Chapter 7

Changing Resource-Based Manufacturing Industry: The Case of the Rubber Industry in Malaysia and Thailand

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Over more than fifty years, the economies of Malaysia and Thailand had relatively high average growth rates that allowed them to move from low-income to upper middle-income status. They were dealt a big blow, however, by the 1997/98 financial crisis. Although their gains from the previous growth were not completely erased by the crisis, neither country ever fully recovered from the adverse impacts. They have since been thought to have fallen into the “middle-income trap,” given their extended period of “dangling in middle status” and a decline in productivity growth (Agenor et al. 2012; Felipe et al. 2012; Aiyar et al. 2012).

In a review of previous studies of the middle-income trap, Doner (2016) suggested that moving beyond middle-income status, among others, requires industrial upgrading from input-based to innovation-based production (of goods and services) to raise value added and to achieve higher efficiency in exports (in terms of price, quality, and delivery). In contrast to highly industrialized economies, however, emerging countries typically have a low level or even absence of technological capabilities for this kind of transformation (Bell and Pavitt 1995; Bell and Figueiredo 2012). Latecomers in manufacturing have to learn basic knowledge and technology before moving toward technological upgrading. To avoid the middle-income trap, it has been argued, three related factors are essential: policies to improve education, infrastructure, and research and development (R&D) (Agenor et al. 2012); institutional strength to support “national innovation systems” composed of local firms, private sector associations, government agencies, and academic institutions (Harrison and Rodrigues-Clare 2010); and close business-government collaboration (Doner and Schneider 2016). However, these factors are not easily available in the middle-income countries. Not only do they require specialized information, efficient cost management, and the participation of various actors, but they may also be hampered by conflicts between old and new interest groups (Aoki 2014; Doner 2016).

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In Southeast Asian economies, a large part of rapid growth has often been attributed to the development of the manufacturing industries, especially foreign direct investment (FDI)-led export-oriented industries. Even so, the contributions of local production of natural resources and resource-based industrial goods should not be underestimated (Khoo and Tsunekawa 2017). The economic growth of many Southeast Asian countries was historically based on natural resources including rubber, oil palm, and rice. These and other commodities still make important contributions to the national economy despite the expanded importance of the export of machinery and equipment.

The purpose of this chapter is to explore the development potential of resource production and resource-based manufacturing industries by focusing on the rubber industry in Malaysia and Thailand. These two countries have been leaders in the production of natural rubber (NR) since the 20th century. After the 1997/98 crisis, the production and export of NR-based products grew in both countries.

However, the timing and sectoral composition in the development of the rubber industry are different in the two countries. Malaysia pioneered the production of raw rubber (the upstream segment of the rubber industry) and intermediate goods (the midstream segment), but its upstream production declined after the 1970s. In contrast, raw rubber production sharply expanded in Thailand, surpassing Malaysia in both production and export by the early 1990s. The development of the downstream segment also contrasts between the two countries. In Malaysia, local manufacturing firms entered the export market of rubber products in the 1980s mainly as original equipment manufacturer (OEM) for foreign customers. In the next decades, some of the local firms achieved key technological innovations in downstream activities and became market leaders in rubber products such as disposable medical gloves. In contrast, Thailand's downstream segment was dominated by foreign tire makers. Only recently has Thailand seen the emergence of young innovative entrepreneurs who attempt to emulate the success of their Malaysian counterparts.

After looking at the outlook of the rubber industry in the two countries, Sects. 7.2 and 7.3 will trace the development of the NR production and rubber-based manufacturing industries in Malaysia and Thailand, respectively. These sections will elucidate the reasons for the different timing and sectoral composition in the development of the rubber sector of the two countries. It will become clear that in spite of such differences, the two countries share a development pattern in one important respect: The public sector played a crucial role in the development of the upstream segment, while the successful development of the downstream segment largely depends on innovative activities of private entrepreneurs to explore niche international markets for specialized rubber products.

As just a short note, the use of the term “resource processing” in this chapter slightly differs from its use in Chap. 1. Chapter 1 treats both the midstream and downstream segments as resource processing industries. This chapter distinguishes the downstream segment from the midstream segment and calls the former the “rubber-based manufacturing industry.” This is to suggest that rubber-based manufacturing production can be regarded as well-established to lead technological upgrading in a middle-income country.

7.1 Outlook of the Rubber Industry in Malaysia and Thailand

The first rubber plantations were established in Malaya in 1896, and rubber cultivation expanded thereafter in Southeast Asia, especially Malaysia and Indonesia, due to the global demand for automotive tires. For some time after the Second World War, the consumption of NR declined due to its growing substitution by synthetic rubber (SR) produced from petroleum.¹ Since the 1980s, however, “oil shocks” and high crude oil prices, reassessments of the qualities of NR, and the use of the radial tire were combined to reverse the declining trend in global NR consumption.

More recent global developments altered the structure of world demand for rubber. Rapid industrialization and urbanization in Southeast Asia since the 1990s, as well as the economic growth of China and India, boosted the demand for rubber in the manufacturing of tires and other industrial goods. From the late 20th century, moreover, awareness of the risks of HIV/AIDS, SARS, and avian influenza, as well as advances in medical technologies, raised the demand for medical examination gloves and condoms (Kano 2014; Kawano 2017). The world’s NR consumption increased from 5.4 million tons in 1993, to 8.7 million tons in 2005, to 12.15 million tons in 2015 (IRSG various years).² Malaysia and Thailand’s rubber industries took advantage of the rising global demand of NR, but in different ways.

Whereas Malaysia was the world’s largest producer and exporter of natural rubber for much of the 20th century, it was only the sixth largest producer and exporter in 2015. In contrast, Thailand is now the largest producer and exporter, followed by Indonesia, Vietnam, China, and India.

In 2015, NR exports from Thailand and Malaysia were valued at \$4,977 million and \$871 million, respectively (GTA 1998–2014). Since 2011, the NR export value has actually declined significantly following the decrease in the international price. However, the export quantity increased in Thailand, which indicates that the demand for NR continues to be solid. Furthermore, Malaysia and Thailand have seen the development of rubber-based manufacturing industries. Malaysia even succeeded in manufacturing high value-added products.

Figure 7.1 shows Malaysia’s exports of NR and rubber-based manufactured products from 1998 to 2013. The left axis indicates the export value of NR (raw rubber and processed rubber products such as technically specified rubber, ribbed smoked sheets, and latex concentrate). The right axis indicates the export value of gloves and other latex products, tires, and other manufactured products. Exports of gloves and other latex products have increased to a great extent, but the tire production has been stagnant, reflecting the failure of the national car project. In contrast, local private firms responded successfully to the new market opportunity opened by the

¹NR includes raw rubber and partially processed intermediate products.

²The main uses of NR and SR are as follows: tires (76%), industrial rubber manufactured goods (12%), and latex products including surgical rubber gloves, medical catheters, and condoms (12%) (IRSG various years).

Fig. 7.1 Export of NR and rubber-based manufactured products in Malaysia, 1998–2013 (million \$). *Note* “Tire” excludes retread tire; the latter is included in “Other manufactured goods.” *Source* Constructed by the author from GTA (1998–2014)

spread of the HIV/AIDS risk. Malaysia today has a 63% share of the world market for examination gloves.

Figure 7.2 indicates that Thailand’s export value of NR exceeded Malaysia’s by the end of the 1990s. Thailand also saw the development of rubber-based manufacturing. Different from Malaysia, however, Thai rubber manufacturing has been led by the tire industry, in which large foreign firms are dominant.

7.2 Development of the Rubber Industry in Malaysia

To understand the development potential of the rubber industry in Malaysia and Thailand, we need to consider it as being composed of various activities in the rubber-related value chain. The value chain is the full range of activities conducted during different phases of production, delivery to final consumers, and various supportive activities (technology development, building of infrastructure and capital equipment, and human resource management). The rubber-related value chain has three segments. The upstream segment involves raw rubber cultivation and harvest through tapping. The midstream segment processes raw rubber into three types of intermediate products: technically specified rubber (TSR), generally called block or standard rubber; ribbed smoked sheet (RSS); and latex concentrate. The downstream segment covers the manufacturing of diverse rubber-based products for transportation

Fig. 7.2 Export of NR and rubber-based manufactured products in Thailand, 1998–2013 (million \$). *Note* “Tire” excludes retread tire; the latter is included in “Other manufactured goods.” *Source* Constructed by the author from GTA (1998–2014)

(tires, belts), industry (plates, bearings), general use (threads, shoes), and hygiene and medical application (gloves, condoms).

7.2.1 Upstream Segment

The development of the upstream segment of the Malaysian rubber sector was greatly helped by the public sector. The technological and productive foundations of the Malaysian rubber sector were shaped by a legacy of colonial R&D, government policies for socioeconomic restructuring, and demographic/geographic conditions (relatively small population and narrow land areas). The demographic conditions partially resulted from the government policy implemented after the 1970s.

Malaysia’s R&D in the rubber industry has a long history. To upgrade the upstream segment, the Rubber Research Institute of Malaysia (RRIM, now renamed the Malaysia Rubber Board, MRB) played a central role. It was established in 1925 by the colonial government against a background of declining and fluctuating rubber price during the 1920s. Not only was rubber an important export commodity for the British Empire, but the revenues it earned were crucial for the budget of British Malaya. Before independence, the RRIM’s R&D concentrated on improving methods of cultivation, pest control, processing, and developing high-yielding clones. The RRIM established a laboratory and a library for recording data, archiving research

papers, disseminating new knowledge, and providing advice to smallholders (MRB 2000).

The most crucial goal of upstream R&D was to improve the yield of raw rubber production. Malaya developed the technology for producing high-yield clones as far back as the 1920s. The first series of clones, RRIM 600, gave an average annual field latex yield of 800 kilogram per hectare (kg/ha).

Independent Malaysia inherited a vibrant rubber sector. Its economy depended heavily on rubber (and tin) exports. The NR production accounted for just under 30% of national revenue, 30% of total employment, and 60% of total exports. In an effort to avoid “mono-culture,” and in response to competition from synthetic rubber and slumping rubber prices, Malaysia gradually diversified into oil palm cultivation (MRB 2000, 2005). However, the NR production continued to be among the most important economic activities.

After independence, the RRIM continued to develop high-yield clones and encourage their use in replanting (MRB 2000). During the 1960s, high-yield clones covered 60% of the rubber land of smallholders (Doshi 1988; Iwasa 2005). In line with the Mahathir government’s Industrial Master Plan I (IMP I) and Industrial Master Plan II (IMP II), the production of the RRIM 900 series of seeds raised the average annual latex yield to 1500 kg/ha by the 1990s. With its innovations in cloning technology, rubber R&D helped to keep the rubber industry of Malaysia ahead of its competitors (Ong 2001; MRB 2009, 2013). At the same time, the RRIM improved methods of cultivation and pest control and provided advice or training courses to planters.

The Federal Land Development Authority (FELDA) is another public institution that deeply affected the transformation of the rubber sector by its land resettlement program. The FELDA resettlement scheme aimed at reducing rural poverty by helping Malay people become independent farmers. Some of the beneficiaries of the FELDA program were engaged in the NR production and received technical assistance from the RRIM, as discussed above.³

Subsequently, however, the deep economic transformation under the New Economic Policy (NEP) brought an unexpected result to the Malaysian rubber sector. The expansion of urban manufacturing industries lured rural Malay youth away from tough and low-paying jobs for the NR production. While the influx of foreign workers dampened the rural wages (Pillai 1992; Rema Devi 1996), the NEP fostered the sense among Malays that they were entitled to better paying urban jobs (Horii 1990, 1991; Iwasa 2005). Consequently, the NR production was increasingly left in the hands of the aged population, which made the maintenance of high quality and high production difficult in Malaysia. Ironically, Malaysia faced insufficient domestic supply of NR when its successful downstream firms needed a greater amount of raw materials, as we will see below.

³However, the life of many small farmers was stressful because they had to bear financial burdens not only for living expenses during the 6–7 years before the rubber trees became available for tapping, but also for replanting costs and export taxes (Doshi 1988; Iwasa 2005). The poverty reduction proceeded slowly. Between 1970 and 1984, Malaysia’s household poverty rate was reduced from 56.7% to 20.7%.

Presently, Malaysia's raw rubber yield is no longer higher than Thailand's. Malaysia's annual average yields of 837 kg/ha in 2010 and 838 kg/ha in 2015 were considerably lower than Thailand's corresponding yields of 1,319 and 1,523 kg/ha (IRSG various years). A big gap exists between the yield produced in a research laboratory and that obtained in actual production.

7.2.2 *Midstream Segment*

It was again public institutions that crucially contributed to the technological upgrading in the midstream segment of the Malaysian rubber industry. When the SR production expanded, B. C. Sekhar, an Indian Malaysian researcher at the RRIM, who had overseen various R&D achievements since the colonial era, realized that the future of NR would depend on competition with SR on the latter's terms and in its markets. He invented a new block rubber processing to produce TSR. It took several years and global promotion efforts for the TSR to be accepted by Malaysia's major customers, especially European tire makers. By the 1970s, Dunlop, Michelin, and other European tire manufacturers accepted the Malaysian block rubber (MRB 2000, 2005).

Sekhar also took initiative in sending young scientists of diverse ethnic backgrounds to study in the United States and United Kingdom. Those scientists returned to the RRIM with cutting-edge knowledge. Later, some of them joined the private sector and contributed to its growth (Pong 2016). In addition, the RRIM's research initiatives formed an important basis for cooperation between government agencies and private firms (Interview 2). One important example is the establishment of the Malaysian Rubber Research and Development Board (MRRDB) for the purpose of public-private R&D cooperation (MRB 2007).⁴

Subsequently, R&D activities in the midstream segment became ineffective because the NEP was implemented, and its "Malay quotas" caused the departure of many non-Malay researchers from the RRIM. This "brain drain" apparently brought about a serious decline of creativity and competitiveness.

Another research institute, the Tun Abdul Razak Research Centre (TARRC), also contributed to the development of the midstream segment. This research institute had been established in England in 1938 as the British Rubber Producers' Research Association but maintained close connections with the public sector. With the Malaysian government's budgetary support, the TARRC was designated to be the RRIM's (later MRB's) global center of excellence for rubber-related science, technology, and applications (TARRC 2013; MRB 2007). The TARRC's principal work covered basic

⁴Malaysian researchers also took the lead in creating a global rubber R&D network. They were convinced that no single country could bear the entire R&D burden and that producing countries should support international rubber organizations (MRB 2009). With the spirit of international cooperation, Malaysia supplied the RRIM 600 seeds to Thailand, Vietnam, Cambodia, Myanmar, and other countries. Malaysia also supplied its new TSR processing technology to the latecomers and even permitted each recipient country to give its own name to the technology.

research for practical uses of rubber. Recently, the TARRC developed a new kind of dry rubber and supported joint R&D projects between the MRB and Malaysia's local retread tire makers to develop commercial application of the new dry rubber for the production of "Ekoperena" or "green tires" (TARRC 2013).

7.2.3 *Downstream Segment*

The downstream segment of the Malaysian rubber sector started to grow under the NEP, but its growth rate was less than the average of the manufacturing industries. It was during the period of Mahathir's promotion of heavy and chemical industries (through IMP I and IMP II) that the rubber-based manufacturing industries really took off. The IMP II, for instance, aimed at, among others, developing new production methods and new materials for industries, including tires, automobile parts, construction goods, and gloves. For this purpose, public institutions were again engaged in R&D activities; in 1998, the MRB was designated an "umbrella institution" that would integrate the RRIM and the MRRDB to conduct joint efforts for rubber R&D. However, the public research institutes could not bring good results comparable to the achievements in the upstream and midstream segments. The failure in the tire industry was especially noticeable.

Nonetheless, the spread of HIV/AIDS gave a special impetus to the RRIM's renewed efforts in rubber glove production. The boom in latex glove usage followed the HIV/AIDS epidemic of the late 1980s. The United States recommended that blood and bodily fluid transmissions be monitored and medical examination gloves be worn for barrier protection. This led to a sudden upsurge in the US import of gloves (especially disposable examination gloves) from 3.9 billion pieces in 1989 to 25.29 billion in 1998 (Ong 2004). A further boost in the usage of medical examination gloves and condoms came with the outbreaks of SARS and avian influenza.

To take advantage of the unexpected opportunities, the RRIM strengthened the upgrading effort for rubber glove R&D. This time, the TARRC joined the endeavor. Its laboratory contributed to developing basic technologies to produce thin, soft, and cheap gloves and passed them to the RRIM for the development of final marketable products (MRB 2000, 2009; TARRC 2013).

Generally speaking, large foreign firms that have abundant financial resources and an assured access to the global market are more competitive than local firms in the development of final products. However, in the case of the rubber glove, it was local entrepreneurs of Chinese descent who successfully developed and marketed high-quality gloves using the basic technologies developed by the public research institutes.

By 1990, approximately 250 rubber glove companies, including foreign enterprises mainly from Taiwan and the United States, were set up. However, the economic recession triggered by the 1997/98 financial crisis caused the number to fall to less than 100 by 2005. At least twenty Taiwanese factories and more than ten American factories ceased operations in Malaysia, primarily because of lower profit

margins due to increasing competition and weak linkages with local suppliers (Interview 2). Coincidentally, several cases of latex protein allergic reaction were reported by the Food and Drug Administration (FDA) of the United States. To respond to this problem, the US and European governments raised their licensing standards for medical latex gloves in 1997 to provide viral barrier protection and pre-empt allergic reactions to latex protein (Ong 2004). The Chinese-Malaysian entrepreneurs took advantage of the new standards to capture the global market by quickly developing allergy-free gloves.

Today, Malaysia's rubber glove industry shares 63% of the world's medical examination glove market (Nopkit 2017). This success greatly owes to technological innovation realized by Chinese-Malaysian firms, notably Top Glove and Kossan. They are the world's largest and second largest glove makers. Their R&D activities have been characterized by entrepreneurial astuteness to pursue niche advantages. In advancing from the initial to higher stages of innovative activities, Top Glove and Kossan showed similar trajectories. Both firms initially acquired basic knowledge and technology from the MRB. At the intermediate stage, they gained from public assistance in the provision of technologies of practical use (Kawano 2017). However, at the highest upgrading stage, Top Glove and Kossan relied on their own efforts to develop human resources and in-house R&D and to formulate business strategies to secure niche markets in the developing countries or low-income countries not targeted by multinational pharmaceutical companies. In these markets, Top Glove and Kossan operated as original design manufacturers (ODMs) and original brand manufacturers (OBMs). However, they remained in the OEM business to keep cordial relationships with foreign pharmaceutical customers. This is because they understood that glove manufacturing is a niche industry tied to natural resources susceptible to price fluctuations on the one hand and subject to market control by foreign pharmaceutical companies on the other. Top Glove and Kossan departed from the "catching up" strategy central to the East Asian development model; their business strategies combined catching up and reaching down to create original development styles. Their development paths indicate alternative ways of acquiring and creating the technological and managerial capacity to innovate (Kawano 2017).

The founders of Top Glove and Kossan were strong leaders who charted their firms' development trajectory amidst growing complexity and turbulence in the business environment. They had exceptional foresight, determination, and a sense of independence. Without much government assistance or the legacy of big family businesses, the two Chinese Malaysians with higher education and some business experience searched for knowledge, strategies, and solutions that allowed their firms not only to survive but to expand and progress.

Because foreign firms are not reliable in the dissemination of technological knowledge to local firms (Doner 2016), the public sector needs to help them, especially in the early stages of basic technological learning and adaptation. These stages require the mastery of basic knowledge and technology over a long period of trial and error, which requires large R&D expenditures. In the commercialization phase, however, efforts by private firms themselves become crucial. Ong Eng Long, former deputy director of the MRB, and technology advisor to Kossan, said, "Malaysia already

moved to the manufacturing segment with the decline of the NR production. Its rubber industry should create other ‘niche’ manufactured goods for a better future. Therefore, we have to consider making stronger public-private linkages and sector business associations” (Interview 2).

7.3 The Development of the Rubber Industry in Thailand

7.3.1 *Upstream Segment*

The upstream segment of the Thai rubber industry has been a great success in which the public sector has played an important role. The basic knowledge and technology of NR were learned from Malaysia; the government agrarian development policy helped overcome natural environment problems such as inadequate rainfall and soil.

The upstream segment in Thailand started to expand only in the late 1980s, much later than in Malaysia. As the only country in Southeast Asia that was never colonized, Thailand barely had any big plantations, and most of its NR production was carried out by smallholders (Barlow et al. 1994). Rice being the most important commodity in the Thai economy, neither state nor society paid much attention to rubber except in the southern region. However, when Malaysia diversified into oil palm cultivation, the Thai government foresaw an eventual shortage of rubber in the market and considered the potential for rubber cultivation in North and Northeast Thailand. An experimental plantation was set up in the Chachoengsao Rubber Research Center. The success of this plantation led the government to launch its rubber promotion policy in 1989, encouraging rubber cultivation in the North and Northeast. The first phase of this policy (1989–1996) saw the expansion of rubber cultivation by approximately 280,000 rai (44,800 ha) in the Northeast. The second phase (1997–2001) targeted an additional 200,000 rai (32,000 ha) (Fujita 2016).

Policy implementation was not effective in the first phase. However, the adverse political impact of the 1997/98 crisis gave Thaksin Shinawatra a chance to alleviate the urban-rural divide by expanding rubber cultivation as part of overall agrarian development. The Thaksin government adopted a rubber promotion policy called the “one million rai project” (especially for the North and Northeast). However, the expansion of rubber-planted areas did not really take off until after 2003.⁵ The most difficult problem was the unsuitability of the natural environment. Unlike the South, the North and Northeast of Thailand have lower rainfall, generally insufficient for *Hevea brasiliensis* (*para rubber*), the species of rubber tree that requires an annual average rainfall exceeding 1,600 mm. To overcome this obstacle, the government set up four rubber research centers, including Chachoengsao Rubber Research Center and Nong Khai Rubber Research Center in the Northeast area. These centers conducted R&D activities in experimental plantations to create new clones suitable for

⁵Presentation by Fujita, Wataru “Social Adaptation to Rubber Boom” in Consortium for Southeast Asian Studies in Asia (SEASIA) 2017, Chulalongkorn University, December 16–17, 2017.

the new planting areas in the Northeast. The original prototype clone, RRIM 600, was sourced from Malaysia. Experiments with combinations of different types of seeds took a year to produce new prototype clones and seven additional years for selective planting and testing on actual production areas (Interview 5, 6; Fujita 2016).

High-yield clones were finally developed and helped to expand rubber areas, especially in the North and Northeast. In 2014, the South still had the largest raw rubber production area, totaling about 14 million rai (or 62.9% of total rubber fields in Thailand). The Northeast region had 4.4 million rai (19.8%); the Middle (East) region had 2.6 million rai (11.8%); and the Northern region had 1.2 million rai (5.5%). The yields of raw rubber were 1,738 kg/ha in the South, 1,788 kg/ha in the Central region, 1,700 kg/ha in the Northeast, and 1,569 kg/ha in the North. This means that the productivity of the Northeast caught up with the traditional South and Central areas (OAE 2014).

Three points about the strengths in the upstream segment deserve attention. First, there has been a successful transfer from Malaysia to Thailand of basic knowledge and technology (including the methods of cultivation, pest control, processing, and the development of high-yield clones), as well as new knowledge concerning smallholders' production and replanting. Thailand was fortunate to have Malaysia, the former world leader of rubber production, as its neighbor (Kawano 2015). Second, the successful development of better clones raised yields above those of its competitors: Thailand's yield in 2011 was 1,374 kg/ha, compared with 1,140 kg/ha in India, 844 kg/ha in Vietnam, 843 kg/ha in Malaysia, and 663 kg/ha in Indonesia (IRSG various years). The key contributions were made by several government agencies. The Office of Rubber Replanting Aid Fund (ORRAF) led smallholders to replant rubber trees, and the Rubber Research Institute of Thailand (RRIT various years) developed new, high-yield clones and offered agricultural extension services (Interview 5).

On the private-sector side, the Japanese tire maker, Bridgestone, encouraged rubber processing firms to improve the quality of NR, which will be described later. The rise in the yield reflected efficiency in planting and the collection of field latex. Third, Thailand differs from Malaysia in having vast areas and a large rural labor force in the North and Northeast regions. The subsequent boom in China's NR demand emboldened planters to cultivate rubber without further support from the "one million rai project."

External demand for NR was a crucial factor in changing the structure of Thailand's rubber exports. China's makers of tires and rubber industrial goods and Malaysia's producers of gloves were the main customers of Thailand's NR. Between 1996 and 2014, China's demand for NR rose about five-fold, while Malaysia's grew 3.5 times. This new direction of NR exports offset the declining or stagnating NR export to developed countries such as the United States, Japan, and the EU (IRSG various years).

7.3.2 Midstream Segment

The technology of the midstream segment is relatively undeveloped in Thailand. It was foreign firms that provided certain opportunities for its development.

In the late 1970s, raw rubber was mainly used to produce RSS and TSR. The TSR production was based on the technology transferred from Malaysia. These two types of processed rubber are used for making tires. Traditionally, NR-producing countries tend to export to selected destinations. Malaysia's largest customer was Michelin in France, while Indonesia's largest customer was Goodyear in the United States. Most companies ignored Thailand because its RSS was of low grade (Suehiro 1989).

In this situation, Bridgestone emerged as a new customer for Thailand. Until the late 1970s, Japanese tire makers lagged behind American and European tire companies. Even as they gained a larger share of the global tire market, Japanese companies were only able to make cheaper tires using low-quality raw materials and low-level technology. However, when one of the Japanese companies, Bridgestone, relocated some of its production facilities to Thailand, it eventually brought a radical change to the Thai rubber industry. The company brought profound transformation of the production and distribution systems in Thailand that was popularly dubbed the "Bridgestone Revolution." Bridgestone introduced the process management system, skill training, new and faster container-based transportation methods, and direct NR purchase from smallholders. The production of RSS in Thailand increased, with most of the output being exported to Japan until the 1990s (Suehiro 1989).

Thanks to the successful type of export, the number of local NR processing firms increased. However, the quality of the Thai products are not of the highest grade. Although Thailand was strong in RSS production, TSR would enable easier inspection and standardization. Furthermore, the latex concentrate in Thailand is often not good enough to produce surgical gloves for medical operations, which require NR of the highest grade (Doner and Abonyi 2013; Interview 2). Compared with Malaysia, Thailand has lagged behind with respect to investment in innovation of the midstream segment.

7.3.3 Downstream Segment

The Thai rubber industry has performed fairly well in its downstream segment, as shown by the large expansion in the export of automobile tires. However, quite unlike the rise of local firms in Malaysia's glove manufacturing, the emergence of tire manufacturing in Thailand has been led by foreign firms. This difference partially accounts for Thailand's lower performance in the downstream segment in comparison with Malaysia. First of all, the number of domestic rubber manufacturing firms is relatively small in Thailand. Diverse rubber products were manufactured by no more than 216 rubber manufacturers in 2014 (RRIT various years). In contrast, a small number of foreign firms (such as the large tire producers) receive roughly

80–90% of the rubber industry's revenue. In fact, Thailand is the world's second largest producer of examination gloves, having 17% of the market (Nopkit 2017). The gloves are produced by about 45 foreign and local companies, mainly those located in Southern Thailand (T.R.I. Global 2016). Even so, foreign companies from Malaysia, China, India, and Australia operate the large facilities producing higher grade products (Interview 4). Moreover, Thai public research institutes are weak in R&D for downstream activities. Facing economic uncertainty, the rising influence of China, and stronger competition from neighboring countries, the Thai rubber industry will need to shift more clearly to high value-added rubber-based manufacturing. To do so, a broader involvement of the government and public research institutes in R&D activities will be required.

However, a new trend of public sector initiatives has emerged in the downstream segment. The increasing rubber demand from China gave the current Prayuth regime the opportunity to pursue a new development of the rubber industry by using foreign investment, especially from China. One big project is to build the Rubber City at the Southern Industrial Estate located in the Songkhla province of Southern Thailand. The land size is 1,218 rai (194 ha). It is designed to be an industrial cluster in which adequate infrastructure, services, and management assistance support the whole value chain of the rubber industry. The construction of the Rubber City is expected to be completed in 2018 (T.R.I. Global 2016; Industrial Estate Authority of Thailand 2015).

In addition, in 2015, the Songkhla University signed a memorandum of understanding (MOU) with the Qindao University of Science and Technology and the Rubber Valley Group from China to introduce joint-double degree programs focusing on learning about rubber products, particularly tires. These close connections with China and the collaboration between universities and the private sector are more abundantly available for Thailand than for Malaysia and may contribute to future development of the downstream segment of Thailand (Interview 1; Prince of Songkla University 2016).

Another important development in the rubber industry was the enhancement of R&D for higher value-added products and processes, especially in the downstream segment. The Prayuth government established the Natural Rubber Innovation Research Institute at Prince of Songkhla University in Hat Yai, Songkhla province. The Songkhla province has a long history as a center of rubber planting and trading as well as a site of foreign investment precipitated by its geographical proximity to raw material production. Based on these conditions, the Prince of Songkhla University has developed rubber technology and polymer science, and the central government selected Songkhla University as the rubber innovation research institute and gave it a big grant in 2015 to support a five-year project aiming at developing new technologies and products for practical use (Interview 1).

However, as Malaysia's experiences show, the development of globally exportable goods is not easy. Thailand may be at a crucial moment in which it is seen if Thailand remains a follower or steps forward as a global leader of rubber manufacturing.

On the other hand, a new and important corporate trend has appeared in the Thai private sector. Some of the big family business companies, especially the so-called "Five Tigers," have entered the glove manufacturing sector. They learn technology

from foreign companies or improve their methods of business management. As in Malaysia, younger generation entrepreneurs, highly educated in engineering and blessed with entrepreneurship, are leaving behind the traditional family business framework to develop the glove sector in Thailand, as the case of Sri Trang Rubber, Thailand's top processing company, shows. These entrepreneurs may be emulating the example of the Chinese-Malaysian entrepreneurs in Malaysia⁶.

Another important and interesting sign of progress may be observed in the activities of small and medium-sized enterprises (SMEs) in the glove industry. For example, Prachai Kongwaree, the CEO of Rubbermate (a rubber glove company) and the president of the Thai Glove Manufacturers' Association, said (Interview 4):

For local SME glove makers in Thailand, the way to a better future is to rely on our own strengths. We can't compete against mass production companies such as Top Glove and Kossan in Malaysia. Yet, if we can provide well-conceived 'Premium' quality or services, at their special request, to our customers, our business and life will be good enough.

In principle, such an approach is not much different from that of Malaysia's large glove companies, which conceived of glove manufacturing as a "niche industry." Thailand's SMEs might find their own niche in the provision of "premium" services.

7.4 Discussion and Implications

This chapter aimed to analyze the progress of the rubber industry in Malaysia and Thailand and explore its development potential in the future. The rubber industry is a typical resource-based industry that could be a vital factor for the future economic growth of the two countries.

The rubber industry in both countries has benefited from state involvement. In Malaysia, the state fostered high-quality R&D for all segments of the industry. It pursued the NR policy as an integral part of the rural development strategy for Malay economic advancement under the NEP. This means that the ethnically oriented affirmative action was incorporated into the upgrading of the rubber industry. However, the Malay-prioritizing measures were accompanied by unfavorable incidental results such as the shortage of a young productive labor force and the "brain drain" from the public research institutions.

In the downstream segment, the private sector played a crucial role in developing globally competitive products. It was local ethnic Chinese entrepreneurs who carved out a highly profitable niche in the glove manufacturing during times of regional and global crises. Their business strategies did not merely follow the "East Asian

⁶I have conducted field research in Thailand intermittently since 2015 and heard several interviewees (including local businessman, suppliers, and researchers in Bangkok, Southern Thailand, and Malaysia) testify that young-generation entrepreneurs are engaged in promising new activities in the Thai rubber industry. I plan to deepen my research on Thai entrepreneurs from a comparative perspective in the near future.

development model.” They created an original approach to technological upgrading and management improvement and combined the catching-up strategy with the reaching-down strategy.

In contrast, the rubber industry in Thailand is unevenly developed. In the upstream segment, Thailand rose from being a latecomer to the world’s top NR producer and exporter by taking advantage of the opportunities opened by the 1997/98 financial crisis and the expansion of China’s demand for tires and industrial rubber goods. Prime Minister Thaksin changed the traditional agrarian policy and facilitated a huge expansion of rubber cultivation through the “one million rai project.” A major contribution to this development was made by the rubber research centers whose R&D activities produced suitable clones and methods for rubber cultivation in the dry northern regions. There have been less impressive advances in the midstream and downstream segments, where Thailand remains a follower, partly because of the dominant position of foreign rubber-based manufacturers. More crucially, the remarkably large demand for NR has pushed the local rubber firms to concentrate on the upstream segment. However, the downstream segment of the Thai rubber industry may be transformed by the emerging young entrepreneurs who seem to be emulating the Chinese-Malaysian glove manufacturers.

The key findings of this chapter are fourfold. First, with different land/labor force availability and environmental conditions, each country responded to the global demand of NR through different learning processes of upgrading.

Second, although the availability of raw material (NR) at a close distance was definitely a source of the competitiveness of their rubber industry, technological upgrading was crucial to produce high value-added products. Public institutions played an important role in this respect by developing the basic knowledge and technology and providing laboratories or equipment for the standardization of the intermediate goods. In the downstream segment, private sector initiatives were crucial for the commercialization of the new technologies.

Third, dynamic entrepreneurship was important for private sector development. This chapter gives the example of the exceptionally astute ethnic Chinese entrepreneurs with high education in the glove industry.

Finally, we can obtain certain insights about the economic prospects of resource-rich countries from the experiences of the Malaysian and Thai rubber industries. The existing literature on the danger of the “middle-income trap” stresses the importance of knowledge, skills, technology, and institutions, but it tends to focus on high-tech industries in which only a few emerging states can hope to be competitive. However, as the development potential of the rubber industries in Malaysia and Thailand indicates, the standard views of technological upgrading may have overlooked an option open to resource-endowed emerging states to avoid the “middle-income trap.” That option is to seek technological upgrading and management improvement in resource-based industries such as Malaysia’s glove manufacturing and Thailand’s production and processing of NR. These sectors exploited a common source of strength—rubber as raw material—that is not usually regarded as a part of the East Asian development model. However, each rubber industry succeeded on the basis of mixed state development strategies, public and private R&D, dynamic entrepreneurship, and public-

private linkages. Even though the timing of development and sectoral strength are different in the two countries, the rubber industry in both responded innovatively to changes in the structure and direction of the global demand for NR and rubber-based manufactured goods. The result shows how resource-rich emerging states can combine their resource advantages with more accessible technological upgrading and create “niches” such as new products, services, quality, and markets.

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 Interview 2. Ong Eng Long, Director of MRPMA; formerly of Malaysian Rubber Board, 15 October and 17–18 February 2016.
 Interview 3. Pong Kai See, president, PRIM, 7 September 2016.
 Interview 4. Prachai Kongwaree, CEO of Rubbermate; president, Thai Glove Manufacturers' Association, 7 March, and 25 December 2017.
 Interview 5. Rubber Research Institute Thailand, Rubber Authority of Thailand, 26 December 2017.
 Interview 6. Rubber Research Institute Thailand, Chachoengsao Rubber Research Centre, 8 September 2014.

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