

## CHAPTER 4

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# Embedding the Economy: The State and Export-Led Development in Taiwan

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The rise of East Asian Tigers Taiwan and South Korea (hereafter Korea) since the 1970s has supported an empirical claim for the importance of the role of the state in economic development. The chief conventional explanation of postwar East Asian success, also known as the developmental state thesis, focuses on the capabilities of the East Asian states in shifting to export-led industrialization (in contrast to the lack of such state capabilities in Latin America and India) and the emphasis on industrial policies to induce entrepreneurship. This process is accomplished by encouraging firms through the mechanism of finance to enter and compete in targeted sectors (like technology-intensive industries) which they would otherwise not be willing or able to enter.

While the old developmental state has been successful in the catch-up project by maintaining state autonomy, for a country to stay ahead, the state needs to develop a concrete set of ties with the private sector to induce the growth of new firms (the so-called embedded thesis) and develop new innovative industries. Essentially, the new developmental project is about exploring the state-society linkages that are conducive to industrial transformation, such as “embedded autonomy” (Evans 1995), “governed interdependence” (Weiss 1998), or the “developmental network state” (DNS; Ó Riain 2004; Block 2008; Block and Keller 2011; Negoita and Block 2012). The transformation often requires decentralized and more flexible state policies and flexible firms to respond and adapt to the rapidly changing global environment and to develop cutting-edge technological capacities continuously in order to stay ahead.

The rise of Taiwan's information technology (IT) sector can serve as an empirical example of one variety of the embeddedness thesis, where the state creates a new class of entrepreneurship and moves up the technology ladder to compete successfully in the global market (Breznitz 2007; Chu 2007; Wang 2010). Despite Taiwan being a showcase of the DNS, the specifics of how this kind of embeddedness works remains unclear under analysis. Many of the narratives center on the leading public research institutes, such as the Information Technology Research Institute (ITRI), in acquiring and researching frontier technologies and transferring them to the private sector. This implies a top-down approach of capability building (Breznitz 2007). Alternatively, analysis focuses on the dense policy networks and the reengineered bureaucracies in building high-tech economies (Chu 2007), thus producing information that is more about government than about the economy.

This chapter reexamines the developmental state thesis by revisiting Taiwan's export-led development since the 1970s. It does so by investigating how the state has assisted firms to successfully compete in the global market and assert themselves in the global value chains. Building on the notion of the DNS (and the embeddedness autonomy thesis), this chapter illustrates the unacknowledged but widely practiced model of loosely coupled Taiwanese para-state agencies coordinating with a series of small and medium enterprises (SMEs) to establish the quality and technical capacities needed to succeed in the global market. Attention is focused on the para-state institutions that serve as the institutionalized linkages (which I define as "embeddedness") between the state and the economy. Moreover, going beyond the well-studied IT sector, I show that this pattern of institutionalized linkages between the para-state agencies and SMEs was prevalent at the onset of export-led industrialization when the state built infrastructures for an export-led economy (when facing a decentralized SME sector) and has continued in its subsequent quest for SMEs' industrial upgrading since the 1990s.

This chapter is organized into three parts: I first revisit the competing arguments on Taiwan's export-led development to establish the context for studying export. I then unpack the specifics of "embeddedness" via studies of export-led development using case studies of para-public agencies, including the Metal Industries Research and Development Center (MIRDC) and the China External Trade Development Council (CETRA) in the 1970s in building the infrastructure for export-led economies in an attempt to open the black box of "doing export." I demonstrate how these initiatives in addressing collective needs such as testing and standardization programs are relevant for understanding the upgrading of the SME sectors in the 1990s through case studies of industry-specific research and development (R&D) centers in

the machinery sector, as well as the initiatives that facilitated the intricate embeddedness between the decentralized loosely coupled network of state agencies and the varieties of networks of producers and suppliers in the quest for upgrading.

### Existing Accounts of Taiwan's Export-Led Development

The key feature of the East Asian developmental state (sometimes called developmental bureaucratic state) focuses on the state's capacities to foster entrepreneurship via financial incentives to induce firms into sectors that they would otherwise not enter and to discipline firms to channel funds into targeted sectors and productive use. Empirically, this has been achieved via exports. The state's ability to push industrialists to export-led industrialization distinguishes the East Asian developmental state from other developing countries, like India; for engaging in export is bound to be more difficult than maintaining a domestic monopoly (Chibber 1999). For instance, the Korean state's power stemmed from its control of allocation of credit and by providing concession loans and credit to push the private sector to actively engage in export during export-led industrialization. Should firms fail to meet performance standards, sticks such as tax penalties, calling in loans, and revoking import licenses were employed (Amsden 1989; Woo 1991; Evans 1995, Kim 1997). The policies developed a class of large conglomerates to compete head to head with multinational corporations (MNCs) (Amsden 1989). In other words, export building was closely associated with the state's capacities to discipline capitalists.

Yet, Taiwan stands as an interesting case when compared with its successful developmental neighbor states. The state used fewer financial incentives in inducing firms into export; instead, policies for export drive were mostly fiscal incentives, such as tariff rebates, tax breaks, and export subsidies, as opposed to sector- and firm-specific incentives like the firm- and industry-specific loans in Korea (Cheng 1990; Wade 1990). Instead of fostering a class of large industrialists to compete internationally, the Kuomintang (KMT) state resumed a direct role in industrialization through state enterprises in the upstream industries, which served as providers for the downstream SMEs, a role that Wade calls "governing the market" (1990). Moreover, the ethnic cleavages in Taiwan favored policies that would fragment business and disperse economic power that would otherwise consolidate the social base of state legitimacy (Gold 1986; Cheng 1990). The historically aloof relationship between the state and society resulted in a distinct dual economy during the export-led industrialization of the 1970s and 1980s. A highly decentralized segment of SMEs fiercely competed in the downstream export sector while

business groups and state enterprises occupied the domestic and oligopolized upstream sector (Wade 1990; Chu 2007).

The presence of the SMEs in the export sector, which went against the experience everywhere else, creates a puzzle that motivates this research. How did SMEs connect to the world market while traditionally it is assumed that large firms could better meet the transaction cost of participating in international markets? As Wade acknowledges in his book, little has been said or research done on this subject (1990). In the few works available, the consensus points to the view that the success of the SMEs in the export sector was independent of the state. For instance, Feenstra and Hamilton (2006) attribute the export-led industrialization to a demand-responsive phenomenon led by US retailers and trading companies outsourcing in East Asia, which occurred independently of the state. In this view, varieties of original equipment manufacturing (OEM) arrangements in which Taiwanese suppliers manufactured products according to foreign buyers' specifications and blueprints connected the Taiwanese SMEs to the world market (Gereffi 1994; Gereffi et al. 2005; Feenstra and Hamilton 2006). Thus, the SMEs learned by doing OEM and gradually moved up the value chains.

The buyer-driven thesis may well explain the individual success of the leading firms, yet it remains puzzling how numerous SMEs acquired the capacities needed to succeed in exports in a context of decentralized industrialization where all the parts to be assembled in a product had to reach the quality for export. It is one thing to talk about imitation and quick response as a source of learning; but to succeed in the international markets could be a daunting task for firms in developing countries. Just think of meeting the rigorous requirements and regulations that advanced countries enforce upon imported goods. The question becomes more intriguing by situating ourselves in Taiwan in the late 1960s, when export was about to begin. Compulsory nine-year education began in Taiwan only in 1968, and vocational training at the high school level had only recently been extended. There was a lack of coherent science education policies as the government debated whether the focus should be on elite education or a more broadly based education that would focus on technological development (Greene 2008). The main arm of the state in coordinating industrial development, the Industrial Development Bureau (IDB), was established only in 1969. But already by 1969, an export boom related to light industries had taken off. How, therefore, did a series of Taiwanese SMEs acquire the technical capacities needed for export and establish economies of trust with foreign buyers in the early 1970s?

Given that export-led industrialization has been vital for understanding Taiwan's postwar development, the way in which SMEs connect to the world

market needs to be studied and explained beyond macro-industrial policies. Wade acknowledges the limits of using industrial policies as an explanatory variable, and his remarks illustrate the complexities that developing countries have to handle in order to succeed in exports:

Government must recognize that successful exporting of manufactured goods to richer countries is not just a matter of getting the exchange rate right and keeping labour cheap, even in the absence of protection. This is because many kinds of manufactured exports to richer countries are only saleable as complete packages meeting all buyer specifications, including packaging, labelling, colors, raw materials, finishes, and technical specifications . . . Thus, marketing, transformation of information, and quality control turn out to be key activities for export success.

(Wade 1990, 362)

Second, studying exports is also theoretically important. Export activities can be relevant to understanding the state-building process and state-societal alliances for latecomers. Chibber (2003) argues that export serves as an incentive structure for large capitalists to accept a strong disciplinary state in Korea. Therefore, if export-led development is an important element in understanding the East Asian developmental state, and if the state-centric thesis is to have explanatory power, it needs to demonstrate how the East Asian states escort firms in their entry into the world market and the forms of embeddedness that demand detailed scrutiny.

Drawing on over a decade of interviews with SMEs in the machinery sector, senior engineers in the public research agencies, relevant government officials who were involved in export promotion in the 1970s, and the first generation of entrepreneurs succeeding in export, together with reports from public research centers, the following case studies open the black box of doing export in the 1970s and show how entrepreneurs and engineers worked together to solve collective problems and build the technical capacities needed to succeed in export. The experience of the bicycle industry is used extensively to illustrate the export drive in the 1970s. Bicycles were one of the first and key export items in the 1970s, and the organization of the industry resembles the industrial structure of Taiwan's SME-based export-oriented industries on the whole. I should make it clear that these initiatives in the 1970s were not only limited to bicycles, but were applicable to many other export-oriented industries. I show how the specific patterns of a DNS coordinating a decentralized economy as discussed in the 1970s were prevalent in understanding the transformation in the machinery sector, which was dominated mostly by SMEs in the 1990s. Examples from the machine tool industry, the bicycle

industry, and the auto parts industry in the machinery sector are used to illustrate the upgrading process since the 1990s.

### **Establishing a Quality Regime: The State, SMEs, and Exports in the 1970s**

The export boom of light industries, such as apparel, household appliances, umbrellas, toys, shoes, hand tools, and bicycles, took off in the late 1960s. For instance, in the case of bicycles, the number of bicycle exported went from 17,000 in 1968, to 107,000 in 1970, to over one million in 1972, and the main destination was the United States. Many entrepreneurs responded to the sudden surge of US demand and the number of firms almost doubled (from 279 to 447 firms) from 1971 to 1975. Most were small in scale, with over 95 percent of the firms having fewer than 100 employees (Hsieh 2011). It is puzzling how these firms mushroomed in such a short time. Yet with the rapid response to demand came shabby products, mounting recalls, and trade disputes in the early 1970s. Many US stores were refusing to sell/repair bicycles from Taiwan by 1973. Together with the mounting trade disputes, a potential market failure was arising. However, despite a setback in 1974 and 1975, bicycle exports increased on a yearly basis, reaching almost three million bicycles in 1980, and ten million in 1986.

How did these SMEs respond to demand rapidly and sustain it after a potential market failure? Conventional accounts focus on the quick response of entrepreneurs to the sudden surge in US demand (Hamilton and Kao 2010). The gradual improvement in quality was achieved simply by buyer pressure and effort to implement quality control, which was in part achieved via learning from the buyers. Proponents of the state-centric theory suggest that the quality inspection scheme introduced by the state whereby all goods had to pass inspection before being exported boosted the image of goods from Taiwan (Wade 1990; Egan and Mody 1992; Chu 1997). However, neither approach explains how technical capacities were gained to meet export requirements given that bicycle production in Taiwan at that time involved numerous small assemblers and parts suppliers, and this would have generated daunting tasks and high transaction costs for a potential buyer.

Using the concept of the DNS as coordinating a decentralized industrialization process, I show that the state was instrumental in building the hidden infrastructure of the export-led economies. It not only enforced the quality inspection scheme that boosted the national image of goods made in Taiwan, thus establishing economies of trust between foreign buyers and suppliers, but also assisted in building the technical capacities of the SMEs. In other words, the state mitigated the potential problems that could occur in

decentralized production, such as issues of trust and lack of competence, as discussed in the emerging “network failure” literature (Schrack and Whiford 2011). MIRDC and CETRA are cases in point to illustrate the state’s efforts in building the hidden infrastructure of the export-led economies via standardization programs, the quality control inspection scheme, and varieties of export promotion services that alleviated barriers for SMEs to enter the world market in the 1970s.

### *Standardization and Capability Building for Export: The Case of MIRDC*

MIRDC, established initially by the United Nations and Taiwan’s Council for International Economic Cooperation and Development (CIECD) in 1963, aimed at promoting the growth and technological development of the metal and metal-related industries. It became a state-funded research institution in 1967, entrusted to the Ministry of Economic Affairs (MOEA), to provide services and technology training to Taiwan’s manufacturing firms, especially SMEs in the parts sector. MIRDC was assigned to the IDB under the MOEA to survey the general state of Taiwan’s machinery sector in the early 1970s. Problems such as lack of interchangeable parts, lack of economies of scale, lack of workable standards, and poor quality were identified and noted as common problems within various industries in the machinery sector. The bicycle industry was among those studied and soon came to the attention of officers of Bureau of Foreign Trade (BFT) since it was one of the rapidly growing export suppliers but with mounting trade disputes (MIRDC Report 1983).

The bicycle industry consists of an assembling sector and a parts sector that produces over one hundred components. In the context of Taiwan’s decentralized production in the 1970s, assemblers acquired parts from various suppliers and assembled complete bicycles for export. At the same time, parts suppliers were not tied to any one particular assembler. The sudden surge of US demand propelled many to engage in bicycle ventures. As one interviewee expressed, “The export orders were like swarming bees, but there was not enough parts” (Interview Chou 2004). Other interviewees stated that to respond to the demand, they asked people around them to start businesses: “We kept asking parts factories (small auxiliary workshops at the time) to produce bicycle parts: ‘You do this and he does that’ . . . that was how we started” (Interviews Mady 2004; Hsu 2004). Yet, the aforementioned problems in the machinery sector were present in the bicycle industry; and a potential market failure was emerging as either orders were not being delivered on time because of shortage of parts or the poor quality of parts, bicycles were

being returned by US customs because of poor quality, or parts suppliers were suffering from phony deals and their production was accruing excessive inventories (Interviews Chou 2004; Chien 2003). Sporadic efforts were made by entrepreneurs (assemblers) to develop blueprints and convince their parts suppliers to follow Japanese Industrial Standards (Interviews Hsu 2004; G. Hsu 2004). In the end, the mounting trade disputes and recalls led to government intervention.

The solution the government decided upon was to improve the quality of bicycles, especially in the parts sector. In 1971, the BFT engaged the MIRDC to work with the industry. According to a former MIRDC engineer who was in charge of the bicycle project, the initial plan was to focus on improving the processing and manufacturing methods, standardization, and quality control, and to teach the firms how to do inspections and verify their components for mass production. In particular, given the same component could be produced by several suppliers in a decentralized SME network, the standardization program was the first priority because all components had to be interchangeable and fit into a bicycle when they were assembled together (Interview Chiang 2010).

Thus, a key element for standardization was to set their own industrial standards, which later became the new revised Chinese National Standards (CNS). The former MIRDC engineer in charge of this Bicycle Assistance Project recalled their standardization efforts and how they worked with bicycle manufacturers at that time:

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 European and American Standards are mostly consumer standards, based on performance and function. The US standards did not care whether your nuts and bolts are interchangeable. 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. Our standards specification would tell you how surface treatment should be done, how one does electroplating and heat treatment. We specified them individually. So our foundation is established based on JIS. At that time, the bulk of our efforts was devoted to standardization. All the nuts and bolts for bicycles, for instance, like for the bottom brackets, we would suggest them to follow this standard . . . 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. 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 Chiang 2010)

Thus, technical learning by Taiwanese 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.

In fact, developing a workable industrial standard dominated the discussion among the various actors involved in exports in the 1970s. The outdated CNS (established in the 1940s) made it impossible to work with the export-oriented sector in the early 1970s, as seen in bicycle exports. Compulsory inspection for certain goods for export had existed since the 1960s to ensure they met the CNS. Items that received disproportional buyer complaints were subject to inspection. Yet, the lack of appropriate industry standards (especially for parts) dominated the discussions in the meetings between bicycle industry representatives and the Bureau of Inspection and Quarantine Control in 1972, when the government first implemented export inspection on complete bicycles. Industry representatives challenged the government's standards as being outdated and thus called into question the basis of the inspection scheme. Assemblers also pointed to the poor quality of the parts as the problem and suggested extending the inspection of parts, establishing standards for parts, and improving quality and the interchangeability of parts (Interview Chou 2004; United Daily 1972/11/20; 1972/09/10; 1972/11/10; 1974/3/22; 1974/12/23).

The MIRDC played a crucial role in developing the architecture of the export inspection scheme, as can be seen in the case of bicycle exports (especially on the standards and testing of parts). The aforementioned standardization initiatives worked hand in hand with the export inspection schemes that came into effect in 1976. MIRDC worked with the Bureau of National Standards to come up with specifications for export inspection based on their prior knowledge through working in the industry. It worked with the Bureau of Inspection and Quarantine Control to execute and evaluate the inspections of items like bicycles.

The conventional narrative goes that the export inspection scheme enforced by the government since 1976 has helped to establish market order and boost the image of goods coming out of Taiwan. Yet, it is plausible to argue that the institutionalization of the export inspection scheme provides an institutionalized basis of technical learning that extended to all

firms. Here, MIRDC served as an important instrument linking the state with the export-led economy. It helped collect information and assisted in the state-building process when Taiwan tried to strengthen its export trade promotion and establish a quality regime, as can be seen in the case of the export inspection scheme. The export-merchandise inspection scheme maintains that merchandise in five broad categories (textiles, electronics, electrical appliances, processed foods, and specified miscellaneous items such as toys, shoes, bicycles, machine tools, hand tools, hardware, and household appliances, etc.) have to pass inspection before export (United Daily 1976/03/13; MIRDC Report 1993). A quality grading system on export factories was introduced whereby export factories must apply for a grade: factories scoring below the minimum are not allowed to export, whereas factories scoring above the minimum are classified into three grades according to their level of quality control. The products with scores in the top grade are exempted from inspection and can be exported directly (Wade 1990). In the case of bicycles, the abovementioned revised CNS became the basis for the export inspection scheme, as happened for many other industries in the machinery sector for which the MIRDC helped to reformulate the CNS. The MIRDC was entrusted to conduct lab testing in various machinery products and parts, such as bicycle parts, valves, hand tools, hydraulic jacks, and milling and lathing machines.

In addition to standardization initiatives, the MIRDC provided varieties of industrial training and extension programs that helped to develop the technological capacities of the SMEs, especially in the parts sector, including on-site problem-solving visits, manufacturing extension programs to SMEs, and seminars on various manufacturing processes (e.g., heat treatment, casting, and forging) for export-oriented industries, starting with the sewing machine industry in the late 1960s, the bicycle industry, the machine tool industry, the fastener industry, and other metal- and machinery-related industries in the 1970s (MIRDC Report 1983). These initiatives paid off and sowed the seeds for successful exports. The bicycle industry is illustrative: the presence of a dynamic parts sector and the improvement in quality of components meant that Taiwan has developed backward linkages and an indigenous parts sector that allowed Taiwanese assemblers to negotiate with multinationals to increase local content when moving up to quality bicycle production. The industry, thus, bypassed the typical third-world factories that were assembling imported parts in exchange for processing fees. Taiwan subsequently became a key supplier of higher end bicycles as it began to win contracts with the more quality-focused bicycle buyers among the US-independent bicycle dealers who comprise the premium market segment, such as Schwinn and Trek.

### *Export Marketing and Promotion: The Case of CETRA*

In addition to building quality capacities for export, the government assisted SMEs with export marketing. The CETRA<sup>1</sup> was established on July 1, 1970, as a government initiative to promote foreign trade. CETRA is a para-state market promotion agency in which the council consists of a few government officials and the majority of board members are presidents of industrial and export associations in the private sector. Its budget came from the export promotion fund, through which export firms were levied 0.626 percent of their total export value. This gave the organization autonomy and flexibility beyond its being dependent upon government budgets. The founder and former deputy chairman of CETRA repeatedly emphasized this important distinction between CETRA and their Japanese and Korean counterparts, as he noted in an interview:

We modeled from other trade promotion organizations in East Asia like Japan (JETRO) and Korea (KOTRA), which were established prior to CETRA. But I think that we had moved beyond them in the sense that CETRA was part of the initiatives of the state and the private sector, whereas both JETRO and KOTRA belong to the government bureaucracy and thus are subject to government budgetary constraints. Their staffs are considered civil servants, whereas CETRA is an independent organization. By being independent I mean that our programs could be more flexible and adapt to the ever-changing world market. Moreover, most of our board directors are industry representatives from various industry associations. By doing so, we have connected all firms in export promotion. In JETRO and KOTRA, initiatives came from the government and expected firms to follow. In contrast, what we had done in Taiwan was that we wanted the firms to take initiatives and CETRA would provide them with the hardware (e.g., exhibition halls and varieties of services) and market information to assist them to succeed in export.

(Interview Mr. Wu 2008)

Thus, from the time of its establishment, CETRA was a public-private initiative that aimed to be flexible and connect SMEs in multiple ways.

CETRA's main functions were to provide information, organize overseas trade missions, and trade fairs as well as to conduct extensive worldwide market research. Existing research has credited its well-developed services when compared with those of other developing countries. These include the detailed computerized database on markets abroad, Taiwanese suppliers, and domestic and foreign buyers, which anyone can access with a minimal fee, and extensive trade information and library catalogues in its office about the available Taiwanese suppliers, aiming at a one-stop source of information about suppliers (Wade 1990). These information and matchmaking services

arguably would lower the transaction costs between buyers and suppliers; just imagine the daunting task for a foreign buyer landing in Taiwan to try to locate numerous SMEs in a decentralized production system.

Huge efforts went into training commodity specialists and collecting market information on both what was being made in Taiwan and the overseas demand for the product. The former deputy chairman reiterated that maintaining an independent organization, one that would be free from political interference, is crucial for them to develop their expertise for export promotion. He makes a distinction between CETRA and the government trade offices:

We can't expect government officers to know about these products. Their main job is to serve the government, not to serve business. And that is why CETRA is a trade promotion agency and we train commodity specialists, whereas the Bureau of Foreign Trade is a trade administration organization, not a promotion one.

(Interview Wu 2008)<sup>2</sup>

CETRA also organized many export promotion missions in the early 1970s to explore potential export possibilities for numerous industries and to conduct market surveys. The tours were organized on a product and industry basis. For instance, many of my interviewees in the bicycle industry went on the initial study and promotion tours. CETRA also offered a variety of trade promotion seminars and training programs for export personnel in the 1970s when trade personnel were scared in a climate in which doing export was a national sport.

One may argue that these services provided by CETRA could be easily handled by trading companies according to the buyer-driven thesis. The Japanese trading companies were said to have played a vital role in handling about 30–50 percent of Taiwan's exports in the 1970s,<sup>3</sup> which was subsequently replaced by US retailers and many local trading companies. In particular, many small local trading companies sprang up in the 1970s and 1980s, from 2,777 trading companies registered in 1973 to 55,000 in 1985. These small trading companies not only played the role of agent in handling trade, but were often involved in creating entire supply chains and collaborating with US buyers (Hamilton and Kao 2010). Similar remarks were also frequently mentioned in my interviews. Yet, given the small size of Taiwanese trading companies (with an average of fewer than ten employees) and the scarcity of trade specialists in the 1970s, it is plausible that entrepreneurs had also benefited from the various services that CETRA provided. It could be that the market information and overseas trade missions and fairs organized by CETRA had lowered the entry barrier for entrepreneurs to venture into

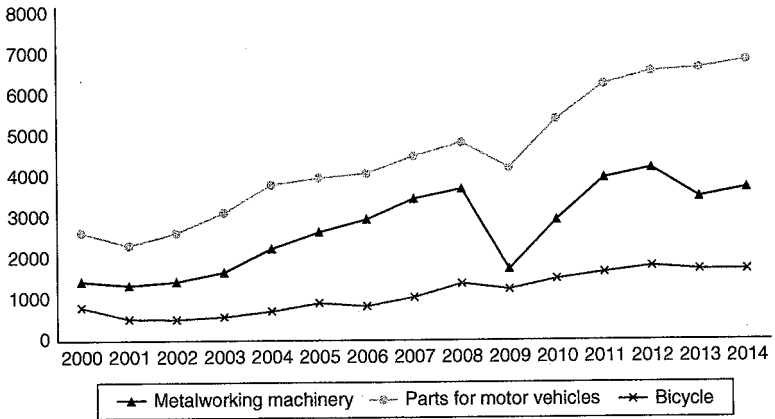
setting up their trading companies, or for small manufacturers to succeed in export. In other words, trade promotion agencies like CETRA served as the hidden infrastructure to induce export-oriented entrepreneurship by disseminating trade-related information and providing external economies that those interested could tap into in the critical period of the 1970s.<sup>4</sup> In fact, many informants concurred that participation in these export promotion tours were useful for them to understand the potential export markets at a time when information was limited, as was the kind of market information provided by CETRA.

It is plausible to argue that these para-public institutions sowed the seeds and provided the infrastructure that explains the dynamism of export entrepreneurship as seen in the export success of the bicycle industry and the proliferation of trading companies in Taiwan. It is unlikely that a small company was able to research and obtain the varieties of information needed for export and to meet the requirements for various designated countries on their own. Access to these services also explains how many small manufacturers were able to export directly on their own instead of depending on large trading companies, as in South Korea and Japan. These initiatives that built the infrastructure of export-oriented economies are contrary to the conventional wisdom of state intervention via finance, upon which the idea of a developmental state draws (Woo 1991). In Taiwan, the state was linked to the private sector through a variety of para-state agencies.

### **The Quest for Industrial Upgrading Reconsidered: The 1990s Onward**

In addition to the celebrated stories of the industrial transformation in the IT sector, various industries in Taiwan's machinery sector, mostly SMEs, have continued to be strong exporters in the global market, contrary to the prediction of a hollowing out of SME-based industries (Hsieh 2014). For instance, export-oriented industries like bicycles, machine tools, and auto parts have continued to be strong exporters, and statistics suggest that the total export values have doubled or even tripped in the last decade, as illustrated in Figure 4.1. Moreover, parts suppliers have been strong exporters by inserting themselves into varieties of global production networks, as exemplified by the increasing export shares of bicycle parts, auto parts, and fasteners. Their adaptation to global competition creates a puzzle given their relatively small scales and low R&D expenditures. This is not to mention that the state support they have received is minimal compared to the targeted high-tech sectors, such as the IT industry.<sup>5</sup>

In what follows, I show that the underlying mechanisms that made the DNS tick in the 1970s have continued to work against the backdrop of



**Figure 4.1** Export value of selected industries (Unit: million US dollars).

Sources: Statistics of Import and Export of Republic of China. Bureau of Foreign Trade. Retrieved May 5, 2015 (<http://cus93.trade.gov.tw/fsci>).

high-tech growth by facilitating industrial upgrading and export for the SME-based machinery sector since the 1990s. The SME experience suggests that broad and overlapping ties were constructed among varieties of lower ranked state agencies, public technology supporting agencies, and varieties of SMEs in advancing industrial upgrading and innovation, following the similar patterns of decentralized coordination from the 1970s. This is contrary to the existing emphasis on the top-down division of labor between leading research institutions such as the ITRI in conducting the lion's share of R&D and the private sector in development and commercialization (Brenzitz 2007; Chu 2007).

This kind of support focuses on an overarching support to solve collective problems, alleviate the R&D burden of SMEs, shorten their learning curves and induce firms to engage in complementary investments in a context of decentralized production. This includes initiatives and technology support that extend to the entire supply chain to ensure technology indigenization and export-diversification growth, to bridge different production networks, and to facilitate cross-industry fertilization as a means of innovation. I use cases from the machinery sector, including bicycles, auto parts, machine tools, and fasteners, to illustrate these initiatives.

### *Building Technological Capabilities for Export Success*

The state's effort to develop closer collaboration with industries in the quest for upgrading is exemplified by the IDB's Program for the Development

of Critical Components and Parts in the 1990s. Several industry-specific research centers were established, including the Automotive Research and Testing Center (ARTC), the Bicycle R&D Center (BIRDC), the Precision Machinery Research Development Center (PMC), the Plastic Industry Development Center (PIDC), and the Footwear Technology Research Center (FTRC). These centers are considered public-private partnerships as funding comes from both government and industry. Board members include firm representatives, MOEA representatives, and university professors.

In evaluating the actual operation of the centers, studies have revealed that the services that provide external economies applicable to all firms in the industry work best in assisting firms to move up to a higher segment of trade in the global market, despite the initial goal of developing critical components and parts. In particular, building international accredited independent/professional R&D testing labs has been fundamental in assisting the technology development and export of the SMEs, similar to what the MIRDC did in the 1970s in working with parts suppliers and specialist firms on standardization and testing. These industry-specific R&D centers provide testing and certification of products for the designated markets. (For instance, BIRDC built a database of worldwide industrial standards for bicycles and parts and the respective testing methodologies. Similar cases can be found for auto parts for the ARTC and machinery equipment for the PMC.

R&D-related testing has been crucial for problem solving in complex product development and is, thus, fundamental to innovation. A remark by the PMC's general manager well captures the necessity of the testing in R&D and collective problem solving provided by the center:

Testing helps to reveal the problems of the product we are trying to develop. Once the problem is identified, we can then proceed to find a solution for improvement . . . Of course, big firms also build their own R&D labs with a focus on developing their products. We focus on building a lab to address common needs, such as testing. The SMEs tend to rely on (expect) the industry R&D center to solve collective problems . . . You can consider PMC as a place to incubate technical skills and a think tank for collective problem solving. For instance, we provide training of skilled technicians for new technology, disseminate them and develop new testing methodologies as technology evolves. It is like sowing the seeds.

(Interview Chan 2011)<sup>6</sup>

Testing services by the industry R&D center can also mitigate undue risks because firms can take advantage of the lab's testing facilities without having to invest upfront in testing equipment for something that may not work. This kind of infrastructural support facilitates learning by inducing firms

to explore possibilities for new methods of product development that they would otherwise not undertake (Interviews Chan 2011; Glee 2011).

Moreover, these R&D-related testing services have been important in assisting firms to succeed in diversifying export outlets and move to higher value-added production, as the regulations for advanced countries often involve stringent quality control and standards compliance. The compliance to CE Standards (European Community Marks)<sup>7</sup> for machinery exports and the US Fastener Quality Act in the 1990s are examples of initiatives by R&D research centers to assist firms to overcome export barriers and technology upgrading. The industry R&D centers proactively responded to potential changes in standards of the export market and the respective changes needed for testing methodologies and manufacturing methods to ensure that firms were not shut out of the export market. The senior engineer of the PMC explained their efforts in studying the CE marks for the machine tool industry:

We were both involved in investigating the impacts of CE marks. I was mainly concerned with technical details associated with the changes in the technical standards. But he (the general manager) was quick in bringing to our attention the serious consequence that export firms would be shut out from the EU market if they could not meet the standards. Goods can't even enter the customs. What these new regulations involved are not just technical standards but safety requirements. We used to just think of design in terms of functionality, but now our designs need to incorporate risk management and assessment.

(Interview Huang PMC 2011)

Similar cases occurred in the fastener industry. The MIRDC's testing division took the initiative to study the US "Fastener Quality Act" (Public Law 101-592), which came into effect in 1993, and the CE standards and to inform fastener suppliers of the potential consequences. They explored the new testing requirement, interpreted the regulations, and developed measurements and solutions at a time when SMEs were unaware or adopted a wait-and-see strategy (Interview MIRDC Lin 2013). ARTC engineers maintained that the ability to conform to the US and EU safety standards was crucial for auto parts makers to succeed in breaking into these markets (Interview ARTC 2013).

Having access to industry-specific testing centers in Taiwan means that SMEs, especially parts makers, can tap into the external economies provided by the semipublic research agencies, whereas an individual SME is unlikely to be able to function effectively on its own. These collective problem-solving services, such as testing and standards compliance, alleviate the burdens of SMEs by reducing entry barriers for export and R&D. The result is export

diversification by SMEs in the machinery and transportation sectors. For instance, in the past decade, about half the total exports went to the top five destinations in the aggregated transportation industries, while over one-third of the total exports went to destinations outside the top ten countries. In the machinery sector, over 50 percent of the total export value went to countries outside the top ten export destinations, while the top five export destinations received less than 50 percent of total exports (Hsieh 2014).

### *Bridging Different Networks and Facilitating Learning*

Public technology support agencies also play an orchestrating role in bridging different networks and resources. They connect SMEs from different production networks and facilitate cross-industry fertilization where innovations and breakthroughs occur through recombination of existing means. For instance, ARTC connected firms in the IT industry with auto parts component makers in pursuing electronic applications on auto components and orchestrated the development (Interview ARTC 2013). Linkages are also made among various industry R&D centers. The PMC initiated a research consortium with other industry-specific R&D centers in developing specialized equipment for manufacturing technology by tapping into others' expertise. In other cases, the BIRDC, working with the MIRDC and other research institutes specialized in materials, explored the application of magnesium material for bicycles.

In a context of decentralized industrial structure, the technology extension services focus on enhancing local spillover effects, integration, and developing technical capabilities of the entire supply chain as opposed to a top-down technology transfer to selected firms. The technology adaptation and breakthroughs often occur at the level of intermediate input (meaning the parts sector) and work upward and downward along the supply chain to create backward linkages. Thus, R&D centers work with SMEs to develop supply chains. For instance, in an initiative to apply hydro-forming manufacturing technologies to bicycle tubes, the MIRDC approached the case by first developing locally built equipment for manufacturing this technology. The MIRDC formed a research consortium and connected firms from different production networks, including materials suppliers, mold-making specialists, processing specialists, equipment builders, bicycle tube makers, and bicycle assemblers. An engineer explains the importance of developing the entire supply chain for the specific manufacturing technology so as to induce further manufacturing applications and adaptation among SMEs:

An equivalent machine imported from Germany is too costly for the SMEs to consider experimenting with this new production technology conventionally

used for heavy industries and apply it on consumer industries... Once we can build the equipment for this manufacturing technology locally at a modest cost that fulfills the functions, we are able to induce others to apply this new production technology. We then broaden the impact of application of this technology.

(Interview Chung 2008)

At the same time, cascading of knowledge goes both ways: the MIRDC engineers acknowledged that they have learned tremendously from these SMEs by working on the project; they had subsequently taken the experience to work with other consumer industries that could benefit from this production technology (Interview Chung 2008).

The technology support institutions work to sustain industrial clusters instead of growing individual firms. The fastener industry, made up predominantly of SMEs, successfully made the transition to become higher grade fastener suppliers for the auto parts and aerospace industries from producing lower end standardized fasteners that face fierce competition from countries with lower wages. The MIRDC was central in facilitating key production technology breakthroughs by working with the entire fastener supply chain and tapping into the decentralized network. The MIRDC first worked with machine-tool firms and fastener-parts makers to develop the required equipment for the advanced manufacturing technology. Subsequently, the upgrading diffused not just among the fastener manufacturers but also to a wide range of auxiliary specialists and equipment manufacturers (Hsieh 2014). Like the case in hydroforming application, once the supply chain for the equipment is established locally, the technology can be widely diffused and extended to different applications.

In a decentralized structure where firms, state agencies, and public research agencies are connected in multiple ways, SME learning started with standardizations and quality control to succeed in the export market. Along the way, varieties of public agencies provided external economies for the firms to tap into to build their technological capabilities. They disseminated technology to induce entrepreneurs to engage in complementary investment. Instead of pursuing cutting-edge frontier research, they employed pragmatic R&D aimed at solving problems, breaking the bottlenecks that the industry faced, and responding to common demands by the industry. These initiatives, in turn, shortened the learning curves of SMEs and alleviated undue risks. These R&D alliances were often about promoting learning as opposed to mutual risk reduction (Mathews 2002). This accounts for Taiwanese SMEs' technological capacities, despite their relatively low R&D

expenditures, and their ability to connect to varieties of global production networks.

The aforementioned cases demonstrate that the linkages that are conducive to learning and export success rest upon routinized interactions among lower ranked officials, engineers of semipublic funded labs, and SMEs where the networks are extensive and the actors are connected in multiple ways. One might question how effective these technology extension services and their collaborations with SMEs are. How can we be sure that these R&D centers are capable of connecting suppliers from different fields since they are not firms competing in the market? This is especially so when the R&D done by elite research institutions such as the ITRI has frequently been criticized for technologies that have no commercial value or are so advanced that cannot be easily commercialized when working with SMEs. In other words, how could these lower ranked, para-state agencies, with much less funding and fewer Ph.D. researchers, be capable of identifying partners for product developments and capability building? Engineers in these technology supporting agencies credit the varieties of industrial training, problem solving, technology extension services, and testing services that they provide as the working ingredients that connect them with SMEs in various industries, especially in the parts sector. In particular, testing services for various industries have helped them build knowledge and gain access to industries (Interviews MIRDC Lin 2013; Kao 2013; Chung 2008). In other cases, the testing services helped them to identify the market trends and industry prospects to feed back to the IDB and the MOEA when discussing or evaluating new government initiatives and grants (Interview ARTC2013). Engineers also point out the fact that they are in direct communication with the owners of SMEs, who are usually directly involved in R&D, thus eager to solve problems and to learn, make these collaborations possible (Interview MIRDC Chen 2013).

## Conclusion

These cases suggest that the state in Taiwan is embedded in the economy via varieties of para-state agencies where diffused and decentralized linkages have assisted the network of SMEs to build technological capabilities needed to succeed in the global economy. These successful initiatives may constitute a very small portion of the government's expenditure on R&D activities and are often invisible, since they tend to be situated in the peripheral offices as projects of the hidden developmental state (Block 2008; Ó Riain 2011). These initiatives are invisible because they build collective goods as opposed

to growing individual firms. In the interviews, individual SMEs often claimed that they did not receive government assistance (in financial terms); yet if the question were rephrased to ask whether they used the testing services at the industry R&D center, the answer would be yes. These responses may well capture these invisible initiatives.

Thus, the multiple and overlapping linkages, which tend to fly under the radar, are the backbone of export-led economies by establishing the quality regime (capabilities building), including technical standardization and quality control, which in turn boosts economies of trust between foreign buyers and suppliers. Subsequently, the initiatives have been successful in sustaining clusters, building technological capacities, alleviating SMEs' R&D burden, and averting risks. These linkages cultivate entrepreneurship by reducing entry barriers for export, diffuse and disseminate information, and are conducive to broad-based development, as illustrated in the dynamism of the parts sector. The transformation and export success illustrated here is contrary to the conventional view that the state and the business elite form cozy relationships to generate coherent industrial policies. Yet these under the radar initiatives are equally important as, if not more important than, higher level and formal ones. The diffusion of power also explains why embeddedness does not turn into crony capitalism.

The specific ways in which the state has coordinated decentralized economies, addressing the common problems and not picking winners, have preserved interfirm collaborations and impacted subsequent forms of firms' technological learning. They encourage inter-sector exchange and recombine resources among different networks, which is conducive to innovation and technology diffusion, as illustrated in the industrial upgrading quest in the machinery sector. Lastly, the narratives presented differ from the conventional view of how the East Asian developmental state intervenes to ramp up production for export through financial incentives. Instead, it centers on the institutionalized linkages among lower rank state agencies and public research institutes and firms, an argument that resembles the literature of the DNS in facilitating frontier technology development in advanced countries. The Taiwan experience contributes to the literature by arguing that the DNS could also prevail for late developers at the onset of industrialization in the attempt to correct potential network failures resulting from decentralized production. Here, export making is closely associated with state building, which refers to the capacity of the state to develop linkages with the private sector through varieties of para-state institutions to extract and collect information from producers through routinized interactions so as to build and mobilize a greater level of industry collaboration. These decentralized and institutionalized linkages are what make a DNS tick.

## Notes

1. CETRA was renamed the Taiwan External Trade Development Council (TAITRA) in 2004.
2. Mr. Wu Kuan-Hsiung, the former deputy director of CETRA, repeatedly emphasized the importance of independent export promotion agencies in his public speeches (see Wu 1999, 204).
3. Formal statistics were not available; thus the figures were based on rough estimation and speculation from various sources (Wade 1990, 147; Hamilton and Kao 2010, 133).
4. CETRA's orientation shifted to trade diplomacy and industrial targeting by focusing on diversifying Taiwan's trading partners in the 1980s after Taiwan lost its international recognition (Wade 1990). By then, its significance might have been replaced by the many private trading companies that had sprung up. Still, I maintain my view on its contribution for the critical period of the 1970s in laying the foundation for export development.
5. The IT sector has received many fiscal incentives, such as five-year tax holidays or a 20 percent tax credit against shareholder's income tax; loans at preferential interest rates; a favorable schedule for equipment depreciation and tax deductions; duty free imports of crucial components; R&D matching funds; and exemption from commodity taxes on exports, under the program of ten emerging industries (Chu 2007, 104–105).
6. Similar remarks were made by engineers working in MIRDC and BIRDC.
7. CE marks basically comprise the European safety standards which demand that goods entering the EU meet the requirements of applicable EC regulations and directives. They came into effect in 1995.

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