideas and technologies, but also to enhance their technical levels. In other words, apart from the necessity of integrating the technical division of labour, close association can enhance the technological capabilities of the parties involved. It is a process of dynamic integration (Sayer and Walker, 1992). Production networks can be learning channels.

For example, as a pure foundry, TSMC did not produce its own brand-name product, and thus did not keep its own design team. Under these conditions, TSMC had to rely on its customers, mostly the fabless design houses but also some full-service companies like AMD, to provide testing vehicles for its production lines. From the beginning, TSMC was selective about its customers. This led James Dykes, the first president, to claim that TSMC cares more about *those for whom* it produces than what it produces. 'Because we are an ASIC foundry specialist, we do not care what product we are ordered to produce. Our major concern is if our customers are good enough to provide advanced (or at least relatively advanced) product requirements for us to meet. We wish to build up long-term relationships with our customers, so that we are able to co-operate closely with them to get things done and, at the same time, grow up together' (*Common Wealth*, July 1987). TSMC collaborated with a number of 'critical' customers. These customers brought their own various requirements to the relationship and, in turn, provided TSMC with opportunities to experiment with new process technologies. TSMC used Etron's (鈺創科技) SRAM to test 6-micron process technology and successfully produced it in huge volumes. TSMC also allowed Sunplus to design sophisticated consumer ICs and, in turn, Sunplus (凌陽科技) pushed TSMC's technical capabilities ahead.

Most of these foundry agreements take time to negotiate and reinforce. Normally, the preparation of a new design as a testing vehicle in a fab[5] requires about six months and completion of more than one hundred steps. The process involves many time-consuming and tedious tasks. It is a very uncertain process and liable to opportunist behaviour, i.e. one of the parties of the agreements could turn its back and break up the deal. To keep the agreements operable, partner firms must trust each other and expect more economic benefits to accrue from following the agreement than violating it. Trust is not enough to support the operation of collaborative agreements. Firms engaged in these activities expect a long-term addition of value in the process of cross-fertilising technologies. It is the quasi-rent incurred by the association with the resources of each partner that encourages them to stay in the agreement (Foray, 1991). Under such circumstances, TSMC and its critical customers exploit each other's talents and take a long-term view of their collaborative relationship.

Collaborative ties exist not only between the design houses and their fabrication partners, but also between them and their customers. Many companies report that they have kept some 'critical' customers with whom they frequently meet and exchange information. The concept of 'critical' is based primarily on the quick dissemination of new product ideas from the customers to the designers. Sam Lin, the President of Weltrend Semiconductor, a specialised monitor IC design house, illustrated this concept as follows. 'When a new idea emerges, our critical customers discuss it with us first. They are experienced people in the marketing of electronic products, thus they have accumulated a lot of experience and a "market sense" about new product trends. Once they find a profitable product idea, we are the first to be informed, and after intensive communication, we decide together whether to enter the new product line or simply give it up'.[6]

It is especially important, given short product cycles, for the IC designers to get early after-use evaluation from their customers. IC suppliers meet with their customers repeatedly to get feedback on new products, so they can improve them and even plan the next generation of products in advance. In the process of transacting everyday business, although some conflict is inevitable, the two sides of the transaction recognise the importance of co-operation in the face of fierce competition on timing and quality. It is important to get customer feedback during the design stage, since this is where the specs and functions of an IC product will be set up. Inter-firm linkages, through information sharing, enable IC companies and their customers to develop new products ahead of competitors and respond rapidly to new market opportunities. To some extent, this constitutes the competitive advantage of Taiwan's informatics industries in this era of competition based on the timing of access to market.

In addition to the above types of intra-industry interaction, external connections between IC firms and firms in other industries present important learning opportunities to the parties involved. In some cases, inter-industry interactions lead firms to engage in innovative experimentation and encourage new product ideas or process technologies to emerge.

Interactions between equipment suppliers and Taiwan's IC manufacturing firms are crucial to the latter's competitiveness in production capacity. The technological lag between Taiwan's IC manufacturing firms and the most advanced firms decreased from more than five years in the late 1980s to less than two years in 1994. The technological progress made by these firms partially derived from the advantage of backwardness. Taiwan's IC firms took advantage of learning economies, and absorbed the experiences of advanced firms. As Mosel's (茂矽電子) vice-president said, 'We are not on a high enough level to compete on the technological frontier. Thus we do not have to rush to get the most state-of-the-art machinery. What we have to do is evaluate the performance of machinery employed by advanced firms, and then choose the best ones'.[7] Taiwan's IC engineers consulted with equipment manufacturers when yields were not as high as desired, according to Japanese equipment vendors (*Nikkei Electronics Asia*, November 1995). Equipment firms readily provided information to IC makers, such as whether a problem was in the lithography or etching, and built up a pool of knowledge, which could be used to resolve other production problems. In most cases, once a problem was identified, equipment vendors would send a team of specialists to work closely with the production engineers of the IC manufacturer. Both parties accumulated a stock of knowledge, which was important for the improvement of yields in wafer fabrication.

Taiwan's latecomer firms not only improve manufacturing efficiency by shopfloor learning. In addition, and more importantly, learning happens within, as well as between, the firms in different phases within the production chain. A model of network learning fits with the cross-fertilisation between the IC firms in Taiwan's disintegrated system.

A place for learning: the industrial district and global networks

Learning is a process of continuous negotiation among interconnected firms. Learning is also a contextualised process. Geographical nearness will enhance the efficiency of communication, and thus learning. In contrast to traditional agglomeration theory, which follows standard neo-classical logic in conceptualising local economies as collections of atomistic competitors regulated solely by price/cost signals, industrial district theory emphasises the contextual significance of communal non-economic institutions and the importance of relations of both competition and co-operation among economic agents in the district (Harrison, 1992).

One of the mechanisms that facilitate collective learning is experience shared among the employees in the district. Taiwan's high-technology district is characterised by informal technical exchange and boundaryless careers among the employees. For example, UMC, Winbond and HMC were all basically spun off from the same research institute, ERSO, so most of their employees know each other well. These relations between colleagues weave webs of information exchange, which allow these engineers to exchange ideas and solutions to practical barriers in the production process. The networks of information exchange in the HSIP remind Nasa Tsai (蔡南雄), Vice-President of Mosel, of the open technical community in Silicon Valley. He had benefited from that kind of technical help in his early days in

Silicon Valley, and found a similar technical milieu existing in the HSIP. He expressed his appreciation of these networks by saying, 'The informal co-operation among engineers working for competing companies in the HSIP surprised our Japanese guests. They were not able to imagine such a practice occurring among their big companies. Here, employers compete, employees co-operate' (*Common Wealth*, June 1996).

Besides, the movements of the experienced engineers among the high-technology firms also help the formation of new firms and the diffusion of technology in the Hsinchu—Taipei Region, and constitute a dynamic technology district. According to a recent survey (Hsu, 1999), over 80 percent of the IC employees in the HSIP agree that a pattern of fluid careers (changing jobs at least three times in five years) exists in the region's high-technology industries, and 47.2 percent of the informants reported that supplier-customer relationships exist between their original and their new employers. Over 93 percent of the interviewees agree that geographical proximity renders the job-hopping easy and costless, and consequently technology diffusion is broad and effective. As employees change jobs between the firms in the vertically-disintegrated industrial system, the demand to integrate the division of labour between these firms is partly met. In other words, in the Hsinchu—Taipei networked industrial corridor, the floating labour market serves as a channel to enhance co-operation and thus technological learning (Hsu, 1999).

Mutual adjustment and experience sharing are critical for an industrial district to increase the absorptive capacity of learning, but it is also important to keep the district open to outside resources, if the system is to avoid locking in obsolete technologies and maintain its learning momentum (Grabher, 1993). In other words, an industrial district has to be a localised industrial system within a global industrial network (Amin and Thrift, 1992). An open industrial system allows the district to continuously upgrade technical levels and to develop new products through the establishment of networks. Taiwan's IC industry had benefited from the cross-border connection since the initial stage in the 1970s. Taiwan's government launched the IC technology transfer deal with RCA of the United States, and further fostered the first local IC firm, UMC (Mathews, 1997). From then on, Taiwan's public laboratory and private firms had continuously recruited high-calibre overseas Taiwanese engineers, or set up listening posts in Silicon Valley, the most innovative hub of the informatics sectors, to tap into newly developed industrial technology and management knowledge.

The growing integration of the technical communities in the two regions has created new patterns of cross-regional collaboration (Hsu and Saxenian, 2000; Saxenian and Hsu, 2000). In some cases, collaboration occurs between the specialised divisions of a single firm. This includes start-ups like Macronix (a Flash Memory IC Maker based in Hsinchu with a design centre in Silicon Valley) and ISSI (a SRAM maker based in Silicon Valley with a manufacturing division in Hsinchu) as well as larger, more established companies like Acer (宏碁電腦, the largest PC maker headquartered in Taiwan, with a division in Silicon Valley). In these cases, the division managers are well connected in the local labour market and technical community and also have close, trust-based working relationships with their colleagues in the main office. This allows them to avoid many of the problems that corporations have when they seek to acquire technology in foreign locations like Silicon Valley. They need to be able to integrate into local social networks to gain access to technology and market information, while simultaneously being able to communicate quickly and effectively with decision makers in the headquarters.

More frequently the cross-regional collaborations involve partnerships between specialist producers at different stages in the supply chain. The relationship between Taiwan-based semiconductor foundries and their Silicon Valley equipment manufacturers is a classic example. Steve Tso (左大川), a Senior Vice President in charge of Manufacturing Technology and Services at TSMC , worked at semiconductor equipment vendor Applied Materials in Silicon Valley for many years before returning to Taiwan. He claims that his close personal ties with senior executives at Applied Materials provide TSMC with an invaluable competitive advantage by improving the quality of communication between the technical teams at the two firms, in spite of the distance separating them.

The interactions between TSMC and Applied Materials engineers are continual, according to Tso, and, for the most part, must be face-to-face because the most advanced processes are not yet standardised and many of the manufacturing problems they face are not clearly defined. Tso reports that he travels to Silicon Valley several times a year, and that teams of TSMC engineers can always be found in the Applied Materials' Silicon Valley facilities for training on the latest generations of manufacturing equipment. Engineers from Applied Materials, likewise, regularly visit TSMC. He argues that this close collaboration helps TSMC develop new process technologies quickly while avoiding the technical problems that frequently arise when introducing new processes. It also keeps them abreast of the latest trends and functions in equipment design.[8]

A comparable level of collaboration is required between the semiconductor foundries and their customers, the firms that design the integrated circuits. TSMC's Tso claims that the engineers from Silicon Valley-based customers like AMD, National Semiconductor, S3 and Trident can always be found in their offices. In fact the TSMC facility in Hsinchu is flexibly divided into workspaces in order to allow their customers' technical teams to work closely with TSMC teams. Likewise, TSMC engineers spend significant amounts of time in their customers' facilities in Silicon Valley.

Taiwan's other leading semiconductor foundry, United Microelectronics Corporation (UMC), has gone one step further and institutionalised this collaboration with their customers. Robert Tsao (曹興誠), President and CEO of UMC refers to the joint ventures as 'cross-Pacific consortia' that pair Silicon Valley's fabless chip designers with UMC's fabrication capabilities. The first, called United Semiconductor Consortium (USC) is a joint venture between UMC (with 43 percent of the total US $400m investment) and Silicon Valley-based Alliance Semiconductor (20 percent) and S3 (25 percent)—both of which were either founded by Taiwanese or have them in key technical or managerial positions. USC, which started production in 1996, guarantees the design firms with secure foundry space even in the case of industry-wide capacity shortages, while simultaneously guaranteeing UMC the capital needed to build the fab as well as full capacity utilisation. An even more ambitious consortium, United Integrated Circuits Corporation, links more than eight Silicon Valley design firms (each with 5-10 percent share in the $600 million fab) with UMC (40 percent), and includes Oak Technology, Trident Semiconductor, Opti, ISSI, and ESS—all of which were started by Chinese entrepreneurs.

The fabless partners in these joint ventures aggressively push their foundry partners to improve process technologies (because the growing complexity of chips poses more and more manufacturing challenges), while the foundries collaborate closely with their customers to help introduce innovative new products rapidly. Increasingly these relationships thus involve the sorts of close communication and joint-problem solving in which the partners learn from each other and cross-pollinate technology while avoiding excessive mutual dependence. The extensive collaboration required to make these partnerships work depends critically on the high levels of trust and local knowledge that exist in the overseas Chinese community—and that allow partners to respond quickly to fast changing markets and technologies while freed of the need to precisely specify rights and responsibilities through elaborate contracts or bureaucratic rules.

While Silicon Valley and Hsinchu remain at different levels of development and are differently specialised, the interactions between the two regions are increasingly complementary and mutually beneficial. As long as the US remains the largest and most sophisticated market for technology products, which seems likely for the foreseeable future, new product definition and leading edge innovation will remain in Silicon Valley. However Taiwanese companies continue to enhance their ability to design, modify and adapt as well as rapidly to commercialise technologies developed elsewhere. As local design and product development capabilities improve, Taiwanese companies are increasingly well positioned to take new product ideas and technologies from Silicon Valley, quickly integrate and produce them in volume at relatively low cost.

Most late-industrialisation studies take the multinational corporations (MNCs) as the key figures in the globalisation process (Dicken, 1992), and choose a dualistic viewpoint about the global flow versus local space (Castells, 1989). However, as Storper (1997) argued, the interplay between the global and the local can take different types of governance mechanism and divergent forms of embeddedness. The hierarchical system of the MNCs can be just one of them, and not even the most effective one, and the global connection can be, rather than a dis-embedding flow, a re-embedding process in different geographical scales of social networks. The Hsinchu—Silicon Valley connection suggests that localisation is not at odds with the globalisation of economic activity. Rather, the two are mutually reinforcing. Globalisation is increasingly a process of integration of products through collaboration at an international level. This is best viewed as a process of recombination or of repeated convergence and divergence in which firms specialise in order to become global, and their specialisation in turn allows them to be better collaborators. The best environments for breeding such specialist firms are the decentralised industrial systems of places like Silicon Valley and Hsinchu. Just as the social structures and institutions *within* these regions encourage entrepreneurship and learning at the regional level, so the creation of a transnational technical community facilitates collaborations among individuals and producers between the two regions, and supports a mutually beneficial process of reciprocal industrial upgrading.

The development of a transnational community—a community that spans borders and boasts as its key assets shared information, trust, and contacts (Portes, 1996)—has been largely overlooked in accounts of Taiwan's accelerated development. The social structure of a technical community appears essential to the organisation of production at the global as well as the local level. In the old industrial model, the technical community was primarily inside the corporation. The firm was seen as the privileged organisational form for the creation and internal transfer of knowledge, particularly technological know-how that is difficult to codify (Kogut and Zander, 1993). In regions like Silicon Valley, where the technical community transcends firm boundaries, however, such tacit knowledge is often transferred through informal communications or the inter-firm movement of individuals (Saxenian, 1994). It is a kind of community of practice (Wenger, 1998), i.e. a group with shared beliefs in technology trends and ways of doing things, which has expanded unexpectedly to straddle the Pacific.

The experience of Taiwan, a latecomer in the global production networks, has demonstrated the possibility of industrial upgrading through inter-regional co-operation and the reversal of 'brain drain' in the developing countries. At first, policymakers in Taiwan began to recognise that the brain drain in the 1960s could become a potential asset as they sought to upgrade the island's position in the international economy in the 1970s. They sponsored frequent technical meetings and conferences that brought together engineers based in both the US and Taiwan. They actively recruited Taiwanese engineers in the US, encouraging them to return home, either temporarily or permanently. And drawing heavily on policy advice from overseas Chinese, they developed strategies to upgrade the technological capabilities of the private sector and to promote new firm formation and competition in the emerging information technology industries. In the 1970s and 1980s, government agencies in Taiwan aggressively transferred state-of-the-art technology from the US, created a venture capital industry long before it became fashionable elsewhere in the world, and developed other measures to diffuse technology, including the formation of the Hsinchu Science-Based Industrial Park.

By exploiting this overseas resource, Taiwan's policymakers unwittingly supported the extension of Silicon Valley's Chinese network to include their counterparts in Taiwan. Frequent advisory meetings and technical interactions supported the creation of personal and professional relationships between engineers, entrepreneurs, executives, and bureaucrats on both sides of the Pacific. One indicator of this process is the list of recipients of the Chinese Institute of Engineers, USA (中國工程師學會，美國分會) Annual Awards for Distinguished Service and for Achievement in Science and Engineering, which reads like a Who's Who of Chinese technologists based in the US and Taiwan over the past three decades.[9] In short, an unintended consequence of Taiwan's outward-looking technology strategy was creation of an international technical community, one that is now self-sustaining.

The accelerated growth of the Taiwanese economy in the 1980s, combined with active government recruitment, ultimately spurred a reversal of the brain drain. Lured primarily by the promise of economic opportunities as well as by the desire to return to families and to contribute to their home country, growing numbers of US-educated engineers returned to Taiwan in the 1990s.

This Hsinchu—Silicon Valley case suggests that collaboration between producers located in differently specialised but similarly organised regional economies can foster a positive-sum dynamic of reciprocal industrial advance. These inter-regional relationships support entrepreneurial success in both regions by supporting joint problem-solving and complementary innovation (Sabel, 1989). And like the relationships between specialist firms and their suppliers within the industrial districts, these inter-regional networks cannot be understood purely as market transactions or 'commodity chains' linking independent firms in different locations (Gereffi and Korzeniewicz, 1994.) Rather, the economic ties are dependent upon a social structure and culture that foster openness and co-operation between producers in geographically distant regions. Close, trust-based relationships among the transnational community of Taiwanese engineers are thus an essential precondition for the flexible collaboration needed to adapt and survive in today's fast-paced competitive environment. The key in the connection comes not from the ethnic ties only, although they are undeniably important, but from the similar but complementary industrial structures between the two regions. Both Hsinchu and Silicon Valley are decentralised industrial systems, the former being specialised in manufacturing or low value-added design tasks, while the latter is good at advanced product definition. This helps to clarify why overseas South Korean engineers could not build up the same connection in their motherland, because the business environment dominated by *chaebol*, vertical integrated conglomerates, did not provide an appropriate environment for the returnees to start up their businesses and engage in collaboration with their Silicon Valley counterparts.

Dynamic institutionalism: history and change

Institutions are the bases on which capitalist relations of production and exchange are embedded (Dosi *et al.*, 1994). The roles played by institutions may change as the structure and technological level of industrial systems change (Nelson, 1994). Institutions that perform well in certain situations may become obsolete in other contexts such as rapid globalisation process (Pempel, 1999). For example, from a learning perspective, government subsidies are enough to encourage and discipline private firms to engage in production efficiency improvements, as Amsden argues. Nevertheless, it is doubtful whether the government is the best candidate to coordinate nearly self-spontaneous learning networks. The technological strategies pursued by the industrial system may result in different forms of institutional embeddedness.

The developmental state is argued to be the most powerful facilitator in the late-industrialisation paradigm. A number of studies point out that Taiwan's government has played a critical and leading role in the development of an IC industry (Hong, 1992; Liu, 1993; Chu, 1995; Mathews, 1997). However, Taiwan's developmental state did not base its IC industrial policy on its own bureaucratic apparatus, but on the advice of experienced overseas Chinese engineers. The advisors' role was the key to the information collection, evaluation and selection, and to the implementation of the technology transfer deal with the leading foreign firm (RCA) in the initial stage. It is doubtful whether Taiwan's government could have fostered the new technology-intensive industry without the overseas advisors' recommendations. In other words, the state benefited from this element of social embeddedness with the overseas technical community.[10]

The state's leadership changed as the IC industry diversified in the sources of technology and the recruitment of manpower, particularly while the connection between Hsinchu and Silicon Valley became the major channel for Taiwan's IC firms to upgrade along the technology trajectories. Take the submicron project as example. In 1991, ERSO expected to upgrade Taiwan's IC technology to the submicron level and, at the same time, build up new cooperative relationships with private companies. ERSO initiated a working alliance with UMC and TSMC, and asked them to contribute a percentage of the R&D fees for the project. Another six IC firms were invited to form a user alliance, and to gain access to the developed technology by paying fees. But the private firms were lukewarm toward ERSO's idea. Most of these firms started their own submicron projects through technology co-operation with foreign companies in Silicon Valley. They no longer had to rely on ERSO. The tension between ERSO and the private companies increased when ERSO planned to spin off a new company embodying the fruits of the submicron project. UMC and other companies contended that the new company would hurt them since it had benefited from government grants. Fierce debates between ERSO and the private companies broke out in the newspapers and in public meetings. The debate covered not only ERSO's technology project, but extended to the role ERSO/ITRI should play in the future.

The confrontation between ERSO and the private IC firms exploded during the budget review in Parliament in 1993. UMC, TSMC, and other IC companies protested that ERSO's research projects monopolised the government grants and human resources needed by private companies to engage in R&D. These companies complained that ERSO was so inefficient in its projects that it should not be allowed to monopolise huge government grants. They asked lawmakers to cut ITRI's budget, and force ERSO to become a better partner with the industry. As a result, NT$50 million was cut from ITRI's $350 million budget. Robert Tsao, ex-vice head of ERSO and now the chair of UMC, declared that ERSO should never engage in technology projects again. He even rejected any roles ERSO might play in the future development of Taiwan's IC industry (*Common Wealth*, September 1993). Ironically, the same private companies that were once cradled by ERSO became its gravediggers.

Even the funding sources of the IC startups clearly illustrated the changing role played by the developmental state. At first, state-owned banks were the main financial source for IC investment. Chiaotung Bank (交通銀行) and the China Development Fund (中國開發基金) provided substantial capital for IC firms like UMC and TSMC in the early stages, as the private capital hesitated to take risky ventures.[11] The government-controlled banking system was a powerful tool during the state-led development stage. Nevertheless, as private commercial banks were allowed to open in the early 1990s, this important financial tool was no longer monopolised by the government. More private banks are taking an interest in lending money to IC ventures. In the recent burst of investment in Dynamic Random Access Memory (DRAM) ventures, banks, both local and foreign, have been eager to coordinate lender groups, and even fight with each other for the right (*Wealth Magazine*, 1996 June).

Other financial support has come from venture capital and the stock market. These mechanisms have become increasingly effective in drawing small capital into the booming IC sector.[12] Some venture capitalists, like Champion Investment, and some securities companies, like Chien-Hong Securities (建宏證券), are becoming very important investors in high technology sectors. Venture capital not only provides funds, but also is increasingly involved in the management of the new venture. Jeng-Jong Guo, who started up several new IC companies in the HSIP and is now the president of Utron Technology, explains that 'banks live on the loan interest. No matter whether your business succeeds or fails, they will charge you a certain amount of interest. But this is not the case with venture capital. They will earn substantial returns if your company succeeds, and will lose money if you fail. In most cases, they will work closely with you to get things done, and both benefit together'.[13]

The declining of the state's role did not mean an institutional vacuum in the IC industry. In contrast, new actors played more important roles in supporting the growth of the vertically disintegrated industrial system. Trade associations, for instance, can be established independently of any one company, and have the power to represent, aid, and guide participating firms. They represent the industry to the government, educate members about the effects of government policies, and encourage collective action (Sayer and Walker, 1992). They are an important mechanism of integration for most industries. In the HSIP, the Association of Allied Industries (AAI, 科學園區同業公會) was organised by most of the high-technology firms in the HSIP, and thus contains IC firms but also PC, communication, and other companies. AAI was established to serve as the counterpart of the official Science Park Administration, and tries to work together with the Administration to solve problems occurring in the HSIP. In particular, ameliorating the diseconomies connected with agglomeration has required collaborative efforts by the Administration and the industries. For example, the AAI is actively engaged in developing solutions to the environmental pollution being caused by the HSIP. The AAI is also involved in lobbying at the national level. One subcommittee was set up to study the legal problems surrounding Intellectual Property Rights (IPR), business secrets, IC layout protection and the like.

A new organisation, the Taiwan Semiconductor Industry Association (TSIA, 半導體工業協會), was established in 1998. It was formed from AAI, and is to act as a counterpart of the Semiconductor Industry Association of America. According to Huey-lin Chen, the deputy director of planning and exploratory research division at ERSO, who is in charge of the coordination of the IC firms, 'Sometimes, when foreign organisations like SIA of America have technology co-operation deals to negotiate with us, we do not have an organisation to serve as the counterpart. Such deals occur more frequently as our

IC industry grows more global. At the same time, we need an organisation, which is able to coordinate firms to lobby the government for favourable policies, and to serve as a neutral third party to coordinate firms in the formation of research consortia. Under such conditions, we need to set up an exclusive IC association'. In 1999, the TSIA acted as the coordinator to organise Taiwan's IC manufacturing firms to fight against the tort indictment by Micron Technology, an American DRAM specialist.

As technology becomes more complex, Taiwan's IC companies must keep abreast of global trends, and the links between the HSIP and Silicon Valley grow stronger. In particular, access to the engineering talent and embodied technologies in Silicon Valley has become a critical competitive advantage for Taiwan's industry. The global links unfold in several ways. Taiwan's companies recruit overseas engineers, who set up listening posts in Silicon Valley to tap into the brain power there, or successful overseas engineers return to Taiwan to start up their own businesses. All of these possible links are established smoothly, with the mediation of overseas organisations.

One of the most important overseas organisations for high-technology industries is the Monte Jade Science & Technology Association (玉山科技協會). It was initiated by a group of overseas Taiwanese engineers and professionals in high-technology firms in the Silicon Valley. It was formed to promote co-operation and mutual flow of technology and investment between Taiwan and Silicon Valley. This association opens up opportunities for professionals and corporations at both ends of the Pacific to network and share their experiences, according to Monte Jade's documents. The activities of the Monte Jade include monthly dinner meetings, which encourage and promote networking among members, special-topic seminars that are put on in co-operation with other professional organisations, and social events and entertainment. Monte Jade has a special committee of the Board of Directors that offers assistance to members who are entrepreneurs, helping with corporate formation, growth, and development. It also offers assistance to corporate members with the flow of investment funds, technology transfer, and mergers and acquisitions. At the same time, in order to promote better networking among members and provide information about the latest trends in high technology, Monte Jade publishes a monthly newsletter. Through Monte Jade's efforts, many networking opportunities have been created and have proliferated. For example, in 1996, the Monte Jade held a Venture conference that brought together several dozen potential entrepreneurs from Silicon Valley and venture capitalists from Silicon Valley, Taiwan, and Japan. The entrepreneurs had an opportunity to present their business plans and to meet privately with the funders. A substantial proportion of the ventures were actually funded as a result of this conference, and many also gained important advice and mentoring. The event was so popular that it will now become an annual event. Following Monte Jade, more than ten professional associations, organised and steered by overseas Chinese engineers in Silicon Valley, now exist to enhance the cross border collaboration between Taiwan and the US (Saxenian, 1999).

Associations, formal or informal, local or overseas, allow intensive interactions between technology and capital, and render new investments and new employment possible. All of these supporting institutions not only attack the problems of market failure (the lack of public goods), but also enhance networking between the constituent parts of the industrial system. Through networking, institutions maintain and promote possibilities for collective learning for the disintegrated industrial system. As the vertically disintegrated industrial system become more coherent, the process of technology learning becomes more interactive, and the underlying institutions become richer in content, broader in scope, and more diversified. This goes beyond the state-led industrialisation argument.

A comparison with other industrial districts

The story of Taiwan's IC industry has demonstrated several key for which Amsden's late-industrialisation paradigm could not offer full explanations. Firstly, although Taiwan's state did foster the IC industry at the initial stage, as did its South Korean counterpart (Mathews and Cho, 2000), it took different strategies to get the job done. In South Korea, the state targeted the *chaebol*, the big industrial giants, encouraging them to enter this risky industry by offering generous banking loans and market protection. Taiwan's developmental state, as shown above, did not choose specific big firms, but provided infrastructures (ERSO and HSIP) and subsidies (tax breaks and cheap land) in order to encourage the formation of spin-offs. In a sense, the state played the role of demonstrator to show the private capital the profitability of what seemed to be risky business, and lowered the entry barrier for IC start-ups by subsidies, rather than playing the role of omnipotent planner as in the South Korean case.[14] These different strategies led to different industrial landscapes. While the South Korean IC industry was dominated by a few key giants like Samsung (三星), Taiwan's IC industry consisted of more than hundreds of SMEs, which benefited from the demonstration effect. Secondly, Amsden argued that the diversified business groups (*chaebol*) took advantage of their internal resources and deep pockets to learn by doing, but, in contrast, Taiwan's SMEs, possessing meagre technological and financial resources, grew through dense networks that facilitated external learning from their suppliers and customers. Finally, as Amsden did not explicitly deal with the issue of the evolution of the local-global connection in the South Korean late-industrialisation model, I argue that the success of Taiwan's high technology SMEs comes from the combination of a local vertically disintegrated district and a global hub, Silicon Valley. The late-industrialising firms not only benefited from the institutional embeddedness on the local developmental state as Amsden vividly illustrated, but also from tapping into the transnational connection with the overseas Chinese technical community. Although it has been well recognised that social and institutional embeddedness existed on the local level (Granovetter, 1985; Scott, 1988), the story of Taiwan's high technology SMEs system needs to invoke transnational embeddedness in order to explain the evolution of the late-industrial district.

The late-industrial district lying along the Hsinchu—Taipei Corridor also displays features that contrast with the concept of the non-Western new industrial district proposed by Park and Markusen (1995). These authors introduce the notion of the satellite industrial district, consisting of branch operations of non-locally based corporations, and argue that this type of state-led and non-place embeddedness would predominate not just in South Korea, but also in non-Western late-industrialising countries in general. In this sense, it is agglomeration economies, rather than dynamic learning effects, that provide the *raison d'être* of the creation of the late-industrial district.[15] It is true that state initiatives can be critical to the initiation of a new high technology district, as the Hsinchu case shows. It is also true that, in this case, local embeddedness was not enough to support the development of this late-industrial district. Taiwan's late-industrial district allowed the state to foster a vertically disintegrated industrial system, in which the networks between the indigenous high technology SMEs (not the branch plants of non-local big oligopolistic firms) facilitate collective learning. More importantly, the existence of complementary regional industrial systems and the cross-border overseas Chinese technical communities infused this late-industrial district with entrepreneurs and technologies from the United States. The lesson here was that, in spite of the fact that the state played a central role in the early stages, it was the transformation from agglomeration economy into learning district that drove the process of the late-industrialisation.

In brief, Taiwan's late-industrial district is similar to its South Korean counterpart in the state leadership, but differs in that Taiwan's state adopted spin-off strategies to encourage entrepreneurism, and to foster the formation of a decentralised industrial system, which allowed the complementary connection with Silicon Valley. In other words, while Park and Markusen depict the governance mechanisms in the satellite industrial district at the scales of the local market-type and the non-local hierarchy-type, I argue that Taiwan's late-industrial district is embedded in both local and global networks.

The late-industrial district also differs from its prototype, the Italian industrial district. It is widely argued that the four features constituting the essence of an industrial district are: interfirm dependence, local industrial embeddedness, an industrial atmosphere, and institutional thickness (Amin, 1994), although there exist some controversies about the nature and dynamics of the industrial district (Harrison, 1994). As shown above, Taiwan's late-industrial district possesses the ingredients of vertical disintegration, collective learning, and institutional embeddedness. It seems the Taiwanese offspring resembles its Italian ancestor. However, two major characters distinguish Taiwan's industrial district from its Italian equivalent. First, it is clear that Taiwan's district was given birth by the big push of the developmental state, rather than being created by a spontaneous cluster of inter-dependent firms. Secondly, while the Italian district and its American sibling, Silicon Valley, based their innovative performance on local interdependency, Taiwan's industrial district benefited mainly from the dense networks of the cross-border technical community. Indeed, it is the state leadership and global connection that set Taiwan's late-industrial district apart from the Italian archetype. It is in this sense that the term 'late' industrial district is used.

Conclusion

This research examines the late-industrialisation paradigm by exploring the case of high-technology development in Taiwan. Latecomer advantage, in the South Korean case, as illustrated by Amsden, was constructed on the base of learning and strong state intervention. Amsden argues that a developing country had to compete in the world market by technological learning in the production process. To facilitate the learning process, developmental states provided subsidies for vertical-integrated conglomerates such as *chaebol* to undertake take risky investment, those who hesitated to upgrade along the learning curve lost out.

Although it has been praised as a model of developmental statist paradigm such as South Korea, Taiwan's high technology industry demonstrates a different story of late-industrialisation. The industrial system in Taiwan featured vertical disintegration, learning networks and redundant institutional embeddedness. Although Taiwan's government acted as a developmental state in order to promote the new industry in the first stages, it was cross-border connections in technology and manpower that helped to upgrade technical expertise in the late-industrial district. Meanwhile, the decentralised industrial system promoted mutual learning between constituent firms, and the dense social ties and floating labour market enhanced technology spillover in the district.

In brief, Taiwan's high-technology industries reveal the advantage of flexible specialisation and collaborative learning in the globalisation process, and the connection between the social and professional communities in Taiwan and Silicon Valley provides the bridge for technological co-operation, and has enhanced the learning capabilities of the latecomer firms. In other words, the central agent of Taiwan's story is the technical community, rather than the large conglomerates (*chaebol*) in the South Korean case. This research concludes that in spite of similar appearances of late-industrialisation, Taiwan and Korea have indeed taken different trajectories in order to build up competitive advantage.

Notes

[1] The term 'embed' is used here and later in this chapter in a sociological sense, i.e. agents' activities are influenced and even determined by their situated social structure.

[2] Evans defines four roles played by the developmental states, based on the relationships between the state and the industry: custodian (regulator), demiurge (producer), midwife (creating private firms), and husbandry (supporting private firms).

[3] Some of the outstanding Silicon Valley returnee-became-entrepreneurs included Macronix International Corporation(flash memory), Mosel-Vitelic (DRAM), Integrated Silicon Solution Incorporated (SRAM), and VIA Technology Incorporated (chipset). Besides these, some returnees were recruited by existing IC companies to take charge of new product development and management. Overall, in 1995, six of the top ten IC design houses were set up by returnees (ERSO, 1995).

[4] To take chipset firms as example, Taiwan's top three chipset design houses, VIA, SIS, and Acer Lab, were all started up or managed by returnees. They produced more than half of the world market share.

[5] In the world of semiconductors, the term fab refers to a foundry. A fabless company designs a product (usually, a semiconductor) but does not make the product itself.

[6] Interview with Sam Lin, September 5, 1997.

[7] Interview with Nasa Tsai, Mosel, September 9, 1995.

[8] Interview with Steve Tso, Hsinchu, March 15, 1999.

[9] For the list of recipients, see http://www.cie-gnyc.org/Rwinner.htm.

[10] 'Flexible developmental state' was O'Riain's (2000) name for this category of state activities, i.e. policies founded on the professional community. The 'bureaucratic developmental state' was founded in the domestic capital.

[11] In these cases, the basic spin-off pattern is as follows: at first, ERSO establishes a demonstration plant within the lab and transfers technology from foreign companies. After mastering the transferred technologies, it privatises and commercialises the plant, and finally spins it off. This group includes UMC (1980), TSMC (1987), TMC (1988) and recently VISC (1994).

[12] Well-known examples in this group are Mosel-Vitelic (1984) and MXIC (1989). The stories of these two firms are typical: several experienced IC engineers who had worked in Silicon Valley for more than ten years decided to start up a new business in their homeland, and risked their fortunes on the burgeoning industry. While looking for funding, they got positive responses from local venture capital.

[13] Cf. Saxenian (1994) on the role of venture capital in the development of Silicon Valley.

[14] The difference in industrial policies comes from the difference ruling regimes and state-business relationships in Taiwan and Korea respectively. Korean governments, even the dictator administrations, had to rely on the big business (the four *chaebol*) to run and win the elections, and they embedded economic development in the support of the *chaebol*, thus they adopted a 'pick the winner' policy to favor the *chaebol*. However, in Taiwan, the then ruling party (KMT, 國民黨), believed to be the richest party in the non-communist system, possessed its own party assets, and thus it was not necessary to get donations from business in order to run election campaigns. At the same time, KMT administration, a Leninist party, controlled by Mainlanders, kept local Taiwanese groups from influence after they retreated from China in 1949. Thus, in terms of decision-making in industrial

policy, the government appeared to play an impartial role by providing subsidies to those who were qualified to apply. In consequence, it led to the proliferation of small and medium-sized enterprises. See Cheng(1990) for details. Here we echo Douglass's (1994) assertion that much of the recent literature tends to assign all NIC states to an undifferentiated model of the 'developmental state'. However, a closer examination reveals significant differences among them in terms of the state's relations to capital, labour, and the external economy that not only defy reduction to a single model but also show that options for moving away from labour-intensive segments of production for world markets vary considerably.

[15] According to Park and Markusen (1995), the satellite industrial district was painted as a collection of subsidiaries of non-local oligopolistic firms and inter-regional, rather than an intra-regional labour market, which engaged in unskilled processing under the auspices of developmental state. In this sense, the district was no longer to be seen as a clustering of firms with social embeddedness, but as an expression of pure Hooverian agglomeration economies.

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