3 The creative role of the state and entrepreneurship

The case of Taiwan

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The dominant views in understanding postwar East Asian development have centered on the role of the state in facilitating economic development; they range from an earlier emphasis on the top-down approach of statism to the current emphasis on "embedded autonomy." The latter is about the type of state-society linkage conducive to the joint project of industrial transformation (Evans 1995). Of major concern are the "institutional innovations" that can lead to development and innovation (Block and Evans 2005: 515; Evans 2005; Block and Keller 2011). This chapter reassesses the issue by revisiting the role of the state in cultivating entrepreneurship through a historical analysis of the Taiwanese experience during the postwar period. Going beyond the conventional account of the East Asian developmental state, which comprises state control of finance and close ties between the state and the business elite, the chapter highlights the multiple linkages among the various Taiwanese state agencies and a series of small and medium-sized enterprises (SMEs) in enhancing the technical learning and export capacities of firms to succeed in the global market. Through an in-depth case study of the Taiwanese bicycle industry, a key export industry since the 1970s, this chapter reveals an unacknowledged model of state–industry relationship, one that goes beyond the well-understood model developed from the information technology (IT) industry.

Role of the state in industrial transformation of late developing countries

A prominent trend in understanding the role of the state in developing countries is the theory of late development. The latecomer thesis originated in the work of Gerschenkron (1962) on late-industrializing European countries in the nineteenth century, which then provided the basis for the contemporary version of the developmental state theory to explain the rise of postwar Japan and the East Asian Tigers: Taiwan and South Korea (Johnson 1982; Amsden 1989; Wade 1990). This theory focuses on the need for a specific state structure to create an export-based industrial system and induce industries to catch up technologically with those in advanced countries to compete internationally.

The conventional latecomer's catch-up model involves state control of finance

whereby the state provides patient capital (which means large sums of capital for investment for a long period) to encourage the private sector to enter targeted industries, the so-called model of picking national champions. Empirically, East Asian states adopted industrial policies by urging private sectors to enter fields that they otherwise would not have been willing to enter or capable of entering, as epitomized in the success of the creation of world-class Korean large conglomerates (called *Chaebol*; Woo 1991; Amsden 1989). In the Taiwanese context, in the 1970s and 1980s, the state took on the role of direct producer in the way Wade terms "governing the market" (1990) by using state enterprises to engage in a big push in heavy industrialization in the upstream industries (such as steel and petrochemicals) to induce entry of the private sector into the downstream industries.

While it may be sufficient for the state to act as a direct producer or planner to bring about industrialization, this position argues that for development to be sustainable the state must have the capacity Evans calls " embedded autonomy", according to which the cohesive state incubates and nurtures new private firms by inducing them to invest in areas they would not otherwise undertake (midwifery) and then constantly pressures these firms to continually upgrade themselves (husbandry) in moving upward in the international hierarchy (Evans 1995). Local entrepreneurship is needed due to the rapidly changing nature of the high technology sectors in international competition. Prodding is needed because the natural inclination of business is toward short-term profits and may not take into account long-term developmental goals.

The linkages in the East Asian context focus on the state and large business nexus as a way for industrial transformation. The dense and tightly knit network between the Korean state and the *Chaebol*s was the showcase of the developmental state (Kim 1997; Woo-Cumings 1999). In this account, a cohesive state structure is required, often with a pilot agency for formulating sound industrial policies and forming dense policy/personal networks with the large business elite (Evans 1995; Chibber 2002). Emphasis is placed on a few large corporate businesses because when the state intervenes, it tends to reduce the number of players/producers in the industry, which makes monitoring, signaling and sanctioning easier and thus cooperation between the state and private partners possible (Noble 1998; Okimoto 1989). State intervention tends to generate industrial concentration. There are also technical reasons to favor large industrialists, for they are considered capable of reaching economies of scale and of absorbing, improving and diffusing western technologies and, in turn, competing with advanced countries in the international market.

Taiwan as a puzzle

Yet, the Taiwan experience suggests a deviation from the above approach, for the state relied less on finance as an instrument to induce industrial development: it did not give out patient capital to firms. The émigré KMT regime and their aloof relationship with the local indigenous elite prevented the concentration of large businesses because the formation of a Taiwanese capitalist class would have been

a major threat to the regime (Cheng 1990; Gold 1986). Consequently, the private sector's lack of access to long-term capital brought about a decentralized industrial structure with numerous SMEs. The conventional wisdom would imply that a decentralized industrial structure with numerous SMEs and a distant relationship between private capitalists and the state would be unfavorable for Taiwan's quest for rapid innovation-based industrialization.

At the same time, the statist model of creating national champions to compete internationally becomes ill-adapted, as can be seen in the recurrence of global financial crises in the past two decades. The Korean state-large C*haebol* coalition, in which the state underwrote a system of business financing that led to large investment through massive debt-to-equity ratios via government guaranteed loans in the 1980s and international loans in the 1990s, was under siege when the impatient capital of the latter led to disastrous results in the 1997 Asian financial crisis. Moreover, the moral hazards created by these "too big to fall" corporations, together with the declining state power to discipline them, generated discontent within the society in a wave of democratization and cast doubt on the viability of the state-led model in the light of financial liberalization and increasing international mobile capital.

Taiwan's transition to high technology industrialization with an economy dominated by a system of SMEs and the fact that it has adapted to the globalized economy relatively unscathed by cyclical international financial crises have posed a puzzle to students of state and economic development. Are there alternative explanations? The success of the dynamic system of Taiwanese SMEs quickly lent support to the varieties of network and organizational theories in explaining economic outcomes associated with the literature on industrial districts and social capital (Powell and Smith-Doerr 1994; Woolcock 1998; Storper 2005).[1] This society-centered approach ranges from an emphasis on local linkages and networks among firms that facilitate trust and cooperation and thus flexibility to the global production network (GPN) where integration into the GPN was the key to the drive behind high technology development. Empirically, the former suggests the importance of trust and cooperation derived from inter-firm networks independent of the state in contributing to Taiwan's economic success (Hamilton *et al*. 2000; Biggart and Guillen 1999). The latter emphasizes the role of multinational companies (MNCs) in connecting the Taiwanese suppliers to the world market, while the technological learning of the SMEs stemmed from doing original equipment manufacturing (Gereffi 2005; Henderson *et al*. 2002; Humphrey and Schmitz 2002; Chen 2009). Contrary to a state-led approach that emphasizes intervention in ramping up production, this position argues that the Taiwan experience has been a demand-propelled industrialization influenced by retailers in the United States and MNCs (Feenstra and Hamilton 2006; Hamilton *et al*. 2011; Hamilton 1999).

As important as the advantages that inter-firm linkages could bring about are, the society-centered approach lacks mechanisms to explain technological learning and upgrading. For example, the trust and cohesion emphasized by the network literature does not provide insights into the technological learning and

capacity building of the SMEs. Moreover, the linkages to MNCs alone do not explain the variations in upward mobility among countries.

At the same time, studies by the proponents of the statecentric theories began to search for new forms of alliances between the state and industries that would be conducive to innovation in the globalized world; and analyses of the transformative state capacities that examine the evolving role of the state in responding to globalization have proliferated in the past decade. (Weiss 1998, 2003; O'Riain 2004; Evans 2005; Chu 2007; Block 2008; Breznitz 2007; Block and Keller 2011; Negoita and Block 2012). The literature some term "developmental network state" (DNS) focuses on the multiple linkages among the state, local firms and foreign capital in facilitating innovation and development in a globalized world. The focus is on a decentralized network structure of the state with multiple connections to various actors in coping with the changing reality where production and innovation have extended across national boundaries and involved complex collaborations in an era of liberalization with increasing foreign investment in various parts of the world (O'Riain 2004). The success of the Taiwanese IT industry has served as a prime example for the DNS literature. The embeddedness thesis in the Taiwanese context focuses on the role of state-funded research institutions, such as the Information Technology Research Institute (ITRI), and their collaboration with the private sectors in the development of the IT sector as a way of accounting for Taiwan's success in moving to high technology industrialization (Wang 2010; Mathews 2002; Amsden and Chu 2003; Mathews and Cho 2000; Mazzoleni and Nelson 2007; Breznitz 2005). Most of the narratives have agreed on the well-functioning division of labor between the state and the industry in contributing to the industrial ascent of the IT industry. The public research institutions focused on acquiring and absorbing new technologies and conducted most of the R&D up to the level of a working prototype. They then transferred and diffused the results to the private firms. The private firms, in turn, concentrated on final development and commercialization.

Despite the growing interest in public–private synergy, the actual working of these linkages remains underexplored; the existing studies tend to prescribe what the state ought to do and assume that the society will follow.[2] If Taiwan is considered as a case for the neo-developmental state theories, the actual working of these linkages between the state and society requires detailed scrutiny. This chapter joins the debate by addressing the following question: If succeeding in the world market has been an important element of Taiwan's postwar accomplishments, how do we explain the way in which Taiwan's SMEs connect to the world market as a distinctive feature of the country's postwar development? What happened in Taiwan went against the experience everywhere else. Traditionally, exports have mostly come from large firms because they can better meet the transaction costs of participation in the international market. If size and scale of economies are crucial to competing in the world market, how did a series of Taiwanese SMEs acquire the technical capacities needed for export and establish economies of trust with foreign buyers in the 1970s? If the various "embedded

autonomy" theories are to have explanatory power, it has to be shown precisely how the state escorted the SMEs onto the world market.

Developing linkages with society: case study of the bicycle industry

This chapter explores the role of Taiwan's state agencies in assisting the SMEs in the export market through an in-depth case study of the bicycle industry, a key export industry in the 1970s, and investigates the mechanisms of the role of the state in the technological learning of the SMEs. This study focuses on an unacknowledged model embedded widely in Taiwan's practice that would account for the industrial upgrading based on the SMEs' networked learning and innovation. By revisiting the initial period of export-led development and its subsequent transformation, I intend to unpack the patterns of state–industry alliances that were conducive to development and to illustrate the processes involved.

Through in-depth case studies of the Metal Industries Research and Development Center (MIRDC) and, later, the Bicycle Industry Research and Development Center (BIRDC), and their specific patterns of interaction with SMEs, especially in the parts sector, I show the specific ways government-funded research institutions were able to enhance the export capacities and technological learning of the private sector. This case study provides insight into how and what kind of institutional arrangements can be made between the state and a series of SMEs in export-led development—an insight that goes beyond the conventional preference for the state–large firm nexus—and that is amenable for broad-based entrepreneurship to take root. The key argument is that the inherent nature of the groups created specific patterns with which the state developed linkages.

The bicycle industry is chosen because it is an industry dominated by SMEs in Taiwan and is typical of the export sector. It consists of an assembling sector and a parts sector with an organizational structure that exercises extensive subcontracting practices (as opposed to vertical integration); thus, it has overall similarities with the decentralized industrial structure of the Taiwanese economy. The industry is an export-oriented industry. It has been incorporated into global bicycle production since the 1970s, with over 90 percent of the bicycle production for export. Moreover, the industry has demonstrated an upgrading process, moving from being a Third World producer to becoming a key player in the global bicycle industry, despite losing advantages to cheap labor abroad. While there has been an increasing movement of production offshore, the bicycle industry continues to maintain its production in Taiwan and compete in the high-end segment of the bicycle trade. Bicycles exported from Taiwan reached 10 million in 1998, dropped to 4 million in 2003 and rose to five million in 2008. While the total volume of bicycle exports has declined, their total value has increased. For instance, the average price of an exported bicycle has risen from an average of US$ 95 to US$ 300 or more from 1998 to 2000. These figures suggest that upgrading has occurred. Therefore, this is an ideal case for assessing the hypothetical changing role of the state in the export and technical upgrading process.

In what follows, three points are made concerning the role of the Taiwanese state in enhancing the export capabilities and technological learning of SMEs, as seen in the bicycle industry, and the changing state–business linkages. First, I show how standards setting and the export inspection scheme were crucial in establishing learning and linkages between the state and the export-oriented private sector. The focus on quality improvement via standardization was important not only in building the technical capacities the SMEs needed for export, but also to establish economies of trust with foreign buyers, an important element in overcoming the disadvantages a decentralized structure could bring. This technological learning via standardization, an overlooked aspect in the existing literature, gave rise in turn to a vibrant parts sector and created the backward linkages and entrepreneurship needed for broad-based development.

Second, I demonstrate the limitations of the winner-picking policies upon which the East Asian developmental state literature draws when dealing with a decentralized industrial structure. The top down alliances of picking winners as illustrated in the case of the derailleur project and the Center-Satellite Factories Program actually created dissent within the industry.

Third, through the case study of the BIRDC, I show how the actual workings of the alliances between the state and a series of SMEs in the quest for innovation were carried out through capability building by providing external economies applicable to all firms. The state agencies played the role of information disseminators and orchestrators in bridging different networks and resources, which reduced the entry barrier for entrepreneurship and alleviated the R&D burden on individual SMEs.

Building export capacities via standardization

The export of bicycles skyrocketed in the early 1970s, and the main destination was the United States. For instance, a total of about 17,000 bicycles were exported in 1968, and 107,000 in 1970. By 1972 this figure had reached one million, and 1.3 million in 1973. This export pattern conforms to the general trend of export-led industrialization in the 1970s. It is striking that so many manufacturers mushroomed in exporting products, from about 250 firms (registered) in the 1970 to 447 (registered) by 1976. Moreover, over 80 percent of them had fewer than 30 employees, and over 90 percent had fewer than 100 employees. How did these SMEs gain the capacity to export so many bicycles, and sustain it? Entrepreneurs attributed this to their quick response to the market. Yet their quick response initially consisted of exporting shabby products, for many were recalled or returned at US Customs. Buyers' complaints were mounting. By 1973, many US stores refused to sell bicycles from Taiwan. In what follows, I will illustrate the intricate dynamics of the ties between the state agencies and firms in building export capacities by focusing on improving quality and technological learning via standardization.

In 1971, one of the first measures adopted by the Bureau of Foreign Trade (BFT) was to entrust the MIRDC with studying the bicycle industry and improving its technology.[3] The initial plan was to focus on improving processing and

manufacturing methods, standardization and quality control in order to teach firms how to do inspections and verify their components in mass production. A former engineer at MIRDC who was in charge of this Bicycle Assistance Project recalled the state of the industry and how he got involved with it:

> At that time [in 1970–71], BFD entrusted a case to us, asking, given the current problems we faced in the world market, how would we promote bicycle exports?…At that time, CETRA (China External Development Trade Council)[4] helped us collect bicycles worldwide, ranging from high-quality grade to cheap ones for us to study and do quality comparison and benchmarking…There were no standards or regulations on these parts at that time. There was the Chinese National Standards (CNS) established in 1947. But it was 1971 that we were talking about…So what we did was: first of all, visited all assembling factories, and through them we found all their parts suppliers and listed them all in the first year. We then surveyed all parts makers in the second year of the project and checked out their technology levels…Just assembling factories, there were over two to three hundred at least doing exports, ranging from small family [businesses] which had no modern equipment to some established factories. You can imagine all the possible problems.
>
> (Interview C0104)[5]

So the first step was to focus on improving quality. Standardization was the key because all the components should be interchangeable or fit when they were assembled together, since the same component could be produced by several suppliers in a decentralized SME network.[6] A key element for standardization was to set up the manufacturers' own industrial standards, which later became the new revised CNS. The former engineer who was involved in the project explained how this came about:

> For example, we were trying to understand where our standards should be. We looked at the Japanese Industrial Standards (JIS), the US Standards, German Industrial Standards, and integrated them and came up with our standards. … For instance, the JIS is very detailed. It tells you the exact tolerance and how you verify, sample, and inspect. The American requirement came later. The US standards did not care whether your nuts and bolts are interchangeable. The European and American Standards are mostly consumer standards, based on performance and function. It does not give you the details of size and tolerance or individual parts specification unless there is a safety issue involved. But we [i.e., Taiwan] were not up to that level yet, so we opted for a very detailed one. For instance, our standards specification would tell you how surface treatment should be done, how one does electroplating and heat treatment. We specified them individually. Our foundation was established based on JIS. At that time, the bulk of our efforts were devoted to standardization.
>
> (Interview C0208)[7]

Despite the emphasis being on standardization and quality control, it could be argued that the technical learning of these SMEs began in this way—learning about specs, learning about making the right blueprints, and learning how to verify one's own design and product. The engineer explained how they worked with firms on quality control:

> Then, the next question arises: one may then ask, how did one know if they had done it correctly [even] if they had followed the spec? We then showed them how to make gauges based on these standards and told them to follow this to verify and enhance precision before it went to production. It was about standardization. We spent a lot of time on this. The gauges that we developed at that time are still at MIDRC, at least when I visited in 1993. We also taught the assemblers how to do quality control and inspection of parts makers, and they would follow this standard. The problem at that moment was about standardization, not product development.
>
> (Interview C0208)

Here MIDRC was important in circulating and passing on information, such as JIS standards and the subsequent US Consumer Safety Commission's regulation on bicycles, to numerous parts makers. Technical learning via quality control and standardization meant that the manufacturers finally made the grade to become "qualified players" competing in the world market.

Establishing economies of trust: the development of an export quality inspection scheme

To build export capacities, the state enforced an export inspection scheme starting in 1976 as a way of establishing economies of trust between Taiwanese suppliers and foreign buyers. The MIDRC played a crucial role in realizing a workable export inspection scheme (in consultation with the export firms themselves) that did indeed improve the overall quality of the goods coming out of Taiwan.

When the export inspection scheme was first introduced in the 1970s for bicycles, export firms protested against the measure and treated it as government red tape. They held that the government did not know much about the export market and that the guidelines it had followed (the CNS from 1940s) were outdated (*United Daily News* March 28, 1971). MIDRC worked with the Bureau of Inspection and Quarantine Control in executing and evaluating the inspections of items like bicycles, as well as working with the Bureau of National Standards in coming up with the specs for export inspection based on their prior knowledge gained from working in the industry. Contrary to the image of a top-down process of implementation of state policies, the MIRDC acted as an instrumental intermediary between the state and the private sector. It helped collect information and assisted in the state-building process when Taiwan tried to strengthen its export trade promotion, as seen in the case of the export inspection scheme.

The existing literature credits the government's ability in elevating the reputation of products exported from Taiwan; and the inspection scheme boosted the national image in the 1970s, when complaints were piling up (Chu 1997; Wade 1990; Egan and Mody 1992). The case of bicycle exports was no exception. But what is often overlooked is the technical learning and the collective gains in terms of image boosting that accompanied this inspection scheme, and that they in turn lowered the entry barrier for exports for the SMEs. Moreover, the inspection scheme implies that the earlier efforts at standardization had become institutionalized and that information was able to reach all the firms that wished to undertake the venture.

Most entrepreneurs concurred that this export quality inspection scheme was important for enabling SMEs to reach out to the world market because it demonstrated their abilities to meet the spec and quality standards. "Standards and spec are very important!" exclaimed one industry veteran (Mr. Hsu). An assembler explained how they learned quality control:

> At that time, the inspection bureau and BFT offered seminars on quality control. They gave factories grades like ABCD based on their factories' capability in meeting quality requirements. There was incentive for making it to the top grade. That's say, if you were grade A, you paid 0.1 percent in export funds. … This was how we started to learn about quality control and quality improvement.
>
> (Interview Senior Chou)

Another assembler credited the contribution of the quality control program:

> Thirty years ago, the problem was about quality. You know the story about the shops in the US that refused to repair bicycles made in Taiwan. So the government introduced a quality inspection scheme based on grades and entrusted the MIDRC to conduct the inspections. At that time, all exporters, except Giant, needed to bring their bicycles for inspection before export. I told the Vietnamese government that if they wanted to improve exports, they should adopt this inspection scheme by grades.
>
> (Interview Mr. Pai II)

This pattern of assistance by MIDRC to the bicycle export industry in the 1970s was actually part of a general trend in the state's efforts to respond to export problems. Several other industries had similar patterns and faced similar problems, starting with the sewing machine industry in the late 1960s and the machine tool industry and other machinery-related industries in the 1970s. As in the bicycle industry, technological learning in these firms also sprang from standardization and quality control measures that were applied to all firms (*MIDRC Report* 1973, 1983; interview info). This is in contrast to the conventional wisdom that focuses on the state's inducing entrepreneurship via finance, and which is used to support the idea of a developmental state (Woo 1991).

Moreover, reading through newspapers of the 1960s and 1970s (also confirmed by *MIDRC Report* 1973, 1983) reveals that the MIDRC organized many seminars on processing technologies (heat treatment, forging, die-casting, welding, etc.), skill training of primary labor forces, on-site training for production workers, maintenance of equipment and management of modern factories, at a time when formal science and technical higher education was just taking off. The MIRDC thus served as the information arm of the government by surveying factories in different industries and by understanding the level of technological development and the problems of the different industries. In addition to setting the technical specs for different industries, the MIDRC provided a platform on which they could all improve their skills. This experience in the early 1970s vis-à-vis standardization and quality control became the basis of engineering skills formation, and the various supports provided a foundation for the bicycle parts sector.[8]

Creating backward linkages: the consolidation of a vibrant parts sector

The immediate consequences of this specific type of institutional arrangement in export strengthening and technological learning created backward linkages to the society by establishing a vibrant parts sector. By the early 1980s, Taiwan was the number one world exporter of bicycles and had gradually become a supplier of premium-quality bicycles. Existing studies attribute the success to learning by doing original equipment manufacturing; and thus the learning came (a) from foreign buyers such as Schwinn, and (b) from the leading bicycle assemblers like Giant, who in turn passed on knowledge to the parts makers (Cheng and Sato 1998). If one situates the question in a comparative context, however, it would be: How did Taiwan become the chosen one? For instance, the other outsourcing option would have been South Korea, which shared a similar level of development with Taiwan and had been actively engaged in exporting bicycles since the 1970s. It is plausible to argue that the earlier technical development of the parts sector, the one that focused on standardization and inspection, paid off and sowed the seeds for subsequent development. Without the presence of a dynamic parts sector and without the foundation for improvement in the quality of components, the Taiwanese firms would not have been able to win contracts with the more quality-focused bicycle buyers among the US independent bicycle dealers, like Schwinn, who made up the premium market segment.[9]

The presence and dynamism of the parts sector allowed the assemblers to negotiate with MNCs to increase local content by using local parts, instead of becoming the typical Third World factories that assembled imported parts in exchange for processing fees. The former vice president of Schwinn recalled the situation of sourcing in East Asia in the early 1980s, and how Schwinn came to use Taiwanese bicycle components (for higher-end bicycles) instead of Japanese ones:

> Schwinn was the first to move [referring to the first high-end bicycle manufacturer to outsource to Taiwan]. When Schwinn was in the process of

> making that move, Giant [the Taiwanese bicycle assembler] rapidly expanded the supply base in Taiwan. It also came at the time when yen appreciated against the dollar rapidly, and that season we could no longer afford to purchase the componentry from Japan because of the yen parity in 1982 and 1983. … Giant had just started this expansion in the supply base in Taiwan for several years. It was no longer financially viable for the Americans and Taiwanese to spec and buy the Japanese componentry. So this accelerated it. … Giant said, "We [i.e. the Taiwanese parts suppliers] were just about to be ready. Let's go ahead right now this season and do this and push these new vendors. Let's take a year to make this conversion."
>
> (Interview T0204)

The interviewee went on to compare the difference between Taiwan and Korea and explained why Schwinn did not choose Korea as the sourcing site:

> We went to survey the Korean parts business. The component situation was well behind any kind of development Taiwan was doing. It was not developed and it was not going to get developed unless someone put the time and effort into it. There was not this vision and grain to develop Korea as a source of industry. … I met with the components people in Korea, but the only viable item was the tires and tubes. That has been going on since the sixties.
>
> (Interview T0204)

The owner of a Korean bicycle assembling firm articulated his dilemma from the time he started in the export business:

> That company [a Japanese factory in the export-processing zone that he had taken over] was buying most of the components from Japan, because they were in the free export zone, like a bonded factory. They imported most components and started to import some components from Taiwan. They did not buy components from Korea. When I started this business, I had to import all components from Japan. By the late 1970s, the Taiwanese started to beat the Japanese and were becoming more and more competitive in the 1980s. So it was very difficult for us to compete with the Taiwanese assemblers with components from Japan in the US and Canadian markets. So from the start, my business was difficult.
>
> (Interview KC0104)

Subsequently, the dynamic parts sector, together with the assemblers, consolidated Taiwan's position in the global bicycle trade from the 1980s.

The illustration and comparison with the Korean bicycle industry is not meant to discredit the postwar economic success of Korea, but simply to illustrate that the legacy of the Korean model of state-large firm nexus does not favor the development of an SME-based parts sector despite its relative success in its targeted industries (e.g. auto).

Picking winners? The limits of top-down alliances in a decentralized industrial structure

Not all state involvement in the industry works towards the industry's advantage. The decentralized nature of the industry made the winner-picking approach, the conventionally understood ingredient for success in East Asian industrial transformation, difficult to realize. The case of the bicycle industry is illustrative.

As an industry grows to be a successful export industry, the conventional account goes that the state plays an important role in its upgrading process through Center-Satellite Factories Programs and involvement in the R&D of key components. The Center-Satellite Factories Program in Taiwan was an attempt by the government in the 1980s to coordinate the SME networks by bringing the smaller suppliers into the orbit of the larger assemblers in various industries involving the parts sector. The assumption was that with stable demand, smaller suppliers would be more willing to invest in upgrading and improvement in technology, following the Japanese example. In the case of the bicycle industry, the Program focused on supply-chain management, quality assurance, cost reduction, etc. Yet my interviews with participant firms found mixed results. In part, the open overlapping network made this kind of systemization difficult to implement. The decentralized nature of the bicycle production network meant that the assemblers were not big enough to bind all the parts makers. What ended up happening was that there was overlapping of parts suppliers among the four major bicycle-assembling factories participating in the Program. Suppliers found it too much work to adjust to different interfaces (interviews Liao, Hsu; *IDB Report* 1993: 24). The spokesperson of the leading assembler articulated the problem:

> We did form a supplier network. But even so, there was overlap among the parts suppliers among different assemblers. This had become a problem. For instance, Maxxis [a tire manufacturer] supplied to all major assemblers, like Giant, Merida, Fairly, and Pacific, and so did other parts makers. Suppliers ended up participating in several systems. This was not sensible at all. This was how we [meaning the industry] then established the bicycle industry association (TBEA) so that everyone could discuss issues on the same platform.
>
> (Interview GH0204)

The decentralized nature of the industry caused it to push for an industry-wide association to address common needs, such as problems experienced in management, export promotion and trade.

Starting in the mid-1980s, the Industrial Development Bureau (IDB) under Ministry of Economic Affairs began to support the crucial component project and entrusted ITRI with the research as a way to assist technological upgrading of the industry to cope with increasing competition from lower-wage countries. Existing studies see the programs of joint product development of the carbon-fiber bicycle frame between a leading assembler and the ITRI as well as the patented

breakthrough in derailleur components and subsequent technology transfer to derailleur companies as successful initiatives of the state–industry alliance (*ITIS Report* 2000; Amsden and Chu 2003: 86). But closer examination with interviewees in the industry suggests mixed outcomes and a distant working relationship with the ITRI on these measures.[10] The interviewees questioned the feasibility of the commercialization of these products developed by the ITRI and felt that the SMEs were more in tune with the international market demand (interview info). This distance can be partly explained by the knowledge and communication gap between SME-based entrepreneurs and highly educated ITRI engineers.

The most controversial case was that of the crucial component project on derailleurs (bicycle gears). Even as Taiwan's bicycle industry became the number one exporter in the world, derailleurs continued to be controlled by Shimano, the Japanese component maker and world leader in the derailleur field. Thus, upgrading involved R&D on a core component in order to bypass the Japanese supplier. The establishment of the BIRDC in 1992 was the Taiwanese government's general attempt to set up an industry-specific R&D center co-funded by the state and the private sector to promote the industrial upgrading of the bicycle industry. The initial goal focused on R&D for crucial components, and research went mainly into the development of derailleurs so as to decrease the industry's dependence on Japanese parts makers. Yet, the single focus on derailleurs led to complaints of unfair resource allocation and suspicion of collusion of collective means for private goods, whereas the firms expected the Center to fulfill the needs of the industry as a whole, especially since only a few firms were producing derailleurs (*IDB Report* 1993: 116).

Firms that manufactured other parts claimed that R&D should focus on their areas because they were equally important in contributing to the export and performance of the industry. A leading handlebar maker explained:

> the R&D Center cannot just support the development of derailleurs; they need to work in other areas as well, right? Especially given that other components are growing while derailleurs are shrinking [in terms of quantities exported by Taiwan]. … The truth is that the overall capacity of the R&D Center cannot even compete with Shimano [i.e., Shimano's R&D department].
>
> Interview HL0102)[11]

At the same time, the assembly firms protested that Taiwan's main strengths in bicycle development related to materials and frame, and therefore that the upgrading of frames should be the priority, not derailleurs (*IDB Report* 1993: 114). In short, the concerns were predominantly that over-concentration on the upgrading of derailleurs, along with neglecting other possibilities, might undermine the competitiveness of the industry as a whole. Conflicting views on the priorities for R&D led to a halt in the operation of the Center, especially after the disclosure of a financial scandal involving executives of the Center who had had dealings with the major derailleur firm in the first year of the Center's operation (*United Daily News* August 17, 1993).

Coordinating networks: capability building by providing external economies applicable to all firms

The winner-picking approach experienced strong resistance from the industry.[12] As a response to the collective demand of the industry, the restructuring of the BIRDC sought to supply the various needs of the industry and service all its firms in areas where each individual SME could not deliver. These areas were related to technological development, including product development testing and certification, quality assurance, materials and manufacturing processing technologies, standards setting, R&D analysis and design simulations and collection of marketing information (*United Daily News* June 25, 1994: §B09).[13] This approach of logistical support for product development that could benefit all was similar to what the MIRDC did in the 1970s.

One important means was the establishment of an independent professional R&D testing lab for the center. The BIRDC had collected almost all the industrial standards of the world and was able to perform tests and certification according to requirements (interviews C0104, H0108, W0103). One might wonder why testing and providing logistical support were important and how these means could possibly enhance the innovative capacities of the firms. Could they not be done by the firms on their own? I will use quotes from the former general manager of the Center to illustrate the relevance of an independent professional testing lab and its importance to R&D for SMEs. When asked how it would differ from firms' own testing facilities, he observed:

> It is a matter of credibility. Of course an individual firm is going to claim that their product is reliable and good. Judging from these firms' equipment, I wonder about the level of testing they could achieve. Of course, a few bigger ones have invested in testing equipment and do it relatively well. But most factories can't afford to spend that much money on testing equipment. Second, testing involves two dimensions. First of all, if it is just to verify and test whether or not my product meets the standards and is reliable; that is easy to do. Second, the testing becomes crucial when I am doing product development because I need to crosscheck and verify testing results at the R&D stage. Then this testing is more complicated. Let's take the suspension fork—put aside the suspension frame for now, that is even more difficult—as an example: you can probably verify whether it is safe or not. But the Center can tell you your damping ratio, and they would test for other, related technical issues, not just safety. Moreover, they can tell you how to improve the product, starting from the design aspects. You may be able tell whether a product is good or bad, but you don't know how to improve it. This is what professional testing can do. In my view, the R&D Center has done quite well in this area.
>
> (Interview C0204)

These collective services provided by the BIRDC, which may seem subtle, were effective in assisting SMEs, especially among the parts sector, in R&D and for

export.[14] These services contributed to the strength and upgrading of the industry as a whole. Let's take R&D testing as an example. Testing and certification by an independent professional testing lab for the bicycle industry boosts the image of the export firms and establishes trust between the suppliers and foreign buyers. One important element for successful export is meeting the quality and industrial standards of the designated countries, and third-party testing and certification are usually required by the designated country. An engineer from the R&D Center shared anecdotes about how parts makers used the lab to demonstrate the technical capacities the firms possessed to potential buyers and noted:

> Our lab is the showroom. What I mean is that some firms would tell their buyers that we were their subunit and take them here to show off. We would have to explain to the buyer when they came to visit that the company had entrusted us to conduct R&D testing and quality testing services for them, and that we provided the services to all firms.
>
> (Interview H0108)

The testing became an especially important part of the R&D process after the rise in popularity of the mountain bike in the 1980s. The changes that accompanied it created new possibilities for bicycles with technological complexities. This meant that the standards and requirements relating to bicycle manufacturing became even more detailed, diverse and complicated. Thus, having access to a testing center in central Taiwan, where most bicycle manufacturers were located, enabled the SMEs, especially parts makers, to tap into the external economies provided by the semi-public research agencies and to reduce the entry barriers for export and subsequent R&D.

Situating the question in a comparative perspective further illustrates the necessity for this type of overarching support for helping the parts sector to upgrade. In my comparative study with the Korean bicycle industry, when I inquired why parts makers did not export, I discovered that a key problem they encountered was the inability to meet the industrial standards of the export countries. Studies on Thailand's auto parts industry suggest that it has a weak indigenous parts sector despite the industry's being incorporated into the global production chains of automobiles. This industry consists of low-skill processing jobs and assembly activities using imported high-tech inputs. In other words, despite industrialization, backward linkages have not been created. A key problem challenging the local Thai parts makers is their inability to deliver parts of export-grade. Problems that firms have experienced include lack of an independent testing facility, lack of a broader effort to develop an automotive engineering program, and lack of technical and skill training.[15] Parts makers have had to pay hefty sums of money to send their products overseas for testing, usually to their assemblers in Japan. Without this testing, they are unlikely to win contracts from MNCs or to enter the international market (Doner 2009: 257). Put simply, they lack the kind of technological learning that is gained from learning quality control. The weak linkages between different levels of state bureaucracy and

between state agencies and the parts makers make coordination and implementation impossible.

In addition to providing externalities for R&D testing and information dissemination, the state agencies have bridged resources and disseminated ideas between different networks in various industries and state research labs. For instance, the BIRDC assists in the upgrading bicycles by being a coordinator and integrating R&D resources from different publicly funded research institutes—resources and connections that are difficult for individual firms to obtain (interview Pai). The study of the application of new materials is a case in point. The center conducted a feasibility study for the use of magnesium in bicycle production and identified the bicycle components that might benefit from incorporating this new material. The application of a new material may in turn involve a new manufacturing method that the MIDRC could weigh in on. The Center would then coordinate between different public research labs and distribute the knowledge to firms, for example, by organizing seminars. In other words, rather than picking winners, the Center identifies common knowledge that is useful to firms. It is up to the firms to keep innovating and to apply that knowledge for their own purposes. It is plausible that this approach has contributed to alleviating the R&D burden on SMEs by shortening the learning curves of firms.

In other areas, the services provided by semi-public funded research labs such as the BIRDC and MIDRC have not only eased the R&D burden of SMEs and reduced undue risk-taking, but have also encouraged learning by inducing firms to become more creative in exploring ways to develop their products that they might not otherwise have undertaken.[16] For example, one interviewee reiterated the importance of working with MIDRC and the importance of inter-industry learning:

> Although MIDRC is not necessarily specialized in bicycles, they know a lot about materials. Moreover, they have worked with many different industries and they share with us their ideas from other industries. Of course, they cannot play favorites with individual firms, but we all have access to their facilities. It is imperative that we work with the R&D lab at the stage of product development because we can use their facilities for testing, so we don't have to invest in testing equipment up front for something that we don't even know is going to work.
>
> (Interview AL0208)

Evaluating the shifting roles of industry-specific R&D centers and the MIDRC in working with a series of SMEs suggests that embeddedness (linkages) can in fact be helpful when the focus is on problem-solving that benefits and seeds the development of an industry as a whole, especially when dealing with a decentralized network. The initial stage of these linkages in Taiwan was driven by meeting export demand. Standardization learning was a means for technical improvement, and it permitted the decentralized network to become qualified players in the world market. Subsequently, despite efforts from the state to pick winners, what

proved to be a functional institutional arrangement for SMEs was when the state agencies provided capability building by supplying external economies for firms to tap into, and when the state agencies connected multiple networks to realize projects.

Conclusion

This research reveals an alternative development of SME-based entrepreneurship achieved by tapping into the external economies and resources provided by public research institutions. This interpretation is contrary to the conventional belief that the state is involved in the economy mainly by acting as a financier. In this analysis, the various state-funded research agencies have filled in the space that links the state and the society by coordinating and collecting information that feeds back to the state while disseminating and recombining resources among different networks (within state agencies, between the state and the private sector, and between different industries) that are conducive to technological upgrading in the private sector. This kind of diffused and decentralized linkage between state and society has assisted the network of SMEs by alleviating their R&D burden, averting risks, reducing entry barriers to export, cultivating entrepreneurship by information diffusion and facilitating inter-industry exchanges.

Second, departing from the existing emphasis on the role of public higher-rank research institutions as the drivers in orchestrating R&D activities, the findings reveal the limitations of the top-down model of research alliances when dealing with a decentralized industrial structure. The stories conveyed here show that the linkages that are conducive to learning and catch-up are not based on the state and business elite forming cozy relationships leading to coherent industrial policies, but rest upon routinized interactions among lower-rank officials, engineers of semi-public funded labs, and series of SMEs where the networks are extensive and the actors are connected in multiple ways. The multiple and overlapping linkages—which tend to fly under the radar—are equally, if not more important than the higher-level formal ones. This diffusion of power also explains why embeddedness does not turn into crony capitalism. The linkages are conducive to broad-based development, as can be seen in the parts sector.

Third, this diffused model of linkages echoes the recent revival of interest in the "Developmental Network State" in facilitating innovation in industries that demand rapid changes in the transformation of higher-income countries (O'Riain 2004; Breznitz 2007; Block and Keller 2011). The historical account here suggests that such a pattern of collaboration worked at its best at the earlier stage of industrial development. It is not just the timing and stage of development that matter, but the patterns of state intervention needed to respond to the nature of the social groups the state intends to embed with.

Lastly, this pattern of institutional linkages with emphasis on the capability building of local entrepreneurship explains how the Taiwan SMEs were able to negotiate with MNCs, and how the economy was able to withstand the cyclical financial crises that have hit developing countries. The alliances between states

and foreign capital in the past two decades, as witnessed in the establishment of numerous FDI export zones in developing countries and even in developed countries, are believed to drive economic growth in emergent economies. Yet the recent 2009 economic crisis reveals the limitations of this kind of FDI-driven model. The acclaimed success of the DNS, as in Ireland, has been largely fleeting (O'Riain 2011; Breznitz 2012). The Taiwanese experience reemphasizes the importance of indigenous entrepreneurship in responding to challenges in a globalized world. It is possible that without hefty patient capital from the state, SME-based entrepreneurship can thrive under certain institutional conditions. The process is not free from conflicts, but a successful outcome necessitates a state that is capable of adjusting and responding to changing conditions. It requires a bureaucracy not only capable of intervening in and initiating projects when needed, but capable of exiting and playing only a supporting role when those projects have matured.

Notes

1 This has been the dominant account within Taiwan in accessing the role of the SMEs in contributing to the Taiwan miracle (see Shieh 1992; Ka 1993).
2 See Moon and Prasad (1998) and Campbell (1998) for criticisms on the "embedded autonomy" approach to the developmental state.
3 MIRDC, established by the United Nations and Taiwan's Council for International Economic Cooperation and Development (CIECD) in 1963, aimed to promote the growth and technological development of the metal and metal-related industries. It became a state-funded research institution in 1967, entrusted by the Ministry of Economic Affairs to provide services and technological training to the manufacturing firms in Taiwan.
4 It was accomplished by the export-promoting organization established by the state in 1970. Aiming at trade promotion, the organization worked closely with export-oriented firms especially at the initial stage of export development in the 1970s. The funding came from the export promotion fund, whereby firms were levied 0.6 percent of their total export values by the state.
5 All quotes used here have been verified by various sources. Quotes are used extensively because they are crucial in reconstructing the context of how ideas came about.
6 This was a key problem at the initial technological development of this network-based organization for other industries. Similar problems occurred in the sewing machine industry in the 1960s. See *MIDRC Report* 1983: 26.
7 The Engineer's description is confirmed in *MIDRC Report* 1983: 28.
8 Interviewees also mentioned some individual entrepreneurs taking the initiative in disseminating information on JIS standards. Yet, judging from the evidence, I would suggest that the leading roles of individual entrepreneurs should not be overstated. Given the decentralized nature of the industry, it is unlikely that a firm at that scale would have been able to grow the whole parts sector. The key point here is that the MIDRC played a role in disseminating information across sectors, which accelerated the learning process.
9 Prior to the dealing with Schwinn, Taiwan's bicycles had been sold mostly in low-end mass merchandisers and discount chains such as Toys"R"Us, Walmart, and Sears.
10 Similar problems have been reported in studies on the machine tool industry (Gau 1999; Chen 2011).

11 The budget of over NT 200 million, an unprecedented amount of research funding allocated to the bicycle industry, was set for the derailleur project over five years starting in 1993. In contrast, the estimated R&D expenditure by Shimano, the leading Japanese derailleur maker, was about NT 300 million per year.
12 The IDB then moved the crucial component derailleur project from the BIRDC to the Mechanical Lab of the ITRI (United Daily News May 12, 1994). Even so, there was resistance from the industry to endorsing the derailleur project at ITRI (United Daily News June 1, 1994).
13 In fact, firms had been pressing for a professional testing center at several seminars and meetings with related government institutions when discussing the needs of the industry (e.g., *IDB Report* 1993; United Daily News June 25, 1994: §B13).
14 The importance of an R&D testing lab, and of collecting different national standards, has also been considered as important measures adopted by the R&D Center for machine tools in that industry's upgrading efforts since the 1990s.
15 For example, the proposal of creating an independent testing center for the industry gained little support among assemblers and government officials because assemblers had their own testing facilities and the government did not see the need for a separate testing center for parts makers (Doner 2009).
16 Matthews (2002), in his study on the ITRI research consortium, points out that a distinctive feature of the public research and development lab in Taiwan is its emphasis on learning and catching up, whereas research alliances in Europe and the United States are often about mutual risk reduction.

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