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INDUSTRIAL STRATEGY AND ECONOMIC TRANSFORMATION:

Lessons of five outstanding cases

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Abstract

Industrial development, especially industrial structure up-grading and diversification, is considered essential for economic transformation and sustained growth. The objective of this paper is to obtain insights into how crucial factors for industrial development, such as accumulation of knowledge and capabilities, technological innovation, infrastructure, institutions, interact in practice, focusing on several outstanding cases of industrial development, which produced a remarkable economic transformation. In these cases, different factors including investment in infrastructure, technological breakthrough, as well as external factors, triggered the economic transformation, but it could not have happened without continuous accumulation of capabilities and knowledge through learning. In all cases, effective institutions accomplished the role of facilitator or catalyzer of transformation.

1. INTRODUCTION

Industrial policy and economic transformation have been attracting renewed attention of late. Thus several studies in the past decade or so have focused on industrial development, especially industrial structure upgrading and diversification, as a basis for sustained economic growth and development.

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These studies have emphasized such aspects as the accumulation of knowledge and capabilities, and creation of a learning society (Cimoli, Dosi and Stiglitz 2010; Greenwald and Stiglitz 2012); exploiting and changing factor endowments and comparative advantage (Lin 2012); need to compensate for the information externalities generated by pioneer firms (Rodrik, 2004); and pragmatic policymaking for developing countries that must cope with the strong pressures of market-orientation and globalization of our times (Ohno 2013).

The main objective of this paper is to obtain insights into how the above-cited crucial factors interact in practice, focusing on several outstanding cases of what we term "industrial policy." which resulted in a remarkable economic transformation in a country or in regions of a country. These five cases are of the automobile industry in Thailand; the transformation of the "Cerrado" in Brazil from barren lands to a source of high-productivity agriculture; the garment industry in Bangladesh; salmon fishing in Chile; and the upgrading of Singapore's industry from labor to knowledge intensive.

As these five cases suggest, we use the terms the terms 'industry' and 'industrial sector' very broadly to refer not only to manufacturing sector but also agro-business, modern agriculture, aquaculture, transport, logistics, tourism and any other activities that produce non-traditional or "modern" goods and services that require significant human and/or physical capital. Similarly industrial strategy refers not only to narrowly defined 'industrial policy' targeted at manufacturing but also other policies such as education policy, fiscal policy, financial policy, trade policy and labor policy, which encourage the development of the aforementioned productive activities.[2]

The next section briefly reviews the major findings of some recent studies related to industrial policy and economic transformation and sketches the analytical perspective of this paper. Then, country case studies will be presented. Finally, the concluding section attempts to extract lessons that could be derived from these cases.

2. AN ANALYTICAL PERSPECTIVE

2.1. MAJOR FINDINGS OF SOME RECENT STUDIES RELATED TO INDUSTRIAL STRATEGY AND ECONOMIC TRANSFORMATION

(A) LEARNING AND ACCUMULATION OF KNOWLEDGE AND CAPABILITIES

Noman and Stiglitz (2012, p.7) emphasize that "long-term success rests on societies' 'learning'—new technologies, new ways of doing business, new ways of managing the

[2] Greenwald and Stiglitz (2012, p.3) use a similar definition: "Industrial policies are what we call those policies that help shape the sectoral composition of an economy. The term is used more broadly than just those policies that encourage the industrial sector. A policy which encourages agro-business, or even agriculture, is referred to as an industrial policy."

economy, new ways of dealing with other countries." Related to this notion of a "learning society" is Cimoli, Dosi, and Stiglitz (2009)'s view that great industrial transformation "entails a major process of accumulation of knowledge and capabilities, at the level of both *individuals and organizations*." The author finds a lot of similarities of this view with that of the 'Capacity development (CD)' approach in which the capacity refers to individuals', organizations' and society's (or the country's) as a whole. Knowledge and learning in a CD process has increasingly been a feature of recent discussions (Hosono *et al*. 2010, p.180-181).

Noman and Stiglitz contend that "capabilities have to do with the problem-solving knowledge embodied in organizations—concerning, for example, production technologies, marketing, labor relations, as well as the 'dynamic capabilities' of search and learning". (*Ibid.* p.2) Here again, we find similarities between their ideas and the concepts of CD. The problem-solving knowledge could be considered as a core capacity in terms of CD, which could include problem-identifying and problem-solving capacities (Hosono *et al*. 2010, p.180).

Regarding this aspect, Greenwald and Stiglitz (2012, p.18) further elaborate: "The discussion so far has focused on 'learning,' but even more important is 'learning to learn' (Stiglitz 1987). Industrial and trade policy can enhance an economy's learning capacities, its underlying 'capabilities,' and development strategies need to be focused on that, especially in an era with fast-changing technologies, where specific knowledge learned at one moment risks rapid obsolescence."[3] In the management field, this fundamental capacity based on "learning to learn" of individual workers and of an enterprise as a whole could be enhanced through "continuous improvement activities (also called *kaizen* activities)" aimed at improving productivity by organizational or work flow and incentives modifications—with the participation of workers—rather than via significant physical investment. These activities enable the enhancement of both workers' and enterprises' capabilities to get more out of its physical assets. This paper will highlight this fundamental aspect of learning when it discusses the Singapore case later.

(B) CHANGE OF ENDOWMENTS AND COMPARATIVE ADVANTAGE

According to Noman and Stiglitz (2012), the "old" policies focused on improving economic efficiency *within a static framework*. "But the essence of development is dynamic. What matters, for instance, is not comparative advantage as of today, but dynamic comparative advantage" (p.7).

Justin Lin (2012a) discusses "changing comparative advantage": "The more effective route for their learning and development is to exploit the advantages of backwardness and upgrade and diversify into new industries according to the changing comparative advantages

[3] This view is also similar to the recent argument on CD. The wider acceptance of systems thinking in the current CD discussion is based on the assumption that it can better capture and explain the complexities of multilayered transformative processes in a constantly changing external (that is, development) environment (Hosono *et al*. 2010, p.181).

determined by the changes in their endowment structure" (p.73). Lin puts it: "Conceptually, it is useful to add infrastructure as one more component in an economy's endowments. Infrastructure includes hard infrastructure and soft infrastructure" (*Ibid.* p.22). The New Structural Economics, which he advocates, "considers human capital to be one component of a country's endowment....And, several components, among others, infrastructure and human capital, which determine changing comparative advantage, are endogenous"(*Ibid.* p.36).

The concepts of accumulation of knowledge and capabilities, and the creation of a learning society, especially for "learning to learn" or core capacity, discussed above, are intimately related to the "soft infrastructure" (or human capital), which, together with "hard infrastructure," constitutes an important part of a country's endowment.

However, we should emphasize the fundamental differences between "hard infrastructure" and "soft infrastructure" in this context. First, while the former (roads, ports, airports, energy plants and so on) could be realized through intensive investments in a relatively short period, the latter is achieved only through a longer-term, incremental process, and is essentially path-dependent. Second, investments in learning are high-risk, and risk markets are absent (especially in developing countries), which also discourage such investments (Noman and Stiglitz 2012, p. 6), while the feasibility and rate of return of investments in hard infrastructure can be measured. Both knowledge and hard infrastructure tend to have a public good dimension but as Noman and Stiglitz (2012) mention, "markets by themselves are never efficient in the production and utilization of public goods" (p.5) .

JICA and JBIC (2008, p.48-55) review some cases of the industrial development of Asian countries through "developing new comparative advantage". Diverse specific cases are discussed: the Development of ICT industry through higher education; investment climate enhancements through the establishment of special economic zones; strategic human resource development and support for overseas employment; and establishment of a development corridor. In this study, both "soft" and "hard" infrastructures are included.

(C) LEADING INDUSTRIES, ECONOMIC TRANSFORMATION AND ROLE OF GOVERNMENT AND INSTITUTIONS

Now two basic questions need to be answered in this context. One is how and under what conditions do countries change endowments? The other is how and under what conditions do countries take advantage of changing comparative advantage to develop new industries?

Endowments could be changed dynamically. As soft and hard infrastructures, important components of endowments of a country, are endogenous and essentially public goods. As the market is often not efficient in the production and utilization of public goods, government and/or public and private institutions have to play an important role in the process of dynamic change of endowments. In this regards, more attention is increasingly being paid to the government, and public and private institutions as agents for accomplishing this role, together with appropriate policies related to such issues.

The Growth Commission's report studied the experience of 13 countries that achieved annual growth rates of seven percent or more for at least 25 years. The report identified "committed, credible, and capable governments" as one of five characteristics of high-performing countries. These governments, except that of Hong Kong, were more hands-on, intervening with tax breaks, subsidized credit, directed lending, and other such measures. These interventions may have helped them to discover their comparative advantage (Noman and Stiglitz 2012, p.12).

Their finding is convincing as it drew on the experience of 12 high-performing countries throughout the world. However, this governments' role referred to by the Growth Commission's report is related basically to the static comparative advantage of countries. Rodrik (2007)'s view on "self-discovery" as well as market failures related to information externalities is important principally in terms of static comparative advantage. As the dynamic change of endowments that transform long-term comparative advantage is endogenous, the governments also have an important role to play in relation to dynamic comparative advantage. Noman and Stiglitz (2012, p.40, note 15) mention this point. In short, governments' role is two-fold: 1) facilitating 'self-discovery' of static comparative advantage and 2) investing in soft and hard infrastructures which are endogenous components of endowments for dynamic comparative advantage.

This paper's objective is to get insights into both of these aspects, but with special reference to the second aspect, based on case studies of countries which realized outstanding economic transformation, not just high performance in terms of growth. We will focus on (a) how factor endowments dynamically changed in terms of hard and soft infrastructures; (b) how investment in hard infrastructure was made and how learning as well as accumulation of knowledge and capabilities were achieved; (c) how the transformation was triggered (initiated) with the change of endowments; (d) what kind of drivers (driving forces) kept the momentum of transformation; and (e) what kind of strategy/vision was behind and what policies and institutions promoted the process.

The World Bank (2012, p.218) summarizes the current discussion on "industrial policy" highlighting three schools of thought: (i) New Structural Economics; (ii) an approach that emphasizes the policy process and especially a public-private partnership; and (iii) the school of thought that stresses spillovers of productive knowledge-mastering ways of doing things. The document cites views of opponents regarding, among others, the practicality of implementation of such policy, doubting, especially, whether the public sector has the capacity to identify industries with potentially sizable knowledge spillovers and dynamic scale economies.

This paper's analysis on the abovementioned five aspects, in addition to addressing basic questions of the 'industrial strategy and economic transformation agenda' discussed in this section, would also get insights into several aspects of the controversy between the three schools of thought and those opposing them.

(D) TYPOLOGY OF INDUSTRIAL DEVELOPMENT AND TRANSFORMATION CHALLENGES

Challenges facing countries are different as they move along the development path and endowments change. Industrial development strategies could be different according to these challenges countries face. They could have different focuses on infrastructure, human resource development, technological innovation and so on. In some countries, industrial challenges are shaped by special circumstances affecting particular groups such as resource rich countries, small countries, and post-conflict countries.[4]

A typological approach could be useful to address these diversities. JICA and JBIC (2008) distinguish, first of all, resource-rich countries and resource-poor countries. The World Bank (2012) identifies eight categories of "job challenge," including resource-rich countries, urbanizing countries and conflict-affected countries.

From the 'economic transformation agenda' point of view, meaningful categorization could be made according to both the endowments of such almost fixed or exogenous factors as mineral and energy resources on the one hand, and to the endowment of endogenous factors such as hard and soft infrastructure on the other. In this sense, as regards the former line of typology, we need to introduce categories of resource-rich countries and resource-poor countries. As for the latter line, we need to take into account the development phases reflecting human resource development as well as physical infrastructure endowment such as 1) agrarian countries, 2) urbanizing and early-industrializing countries based on labor intensive sectors, 3) industrializing countries with higher skills and technology, and 4) countries with high-level technology and innovation capabilities.

These categories are not mutually exclusive and might not cover all types of divergence among countries. Having this endowments-based categorization in mind, we selected for our analysis three resource-poor Asian countries with different phases of development: Bangladesh, Thailand and Singapore. From Latin America, two resource-rich countries are included: Brazil and Chile. All of them have been at least fairly high-performing countries for about a couple of decades.

2.2 RESEARCH QUESTIONS FOR CASE STUDIES

The most important research question to be answered in case studies of selected countries is how economic transformation was achieved with endowment changes and how such endowment changes had been attained. More concretely, how learning and accumulation of knowledge and capabilities took place and how hard infrastructure was constructed, as well as what kind of policies and what kind of institutions enabled the process of change and

[4] This typological approach is inspired by World Development Report 2013, p.18-19.

transformation. These practical aspects need to be analyzed in order to get insights into successful industrial strategies with impacts on economic transformation.

As mentioned above, how the transformation process was triggered (initiated) with the change of endowments and what kind of drivers (driving forces) maintained the momentum of transformation are important research questions as well.

3. CASE STUDIES

3.1. CASE 1: EASTERN SEABOARD, "DETROIT OF ASIA" AND BEYOND: PRODIGIOUS DEVELOPMENT OF THAILAND'S AUTOMOBILE INDUSTRY

In 1995, Thailand's annual automobile exports were less than half a billion US dollars, well below exports from India and Malaysia. By 2008, exports approached US$28 billion, making Thailand the largest automobile exporter in the ASEAN region, the third largest in Asia, after Japan and South Korea, and the seventh largest exporter in the world in 2012. Production of 1 million cars was achieved in 2005 and 2.5 million cars in 2012. It is estimated that there are about 690 first-tier parts makers, 30 percent of them Thai majority joint venture companies, and 23 percent of them pure Thai companies, and 1,700 second- and third-tier parts makers, most of them locally owned small and medium enterprises (SMEs), supporting the automobile industry in Thailand in 2010 (Natsuda and Thoburn 2011, p.8). At present, the automobile industry is the principal engine for growth in Thailand's economy. "The Detroit of Asia" envisaged once by the Thai government is now a reality and the "automobile belt" is established from Ayutthaya to the Eastern Seaboard.

(A) ACCUMULATION OF KNOWLEDGE AND CAPABILITIES, PREREQUISITE FOR DEVELOPMENT OF AN AUTOMOBILE INDUSTRY

As Athukorala and Kohpaiboon (2011) mention, "the automobile industry has been the target of industrial development in many countries as a growth driver—a source of employment, technological expertise, and a stimulus to other sectors through backward linkages….But only a handful of developing countries have managed to develop an internationally competitive automobile industry."[5]

Development of an automobile industry requires skilled labor and supporting industries to provide up to 20,000 to 30,000 parts and components. Supporting industries and automobile assembly plants are closely related and provide externality to each other. Accordingly, in many countries, lack of supporting industries made the installation of automobile assembly plants

[5] It goes without saying that the automobile is a complex product, consisting of a large number of parts and components which involve different production processes and factor proportions. Many of these parts and components are manufactured by independent suppliers in other industries such as textiles, glass, plastic, electronics, rubber products, and steel and other metals (Athukorala and Kohpaiboon, 2011, p.1).

difficult, while supporting industries are constrained by the demand of parts and components of assembling plants. Their relationship is like that of the chicken and egg. Furthermore, the development of supporting industries for automobile industries takes years because they need a prolonged process of accumulation of knowledge and capabilities, especially the formation of human resources and learning about technology.

Among several policy measures, a series of initiatives by the Thai government to incrementally enhance the localization of parts production was important for the accumulation of knowledge and capabilities of supporting industries. In the 1960s, the Board of Investment (BOI) introduced the Industrial Investment Promotion Act, and six major foreign automobile joint venture companies were established with Thai capital by the end of the decade. However, the production of vehicles remained very limited, accounting for only 18.5 percent of the total sales of automobiles in the country in 1969, and the process heavily depended on assembly operations using imported complete knock-down (CKD) kits that created a serious balance of trade and payment deficits (Natsuda and Thoburn 2011, p.13).

The specific policy for the automobile industry was introduced for the first time in 1971, establishing, among others, a local contents requirement (LCR) of 25 percent, which became effective in 1973, and conditions for new market entry over 0.2 million baht for investment (except for land) and production capacity of 30 units per day, in order to achieve economies of scale, which is essential for competitive development in the automobile industry.[6] The LCR encouraged car assemblers to produce locally or to purchase parts from local companies. This was not easy because supporting industries in Thailand did not exist. Assembling companies had to start the process of localization from scratch. Following this, the LCR was raised incrementally through 1994 up to 60 percent for pick-up trucks with gasoline engines and 72 percent for those with diesel engines. The LCR was abolished in 2000 in consideration of WTO rules.[7]

Techakanont (2008, p.8) considers that "the most important policy of the Thai state was the implementation of the LCR." In order to comply with the LCR, automobile assembly companies in Thailand had to increase the local content of components which were produced by themselves, to ask their component suppliers in their countries of origin to invest in Thailand, or to support local Thai firms to produce components with the required quality standard. Yamashita (2004, p.5), based on his extensive field research concludes that "the process of adaptation to the LCR enabled the accumulation of a very wide range of automobile

[6] As regards this new policy, see Natsuda and Thoburn (2011), p.13.

[7] From 1978, the LCR for passenger cars was increased from 25 percent to 35 percent in the first two years and was then raised by 5 percent every year until 1983, eventually reaching 50 percent, and for commercial vehicles from 20 percent to 45 percent. The new policy also required assemblers to localize specific parts production by introducing a 'mandatory deletion' scheme, targeting specific parts such as brake drums and exhaust systems. In 1994, the LCR was further raised to 60 percent for pick-up trucks with gasoline engines and 72 percent for those with diesel engines. In 1996, the government announced the abolition of the LCR by 1998 prior to the WTO target date, although, eventually, the period was extended to 2000 (Natsuda and Thoburn 2011, p.15).

parts industries and formation of skilled technicians and engineers, both of which are indispensable for the development of the automobile industry."[8] Through this process, assembly companies have offered continuous technological support to local supporting industries.

In this context, it should be emphasized that "most of the policies in the early 1980s were deliberated in a formal public-private cooperation committee (PPCC) before they were officially declared as government policy" (Techakanont 2008, p.12) . Doner puts it: "the policymakers were quite flexible for assemblers to choose how to produce parts: either produce them locally or assemble components from imported parts" (Doner 1991).[9] Assembly companies asked the Thai government to revise the LCR policy when they reached the 54 percent level because any further increase of the LCR percentage would make it difficult to assure the safety of the cars and reduce further the cost of production. Responding to this request, the government switched its policy from the LCR to one requiring the local production of specific important components such as engines (Techakanont 2008, p.9).

(B) FORMATION OF AUTOMOBILE CLUSTERS AND INDUSTRIAL ESTATES

The government facilitated the formation of industrial clusters by establishing the infrastructure for manufacturing activities, especially, automobile assembly and parts production. Automakers and their components suppliers enhanced their competitiveness when they were agglomerated as a cluster with articulated value chains.

For this purpose, the Industrial Estate Authority of Thailand (IEAT) was established in 1972 and many industrial estates (IEs) were constructed, firstly around Bangkok and later on the Eastern Seaboard and its vicinities. The agglomeration of assemblers and part makers in IEs was observed since the 1970s. The establishment of IEs, leading to cluster formations, has been an important instrument through which the Thai government attracts foreign investors by providing infrastructure and tax incentives (Lecler 2002, p.802).

(C) INFRASTRUCTURE WHICH TRIGGERED THE RAPID EXPANSION OF THAILAND'S AUTOMOBILE INDUSTRY, CHANGING SIGNIFICANTLY THE ENDOWMENT OF THE COUNTRY

The automobile industry requires efficient ports and logistics facilities, in order to be competitive in the export market. From this perspective, the most important milestone for Thailand's automobile industry was the construction of infrastructure on the Eastern Seaboard.

The Eastern Seaboard Infrastructure created an export hub and center for technology-intensive industries: 14 industrial estates; 360,000 workers; 1,300 factories; and 516 automobile-

[8] Yamashita (2008, p.5), translation by the author.

[9] Cited in Techakanont (2008), p.9.

related factories. The explosive emergence and concentration of the new machinery, metal and non-metal industries with FDI inflows in the early 90s, which occurred around Leam Chabang, became possible only through the completion of such large-sized infrastructure as the Eastern Seaboard Development Plan, which became a synergetic production nexus and a hub for the shipment of products (Shimomura and Mieno 2008, p.14-16).

The Eastern Seaboard Development Plan is a leading large-scale development scheme that the Thai government implemented in the 1980s with assistance from Japan and the World Bank. It had a twofold purpose of boosting international strength and inviting direct overseas investment in export-oriented industrial fields, and easing the over-concentration of economic activity in Bangkok. The large-scale project, which extends over three provinces in the coastal area southeast of Bangkok, consists of a composite industrial site formed by two deep sea ports, Leam Chabang and Map Ta Put, supported by harbors, roads, railways, dams, service pipelines and other facilities.[10]

Today, Leam Chabang is Thailand's largest port and plays a significant part in increasing trade in Thailand. It is where Thailand's automobile industry is most heavily concentrated, with many automakers' and parts manufacturers' operations set up in the area (Japan ODA White Paper 2005). Figure 1 illustrates how these activities have moved into the Eastern Seaboard demonstrating that this infrastructure produced a major change in the endowments structure in Thailand and played a crucial role in this country becoming the "Detroit of Asia".

(D) "DETROIT OF ASIA" VISION

The Thai automobile industry experienced different phases of development, namely, the introduction of the localization policy (1971-77), the strengthening of localization capacity (1978-90) and liberalization (1991-99) (Natsuda and Thoburn 2011, p.13-20). A new phase started from 2000. The Thai government, after abolishing the LCR in 2000, introduced the New Automobile Investment Policy in 2002, which aimed to develop Thailand into a regional center of the automobile industry in Southeast Asia. Two years later, a further automobile development plan was introduced, the so-called "Detroit of Asia" plan, which was later renamed the "Production of Asia" plan (*Ibid.* p.22). In order to meet the targets of this plan by 2016, the government's first 'product champion', the pick-up truck, was not considered enough. To attract additional foreign investment from automobile producers, the "Eco Car" project was introduced as the second 'product champion' in 2007 (*Ibid.* p.23). At the same time, a policy to strengthen supporting industries through the promotion of SMEs was established: the SMEs promotion law in 2000 and the Master Plan of SMEs promotion in 2003. In addition, the "Automotive Human Resource Development Project (AHRDP)" was launched in 2006.

[10] This summary is based on JICA/JBIC (2008), p.50.

(E) INSTITUTIONS WHICH FACILITATED CHANGES OF ENDOWMENTS

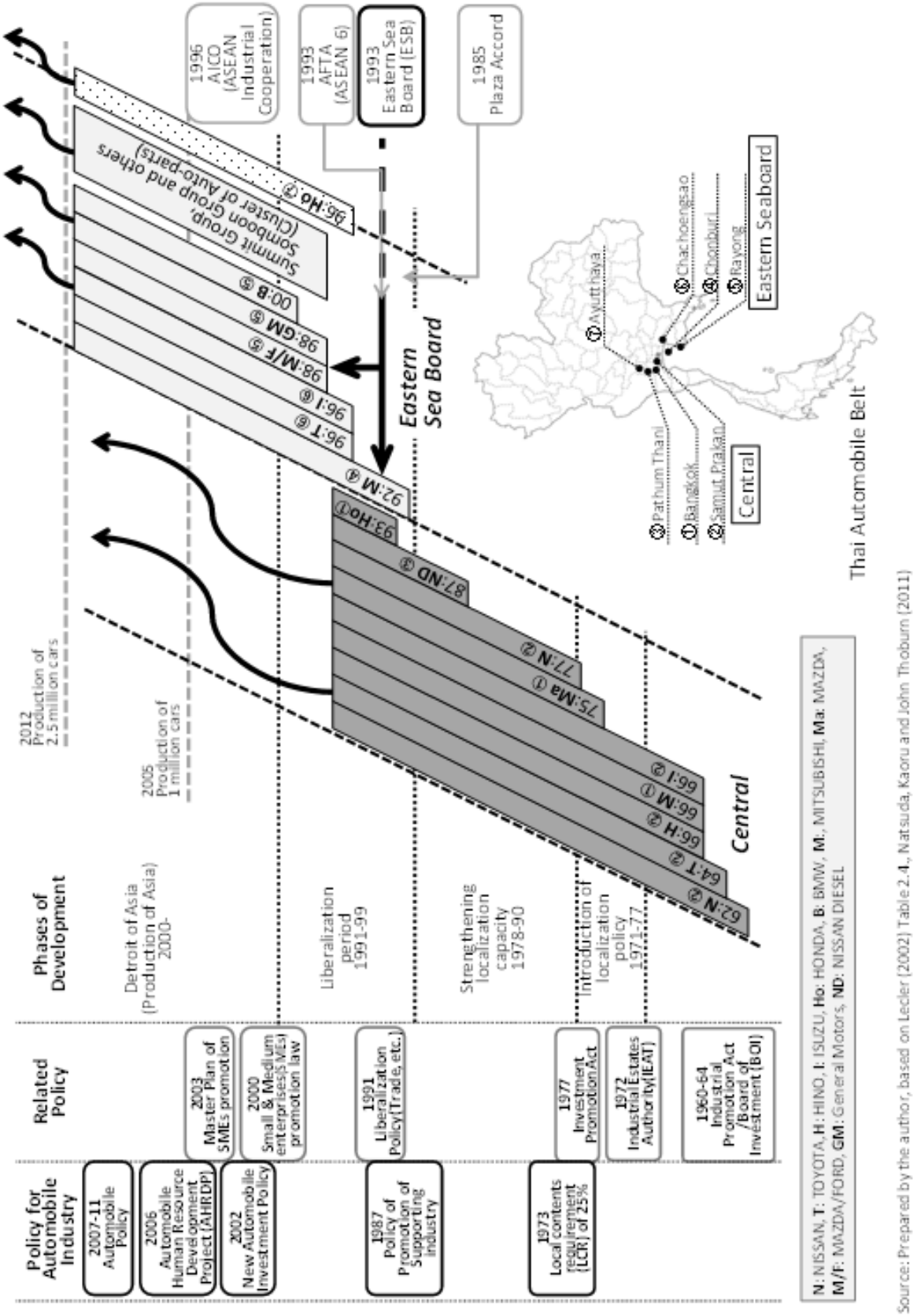
Among others, there are two public institutions that have contributed to the development of Thailand's automobile industry. One is the Automobile Development Committee and the other is the Eastern Seaboard Development Committee (ESDC), a cabinet-level national committee chaired by the prime minister, together with the Office of ESDC (OESD).

The Automobile Development Committee provided an effective institutional setting for middle-level and senior officials to formulate policies in consultation with firms and business organizations. Interference by political leaders and top-level policymakers was virtually absent in the decision making process (Athukorala and Kohpaiboon 2011, p.12). Thai authorities adopted a consensual and pragmatic approach to setting the LCR target in consultation with automakers, as mentioned above. Athukorala, and Kohpaiboon (2011) highlight that the consensual approach to policy making and absence of abrupt policy shifts created stable expectations and confidence in the overall business environment.

As regards the Eastern Seaboard, JICA/JBIC (2008, p.51) evaluates: "The reasons behind the success of the Thai government's plans for the Eastern Seaboard Development are 1) the consistent skill level of the technocrats and their independence from politics; 2) the unique check and balance structure in Thailand (several players sharing influence meant that mutual checks were continuous); 3) the development- centered orientation of the Prem administration and, 4) 'the unintended transparent and open political process' created by the intervention of the media."[11]

[11] Another study reached a similar conclusion: "It was the cumulative synergetic effect of a number of factors that had contributed to pushing the Eastern Seaboard Development Program forward. These included: Effective leadership to ensure the public's interest, competency of technocrats, powerful central economic agencies, special institutional settings, functioning coordination mechanisms, and external global factors" (GRIPS Development Forum 2007 p.131).

Figure 1: Development of Automobile Industry in Thailand



Source: Prepared by the author, based on Lecler (2002) Table 2.4., Natsuda, Kaoru and John Thoburn (2011)

(F) OTHER FACTORS

In addition to the abovementioned factors which enabled the outstanding development of the automobile industry of Thailand, we should add others such as the advancement of economic integration among ASEAN countries via the ASEAN Free Trade Area (AFTA), ASEAN Industrial Cooperation (AICO) and others, and the size of the country's automobile market (the largest among ASEAN countries).

3.2. CASE 2: CERRADO MIRACLE: VAST BARREN AREA TRANSFORMED INTO ONE OF THE MOST PRODUCTIVE AGRICULTURAL REGIONS IN THE WORLD

Starting from the mid-1970s, the tropical savanna of Brazil, called the Cerrado, was transformed into one of the world's most productive grain-growing regions in just a quarter of a century, realizing modern upland farming in a tropical region for the first time in human history. This remarkable transformation has become known throughout the world as the Cerrado Miracle (*The Economist* 2010). Today, Brazil is one of world's major grain-producing countries, and in 2012 exported the world's largest volume of soybeans. Dr. Norman E. Borlaug, who received the Nobel Peace Prize for his work related to the Green Revolution, rated the development of agriculture in the Cerrado as one of the great achievements of agricultural science in the 20th century. The World Food Prize founded by Borlaug was awarded in 2006 to two Brazilians who contributed to the Cerrado Miracle. This agricultural transformation not only increased the production of competitive commodities such as soybeans, corn, coffee, sugar, and cotton but it also enabled the development of food value chains both inside and outside the Cerrado region. While the production of broiler chicken and pork had been growing steadily in the 1990s, this growth accelerated at the end of the decade and a sharp increase in meat exports was seen.

The Portuguese word *cerrado* refers to "closed" land, or land that was for many years regarded as being unfit for agriculture. The total area of this vast region is about 240 million hectares, or 5.5 times the land area of Japan. This land was considered to be unsuitable for agriculture because the soil has extremely high acidity, and because lack of potassium and phosphoric acid and damage caused by aluminum hinder crop growth.

(A) CHANGE OF ENDOWMENT BY TECHNOLOGICAL INNOVATION: FROM ALMOST ABANDONED LAND TO FERTILE LAND, "A NEW COMPARATIVE ADVANTAGE" ACHIEVED

For the development of Cerrado agriculture, three technological aspects appear to have been essential. Firstly, soil improvement and the development of new crop varieties suited to the tropical zone were crucial. These constituted the core technological innovations needed to

launch Cerrado agriculture from a base of practically zero. Secondly, there was the need for effective dissemination of new technologies and practices to an increasing number of farmers who were the main actors in Cerrado agriculture. This was because this new industry was undertaken by a large number of farmers and enterprises instead of a limited number of companies, as is the case in some manufacturing industries. Thirdly, a solid and highly effective system was indispensible to continue achieving the technological innovations required for Cerrado agriculture.

The vast land of the Cerrado had a drastic value change, which produced a "new comparative advantage," in the terms of a JICA and JBIC study (2008). Here, technological innovation was crucial, but the inland transport infrastructure constructed before and after the transfer of the national capital from Rio de Janeiro to Brasilia could have been another factor.

The Brazilian government "invested in learning" in terms of Noman and Stiglitz (2012). Investments in learning are highly risky, and risk markets are absent (especially in developing countries), which also discourage such investments (Noman and Stiglitz (2012, p.6). For Cerrado agricultural development, the government took the initiative. The Brazilian Agricultural Research Corporation (EMBRAPA) and its Cerrado Agricultural Research Center (CPAC) were established in 1973 and 1974, respectively, and did in fact achieve a lot of innovations: recent discussions on the Cerrado point out that EMBRAPA's greatest contributions were soil improvement in the Cerrado and breeding improvement for soybeans and other crops. A significant technological breakthrough was the success in developing new varieties of soybeans that were fit for the tropical climate.

Soybeans, a crop suited to temperate regions, bloom and sprout by sensing differences in day length (photoperiod), and soybean cultivation was therefore difficult in the tropical region. Cultivation is even more difficult in lower-latitude areas in the Cerrado because the day length is nearly constant year-round. Dr. Plínio Itamar de Mello de Souza developed the revolutionary varieties of soybeans suited to the tropical region. Dr. de Mello collected 3,000 soybean varieties from the southern United States, the Philippines, Japan, and other parts of the world, selected those with low sensitivity to changes in day length, and then selected those that grow tall in tropical regions, and crossbred them with varieties with high yields. Finally, in 1980, the first soybean variety was completed for cultivation in the Cerrado.

Soybean varieties adapted to tropical zones were essential not only as a new crop, but also for soil improvement in the Cerrado. Soybeans fix nitrogen in the soil through root nodule bacteria and facilitate the soil to absorb fertilizers. Therefore, soybeans played the role of a precursor among the plants introduced to the Cerrado.

(B) ACCUMULATION OF KNOWLEDGE AND CAPABILITIES

Although the technology for Cerrado had been developed from scratch, there had been years of effort to establish Cerrado agriculture even before the establishment of EMBRAPA. Initiatives of farmers with experience in the southern region (the non-Cerrado region) were crucial as well. They undertook pioneering experimental work in the Minas Gerais Cerrado

region. Drawing on their experience, the Program of Guided Settlement of Alto Paranaiba (PADAP) was implemented by the state of Minas Gerais together with the Cooperative Cotia. It was the first structured program to prove the feasibility (for business development) of Cerrado agriculture. The starting point was São Gotardo, in the state of Minas Gerais in 1974.

On the basis of the successful PADAP experience, the Japan-Brazil Cooperation Program for Cerrados Development (PRODECER) was launched to extend Cerrado agriculture to other areas of Minas Gerais. The pilot projects of the first phase of PRODECER fully demonstrated the feasibility and high potential of Cerrado agriculture. The second phase of PRODECER carried out full-fledged projects in Minas Gerais as well as in the states of Goiás and Mato Grosso do Sul. At the same time, PRODECER also started pilot projects in the states of Bahia and Mato Grosso. The third phase of PRODECER covered the states of Tocantins and Maranhão. In this way, PRODECER was scaled up from the core regions to the frontier regions of the Cerrado. Figure 2 depicts PADAP, PRODECER, and the development of Cerrado agriculture.

In this process, there has been continuous learning and accumulation of knowledge and capabilities for both the researchers and farmers. How did these groundbreaking technologies developed by EMBRAPA spread? How did the pioneers of Cerrado agriculture improve their technological capabilities after they settled in the Cerrado, once believed to be sterile, and strove tirelessly to establish agricultural land? As noted by Dr. Eliseu Alves, who is known as the father of EMBRAPA, many of the farmers who migrated to the Cerrado from southern Brazil had experience in agricultural production and were proactive about adopting new technologies. Cooperatives such as Cotia contributed greatly to the process of technological dissemination. The Technical Assistance and Rural Extension Company (EMATER) was initially in charge of disseminating technologies developed by EMBRAPA. A recent study by the Inter-American Development Bank points out that after the company was liquidated as part of a deregulation policy, producers utilized technological innovations through cooperatives and other organizations.[12] In PRODECER, the growth pole strategy was adopted at Cerrado frontiers. Cotia and other cooperatives provided detailed technological consultations for individual farmers, contributing greatly to raising their technological capabilities.

(C) INSTITUTIONS WHICH FACILITATED CHANGES OF THE ENDOWMENT

The single most important institution that enabled the amazing change of the Cerrado and the establishment of Cerrado agriculture is considered to be EMBRAPA. The research begun by EMBRAPA in 1973 progressed steadily, making it one of the largest agricultural research institutes in the southern hemisphere, and one of the largest tropical agricultural

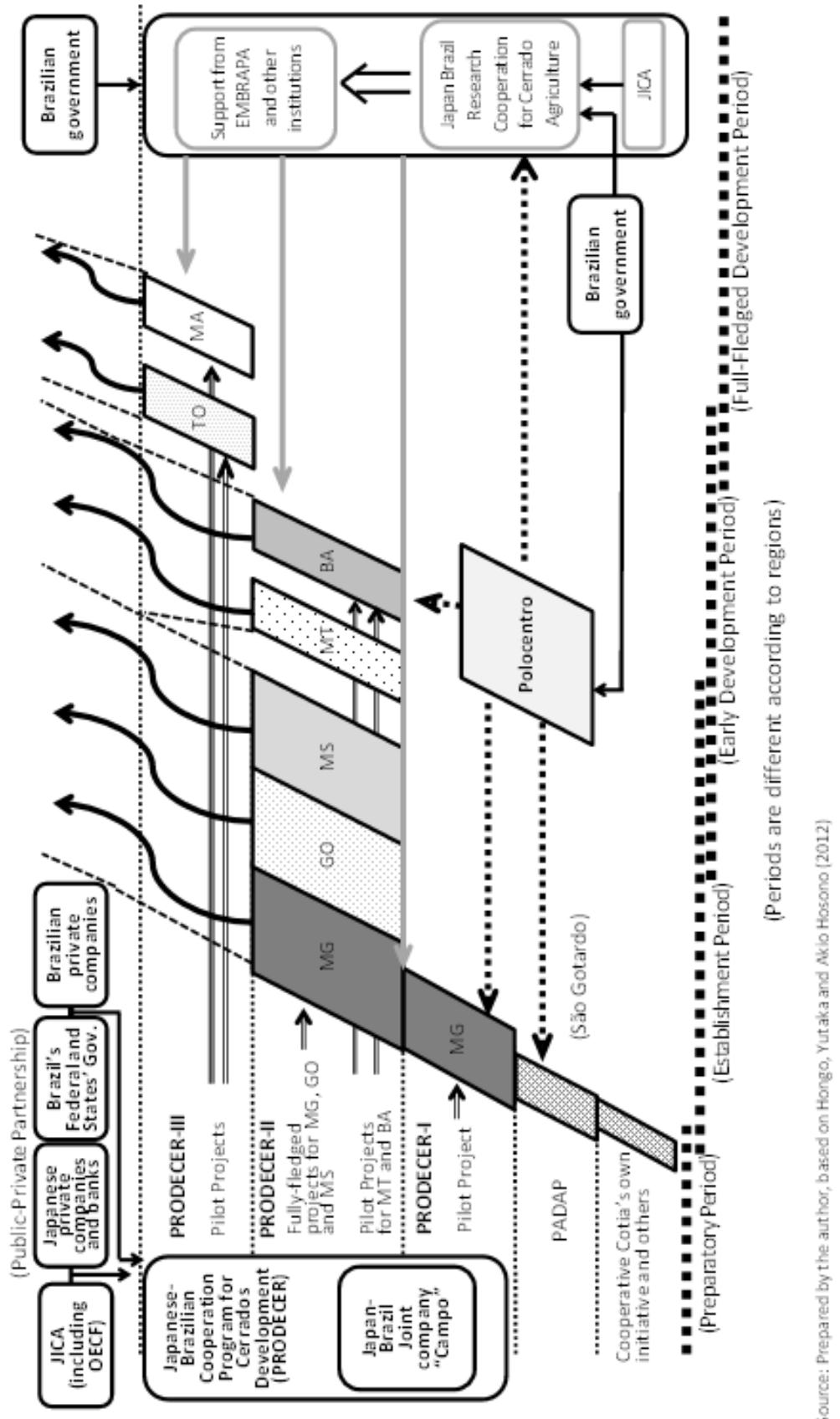
[12] Inter-American Development Bank (IDB) (2010) states that the Technical Assistance and Rural Extension Company (EMATER) worked to widely disseminate the technologies developed by EMBRAPA. After EMATER was liquidated as one of a number of deregulation measures, producers were able to utilize technological innovations through cooperatives and other organizations (IDB 2010, p. 320).

research institutes in the world. As of 2010, there were over 8,637 people working with the institute, with 2,116 researchers, 1,622 of them holding doctorates. Only three researchers with doctorates were with the institute at its founding in 1973. Since then, EMBRAPA has dispatched 3,000 people to advanced countries to study, and it now has 43 affiliated research centers. EMBRAPA is today highly appreciated overseas for its distinguished research. Analyzing the factors behind its success reveals some clues on how to develop institutions capable of research and development activities suited to a country's conditions, which at the same time generate technological innovations, cultivate human resources, and produce 'miracles' similar to that in the Cerrado.

EMBRAPA set the development of Cerrado agriculture as its core mission, achieved success, and therefore established its eminent position, thus succeeding in steadily securing its research budget while maintaining political neutrality; by securing its research budget, further research results were obtained, which further reinforced its position. Alves (2012) described the situation thusly: "What solidified the position of EMBRAPA was the achievement of transforming the Cerrado into a modern agricultural region. EMBRAPA's contributions are at the core of Cerrado agriculture, and society recognized that its involvement is vitally important for its success."

In addition, Alves and other authors emphasize other factors which made the EMBRAPA model successful: close relations between researchers and farmers; meritocratic incentive system and structure; transparency; and so on.

Figure 2. Development of Cerrado Agriculture



3.3. CASE 3: BANGLADESH GARMENT INDUSTRY: FROM ADVERSE INITIAL CONDITIONS AT INDEPENDENCE TO ONE OF THE WORLD'S BIGGEST EXPORTERS OF READY-MADE GARMENTS

In 1981, ten years after Bangladesh achieved independence, raw jute and jute goods were its major exports, corresponding to 68 percent of total exports. In 2011, garments and textiles constituted 85 percent of total exports, of which 76 percent corresponded to garments. These industries' business entities amounted to 50 percent of all manufacturing establishments in the country (UNCTAD 2012, p.11). Today, the garment industry has 5,000-6,000 factories with 7-8 million workers using the assembly-line method of production. The wages of the workers in these industries are around 35 percent higher than the national average (*Ibid.* p.11). Exports as a percentage of GDP tripled between 1990 and 2010, with much of the increase in the thriving ready-made garment industry, which is highly intensive in female labor (WB 2012, p.197). This Bangladesh success story is remarkable, because as a recent World Bank study highlighted, "the country was often held out in the development literature as a hopeless case" (*Ibid.* p.197).

(A) LEARNING, ACCUMULATION OF KNOWLEDGE AND CAPABILITIES

Rhee (1990) undertook extensive research on how this country's garment industry started.[13] In 1978, Daewoo of Korea proposed to the government of Bangladesh, an ambitious joint venture involving the development and operation of tire, leather goods, cement and garment factories. As it turned out, the Bangladesh government actually put the garment industry first. Although the public and private sectors were particularly interested in the garment industry, Bangladesh was not exporting garments because of a total lack of domestic production technology and marketing knowhow, and had no apparent means of acquiring them from overseas (Rhee 1990, p.336). In this context, Noorul Quader, who had been exposed to the foreign business world as a senior official in the previous government, founded the Desh Garment Company, and he expressed the desire to collaborate with Daewoo in a new garment venture in the country (*Ibid.* p.336). Quader and Daewoo signed an agreement to collaborate in the areas of technical training, purchase of machinery and fabric, plant start-ups and marketing. Desh recruited 130 workers for training at Daewoo's Busan plant, where "they received some of the most intensive on-the-job training in garment production ever seen in the history of developing countries" (*Ibid.* p.337) for seven months in 1979.

One of the most outstanding features of this training is, as Rhee emphasized, that in addition to the in-depth, excellent skills training they received, Desh workers received a wide-ranging, high-quality education involving a look at the entire operations of a highly successful, multifaceted international company and the corporate culture that created and supported its superior performance (*Ibid.* p.338). The 115 Daewoo-trained workers who left Desh after the middle of 1981 proved a very powerful medium for transferring knowhow throughout the

[13] This and following two paragraphs are mainly based on Rhee (1990).

whole garment sector and for significantly improving garment exports. In 1985, there were more than 700 garment export manufacturing factories in Bangladesh, compared with a few such factories in 1979. Rhee mentions that many new garment firms have been able to handle production and marketing without involving expatriates or foreign companies because they have been staffed by former Desh workers who had fully mastered production and marketing knowhow (*Ibid.* p.342). However, he also recognizes the continuous need for many of these new factories to collaborate to some degree with foreigners in the areas of marketing and technology (*Ibid.* p.342).

Another noteworthy feature of Daewoo's training is that there were 14 women among the trainees. Rhee (1990, p.337) puts it, "Muslim tradition had precluded females from working in factories in Bangladesh. However, Quader had been so impressed by the efficiency and sheer numbers of women at Daewoo and other garment factories in Korea that he persuaded the Bangladesh government to support female trainees."

Easterly (2002, p.149) comments on the Desh-Daewoo collaboration from the standpoint of learning and knowledge creation: Creating knowledge does not necessarily mean inventing new technologies from scratch. Some aspects of garment manufacturing technology were probably several centuries old. Furthermore, Bangladesh has the legacy of Dhaka Muslin. The relevant technological ideas might be out there floating in the ether, but only those who apply them can really learn them and can teach them to others. In this regard, Mostafa and Klepper (2011, p.3) emphasize that tacit knowledge seeding was essential for the initial establishment and subsequent expansion of the Bangladesh garment industry. They contend that key to the explosive growth of the industry was knowledgeable workers leaving Desh, and then other successful firms, to set up the production processes of later entrants. These workers organized an assembly-line production process, trained workers, and supervised production, effectively diffusing vital tacit knowledge to new garment producers. Despite having limited literacy, Bangladesh had a sufficient number of educated entrepreneurs with some prior business experience who could gather the relevant resources and establish garment factories (*Ibid.* p.29).

The process of learning and accumulation of capabilities continued after this impressive transfer of technology from Korea. Mottaleb and Sonobe (2011) conjectured that highly educated entrepreneurs have been attracted to the garment industry by high profitability, which was boosted initially by the Desh-Daewoo infusion of Korean skills and know-how (p.4-5). Their analysis indicated that the high-level education of manufacturers and enterprise performance were closely associated. This is because manufacturers have to continuously upgrade their skills and know-how in order to survive the intense competition in the world garment market and because high levels of general human capital for the entrepreneur are needed to manage an increasing number of managers and experts (*Ibid.* p.20-21).

(B) CHANGE OF ENDOWMENTS: RURAL DEVELOPMENT AND MOBILIZATION OF FEMALE WORKERS WITH LOW OPPORTUNITY COST

World Bank (2012, p.197-199) classifies Bangladesh as an urbanizing country. Indeed, the changes in rural society in this country have been profound and are related closely to the massive mobilization of female workers by the garment industry located mainly in two big cities: Dhaka and Chittagong. Generally speaking, urbanizing countries are endowed with abundant unskilled labor, and these countries' integration into the world economy can lead to the development of light manufacturing industries. In the case of Bangladesh, several factors interacted in order that this change took place. Modernization of agriculture based on technology adoption which enabled farmers' shift from low-yield, single crop, deep-water rice to double cropping of short maturity, high-yield rice, as well as the well-known rapid spread of microfinance and construction of rural infrastructure, were among major factors that changed the rural society of Bangladesh (*Ibid.* p.197). More specifically, rural roads, irrigation, market facilities and other rural infrastructure, micro-credit, school education and so forth, provided by NGOs, central and local governments and donors, all together enabled the remarkable agricultural and rural development of Bangladesh in the last three decades. In this process, the rural development programs of the government and donors were implemented effectively by the Local Government Engineering Department (LGED), which played a critical role in the provision of rural infrastructure.[14] Micro-credit and related services were also effectively extended by NGOs including BRAC and Grameen Bank.

This process enhanced the mobility and readiness of low-opportunity-cost labor in rural Bangladesh and changed gradually, but steadily, the endowments of the country.[15] The mobilization of this labor was triggered by the Desh-Daewoo garment project. Rhee (1990, p.45) puts it, "development is a dynamic process in which self-generating mechanisms may emerge once action is initiated….To start on the path of development in an outward-oriented direction, a first spark must be created." That spark was the collaborative effort of a domestic catalyst (Desh) that mobilized the necessary local resources and a foreign catalyst (Daewoo). It was a process of self-discovery of the changing comparative advantage of the country.

Hossein, Sen and Sawada (2012, p.5) contend that "in the predominantly agricultural economy with high population density and high population growth, the critical challenge is to

[14] The role of LGED in the rural development cannot be overemphasized. LGED is one of the largest public sector organizations in Bangladesh, with a staff exceeding 10,000 and a development budget accounting for 14 percent (FY2009-10) of the total development budget of the Government. For details of LGED, see Fujita (2011).

[15] We should remember that a pessimistic appraisal was common as regards women's role in the labor market in Bangladesh, which caused pessimism about the country's growth, due to, among others, the fact that most East Asian countries had the advantage of a high initial female labor force participation rate at the start of the growth process. As Hossain, Sen and Sawada (2012, p.29) emphasize, none of the predictions could anticipate that women would offer the secret ingredients of success that was achieved in Bangladesh from exports to schooling to microcredit use. The dramatic nature of the increase in female participation in the growth of ready-made garment (RMG) workers is a case in point.

reduce the burden of surplus labor in agriculture. This challenge can be met through sustained sectoral and social policies and attendant institutional changes *commensurate to each stage of development* to support productivity/growth-enhancing relocation of "surplus" farm labor to non-farm and non-agricultural jobs" (italic is original).

(C) CHANGE OF ENDOWMENTS: CONNECTIVITY AND LOGISTICS UP-GRADING BY INFRASTRUCTURE

When Desh started its business in 1980, its factory was located in Chittagong, the country's main port. The first Export Processing Zone (EPZ) was also constructed in 1983 in this port city. Exports from Dhaka, which does not have an efficient port facility nearby, had a serious bottleneck due to the lack of bridges on rivers which cross Highway No.1, which connects the capital city with Chittagong. As trucks had to use ferries, the transport between Dhaka and Chittagong was constrained in terms of time and unpredictability. This handicap affected the competitiveness of the garment industry in Dhaka. It was overcome by the construction of Meghna Bridge in 1991 and Meghna-Gumti Bridge in 1995. The Dhaka EPZ was constructed in 1993.

Jamuna multipurpose bridge, inaugurated in 1998 as the largest construction in Bangladesh history, has been a major channel for integrating the lagging western region of the country with the leading eastern region, enabling cheaper transportation of gas, electricity and telecommunications, and enhancing the labor mobility of the western region (Hossein, Sen and Sawada 2012, p. 11).

(D) INSTITUTIONS THAT FACILITATED GARMENT INDUSTRY DEVELOPMENT

Initial conditions in Bangladesh, when the garment industry started with the Desh-Daewoo initiative, were affected by high levels of policy distortions and weak institutions. However, in spite of the rigidity of the government's response in terms of the adaptability of the ideas coming from private entrepreneurs, which is very common in developing countries, Yunus and Yamagata (2012, p.5) mention that in the case of Bangladesh the innovative ideas and strategies from the entrepreneurs were well accommodated by the government policymakers. A back-to-back letter of credit (L/C) system[16] and special bonded warehouse facilities were two of the most important features and were formulated based on the prescription of the leading entrepreneurs (*Ibid.* p.5).

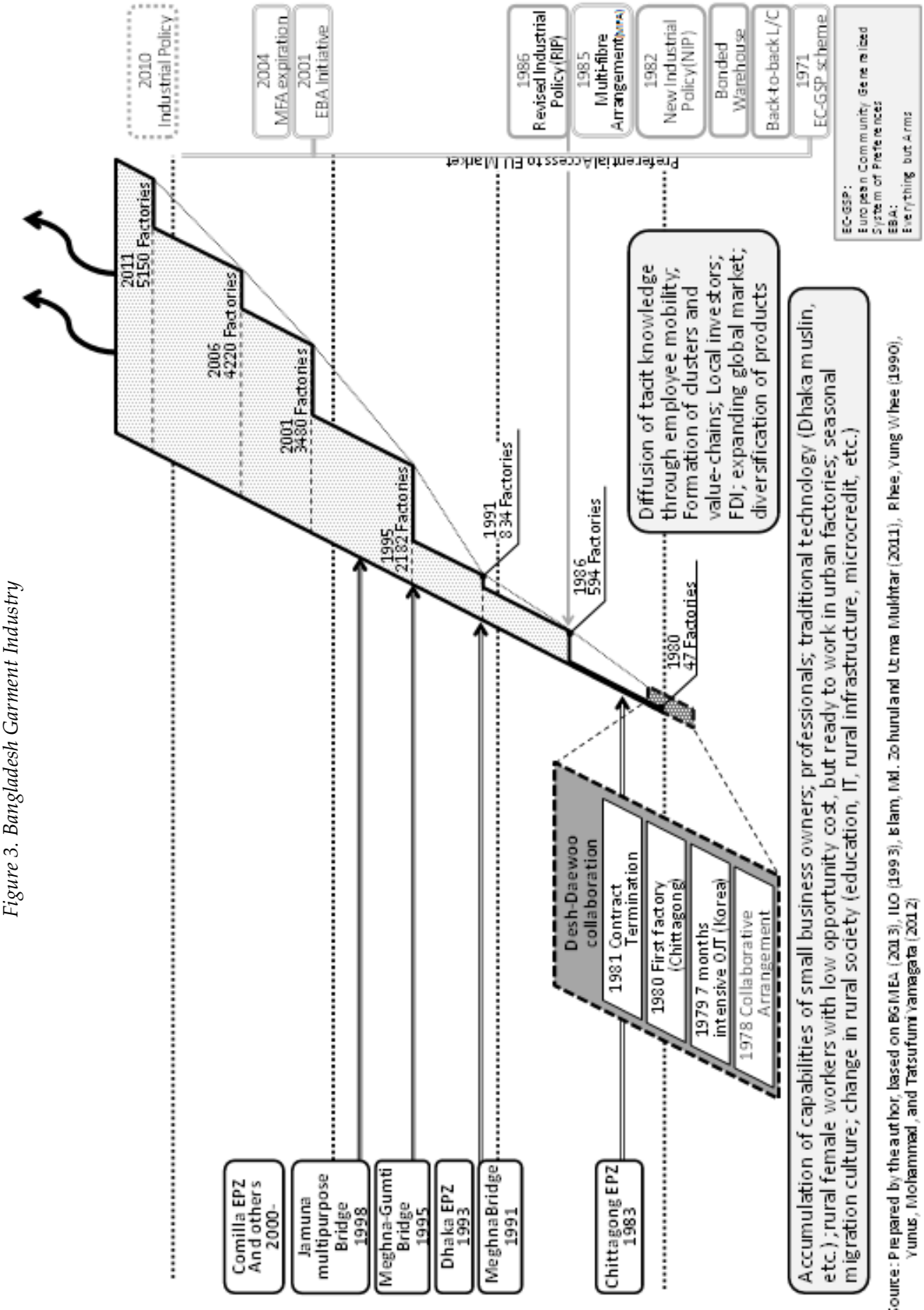
The special bonded warehouses were critical to the initiation of garment export production. According to Rhee (1990, p.339), "it appears that Daewoo's intimate knowledge of the nuts and bolts of the successful bonded warehouse system in Korea, its ability to transmit that knowledge to Desh staff, and the advice that Desh's senior manager gave to administration officials on the new system were instrumental in the design and implementation of the special

[16] For details of this system, see Easterly (2002), p.149.

bonded warehouse system." Although the government did not provide any import financing facility, it did allow the back-to-back L/C, which was a very effective instrument, given the system of strict foreign exchange controls in the country at that time. Here again, Daewoo and Desh's influence on the public agencies was instrumental (Rhee 1990, p. 340).

The consequent accelerated development of the garment industry was enabled by learning and the accumulation of the capabilities as mentioned above. The government facilitated its development through infrastructure investment, construction of Export Processing Zones, policies for the free importation of machines, bonded warehouses and back-to-back L/C, followed by other general policies such as the New Industrial Policy (1982), Revised Industrial Policy (1986), and credit facilities (1991). At the same time, the Multi-Fiber-Agreement (1985) and its quotas as well as preferential access to the EU market have been important factors. Interaction of all such factors is roughly illustrated in Figure 3.

Figure 3. Bangladesh Garment Industry



Source: Prepared by the author, based on BGMEA (2013), ILO (1993), Islam, Md. Zohurul and Uzma Mukhtar (2011), Rhee, Yung Whee (1990), Yunus, Mohammad, and Tatsufumi Yamagata (2012)

3.4. CASE 4: CHILE'S SALMON INDUSTRY: STARTING FROM SCRATCH TO BECOME A MAJOR WORLD SALMON-EXPORTING COUNTRY[17]

Salmon did not exist in Chile four decades ago. Natural salmon still does not exist in the Southern Hemisphere except for king salmon in New Zealand. Now, Chile is one of the world's top salmon-exporting countries, ranked on a par with Norway. It is no exaggeration to describe this as a "miracle." Moreover, Chile is a resource-rich country that is highly dependent on copper exports. In 2011, exports of mineral ores and their refined products corresponded to more than 60 percent of total exports, 52 percent of which are copper ore and refined copper. The challenge for resource-rich countries is diversification of exports. The ensuing export revenue from rich resources leads to strong real exchange rate appreciation and deterioration in competitiveness in sectors exposed to international competition (WB 2012, p.199).

(A) CHANGE OF ENDOWMENT BY TECHNOLOGICAL ADAPTATION/INNOVATION

Chile's comparative advantage in salmon sea farming was definitely confirmed when the Chile Foundation's subsidiary, Salmones Antartica, demonstrated the commercial feasibility of salmon aquaculture at a scale of 1,000 tons a year in 1988. The Chile Foundation (*Fundación Chile* in Spanish) is a public-private corporation that aims at developing technologies for establishing new industries, setting up businesses, and selling successful ones for profit. This unique organization, which has no equivalent elsewhere in Latin America, was created through compensation consultations that the Chilean government had been having in the mid-70s with an American multinational corporation that was nationalized by the previous government.

In general, for a new industry to be established so that it grows in a self-sustaining manner, the industry must demonstrate its feasibility and international competitiveness as a sustainable profit-making business. This requires, as a precondition, technological development, which in turn calls for sizable investment. Many venture businesses invest in the development of such technologies and new products. Although technology development itself carries the risk of failure, the guarantee that the founder's profit will be secured under the protection of patent rights provides a substantial incentive for creating a new industry. This is not to say, however, that the founder's profits in a new industry are always protected by patent or other means. There are many cases to the contrary.

In developing countries trying to catch up with developed countries, for example, entrepreneurs aiming to develop a new industry with the help of technology transfer from other countries usually find it difficult to protect their technologies gained through such transfer. Such technologies will not be protected by patent. As a result, as soon as a company succeeds in technology transfer, others will soon follow in the successful company's footsteps. This will intensify competition. In this case, the profit the pioneer deserves may not be guaranteed. Or

[17] This case study is based on Hosono (2010). The English version is forthcoming.

worse still, the investment may not be recouped. Therefore, Rodrik (2007) argues that costs of "self-discovery" of pioneers should be subsidized (p.117).

This may be described as a case of market failure, in that open access to the information in question discourages investment. Specifically, this is known as market failure associated with 'information externalities'. In the case of Chile in the 1970s and 1980s, the government did not take an interventionist policy of directly supporting the development of industries. However, it is clear that the Chilean salmon industry was not developed as a result of the private sector making voluntary investments from the outset. In this context, noting that the major export items for Chile include copper, grapes, fish, and lumber/wood, Rodrik (2007) stresses that the diversification of export products from the traditional item of copper has not been achieved in a laissez-faire market (p.109).

In the case of the Chilean salmon industry, market failure was averted by the Chile Foundation and Japan-Chile salmon project. The Chile Foundation, a newly-created, semi-governmental foundation made an investment large enough to support salmon production through sea-farming on a major scale and successfully recouped this investment. The foundation thus demonstrated the commercial profitability of sea farming on that scale. In addition to proving the profitability of such venture, the Chile Foundation provided information on salmon farming for free or for a fee as public goods so as to allow many companies to invest in the salmon farming industry without having to make a sizable investment in research and development.

Two private companies had started salmon sea farming before the Chile Foundation started its salmon initiative. In 1978, Nichiro Fisheries of Japan set up Nichiro Chile, which in 1979 launched salmon sea farming, near the city of Puerto Montt, the first of its kind in the country. This was a groundbreaking event that astounded fisheries experts at home and abroad who were familiar with the situation. Nichiro had already accumulated salmon sea farming technology in Japan. Following Nichiro's groundbreaking success in salmon farming, the Chile Foundation acquired the facilities that Domsea Pesquera, a company under the umbrella of Campbell Soup of the United States, had owned in Chiloé Island and elsewhere. This represented the starting point for the Chile Foundation to enter the salmon industry in earnest.

Nichiro's success in pioneering mariculture and its commercialization in Chile had a great impact on the Chile Foundation; it preceded the success of the semi-governmental corporation. Nichiro's corporate history says, "the Chile Foundation of the Republic of Chile had been keeping an eye on our progress in coho salmon sea farming. Upon learning about our success, the foundation wasted no time in launching feasibility studies on sea farming." Despite being a latecomer that followed trailblazing Nichiro and Mytilus (latter-day "Mares Australes"), the second entrant into the market, Chile Foundation's Salmones Antártica successfully put larger-scale salmon mariculture on track. What factors lay behind this success? In short, the Chile Foundation was a semi-governmental corporation capable of mobilizing ample risk capital. Originally designed to encourage venture businesses, the Chile Foundation was in a better position to promote salmon farming than private companies in general.

The Chile Foundation, following the successful achievement of the 1,000-ton program, decided to sell the venture to a private company. This led to an international bidding contest in 1988, in which many companies participated. Nippon Suisan Kaisha (today Nissui), one of the major fisheries in Japan, which operated in Chile at that time, won the bid. As a result, Salmones Antártica became a wholly owned company of Nippon Suisan Kaisha, which had been conducting salmon and trout businesses in the North Pacific Ocean since before WWII and had acquired advanced technical capabilities.

The Chile Foundation unexpectedly came up with the idea of offering corporate consulting services, started by the broadcasting in 1986 of a TV program featuring salmon farming in cooperation with Salmones Antártica. Many Chilean entrepreneurs who watched the program made inquiries to the TV station. Some of them later ventured into the salmon industry. In the mid '80s, the Chile Foundation supported projects by seven private companies.

(B) LEARNING AND ACCUMULATION OF CAPABILITIES AND KNOWLEDGE

In the case of the Chilean salmon industry, the natural conditions, capital, and labor were generally favorable. With technological adaptation and development, the value of these endowments changed, enabling Chile to attain a new comparative advantage. However, what was still scarce were R&D professionals and trained industrial personnel. Introducing and developing technology with high-level professionals is not an easy task for the private sector. Industrial personnel will not be trained overnight, and it will cost a lot for the private sector. In the preparatory phase of the Chilean salmon industry, these circumstances made it difficult for private companies to develop technologies and train industrial personnel by themselves.

This gap was filled by the Japan-Chile Salmon Project, which was implemented from 1969 for 20 years by Japan International Cooperation Agency (JICA) and its counterparts, National Fishery Services (SERNAP) and Fishery Promotion Institute (IFOP), under an agreement between the Japanese and Chilean governments. Because the Japan-Chile Salmon Project was under the auspices of these two governments, technologies developed and personnel trained by the project were public goods and were available to what was to later become the salmon industry in Chile. This allowed salmon firms to save on the cost of investment in industrial personnel training. The Chile Foundation also played a similar role.

Between 1969 and 1989, 28 Chileans received training in Japan under the salmon project, which was implemented by JICA and its counterpart organizations in the Chilean government—firstly, SERNAP, including its predecessor, Agriculture and Livestock Service (SAG), and secondly, IFOP. The training participants to be dispatched to Japan were selected from Chilean professionals who had been assigned to the project based on an order of priority that took their assignments into consideration. What the Chilean participants learned in Japan, where the technology of seed production and fry farming was advanced, as well as in the joint project, later translated into their own specialty, which in turn proved to be of great help in establishing and developing the salmon farming industry in Chile. The Chilean fishery journal *AQUA* attracted the attention of people who had been involved in salmon farming in Chile

when it issued a 20th anniversary special issue (December 2007). The article on the aquaculture pioneers in Chile carried pictures of familiar faces who had worked in the industry for more than two decades. In all, six out of the 11 pioneers in salmon farming in Chile had received training in Japan. Of the six, five played a central role in the Japan-Chile Salmon Project over a long period.

(C) INSTITUTIONS WHICH FACILITATED THE DEVELOPMENT OF THE CHILEAN SALMON INDUSTRY

As explained above, it was important to demonstrate that the salmon business was promising and commercially viable. This was done by conducting feasibility studies and investing in the salmon business. This role was played by the Chile Foundation, and contributed greatly to the establishment of the Chilean salmon industry. In addition, the Chile Foundation's feasibility studies were partly supported by the Japan-Chile Salmon Project. Together with technology development, industrial personnel training was an important activity in this establishment phase.

It was not until the full-fledged development phase that salmon industry clusters increased their importance as an innovation system. It is worth noting here that the nascent form of that innovation system was already emerging in the establishment phase and that the Chile Foundation and the Japan-Chile Salmon Project contributed to the process. Although industrial clusters in a wider sense include research institutes and universities, Chilean universities did little in the role as components of such clusters at the beginning. The scale-up of salmon production resulted in the deepening of the division of labor, the expansion of the value chain, and the development of salmon industry clusters involving a wide range of components, including salmon farming companies and their affiliated firms, government agencies, universities, and research institutes. One of the organizations that played an important role in this context was the Chilean Association of Salmon and Trout Producers (APSTCH, today SalmónChile). The Chile Foundation again made a significant contribution here, supporting the establishment of APSTCH.

The Chilean government, its specialized entities, SERNAP and IFOP, through the Japan-Chile Salmon Project, also served as a catalyst and played a facilitating role contributing to technological development in the area of national salmon eggs production, fish diseases as well as fry farming. Furthermore, the Japan-Chile Salmon Project contributed a great deal to the establishment and enforcement of relevant laws and regulations. The Office of the Undersecretary of Fisheries of the Ministry of Agriculture, established in 1978, played the pivotal role in establishing relevant laws and regulations. SERNAP assumed the responsibility for their enforcement.

Each of these two organizations served as the counterpart organization of JICA. SERNAP, the Chilean counterpart organization for the Japan-Chile Salmon Project until 1987, has put many of the project's outcomes to good use in establishing laws and regulations concerning the aquaculture industry in Chile. For example, technical cooperation in the area of

fishery disease control has resulted in the development of regulations on the prevention of infectious disease epidemics associated with salmon and trout farming. Likewise, a Chilean Ministry of Economy ordinance issued in 1985 has imposed control on imported salmon eggs. The ordinance has also provided for the disinfection of hatcheries, among other control measures. In addition, it has prompted the veterinary check of farmed salmon, making the ordinance the starting point for salmonid infectious disease control in Chile.

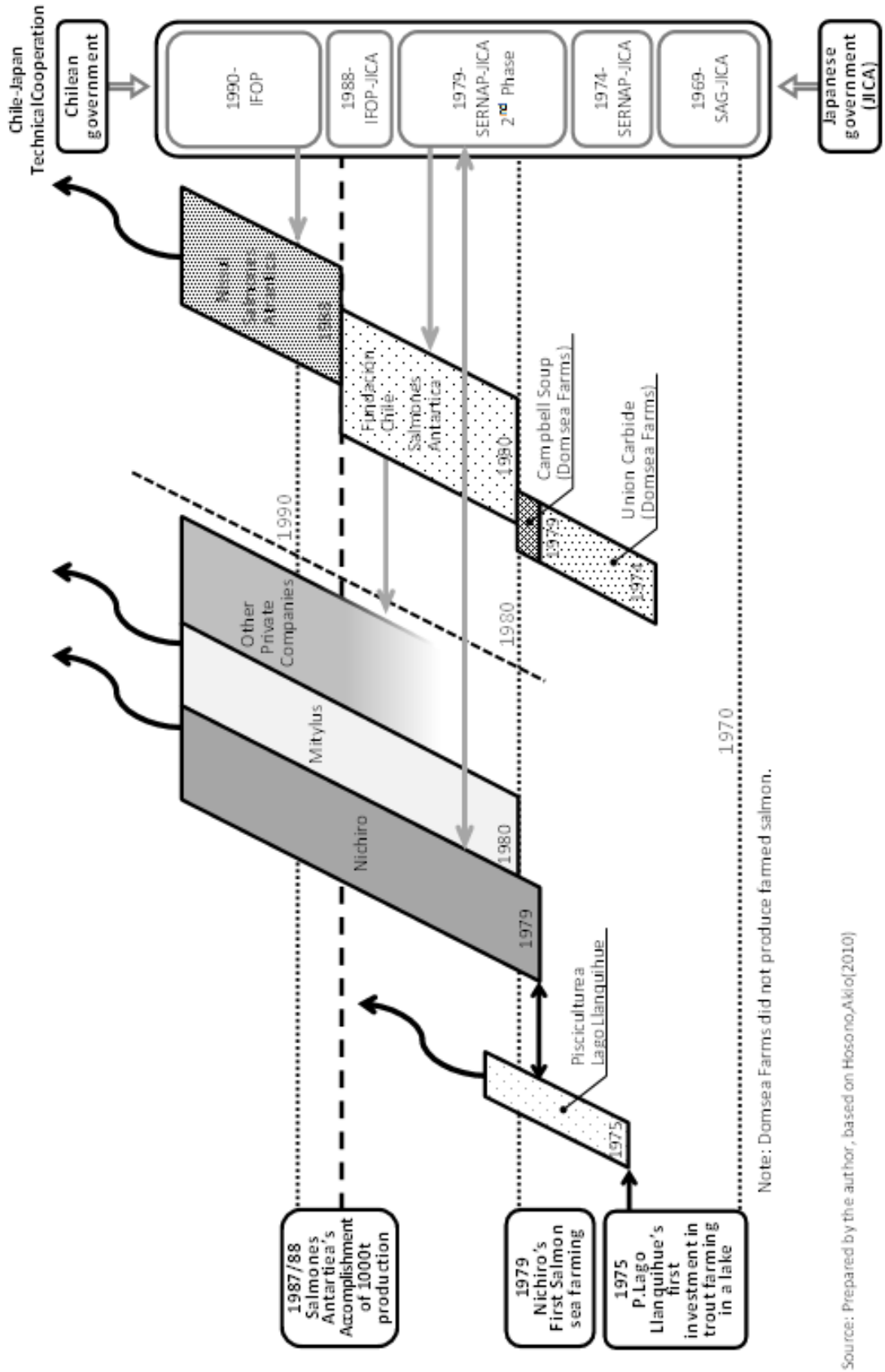


Figure 4: Pioneer Companies and Institutions of Chilean Salmon Industry

3.5. CASE 5: SINGAPORE: BECOMING ONE OF THE WORLD'S MOST COMPETITIVE COUNTRIES WITH HUMAN CAPITAL, TECHNOLOGY AND LOCATION

Singapore, a country without natural resources and with a large number of unemployed people at the time of independence, is today one of the most competitive countries in the world. The experience of Singapore is particularly relevant as a highly successful industrial development and economic transformation case regarding a small country. Its population was 2.7 million in 1985 and 4.8 million in 2008. A small country faces a different agenda to larger countries and needs to adopt different strategies.

Singapore was one of the first Southeast Asian countries to promote export-led growth rather than import-substitution-led growth. In the late 1970s, faced with rising competition from other exporters whose wage rates were lower, Singapore decided to transition from exports dependent on cheap labor into a knowledge economy based on skilled labor and higher value-added exports. During the last three decades, the country has continuously upgraded its industrial structure, overcoming the so-called middle income trap. As Yusuf and Nabeshima (2012) mention in their study on Singapore, Ireland and Finland, by the 1980s, it was becoming apparent that by betting on the technologically dynamic industrial subsectors—principally electronics, telecommunications, chemicals, and pharmaceuticals—small countries could improve their longer-term growth perspective. In this context, the rapid transformation should have demanded increasingly higher-level human resources and entrepreneurs. In many cases, in which foreign direct investment played an important role in transferring and disseminating cutting-edge technology, especially in the areas of electronics, the Internet, and biotech industries, transnational companies would not have been interested in investing in Singapore if the country did not have the human capital and knowledge base to absorb such technology.

The following section intends to get insights into how human resource development and accumulation of capabilities to address the global competition was achieved. Then, the institutions which formulated the country's development strategy and facilitated the transformation will be discussed.

(A) HUMAN RESOURCE DEVELOPMENT AND ACCUMULATION OF KNOWLEDGE AND CAPABILITIES

In the transformation process of Singapore, Yusuf and Nabeshima (2012, p.34-36) emphasize the importance of general-purpose-technologies (GPTs). They further argue: "The revolution caused by advances in semiconductors, electronics, and telecommunication technologies is widely associated with new products and the ways products are manufactured. Undoubtedly, these advances have contributed significantly to economic changes, but product innovation was powerfully reinforced by numerous collaborative innovations in other areas—for example, in services, institutions, organizations, and habits and lifestyles. GPTs have proven to be an extraordinarily potent transformative force because the learning economy generated a

cross-disciplinary matrix of supporting and intersecting innovations that enormously magnified the influence of core technologies."

Yusuf and Nabeshima (2012, p.44) highlight that in embracing technology as a driver of long-term growth, Singapore, Finland and Ireland successfully engaged in building capabilities. This success is the core of the three countries' models and resulted in the making of a networked learning and innovation system of the highest rank. The concept of such capabilities has a close similarity with that of "learning to learn", as coined by Stiglitz and cited in section 2 of this paper. He stresses that development strategies need to be focused on "learning to learn", especially in an era with fast-changing technologies, where specific knowledge learned at one moment risks rapid obsolescence.

So, how did Singapore succeeded in building such capabilities? A close look at Singapore's national initiative in increasing productivity, together with strengthening quality and later with innovation will help us to understand Singapore's experience. "The shift to a knowledge-intensive industrial structure with strong international competitiveness is only possible through the human-resource development of 2.6 million people, the only resource Singapore has," said Prime Minister Lee Kuan Yew.[18] Lee was concerned about how to organize and motivate Singapore's labor force in such a way as to make the most of plant modernization and skills development (JICA/IDCJ/IDJ 2010, p. 30). In April 1981, the Singaporean Committee on Productivity was formed by representatives of enterprises, workers' organizations, government officials, and academia. The committee reviewed the experiences of productivity movements in Japan, another country without natural resources but with abundant labor. It then presented a report to the president of the National Productivity Board (NPB) of Singapore. NPB was designated as the main body for promoting productivity development in Singapore. In June 1983, the Singapore Productivity Development Project (SPDP) was launched with the support of the Japanese government.

Some 15,000 Singaporean engineers, managers, and other professionals participated in the project. Two hundred engineers, managers, and other professionals from Singapore took part in training courses in Japan. More than 200 Japanese experts were dispatched to Singapore. More than 100 textbooks and other training materials were prepared specifically for the project. During the period of SPDP and beyond, labor productivity in manufacturing industries improved by an annual average rate of 5.7 percent (1981-86), 3.0 percent (1986-91), and 4.8 percent (1991-96).[19]

In 1990, when SPDP ended, 90 percent of workers in the country were involved in productivity development activities, compared with 54 percent in 1986. In 2001, 13 percent of the total labor force was participating in quality-control circles, in comparison with 0.4 percent in 1983, when SPDP started. Quality control circles are considered the most effective vehicle for

[18] Remarks made by the prime minister when he visited Kohei Goshi, honorary president of Japan Productivity Center in June 1981. Japan Productivity Organization (1990, p. 1).

[19] The figures and those of the following paragraph are from JICA/IDCJ/IDJ (2010) p.16 and p.22.

improving quality and productivity with the active participation of workers. Through this participatory approach, workers' ideas are incorporated into the production process with innovative solutions. Hence, SPDP became one of the driving forces for productivity gains in Singapore.

NPB's activities gathered considerable momentum, progressing from the awareness stage (1982-85), in which it created widespread awareness of productivity among companies and the workforce, to the action stage (1986-88), when it translated awareness into specific programs to improve productivity in the workplace, and then to the follow-up stage (1988 to the present), in which it encouraged ownership of the productivity movement (Ohno and Kitaw 2011, and Ohno 2013). The NPB was merged with the Singapore Institute of Standards and Industrial Research in 1996 to create the Productivity and Standards Board (PSB), bringing together the soft skills and the technical aspects of productivity. The PSB was later strengthened and reorganized into the Standards, Productivity and Innovation Board (SPRING) in 2002.

NPB, PSB, and now SPRING became global centers of excellence in the field of productivity, quality, standards, and innovation. Other key factors that bolstered these institutions include the transition from a public-sector-led entity to a private-sector-led entity, active advocacy and publicity, human resource development inside and outside the institution, and the establishment of a skills development fund by the government. Singapore's productivity initiative was strongly encouraged by the country's senior leaders, especially Prime Minister Lee. He understood the need for institution building and the need to promote creativity and the capacity to innovate in order to sustain growth for Singaporeans.

Here, it should be particularly emphasized that the above-mentioned process enhanced capabilities of both individuals and organizations. Ohno (2013, p.190) reiterates that a nationwide productivity drive requires a paradigm shift and a mindset change and that it requires the establishment of an attitude by which all people strive for and acquire the habit of improvement, as well as systems and practices that translate such an attitude into action. He further emphasizes that a new way of thinking, living, and working must be firmly built in the minds and actions of all leaders and actors and highlights the importance of strong political commitment from the top and strong organizational backup (*Ibid.* p.190).

(B) INSTITUTIONS THAT ENABLED THE PROCESS OF TRANSFORMATION

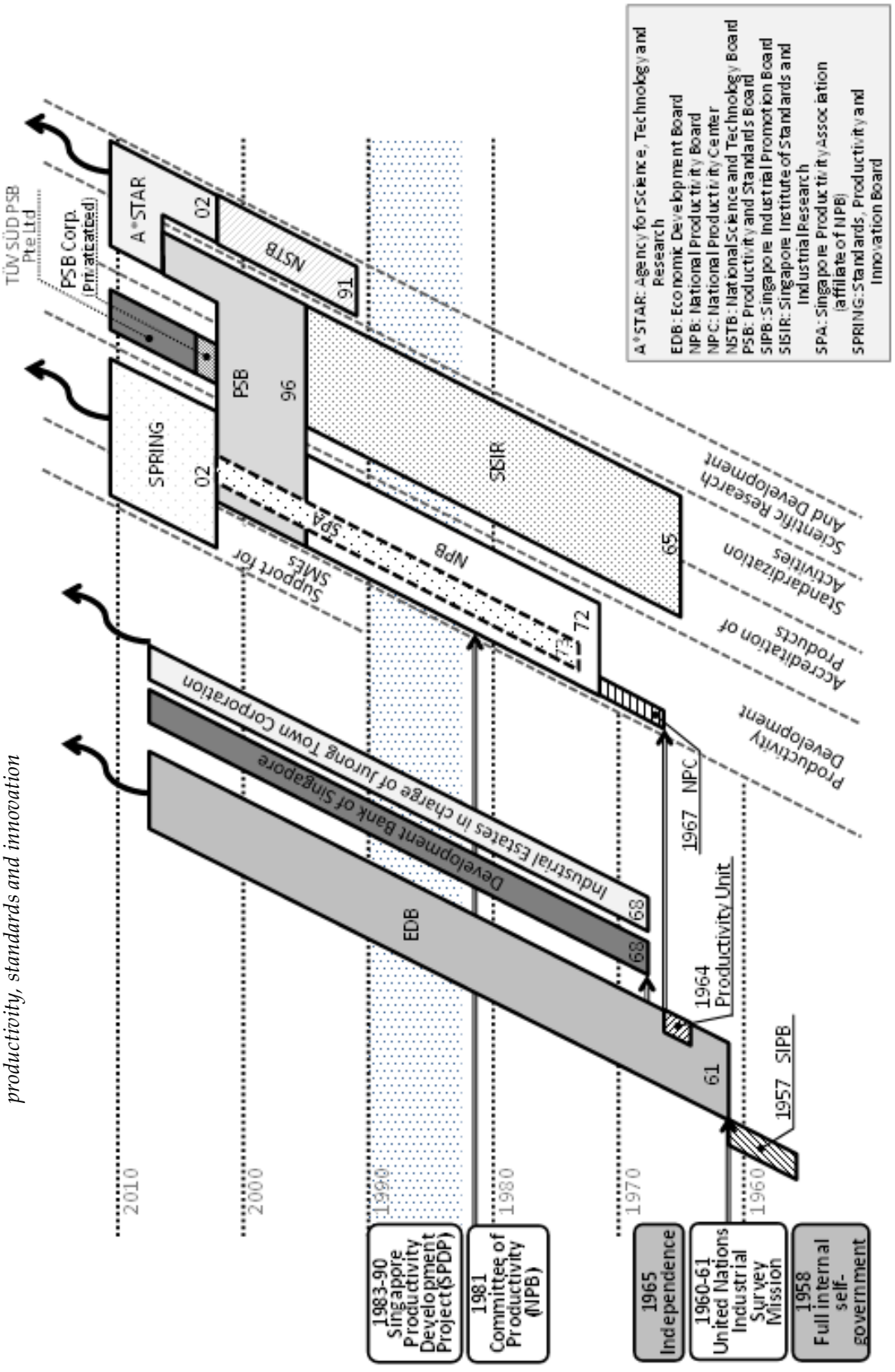
In Singapore, its Economic Development Board (EDB) was a single agency with the task of delivering the key elements of a growth strategy (Yusuf and Nabeshima 2012, p.105). It was established in 1961 with the original goals and organizational structure as spelled out in its first annual report: "The primary function of the Board is to promote the establishment of new industries in Singapore and to accelerate the growth of existing ones" (cited by Schein 2001, p.38). Schein, who described the culture of EDB as "strategic pragmatism" based on an extensive study of EDB, summarizes that Singapore displayed a remarkable adaptive and learning capability without, however, sacrificing short-term problem solving (*Ibid.* p.57-58).

Ohno points out that EDB is a business-friendly, one-stop agency for domestic and foreign investors (Ohno 2013, p.172). EDB, in attracting FDI in priority sectors, uses both broad-based approaches and targeted approaches (*Ibid.* p.172-173). Holding first position among more than 180 countries in the World Bank Doing Business Reports for five consecutive years, EDB also engages in individual negotiations with foreign companies to offer company-specific support and incentives in what is called the "Queen Bee" approach.

Kuruvilla and Chua (2000, p. 40-41) considers the following, among others, to be the major reasons behind Singapore's remarkable success in upgrading workforce skills: General linkage between economic development needs and skill formation/development facilitated by an institutional structure that places the EDB at the center of the efforts with responsibility for both areas; EDB's model of technological transfer linking FDI to skills development as well as of joint government-private sector operation for skill training; and educational reform for long-term skills development.

In the area of productivity, quality, standards and innovation, NPB, PSB and now SPRING, played a crucial role in mainstream cross-cutting general purpose technologies (GPTs) in Singapore's industrial development and economic transformation.

Furthermore, the provision of infrastructure for industrial development by Jurong Town Corporation (JTC) as the principal statutory board for industrial development cannot be overemphasized.



Source: Prepared by the author, based on JICA/IDCJ/IDC (2010), Ohno, Izumi and Daniel Kitaw (2011)

Figure 5: Major institutions of Singapore in areas of economic development, productivity, standards and innovation

It is

seen as a strategic developer of cutting-edge industrial spaces bringing forth new paradigms in industrial planning and urban design (Kaushik 2012, p.13). It now aims at strategic clustering and innovation providing new estates, new cluster hubs, new paradigms, new land creation and eco-sustainability.

Figure 5 illustrates roughly the development of institutions in Singapore responsible for economic development, productivity, standards and innovation, as well as infrastructure provision.

4. CONCLUDING REMARKS: FINDINGS FROM CASE STUDIES

The five cases show how distinctive critical factors identified by several recent studies interact in practice. Learning and accumulation of knowledge and capabilities are essential. The process is gradual, incremental and, generally, path-dependent. It is also vital for changing the endowments to attain dynamic comparative advantage. In most of the cases, the government or public institutions facilitated the process. In Thailand, Bangladesh and Singapore, the constant improvement of the capabilities of those involved in the new industries was crucial.

Change of endowments is also attained by infrastructure construction and technological innovation. They often trigger or accelerate industrial development and transformation. The Eastern Seaboard was crucial for the expansion of the automobile industry in Thailand, which eventually enabled the country to be labeled the "Detroit of Asia". In Bangladesh, construction of more efficient transport and logistics infrastructure facilitated and accelerated the process of transformation via the garments industry. In Brazil, technological breakthroughs changed the endowments and comparative advantage of the country and, together with institutional innovations, triggered the transformation of Cerrado from barren land into one of the most productive agricultural regions in the world. In Chile, technological adaptation and development changed the endowments. But in all these cases, industrial development and economic transformation could not have happened without constant development of capabilities and knowledge through learning. In Singapore, "learning to learn" was a key factor in the country's rapid and profound transformation.

In all five cases, effective institutions accomplished the role of facilitator or catalyzer of transformation. First of all, many of them had been created for specific purposes and embodied long-term vision and sense of mission. Second, most of these institutions regarded public-private interaction, consultation or coordination to be of the highest priority: this was demonstrated in the cases of Thai automobile industry, Brazilian Agricultural Research Cooperation, Bangladesh's garment industry, Chilean Foundation, and Singapore's Economic Development Board, and Standard, Productivity and Innovation Board. Third, most of these institutions adapted flexibly to changes in the global market and phases of industrial development.

These findings generally confirm the conclusion of JICA/JBIC (2008) regarding factors of economic growth found in the Asian experience. They are the mid-to long-term vision for development and strategies, flexibility in responding to a changing environment, and

government's close ties with the private sector, harnessing the private sector's capacity to the maximum.

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