3 From Global–Local Interfaces to Local Value Added, Knowledge, and Ownership

3.1 INTRODUCTION

By definition, latecomer economies from the developing world are late entrants in the global economy and are relatively lacking in capital, skill, and technologies. Thus, they have to rely on foreign sources for these resources and capabilities in the form of FDI, licensing and importation of capital goods, and so on. Furthermore, given the lack of stable sources of export earnings and convertible currencies, competitiveness in the world export market is most vital for latecomer economies to earn the dollars to pay for imported capital goods and technologies. Because FDI firms are always ready to move to other production sites offering lower wages, and tend to become increasingly reluctant to transfer or sell technology as latecomers keep catching up, local ownership of knowledge and technologies is important in the middle-income stage or later. In this sense, the ultimate challenge for latecomer economies is how to eventually create domestic sources of innovation and economic growth.

While all the latecomer economies have been open to inviting FDI for their development, they have found it hard to take advantage of FDI to bring up indigenous capabilities in production and innovation. Marin and Bell (2006) observe that the spillover effect of FDI does not occur if host countries do not focus on the linkages between FDI and the domestic economy. While Taiwan has been seen to rely more on MNCs than South Korea, the success of the Taiwanese catch-up is also supported by the eventual rise of indigenous firms (Amsden & Chu, 2003).

These observations are consistent with the so-called "in–out–in again" hypothesis (Lee et al., 2018), so that while latecomers are

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to be open to GVCs by inviting FDI or MNCs at an early stage of development, they have to create locally owned production and innovation capabilities and thereby increase domestic value added and reduce the backward linkage to GVCs (share of foreign value added in gross exports); then, at the final stage with enhanced local capabilities, they may be open or engage with more GVCs again.

If this dimension of the global–local interfaces is wrongly managed, latecomers often fall into the liberalization trap where local capabilities fail to grow after international liberalization but MNCs become and remain dominant in local economies (Bresser-Pereira et al., 2020). The worst consequence of this trap is premature deindustrialization which often leads to an MIT. Thus, one important argument in this book is that managing the global–local interfaces is a key determinant of building up the technological capabilities and long-term success of latecomer economies. This chapter will elaborate the importance of local value added, knowledge, and ownership, drawing upon several cases, such as resource sectors in Chile and Malaysia (Lebdioui et al., 2021), the auto sectors in four countries (Lee, Qu, & Mao, 2021), and three regions specializing in the same IT sector in Asia (Kim & Lee, 2022). Although the cases in the three sections are originally based on a separate regional, sectoral, or national innovation system perspective, they will be reinterpreted in terms of a new focus on the global–local interfaces and the roles of local ownership and knowledge.

First, section two will elaborate on how local sources of innovation and value added have been created to serve as new engines of export and growth in several resource sectors in Chile and Malaysia (Lebdioui et al., 2021), using the GVC framework. As mentioned in the last section (Section 2.6) of the preceding chapter, these resource sectors are important because they show that achieving growth beyond the middle-income stage has become possible not owing to traditional manufacturing, but to the emergence of new globally competitive resource sectors as exporters. These two economies may be the first example of escaping the MIT after the early incidence

of South Korea or Taiwan. Thus, the emergence and growth of several resource sectors in Chile (wine, fruit, and wood products) and Malaysia (palm oil, rubber products, and petroleum products) as the leading export engines will be discussed to show that this success is led by the emergence and growth of locally owned firms, and that their emergence and growth did not occur spontaneously but because of policy intervention by the government.

Section three will focus on the auto sectors of Thailand, Malaysia, and China in comparison with Korea (Lee, Qu, & Mao, 2021). It will be argued that local ownership and knowledge should also be subject to global market discipline to be able to grow into competitive forces for innovation and growth. The auto sector in Malaysia led by a local brand, Proton, used to be tightly locally owned and controlled but was not export-oriented and lacked global market discipline, and eventually failed to rise. In comparison, the auto sector in Thailand has been doing fine, but is still a limited success with regard to domestic value added due to the lack of local ownership. In contrast, China's automotive sector is neither monopolized nor dominated by foreign joint ventures (JVs). Strong entries by locally owned firms since WTO membership provided fierce competition to incumbent foreign JVs. Support policies have also become more consistent and confident in the 2000s, combined with the aggressive firm-level responses of in-house technological efforts (Chu, 2011; Lee et al., 2017). Overall, China is the case most similar to South Korea in terms of local ownership and support policies, with a slight difference, in that the former relies on discipline from huge domestic markets, whereas the latter relies on discipline from global markets.

Section four discusses the three regions of Penang, Shenzhen, and Taipei in Asia (Kim & Lee, 2022), which all feature the same short CTT-based IT sector but have experienced different paths of development, such as fast catching up in Shenzhen vs. slow catching up in Penang. These deviant pathways will be explained by the various patterns of ownership of firms in the regions, such

as the emergence of strong local ownership of firms in Shenzhen vs. persistent dominancy by MNCs in Penang, besides the role of industrial policy.

3.2 GLOBAL–LOCAL INTERFACES AND INDUSTRIAL POLICY IN CHILE AND MALAYSIA

3.2.1 New Resource Sectors in Chile: Salmon, Forestry, Fruit, and Wine

Section 3.6 in the preceding chapter observes that Chile has been achieving growth beyond the middle-income stage, not owing to the mining sector, but to the emergence of new globally competitive tradable sectors such as salmon, fruit, wine, and forestry. Regarding the growth of these sectors, first, they have not grown naturally and gradually by market forces but are promoted by public intervention, in particular by long-term investments in each of these sectors (Lebdioui, 2019b, 2020; Pietrobelli, 1998). For example, the comparative advantage Chile developed in the salmon and fresh fruit industries was not natural, but instead was acquired through the planned cultivation and accumulation of human capital, technology, and learning, combined with favorable natural endowments. Second, foreign knowledge that was transferred in various modes and further cultivated and developed in the local context played an important role. Third, there was the eventual emergence of local ownership of firms in these sectors, although there were more FDI firms than locally owned firms at the initial stage.

A brief explanation of these three points is provided as follows, relying upon Lebdioui et al (2021) and others.

First, **salmon** was not in the seas near Chile but was cultivated through a series of efforts since 1969 (first through the Japan–Chile Salmon Project) and has been more successful since the 1980s with efforts by Fundación Chile (FCh). It stepped in to acquire Domsea Farms, transfer technology from Norway to Chile, and experiment with the farming of various salmon species under different

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conditions to identify ways to make salmon farming commercially viable. Salmones Antártica, the company created by FCh, reached production levels of around 1,000 tons by 1988 and transmitted a clear message to potential entrepreneurs that the salmon industry was indeed profitable (Lebdioui, 2019a). The experience of this company was then copied by nascent firms, which increased in number from around four in 1980 to 219 in 1997 (Iizuka & Gebreeyesus, 2017). The FCh has also played a key role in experimentation in new activities with latent comparative advantage, developing pioneers and then promoting their role as examples, and in technology diffusion. The FCh's mandate as a nonprofit semipublic agency enabled it to treat R&D and technology as "public goods" to be widely diffused among local entrepreneurs to stimulate emulation and reduce entry barriers to new industries (Hosono, 2016; Lebdioui, 2019a). As local capabilities developed, firms started to develop their own technologies to meet their unique challenges and environment (Hosono, 2010, 2016; Iizuka & Gebreeyesus, 2012). For example, alongside salmon farming, Chile has developed patents for salmon vaccines and biotesting, and developed quality control labs (Hosono, 2010). Currently, the salmon industry in Chile is a thoroughly internationalized activity, with the strong presence of both local and foreign firms.

Regarding the **fruit** sector, Chile has also become successful in exporting more than twenty types of new fruit, including berries, whereas it used to export mainly grapes and apples in the 1960s; these changes were made by planned action including the founding of Corporación de Fomento de la Producción (CORFO), a national production development corporation (Bravo-Ortega & Eterovic, 2015), followed by the Chile–California Program in 1965 between the Universidad de Chile and the University of California and funded by the Ford Foundation. The program entailed sending more than eighty Chilean graduate students to study agricultural economics in California in order to learn how to cultivate and export fresh fruit; the FCh also pioneered the cultivation of berries in the south of Chile, showing entrepreneurs that berry cultivation in Chile was

possible. This role of public entrepreneurship resulted in the introduction and development of a new product as well as new transversal technologies and capabilities, including cold storage systems, which are required to ensure product quality (Lebdioui, 2019a). In the fresh fruit export sector, ProChile, an export promotion agency, helped export market access, while other state agencies played an important role in the development of standards and logistics. Finally, in contrast to the widespread view that fruit cultivation in Chile has been dominated by MNCs, foreign firms only controlled about 23.6% of fresh fruit exports in 1984 and 30.5% in 1991 (Korzeniewicz et al., 1995; Lebdioui et al., 2021).

In the case of **forestry**, CORFO has subsidized investments in the planting of pinus radiata, a non-native tree, since the 1960s (Pietrobelli, 1998). In the forestry sector, technological and industrial upgrading took place as a result of subsidies for plantation activities, bans on exports of raw wood and debarked logs, as well as the attraction of investments from leading producers of wood fiber and forestry-based products (Lebdioui, 2019a, 2019b). The forestry sector is the one that the Chilean government has targeted most explicitly since the 1960s (Pietrobelli, 1998). At the time, the government made "a strategic bet on a nonexistent but potentially profitable sector," as it was known that radiata pine grew faster in certain parts of Chile than the rest of the world (Agosin et al., 2010, p. 7). Nowadays, forestry exports constitute the fourth largest exports of Chile with 9% of the total. In forestry, a majority of foreign companies carried out investments in Chile through alliances with domestic companies already established in the sector. Since the mid-1990s, foreign investment in the sector has continued to exist, but on a small scale (Borregaard et al., 2008).

In the **wine** sector, the role of the state has been key, but mostly through horizontal policies, instead of vertical ones, as in the salmon and fruit sectors (Giuliani et al., 2011). That said, while the wine sector's emergence in the export basket and its technological upgrading are mostly the result of foreign investments, it is worth noting that

Chile was already a producer in this industry at the time. Therefore, while it is a successful instance of export "discovery" favored by foreign investment, it is not a case of product discovery, as in the cases of the salmon and fruit sectors. The wine industry has constantly relied on flows of foreign oenologists and technology experts (Giuliani et al., 2011) as well as companies. In the wine sector, FDI enabled knowledge transfer related to upgrading production functions such as grape growing, wine making, and wine marketing. This favored access to distribution channels in the major markets and the improvement of the image of Chilean wine (Björk, 2005; Kunc, 2007; Kunc & Bas, 2009). Since then, over 200 globally competitive Chilean-owned firms have emerged in the wine sector, with more than USD 1 billion in exports (Pallares-Barbera et al., 2012).

In summary, public institutions and industrial policy have been key in the process of capabilities accumulation that shaped the emergence of these new industries in Chile, through R&D support, funding for technical training and human capital accumulation, regulatory and quality control for export markets, trade promotion, and technology diffusion. Owing to intervention by foreign and public agencies, one essential feature of these nascent industries is the integration of imported knowledge and technologies with local knowledge. Following this, the eventual emergence of local ownership in these new resources sectors had an influence on value addition outcomes in Chile, which became the basis for the sustained growth of exports and per capita income of the whole economy.

In contrast to these new resource sectors, copper, a traditional resource sector, was different in terms of the role of local knowledge and ownership. In the early stages of mining development, foreign-owned firms had no impact on the technological catching up among local suppliers. The situation changed with the nationalization wave in the 1970s, which led to incentives and expectations for local suppliers to collaborate with the state-owned firm, Codelco (Bravo-Ortega & Muñoz, 2015, p. 12). Codelco's vertical disintegration during the 1980s allowed local suppliers to join the supply

chains and increase their technological capabilities. However, the situation has now been reversed; foreign firms produce two-thirds of Chile's overall mining output and local suppliers still struggle to compete with foreign providers. The limited success of the mining sector in Chile is also compared with the sector in Australia where local ownership is dominant; 84% of mining suppliers in Australia are domestically owned, and have accumulated domestic capabilities to produce various technologically sophisticated inputs for mining production (Bravo-Ortega & Muñoz, 2015).

3.2.2 New Resource Sectors in Malaysia: Rubber, Palm Oil, and Petro Products

As one of the second-generation Asian tigers, Malaysia had promoted IT manufacturing or the E&E sector since as early as the 1970s, initially led by the Penang area, which served as one of the earliest manufacturing hubs for MNCs in Asia[1]. In the E&E sector, the government adopted a rather "minimalist" approach, mostly providing basic infrastructure and government services, and promoting FDI by offering tax incentives and low wages (Rasiah, 2017). The initial outcome was the successful growth of low value-added, labor-intensive, FDI-led manufacturing. However, the long-term sustainability of this strategy was not certain, because Malaysia also faced rising wage rates, while other neighboring countries were offering lower wages to attract FDI. This forced Malaysia to move into high-end goods in order to be able to afford high wages for its workers.

In the meantime, the E&E sector in Malaysia was not innovative enough to compete with high-wage innovators from the top, and, at the same time, their wages were already too high to compete with low-wage manufacturers. This is a typical symptom of the middle-income trap (World Bank, 2012), and some studies discussed this possibility with regard to Malaysia (Rasiah, 2006; Yusuf & Nabeshima, 2009). In other words, the E&E sector achieved some form of catch-up

[1] This sub-section relies heavily on this author's work, namely Lebdioui et al. (2021).

with regard to sales and capital accumulation, but not much in terms of technological innovation (Rasiah, 2006).

This situation is partly due to the fact that there was no explicit industrial policy aiming at developing indigenous technologies in the E&E sector until the 2000s. The initial objective underlying the promotion of the E&E sector was indeed employment generation. It is only since the 2000s that more efforts have been made to move domestic firms toward more value-added activities with industrial master plans, tax incentives, R&D grants, and state investments. For example, in the semiconductor segment, targeted investments in high-end activities such as chip design, wafer fabrication, and support R&D have taken place since 2005 (Rasiah, 2017). Despite recent attempts to increase local content and manufacturing value added, the results remained limited (Yean, 2015; Lebdioui, 2019b, 2020). Malaysia's shares of global high-tech exports have decreased in recent decades, and the country is losing its labor cost advantage to neighboring countries (e.g., Vietnam). In the meantime, technology diffusion and domestic linkages remain constrained by the lack of technology transfer by MNCs in Malaysia (Cherif & Hasanov, 2015; Raj-Reichert, 2020).

In summary, the mixed success of E&E can be attributed to a combination of a lack of explicit industrial policy and a critical mass of locally owned firms vis-à-vis the continuing dominance of MNCs in the sector. Again, the dominance of MNCs implies less room for state intervention and less interest in building local capabilities, suppliers, and linkages.

Thus, as pointed out in Section 2.4 of Chapter 2, the driving forces for Malaysia beyond the MIT are not traditional E&E sectors, but the resource-based sectors of petroleum, rubber, and palm oil. Resource-based manufacturing in Malaysia consists of the production and export of rubber-based products (such as latex goods and tires), petroleum-based products (such as petrochemicals, plastics, fuel, and synthetic rubber) and palm oil-based products (such as kernel cake and oleochemicals). In what follows, we elaborate on these

sectors, focusing how this success has been possible, relying upon the literature (Lebdioui, 2019a, 2020; Lebdioui et al., 2021).

First of all, it can be argued that the rise of these sectors as producers and exporters of high value-added goods seems not to have been due to free market forces, but to purposeful plans and promotion by the government, such as fiscal and R&D incentives, and quality control services (Lebdioui, 2019b). In these sectors, the role of state-owned firms has been critical, such as Petronas in the petroleum sector, or that of other public agencies, such as the Malaysian Rubber Board (MRB) in rubber, and the Federal Land Development Agency (FELDA) and Malaysian Palm Oil Board (MPOB) as a merged entity of the former Palm Oil Registration and Licensing Authority (PORLA) and Palm Oil Research Institute of Malaysia (PORIM) (Oikawa, 2016). What follows is an elaboration of each sector.

The **petroleum** sector in Malaysia was initially dominated by multinational oil companies, which remained the main providers of upstream technology in the early periods of resource exploitation, especially given the context of Malaysia's technology-demanding offshore and deep-water fields. To overcome this situation, the government of Malaysia established a state-owned enterprise, Petronas, in 1974, which became possible by proclamation of the Petroleum Development Act (PDA), and the associated Production-Sharing Contracts (PSC). The objective of the PDA was to gain greater national control over petroleum resources, to provide affordable petroleum resources to the local market to form the basis for capital- and energy-intensive industries, and to encourage production linkages in both upstream and downstream activities (Nordås et al., 2003). Petronas has also gradually developed capabilities and upgraded to higher-value activities.

The government also initiated a holistic approach to industrial policy combining local content requirements, tax incentives, skills transfer (through technical and specialized universities), and state-led investments and opportunities for learning by doing (Lebdioui, 2020). These tools have been successful in enhancing the industrial capabilities of local suppliers by allowing local firms to

benefit from more stable intra-industry relationships, exposure to best practices, and improved quality standards, as well as marketing capabilities. This holistic approach led to the accumulation of the capabilities needed for knowledge-intensive activities along the petroleum value chain.

Petronas was a key vehicle for this industrial policy drive as it ran programs such as the Petronas Vendor Development Program to promote local suppliers. Petronas' partners are required to pay it an annual research contribution, the "Research Cess," to promote joint R&D (PSC, Arts 9.1 and 9.2). Thus, the growth of local companies followed that of Petronas, and 74% of the total value of contracts in upstream activities in the petroleum sector was granted to local companies by 1995 (Tordo & Anouti, 2013). Given the key role in promoting production linkages through several initiatives, it is doubtful whether similar value addition results would have been achieved if international oil corporations controlled the sector. Petronas itself has grown into a fully integrated international oil and gas company, which operates in more than thirty countries. It is now on the list of the global Fortune 500 companies.

The plantations in both the **rubber** and **palm oil** sectors were all foreign owned since the colonial period, and there was no interest in increasing domestic value added compared to foreign value added. The largely European-controlled plantation companies preferred to export crude palm oil and did not see many gains in relocating their vegetable oil processing facilities in Malaysia. After the initial entry point into the foreign-dominated GVCs during colonial times, Malaysia broke up those foreign-led GVCs through nationalization of ownership as it executed a hostile takeover of three British palm oil and rubber plantation conglomerates listed on the London Stock Exchange by Malaysian public capital in 1981 (Lebdioui, 2019b; Oikawa, 2016). The interest in processing palm oil and natural rubber locally has increased since then. In addition, in the rubber sector, a large difference in purchasing behavior between domestic and foreign firms can be noted. Foreign-owned firms have fewer forward and

backward linkages to other manufacturers in the Malaysian economy than domestically owned firms.

Interestingly, Malaysia's efforts to stimulate industrial upgrading were met with counter-attacks from the incumbent firms. For example, Malaysia's exports of processed palm oil in the 1970s were blocked by the European common market, which practiced tariff escalation to make sure that refining capacity would remain in Europe. In order to counter the EU import duty structure, the Malaysian government had initially decided to introduce an export duty on crude palm oil. After further tariffs escalation in the EU in the 1990s from about 100% in the 1970s to more than 200% in the 1990s (Gopal, 2001), most of the market deals for Malaysian processed palm oil were signed through government-to-government partnerships under so-called barter arrangements.[2] As a result of this barter trade that enabled export markets to be secured, palm oil refining activities in Malaysia considerably increased and became the most competitive internationally within ten years, achieving both economies of scale and scope. Such upgrading into exporting processed palm oil, rather than crude oil, would not have been possible if there was no change of ownership from foreign to local. Another incentive for processed palm oil rather than crude oil was higher export taxes on crude oil and lower taxes for more processed oil, which made domestic prices of crude and processed oil deviate from the international market prices (Jomo & Rock, 1998; Oikawa, 2016).

This upgrading in the palm oil sector has been backed by increased R&D efforts, which were also led by the MPOB or PORIM before it was merged with PORLA to become the MPOB in 2000 (Oikawa, 2016). The Board or PORIM established in 1979 has been responsible for R&D on all palm oil-related activities, starting with chemistry, quality, analytical techniques, transportation and handling of palm oil products, and later expanding to R&D in oleochemicals and processed palm kernel oil, following the recommendations

[2] Barter grade is a system of trade in which participants in a transaction directly exchange goods or services for other goods and services of equivalent value without the use of money.

of the Industrial Master Plans (Oikawa, 2016).[3] Financial support for R&D from the government also targeted these activities, ranging from oleochemical byproducts to environmentally friendly cultivation and manufacturing methods. Such R&D efforts enabled firms to increase value added in existing products, as well as the introduction of new products in markets (such as biodiesel, specialty fats and vitamin A) (Rasiah & Shahrin, 2006). Government-funded R&D through the MPOB has also been conducted to stimulate innovation toward oil palm biomass, but it is too soon to assess whether those efforts will be fruitful. Indeed, while considerable ground has been covered to pursue value addition to processed palm oil and oleochemicals, further efforts are required to move toward highly sophisticated value-added palm oil-based products (such as biodiesel and specialty oleochemicals).

In the **rubber** sector, the MRB has become the world's leading authority in rubber-related R&D, and has accumulated expertise across the whole rubber value chain from cultivation to plantation management and rubber manufacturing techniques and rubber product marketing (Goldthorpe, 2015). Several Malaysian-owned firms have become world-leading producers of rubber-based products such as latex gloves and prophylactic goods, in highly competitive markets with low-cost producers (i.e., China and India) and other natural rubber producing countries (i.e., Thailand and Vietnam).

3.3 GLOBAL–LOCAL INTERFACES AND INDUSTRIAL POLICY IN AUTO SECTORS IN ASIA

The three countries of Malaysia, Thailand, and China all desired to promote their automotive industries, which are usually regarded as an important industry, with strong backward and forward linkages. They are considered latecomers given that their automotive sectors started in the post-war period or even the 1960s. Therefore,

[3] Research grants in the palm oil industry amounted to around US$565 million between 2000 and 2010 (Rasiah & Chandran, 2015).

these countries have to rely on foreign technology by either importing licensed technology or joining GVCs. Although all of them used industrial policies to increase local value added, their actual growth paths have diverged.[4] This section elaborates on these cases, relying upon my work with colleagues.[5]

A comparison of Malaysia, Thailand, and China would be of interest because they all attempted to implement local content requirements (LCRs) in their automotive sectors before they joined the WTO and later cancelled the policy, resulting in divergent outcomes.[6] Thailand has approximately fourteen automakers, but all of them are majority owned by foreign companies, especially Japanese. Although Thailand has become the largest automobile exporter among the Association of Southeast Asian Nations (ASEAN) countries, the amount of domestic value added generated is unclear, given the dominance of MNCs (Tai & Ku, 2013). This question can be answered by examining several GVC indicators (Lee, Qu, & Mao, 2021). By contrast, Malaysia has focused on establishing a local brand and is the only one that has a national brand in the ASEAN. The first Malaysian car – the Proton Saga – has successfully occupied the domestic market. However, the brand failed to compete in the international market. Thus, the question for Malaysia is why locally owned carmakers, such as Proton, have not been able to maintain that advantage, failing to increase not only the domestic value added but also the export orientation.

In contrast, the automotive sector in China now features fierce competition among foreign JVs and indigenous manufacturers, despite the initial dominance of the former, including one with Volkswagen (Chu, 2011). Indigenous automakers, such as Chery and

[4] Baldwin (2016) observed that, different from the failed "build strategy" in Malaysia, a successful case is the "join strategy" of the automotive sector in Thailand, where Japanese firms established factories in Thailand that focused on the assembly and promotion of Thai component suppliers under LCRs (pp. 250–254).

[5] This sub-section relies on this author's work, namely Lee, Qu, & Mao (2021).

[6] LCR policy is to increase local content ratio or localization rate, which is defined as the percentage of the value of domestically produced parts or components in the value of finished products (Thuy, 2008).

Geely, entered the market after China joined the WTO and rapidly captured market shares in the 2000s (Hu, 2009; Lee et al., 2017). So, the question is how China has been able to upgrade its automotive sector with domestic value added increasing remarkably over time.

3.3.1 Three Factors for Successful Upgrading

In what follows, we focus on the question of what has brought about divergent outcomes in the auto sectors of the three countries. Determining the success (or failure) conditions of industrial policy is of particular interest. Our focus is on the following three factors: ownership of target firms (local vs. foreign), market structure (discipline from market vs. entrenchment from monopoly), and firm-level effort and strategies.

First, given that LCRs are oriented toward independent industrial development imposing restrictions on foreign-made goods in a national economy, they are often compared with a liberal policy stance emphasizing the positive roles of FDI. Amsden's research (1989) is one of the early studies that emphasize the importance of promoting local ownership rather than passive reliance on FDI. Lee et al. (2017) and Lee and Lim (2001) observe that FDI can be an important channel for gaining foreign knowledge, but tends to interfere with the eventual growth of indigenous technological capabilities. These observations are based on comparable examples in the automotive sectors of China and Korea (e.g., Geely and Chery vs. Shanghai Volkswagen and First Auto Works in China; and Hyundai Motors vs. Daewoo, a JV with GM in Korea). Indigenous ownership becomes more important at a later stage because foreign firms tend to become increasingly reluctant to transfer or sell technology.[7]

[7] An example from Lee et al. (2017) is the mobile handset sector in China. To take advantage of the large market, MNCs formed various JVs with indigenous firms to produce mobile phones in China. Nevertheless, in 2001, most MNCs stopped their JV collaborations after China joined the WTO. The same occurrence was observed in Korea when Korean IC chip firms caught up with foreign firms, and the latter became increasingly reluctant to provide designs for chip production (Kim, 1997a; Lee & Lim, 2001).

Specifically, in terms of upgrading in GVCs, Lee et al. (2018) argue that national ownership is eventually necessary to build local value chains for upgrading.

Second, we determine that LCRs are effective when combined with discipline from either domestic or global markets. Aghion et al. (2015) regard competition as a precondition of an effective industrial policy, including LCRs. Greenaway (1992) also considers market structure as a key factor that affects the successful implementation of LCRs. Hao et al. (2010), in a study on the British wind power sector, state that a stable and sizable domestic market is an important factor that can determine the success of LCRs. In the case of Korea, fierce competition is observed mainly among four carmakers, Hyundai, Daewoo, Kia, and SsangYong, although foreign ownership remains limited (Lee, 2011). Furthermore, these brands have been oriented toward the global market from the beginning. Given the oligopolistic market structure protected by high tariffs during the 1970s and 1980s, certain rents are associated with such protection but are used to pay for capital investments that are required to survive in the global market (Jung & Lee, 2010); one of the key elements of industrial policy in Korea is the close linkage between export performance and privileged access to cheap loans and other support measures. The effects of such a combination of oligopolistic rents and discipline from the global market on productivity growth are confirmed by econometric studies by Jung and Lee (2010).

Third, the effectiveness of LCRs is also affected by how firms respond to such policies, along with supplementary ones. Lahiri and Ono (1998), Davies and Ellis (2007), and Hao et al. (2010) also observe that LCRs cannot be effective when implemented alone without support policies, such as other taxations and preferential loans. However, the most critical factor should be the firms' right response to these policies in the form of putting increasing effort into building their technological capabilities. One might reason that the combination of local ownership and pressure from market competition may result in firms exerting more effort for technological innovation and their

own capabilities. Therefore, we still consider additional firm-level responses and strategies as one of the three factors to be considered.

The three requirements mentioned above for a successful upgrade to GVC by industrial policy, such as LCRs, can be discussed with the Korean automotive sector as an example. Over the past fifty years, the Korean automotive industry has grown from a small auto parts supplier to a global center of automotive companies (Lee, 2011; Ravenhill, 2003). Independence in terms of ownership is considered a factor that helps Korean automotive firms achieve industrial upgrades from OEM to original brand manufacturing (OBM) (Lee & Lim, 2001). Hyundai, one of the leading Korean brand cars, chose an independent R&D strategy to develop its own engines after Mitsubishi refused to provide the engine technology. According to Ravenhill (2003), the reason why Hyundai can increase their localization rate faster than other Korean automotive producers is their explicit strategy to avoid dependence on partners and integrate licensed technology from various countries to develop its own technology, including their engine. Although Hyundai Motors was initially a JV, foreign ownership (by Mitsubishi) was limited or less than 20%, and eventually bought out by the Hyundai side. An interesting contrast can be made with the case of Daewoo, a former JV with GM with a share of 50%. In this JV, the perception of Daewoo was that GM was reluctant to transfer core technologies to Daewoo and was not willing to allow Daewoo's foreign expansion plans (Auty, 1994; Ravenhill, 2005). This experience underscores the limitation of the JV strategy without local ownership and control. A similar story of a failure involving a JV is the case of Guangzhou-Peugeot in China (Lee, Qu, & Mao, 2021).

3.3.2 Common Starts with Divergent Ends in Malaysia and Thailand

3.3.2.1 Common Starts

The automotive industries in Thailand and Malaysia began in the 1960s. Initially, both countries aimed to build their own automotive industry, thus restricting importation of CBUs (completely

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built units, namely fully assembled cars) by complicating its process, charging high import taxes, and charging lower tariffs to CKD (complete knock down) cars.[8] Given such policies, the local automotive assembly industry achieved rapid development in both countries in a short time, although the main carmakers are foreign JVs (Tai & Ku, 2013). Both countries desired to restrict foreign ownership in such JV cases to allow domestic partners to have majority ownership. In the 1980s, the direction of the two countries diverged, with Malaysia heading on a nationalist road of promoting locally owned brand cars and Thailand relying on foreign (mainly Japanese) carmakers.

In 1982, the Malaysian government declared the "National Car Project" to establish a national champion brand, Proton, through cooperation among national enterprises, the Heavy Industries Corporation of Malaysia Berhad (HICOM) and Mitsubishi Corporation. With the government's support, Proton became the leading brand in the Malaysian car market at that time (Athukorala, 2014; Wad & Govindaraju, 2011; Fujita, 1998). By contrast, Thailand took advantage of the eagerness of Japanese carmakers to establish assembly lines overseas, seeking low labor costs to offset the cost increases associated with yen appreciation after the 1985 Plaza Accord. The Thai government initiated a series of favorable tax incentives to attract Japanese investment (Tai & Ku, 2013). They also loosened the former policy of restricting foreign ownership in assembly manufacturers in the early 1990s. In 1997, the government officially cancelled the restriction of majority ownership to be held by a Thai national (Intarakumnerd & Gerdsri, 2014). Consequently, Ford, Chrysler, and GM from the United States established assembly factories in Thailand. Their suppliers of parts and components then followed. Japanese manufacturers also built new factories in Thailand in the 1990s. After

[8] Before the 1990s, the Thailand government used to charge import tariffs as high as 300% for passenger vehicles larger than 2,300 cc. Imports of passenger vehicles lower than 2,300 cc were not allowed (Natsuda & Thoburn, 2013).

several years of promotion through policies, the MNC automotive suppliers in Thailand increased to 300 manufacturers from 1987 to 2005 (Wad, 2009). Foreign ownership has taken over Thailand's domestic market not only in assembly, but also parts and supplies to a lesser degree.

3.3.3 Strong Exports with Less Domestic Value Added in Thailand

Ownership in the Thai automotive sector is basically characterized by foreign dominance in parts suppliers and final assemblers. Most of the leading firms in Thailand's automotive industry are JVs with majority shares owned by Japanese carmakers. For example, Toyota Motor Corporation holds 86.4% of Toyota Motors Thailand; Mazda Motor Corporation holds 96.1% of Mazda Sales (Thailand) and 100% of Mazda Powertrain Manufacturing (Thailand); foreign ownership also includes Nissan Thailand and Mitsubishi Thailand (Intarakumnerd & Charoenporn, 2015). By the end of 2005, sixteen car assemblers and 1,800 component suppliers could be found in Thailand. Among the assemblers, Japanese firms dominated the market with a 91% market share (Busser, 2008).

Without national carmakers to monopolize government support or the issue of entrenchment by any carmakers, foreign JVs faced the same market competition. They were also eager to enter the global market or the Southeast Asian market using Thailand as a hub. Thus, the production and export volume of Thailand became the largest among ASEAN countries (Tai & Ku, 2013). However, industry policies for domestic suppliers were not sustained in Thailand; for example, tariffs on the importation of CKD and CBU and on vehicles with various sizes increasingly declined year by year, whereas more incentives were given to foreign JVs (Tai & Ku, 2013).

Given their own need to enhance productive efficiency, Japanese carmakers attempted to train and upgrade the skills of Thai workers and to conduct more technologically sophisticated activities (Intarakumnerd & Techakanont 2016; Lee et al., 2020),

and these efforts may have translated into increasing domestic value added in the industry to a certain extent. However, given that nearly half of their suppliers were also foreign owned, the eventual influence on locally owned suppliers in terms of local value added may have been limited. For example, all the assemblers are foreign-controlled JVs, and among the 635 first-tier part suppliers, almost half are foreign JVs, while local ownership is dominant only by second- or third-tier suppliers as of the mid-2010s (Intarakumnerd & Techakanont, 2016). Thus, even though some trucks use engines locally produced by foreign JVs, their local value added must be limited.

One measure of local value added is the share of foreign value added (FVA) embodied in the gross exports of a country, which is one of the backward linkages in GVC (Banga, 2013; Koopman et al., 2014; OECD, 2017; Wang et al., 2013). The inverse of FVA serves as a measure of upgrading with regard to increasing the domestic value added, because the higher this value is, the lower the share of domestic value added will be. If we compare the FVA trend in the three countries, only China shows a decreasing period from the mid-1990s to the late 2000s, which is similar to that in the mid-1970s to 1990s in South Korea. The rapid decline to a low value like 15% implies that China is engaged in the "made in China" policy. Such a period of decreasing FVA or increasing domestic value added is not clearly observed until the 2010s in Thailand or Malaysia, except for a short period of decline from 2000 to 2003 in Malaysia.

Furthermore, the foreign partners in Thailand do not seem to have pursued globalization in terms of setting up factories abroad. This tendency is not surprising, as it also happened to GM-Daewoo in Korea; GM did not want this JV to go for globalization (Lee & Lim, 2001). This is why Thailand has ended up showing low values of the share of domestic value added embodied in foreign exports as a share of the gross exports of a foreign country (hereafter, DVAFXSH), which is a measure of forward linkages in GVC and of upgrading

the capabilities and competitiveness of intermediate goods (parts and components); higher values of this ratio indicate higher competitiveness of a country's intermediate parts and components in international markets.

3.3.4 National Ownership without Discipline in Malaysia

With regard to ownership, the National Car Project in Malaysia resulted in two national car brands, Proton and Perodua, with majority equities of 70% and 68%, respectively, although their Japanese partners Mitsubishi and Daihatsu owned 30% and 32% of the equity shares, respectively (Athukorala, 2014; Wad & Govindaraju, 2011). In 2004, Proton became a fully Malaysian-owned company when Mitsubishi sold its stake to Khazanah National BHD (the government's investment arm).

To support the growth of the two national carmakers, various policies have been implemented. First, tariffs on CKD kits for national vehicles were exempted to lower the price of national vehicles (Athukorala, 2014; Tai & Ku, 2013). Second, the "Vendor Development Program" was also implemented to boost the development of local SME parts suppliers. Through this program, the parts manufacturers of national cars were provided with production subsidies, which allowed their parts prices to decrease by 10–12%. The number of parts suppliers of Proton increased rapidly from 17 in 1985 to 186 in 1999 (Tai & Ku, 2013).

However, the Malaysian automotive industry lacked competition in the domestic market, and no effort was exerted to export to the global market. The government has forbidden other manufacturers to produce models that could result in direct competition with Proton (Athukorala, 2014; Tai & Ku, 2013). Even the other national carmaker, Perodua, was only allowed to produce cars with an engine capacity of less than 1,000 cc (Athukorala, 2014), despite enjoying the same tariff concessions, tax relief, and other government supports as Proton (Athukorala, 2014).

Before national cars appeared, Toyota and Nissan dominated the Malaysian market. Proton seized the market in an extremely short time with the help of a series of discriminatory policies, occupying an 80% share of vehicles under the 1,500 cc range by 1987 (Nizamuddin, 2008). In 1991, the Malaysian government made a partial reform to reduce the restrictions of the automotive industry, which allowed new entrants, such as Hyundai, Citroen, Rover, and other international car manufacturers into the Malaysian market. By the mid-2000s, despite having fifteen car manufacturers in Malaysia, the major market share remained occupied by the two national carmakers (Wad & Govindaraju, 2011). The two national carmakers thus faced no discipline in the market to upgrade their innovation capabilities, such as the localization of engines and other key parts, as indicated by the high FVA ratio. Furthermore, they did not compete for the larger markets of other countries, which prevented them from achieving economy of scale and from enjoying the discipline from global markets. These firms should have devoted the financial resources from near-monopoly profits to upgrading their technological capabilities to produce their own engines, which did not actually occur.

Eventually, after Malaysia joined the WTO and abolished LCRs in 2004, the dominance of national carmakers weakened steadily over time, and they failed to enter the global market (Tai & Ku, 2013). Proton's market share declined after high-quality models produced by Japanese manufacturers with lower prices were launched in Malaysia (Wad, 2009). National carmakers were not ready to compete with foreign carmakers once the market was open because they lacked technological capabilities. Given its ever-weakening performance, Proton has become a problem for Malaysia. As a solution, it was sold to DRB-HICOM Berhad in Malaysia in 2012. In 2017, DRB-HICOM transferred its 49.9% stake to Geely, a rising Chinese carmaker that also acquired Volvo.[9]

[9] Source: www.thestar.com.my/business/business-news/2017/05/24/drb-hicom-to-sell-49pt9pct-in-proton-to-geely-holding/

3.3.5 Ownership, Competition, and Policies in China

3.3.5.1 Mixed Outcome or Even Failure with JVs in the Early Period

China's automotive industry started earlier than those of Malaysia and Thailand. Before the 1960s, the country had five assemblers with an annual production capacity of 60,000 vehicles. China also intended to build its own automotive industry despite its low level of technology (Yu et al., 2008). This situation led to a change in policy in the 1980s toward inviting foreign JVs with the expectation of technology transfer from the so-called "market for technology," which was also applied to other industries, such as telecommunication equipment (Mu & Lee, 2005). One of the first JVs was the Beijing Jeep Company, signed in 1983, followed by Shanghai Auto Industry Corporation (SAIC)-VW (SVW) in 1984 and Guangzhou-Peugeot in 1985, while more came in the 1990s.[10] In 1988, the government proposed a strategy of supporting three majors and three minors among JVs. With this series of JV agreements, the production of automobiles increased rapidly as new brands were launched, given no competing locally owned brands (Wang, 2007). In these JVs, the cap of foreign ownership was regulated to be 50% or less (Liu et al., 2014) and they were also requested to establish R&D centers (Yu et al., 2008).

However, this strategy of relying on FDI or JV did not lead to the expected outcome in terms of technology transfer and eventual enhancement of technological capabilities of automakers in China (Chu, 2011). In the early efforts, the size of the country was not considerably an advantage; rather, it was a source of information and coordination failure associated with complex politics involving the central and local government that resulted in difficulty in conducting

[10] The 1990s saw a joint venture agreement between SAIC and GM in 1997, followed by Guangzhou-Honda (1998), Tianjin-Faw-Toyota (2000), Changan-Ford (2001), Beijing-Hyundai (2002), Brilliance-BMW (2002), and Dongfeng-Nissan (2002); the Chinese auto market became a global battlefield (Chu, 2011).

Japan- or Korea-style centralized industrial policy (Brandt & Thun, 2010; Huang, 2002; Thun, 2004; Thun, 2006).[11]

Although the central government attempted to achieve economy of scale by limiting the number of automakers (e.g., the so-called three majors and three minors policy) in the nation, provincial governments often circumvented such regulations and actually allowed entries by local or foreign JV firms. Thus, China ended up with more than 110 car assemblers, with about half being foreign JVs (Chu, 2011). The problem in the auto sector in China has been summarized as "outdated products, high prices, and no R&D capabilities," and "too many production sites, indiscreet project approval, redundant investment, and slow localization" (Chu, 2011). In particular, a policy by the central government that allowed only state firms to form JVs with foreign firms is responsible for the situation where each JV adapted an old mid-market design from the foreign partner and concentrated on fulfilling government-mandated localization requirements, rather than trying to develop their own engines (Thun, 2018).

Guangzhou-Peugeot Automobile Company (GPAC) is a representative case as one of the first foreign–Chinese JVs to fail in China. It was established in 1985 as a JV between Peugeot and the Guangzhou Automobile Group. After some success until 1992, sales plummeted due to low competitiveness, and total losses reached RMB 10.5 billion before it was closed in March 1997 (Lassere & Zeng, 2002). Peugeot was unwilling to promote local value chains but kept relying on imported parts, which ultimately raised the final cost of the products (Harwit, 1994). The reliance on CKD kits caused

[11] The size of domestic market can be a strong source of bargaining power in dealing with foreign companies about technology transfer negotiation; however, this does not imply that it is actually used as such unless the local government has an effective plan and will to promote the local industry. Thus, the so-called "trading market for technology" idea is used effectively in the case of the telecommunication switch development, which is not the case in the auto sector. Local government failed to provide an effective coordination to promote a parts supplier network until the 2000s (Chu, 2011).

troubles. For example, production stopped for more than two months in late 1986 when Peugeot and the Chinese company could not agree on the prices the JV should pay for the CKD kits (Harwit, 1994; Peng, 2000). Although the Guangzhou area lacked high-quality parts suppliers, officials there prohibited the purchase of high-quality parts at a low price from suppliers in other areas of China. Instead of using profits to upgrade their products, GPAC had an extremely high dividend payout ratio (Sun et al., 2010); thus, the Chinese side believed that Peugeot focused on obtaining short-term profits from selling CKD kits without facilitating localization.

3.3.5.2 Success with Indigenous Ownership since the Mid-2000s

Only after China joined the WTO in 2001 were locally owned carmakers allowed to enter the market (Lee et al., 2017; Zhao, 2013), causing a rise in competition. Before 2000, JVs dominated the Chinese market (Tian et al., 2010). Since then, locally owned manufacturers, such as Great Wall, Chery, and Geely, rapidly emerged and continued to increase in market share, reaching 30% in 2009 (Tian et al., 2010). In passenger cars, shares by indigenous brands already reached approximately 40% in the 2000s, and for sport utility vehicles, seven of the top ten best-selling models in 2015 were produced by indigenous firms (Lee et al., 2017).

These new companies pursued slightly different strategies from those of foreign JVs in building technological capabilities and acquiring foreign technology. They conducted in-house R&D activities, filing more patents than foreign JVs, and relied on active licensing and international mergers and acquisitions (M&As). For example, Chery bought the used assembly line of the SEAT company (a Volkswagen subsidiary in Spain) and the engine factory of the Ford company based in England in 1997 (Lee et al., 2009). With the imported assembly line, they recruited engineers from foreign JVs; the CEO of Chery (Tongyao Yin) used to be a manager in First Automotive Works-VW (FAW-VW), and more than 100 engineers left FAW-VW to join Chery.

Moreover, thirteen key engineers from Dongfeng-Nissan joined the development team for the popular Tonga QQ model, which took off from Chery (Lee et al., 2007). These key engineers left the JVs in disappointment because the JVs had no ambition to be independent innovators, and they wanted to build an independent automaker in China (Lee et al., 2009).

Given the strong motivation for success associated with private or nonstate ownership and facing tough market competition, indigenous firms, including BYD, invested aggressively in new facilities and technologies to build their technological capabilities. These firms frequently tested and improved their ideas in the market to learn rapidly, launching more than 170 models from 2003 to 2007 (Chu, 2011; Lee et al., 2017). Indigenous firms further built their capabilities through global outsourcing and even acquired foreign companies (Lee et al., 2017). Chery established a JV with Jaguar Land Rover to enhance its brand reputation and technological capabilities. In 2007, Geely set up an overseas factory and bought a stake in UK cab firm Manganese Bronze Holdings (Guo et al., 2017). In 2009, Geely acquired Australia's Drivetrain Systems International, the world's second-largest gearbox manufacturer, and Geely further improved its technological capabilities with the M&A of Volvo.

Currently, given the rise of indigenous firms, the size of domestic market segmented into low and high ends had a role in facilitating the growth of such firms first based on the low-end segment while avoiding direct competition with JVs targeting the high-end market (Thun, 2004, 2018; Tian et al., 2010). Eventually, these indigenous firms, such as Geely, achieved stage-based upgrading, from imitation to innovation, from low end to middle and high end, and from the domestic market to the global market. The rise of indigenous firms also indicates more competition between these local firms and JVs, which further contributes to the deepening and widening of local supply chains in China as an additional factor other than the LCR policy. Given the dominance of local firms in the low-end segment and of foreign JVs in the high-end segment, the competition for the

medium segment forced foreign JVs to attempt to reduce cost, while forcing local firms to improve quality by building their own local supplier network and increasing localization (Brandt & Thun, 2010).

Other than LCRs, three categories of policy initiatives have been implemented for the automotive sector in China, namely, import restrictions, entry control, and market discrimination. First, according to the "Automotive Industry Policy" issued in 1994, import quota licenses are used to regulate the import of auto parts and assembled cars. Even the types of cars allowed for import are determined in consideration of the nationwide policy of automotive sector promotion. Thus, used cars or parts for car assembly are forbidden, which implies that automotive manufacturers are not allowed to import kits to produce cars via semi-knocked down or CKD (Chen & Han, 2007). Second, foreign enterprises are not allowed to establish more than two JVs in China for one specific type of car. For investment projects with regard to such parts as CBU and engines, foreign automotive manufacturers are required to collaborate with indigenous manufacturers (Nan, 2005). Third, foreign cars are discriminated against with higher registration fees and taxes than those for domestic cars (Chen & Han, 2007).

3.4 GLOBAL–LOCAL INTERFACES IN INNOVATION SYSTEMS OF TAIPEI, PENANG, AND SHENZHEN

Scholars from the Schumpeterian School observed that differences in NIS may lead to variations in innovation performance and economic growth[12]. However, the question of why innovation activities and economic development are unevenly distributed over space, even in the same nation, remains unanswered (Asheim et al., 2019, p. 1). This question justifies the concept of regional innovation systems (RIS) and the analysis of innovation and economic performance of regions and cities. Cooke et al. (1998) defined RIS as a region-level "system

[12] This section is a compact rewriting of an article by the author of this book and a colleague, Kim and Lee (2022).

in which firms and other organizations are systematically engaged in interactive learning through an institutional milieu characterized by local embeddedness" (p. 1581). This section looks at this question of uneven development of regions in the context of Asia, focusing on the role of local ownership.

While the Asian economic takeoff has been associated with international integration via FDI or MNCs, we still see some divergence among regions, for instance, Shenzhen versus Penang. Shenzhen in South China was one of the first special economic zones to attract FDI and has spearheaded the economic development of China since the 1980s. Penang in Malaysia has also been one of the first regions in Southeast Asia to attract FDI since the early 1970s, but its growth was somewhat slow compared to that of Shenzhen. The size of the surrounding nation might not be the dominant factor in this difference, given that Taipei has also achieved fast growth while relying on FDI since the 1960s, even though it is a city on the small island of Taiwan.

Among the three regions, Taipei has the highest GDP per capita. Shenzhen and Penang are catching up with Taipei at different speeds (i.e., Shenzhen is catching up rapidly, but Penang is doing so slowly). The innovation performances of these two regions also differ. Shenzhen is more innovative than Penang in terms of the number of US-filed patents. This correlation between innovation and economic performance in the three regions served as a motivating justification of this study to apply the RIS framework and explain their divergent economic performance. Thus, a comparison of these regions in Asia with regard to the broad framework of uneven development of regions would be interesting (Yeung, 2021) given a common initial condition of growth dependent on FDI in their early development stage.

Various studies on cities and sub-national units in East Asia have applied the concept of RIS (Hassink, 2001; Wong et al., 2018; Yang, 2015; Yoon et al., 2015). Among the various dimensions of RIS, this study focuses on the local–global interfaces, namely, where and how

local actors and their learning interact with foreign actors and knowledge sources. Thus, the focus of this study can be justified because the three regions, as latecomers from emerging economies (EEs), share the common initial condition of heavy reliance on FDI in their early stage of development. However, the question is "why and how" these regions have evolved to eventually correspond to divergent outcomes.

3.4.1 Taipei, Shenzhen, and Penang in Asia

Taipei, Shenzhen, and Penang belong to the dynamic economies in Asia, that is, Taiwan, China, and Malaysia, respectively. They can also be regarded as representing the fast economic growth of their respective economies.

Taipei has served as the central city that has greatly contributed to the overall economic growth of Taiwan's economy. Taipei has not only been the center of Taiwanese enterprises but also the headquarters of foreign multinational corporations (Huang, 2008). Several foreign MNCs established their headquarters or subsidiaries in Taipei as early as the late 1950s. But since the 1960s, the vast majority of export-based manufacturing headquarters have flocked to Taipei in order to take advantage of the administrative and policy support from the central government, as Taiwan started to adopt the mode of export-oriented industrialization more aggressively (Chou, 2005; Hsu, 2005; Li et al., 2016). However, the weight of foreign firms has steadily decreased as some indigenous firms have grown into large giants, such as Acer (Amsden & Chu, 2003; Hsu, 2005). In the present study, the term "Taipei City" covers the former Taipei County (New Taipei) and the former Taipei City proper, with its formal merging and recognition in 2010;[13] its population grew slowly from 2.2 million in 2000 to 2.6 million in 2017.

Shenzhen was one of the first four special economic zones that represented the open-door policy of China initiated by Deng Xiaoping.

[13] Since Taipei City and Taipei County were confusingly used in patent data, we designate both Taipei City and New Taipei City as "Taipei City" in our analysis below.

Although it used to be the home of labor-intensive manufacturing that used low-cost labor and supplied to Hong Kong, it has grown into a high-tech region (Chen & Kenney, 2007; Yang, 2015). Reflecting its prosperity, Shenzhen's population has increased from less than 5 million in the 1990s to more than 12 million in 2017.

Penang was one of the earliest manufacturing hubs in Asia to attract foreign MNCs because of its strategic location, low labor costs, and low taxes in areas involving various electronic parts and components (Ariffin & Figueiredo, 2004; Diez & Kiese, 2006; Rasiah, 1988). The operations of MNCs in Penang started in 1972 when the Bayan Lepas free trade zone was launched and initially hosted seven MNCs.

One of the common features of the three regions is that they initially invited and promoted FDI through MNCs by setting up industrial parks, such as the Free Industrial Zone (FIZ) in Penang in 1972, and then the Special Economic Zones in Shenzhen in 1980 (Hsu, 2005; UNDP, 2006). In particular, despite starting later than Penang, Shenzhen has shown faster long-term growth in its income and the number of patents, which makes an interesting puzzle to pursue in this study.

In terms of the trends of per capita GDP in each region and per capita GDP relative to that in the United States, the three regions have a decent record of economic growth and catching up with the level of the United States. Among them, Taipei has reached the highest level, and Penang has reached the lowest level. Since 2000, Taipei has successfully caught up with a per capita GDP of over 80% of that of the United States. Its per capita GDP is more than $50,000 in PPP terms, and it reached almost 97% of that of the United States in 2017. In 2017, the per capita GDP of Shenzhen was $39,245 in PPP terms, ranking second among the three regions, and this level was approximately 72% of the per capita GDP of the United States. In 2017, the per capita GDP of Penang was $27,569 and reached more than 50% of that of the United States. It was even less than 40% before 2000. In this sense, all three regions have a decent record of

catching up, although their speeds differ. In particular, the speed of Shenzhen is faster than that of Penang.

Let us first look at the number of patents, especially those registered in the United States, for fair comparison. The number of US patents registered with the inventor's address in Taipei has increased dramatically since the late 1990s. In 2017, the number of patents was 3,780. Similarly, this parameter has increased remarkably since the late 2000s in Shenzhen, that is, from zero in the 1990s to about 2,500 in 2017. However, this rapid catching up is not realized in Penang, whose number of patents is only 100. This comparison of the three regions remains valid in terms of patent count per person.

This discussion therefore raises one interesting question: "Why has Shenzhen caught up with Taipei faster than Penang?" This study aims to explain the sources of this performance gap among the regions by analyzing their respective RIS beyond a simple count of patents. More specifically, we explore the possibility of different development trajectories among the three regions with regard to the different local–global interfaces or the role of indigenous firms and their contribution to innovation in these regions.

3.4.2 Local–Foreign Interfaces in RIS of the Three Regions

In the context of emerging economies, the concept of peripheral or immature RIS is characterized as being heavily reliant on external knowledge, given its lack of an indigenous knowledge base (Asheim et al. 2019, p. 73; Rodriguez et al., 2014). Similarly, the concept of the dirigiste systems is proposed to refer to a low level of regional embeddedness (Hassink, 2001, Park & Markusen, 1995). The latecomers' reliance on foreign knowledge makes sense, given that typical latecomer economies tend to achieve economic growth by relying on FDI and learning from foreign MNCs (Amsden & Chu, 2003; Bernardes & Albuquerque, 2003; Lebdioui et al., 2021). This pattern indicates that latecomer regions show a low level of patenting at early stages and more citations of foreign patents than indigenously owned patents, even after they start to conduct their own R&D and file patents (Wong & Lee, 2021).

This characterization of RIS in emerging economies in terms of a low level of indigenous knowledge is consistent with national-level studies involving the NIS concept of emerging or catching-up economies. Lee (2013c) and Lee, Lee, & Lee (2021) also found that one of the important attributes of the NIS of an economy showing a performance of rapid catching up is the initially low and increasing level of knowledge localization or degree of intranational creation and diffusion of knowledge, as measured by national-level self-citations. Therefore, during the early stage of economic development, emerging economies are likely to rely on knowledge from foreign or more advanced economies rather than creating and diffusing their own indigenous knowledge. During the stage of economic catching up, latecomer economies can adapt foreign knowledge to a local context to conduct imitative creation (Kim, 1997b) and move on to the stage of proper innovation, which is characterized by an increasing level of knowledge localization and local ownership.

In the context of this research, this specific process and mechanism of "localization of knowledge creation and ownership" would be the key mechanism of more successful or less successful performance of the innovation systems of the different regions of Taipei, Shenzhen, and Penang. Thus, our answer to the question of why Shenzhen has been doing better than Penang is that the former has increased the degree of localization of knowledge creation and ownership more rapidly than the latter, and that in the former region indigenous firms have eventually emerged to become the dominant players of knowledge creation and diffusion within the region, whereas they used to rely on foreign firms as sources of knowledge.

Given the discussion above, first, this study proposes to determine the specific pattern of dynamic changes in the role of foreign knowledge at the regional level. Specifically, given that the highest per capita income is recorded in Taipei and the lowest is in Penang, we hypothesized that Taipei would show a high and increasing level of intraregional knowledge localization and a low and decreasing level of internationalization (or degree of relying on foreign

knowledge). As a rapidly upgrading region, Shenzhen would correspond to an increasing level of intra-regionalization and a decreasing level of internationalization. This pattern of decreases in internationalization corresponds to the decreases in backward participation at GVC measured by the share of foreign value added in gross exports (Lee et al., 2018).

For this purpose, this study develops its own measures of RIS and focuses on three dimensions, namely, intraregional, interregional, and international. This approach is different from the two-dimensional approach in NIS, which is only divided into intranational and international, that is, the former is the exact residual or opposite of the latter. Unlike an NIS study, RIS analysis needs another dimension, the interregional dimension of one region's reliance and interaction with other regions in the same nation. Therefore, this study considers this interregional dimension of how much a region relies on or interacts with other regions in the same nation. In general, one may hypothesize on the basis of a similar logic described above that an advanced or catching-up region would show a high or increasing level of inter-regionalization (high or increasing citations of patents by other regions). We measured these variables by exploring the citation patterns of all patents with the inventors' addresses in localities, regardless of legal ownership, that is, foreign or local ownership.

Second, this study focuses on the role of local/foreign ownership of patents representing knowledge creation and diffusion. This dimension is important because simply relying on foreign-owned knowledge (patents) is insufficient in sustaining the upgrade to the later stages as foreign firms become increasingly reluctant to transfer or sell their technologies to latecomers who are catching up and getting close to the frontier (Lebdioui et al., 2021; Lee, Qu, & Mao, 2021). Amsden and Chu (2003) recognized this point in their study on Taiwan. They emphasized that one of the factors for Taiwan in joining the ranks of high-income economies beyond the middle-income stage is its ability to create a critical mass of locally owned firms, although it used to rely on FDI in its early stage of development. In

this sense, South Korea and Taiwan share a common formula for successful upgrades; therefore, economies attempting to catch up should acquire an indigenous technological capability (Mazzoleni & Nelson, 2007). We will be looking at Shenzhen and Penang from this perspective or in comparison with Taipei when we examine the extent and trend of ownership of patents filed in each region.

Thus, our analysis tests the hypotheses that Taipei has a high level of local patent ownership or a high share of patents filed by locally owned firms, and that Shenzhen shows an increasing share of locally owned patents compared with Penang. One of the causes for the slow catching up of Penang, even though it started earlier than Shenzhen, is its failure to enhance the degree of local ownership in its innovation activities measured by patent ownership in this context.

We can start by looking at the extent and trends of the intra-regionalization index of the three regions. As expected from the hypotheses in the preceding section, the level of intra-regionalization in Taipei is much higher than that of Shenzhen and Penang. In the meantime, Shenzhen and Penang have an increasing pattern, which is consistent with their increasing per capita income that is catching up steadily with the United States' level over time. The degree of intra-regionalization in Taipei has increased from 4% in the 1980s to >10% in the 2000s, indicating a self-citation rate of about 10% at the regional level. By contrast, the level of intra-region self-citation in Shenzhen or Penang is only half of the level in Taipei, or 6% in Shenzhen and 4% in Penang in the 2010s. Less than 10% of intra-regionalization implies that the majority of citations by these regions is attributed to foreign patents. This finding is expected for a region in EEs.

Also available are the extent and trends of internationalization, such as the degree to which patents by inventors in the region tend to cite foreign patents, that is, patents with inventors' addresses in foreign nations. As we expect and hypothesize, the internationalization or reliance on foreign patents of Taipei clearly decreases, which reflects the enhancement of its own indigenous technological

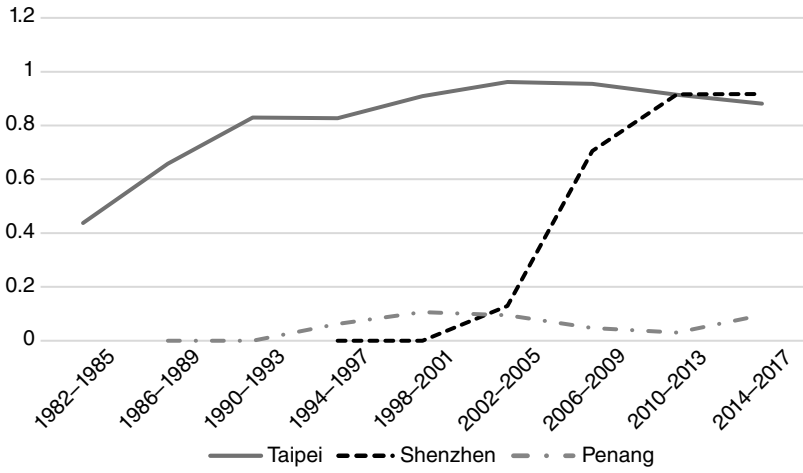

FIGURE 3.1 Local ownership of innovation: Taipei, Shenzhen, and Penang
Source: Figure 6 of Kim and Lee (2022)

capabilities and RIS. The absolute degree of internationalization decreased from 95% in the early 1980s to less than 82% in the early 2000s, although it increased again slightly in the 2010s (Kim & Lee, 2022). By contrast, this trend is unclear in the cases of Shenzhen or Penang, and their level of internationalization remained higher than 90%. However, the level of Shenzhen is lower than that of Penang. This finding is consistent with a higher level of development or catching up by Shenzhen than that of Penang.

Figure 3.1 shows the time trend of the local firm ownership of the three regions. The shares in Taipei rose from about 40% in the 1980s to almost 100% by the mid-2000s. The share of local ownership in Shenzhen reached a similar level by the mid-2010s within a shorter time because it used to be close to zero in the mid-1990s. By contrast, the local share in Penang did not show such a sharp increase, but has remained around 10% since the 1990s.

One can also discuss a more detailed picture by looking at the cross-country decomposition of the top ten assignees in each region.[14]

[14] Refer to the Figures in Kim and Lee (2022).

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The trends in Taipei have confirmed the dominance of Taiwanese firms since the mid-1990s. In Shenzhen, the share of domestic or Chinese-owned firms in the top ten assignees has kept increasing since the late 1990s and reached almost 100% in 2013–2015. This trend is matched with a decrease in shares by the United States and Taiwan. Unlike Shenzhen and Taipei, Penang has remained dominated by US firms with 50–70% shares since the 1990s. This value is matched with a decrease in shares by Malaysian firms from 20% to zero in the mid-2010s. Further detailed information about the specific names of the top firms in each region since the 2000s is available.[15] In Shenzhen, the two Taiwan-origin firms, Hong Hai Precision and Foxconn, ranked as the top one and two in 2005. In 2011, the top four ranks were dominated by indigenous Chinese firms such as Huawei, followed by the Taiwanese firm Hong Hai Precision, which ranked fifth. By 2015, all the top ten firms were Chinese-owned companies led first by ZTE, and then Huawei. In contrast, Penang is still dominated by US firms, including Intel, Motorola, and Altera.

Taipei and Shenzhen have steadily reduced their dependency on the knowledge of foreign firms, which is contrary to the situation in Penang. The considerable creation of knowledge by the indigenous firms in Shenzhen seems to be one of the reasons why it has made a transition from a peripheral to catching up in RIS compared to Penang. The increased indigenous knowledge in Taipei and Shenzhen is the knowledge pool in the region and likely affects the increase in the intraregional and interregional localization of knowledge, as shown above.

3.4.3 The Different Roles of Industrial Policy in the Three Regions

Now let us turn to the burning question of how Shenzhen, following Taiwan, has been able to promote locally owned firms out of their interaction with and learning from foreign MNCs. By comparison,

[15] Refer to the Appendix Tables for Shenzhen and Penang in Kim and Lee (2022).

Penang is more slowly catching up and has remained reliant on MNCs. Broadly speaking, the question of "how" can be placed in the context of a larger question of how to sustain economic growth in emerging economies, thereby overcoming the possibility of the MIT.

First, the Taipei model can be characterized by a high degree of intra-regionalization and the lowest degree of internationalization. However, Taipei also used to be dominated by foreign MNCs and faced a crisis as foreign vendors switched to other lower-wage economies, such as Malaysia, for their OEM orders (Amsden & Chu, 2003, pp. 70–79; Li et al., 2016), as the wage rate in Taiwan increased in the 1980s. This phenomenon is a typical symptom of the MIT. In this situation, many engineers who used to work in foreign-owned television factories left to start their own firms in related areas (Amsden & Chu, 2003, pp. 23–24). For them, the source of technology changed from FDI to technology licensing agreements with foreign entities. Eventually, a more effective model appeared, and that was a combination of firm-level R&D efforts and industrial/innovation support policies by the government, including public–private collaboration (Lebdioui et al., 2021; Lee, Lee, Meissner, et al., 2021; Lee, Qu, & Mao, 2021).

Specifically, public research organizations such as the Industrial Technology Research Institute (ITRI) played the role of a "new developmental state" because they developed high-tech parts and components that were formerly imported and had private firms to produce them (Amsden & Chu, 2003, p. 77). Furthermore, for an important upgrading transition from making small (analog) calculators to laptop PCs, ITRI led a public–private R&D consortium to develop a common machine architecture for laptop PCs and prototypes, which could be easily translated into a series of standardized components produced by manufacturers through mass production. The consortium represented a watershed after some previous failures, indicating the potential of an R&D consortium to help establish new "fast follower" industries (Mathews, 2002b). Despite collaborative relations with foreign entities for technology

licensing, the acquisition of innovation (design) capability required an active learning effort from the Taiwan side. For example, in making circuit chips, Taiwanese engineers went around the world to study large-scale integration applications. Eventually, by combining their observations and knowledge gained from Japanese suppliers, they became good at integrating a large number of parts and components sourced globally at the lowest prices into a small space (Amsden & Chu, 2003, pp. 28–32).

Second, the Penang mode is somewhat the opposite of the Taipei mode in terms of the continuing dominance of foreign MNCs in production and innovation. In the past, MNCs were attracted to Penang's low-cost wages and tax haven. Despite increasing income and wage rates, the share of MNCs in total investment ranged from 60% to 70% from 2014 to 2015. It also fluctuated but had no clear declining trend; conversely, the local investment contributed approximately 30–40% in the same period (Figure 5 in Lee et al., 2020). A new cycle of development is emerging, and the economy of Penang has been diversified from labor-intensive manufacturing operations to high-value-added manufacturing, including services from them, such as software, engineering design, R&D, and industrial system-based services, as well as new service industries such as medical tourism, education, and shared service centers (Penang Institute, 2015, pp. 10–15). These structural changes have also been a response to the rise of China as an alternative location for MNCs (Diez & Kiese, 2006). Penang witnessed some downsizing and exits of MNC manufacturing operations and M&A among multinationals to rationalize their resources and reduce redundancies over the past few years. However, many MNCs maintained certain operations in Penang, as they are provided with strong supply chains, allowing them to produce advanced technologies and services. Some locally owned firms have emerged to advance their high value-added activities in Penang (Diez & Kiese, 2006; Lee et al., 2020). A key factor of this positive scenario is a local institution that has enabled the training and upskilling of their local force, such as the Penang Skill

Development Center, a nonprofit institution that provides technical knowledge and training programs to engineers in the region (Lee et al., 2020).

Third, Shenzhen between Taipei and Penang in terms of the levels of per capita income and of intraregional and international localization of knowledge, although it is closer to Taipei with regard to the share of the local ownership of innovation. The leading companies in terms of the number of patents are Huawei and ZTE. How did these firms grow and become dominant? The answer, which is the same as for Taipei above, is a combination of firm-level R&D efforts and industrial/innovation support policies by the government, including public–private collaboration (Lebdioui et al., 2021; Lee, Qu, & Mao, 2021, Yang, 2015).

Specifically, the industrial policy in China has been called a "trading market for technology" (Mu & Lee, 2005), that is, the Chinese government used its huge bargaining power associated with the size of China's market to require foreign joint venture firms to transfer important parts of technologies. A famous example is the indigenous development of the fixed-line telephone because of the technology transfer and diffusion from a JV, Shanghai Bell, with the Chinese side owning 60% or a majority of shares. The transferred key technologies were later diffused to a local R&D consortium to develop Chinese-owned fixed telephone switches. This consortium finally transferred the technologies to ZTE, two other SOEs, and one private firm (Huawei) to be in charge of the actual production. When these four indigenous Chinese firms started to compete directly with JVs, the role of the Chinese government was to provide market protection and give financial and moral incentives for the adoption and use of domestic products (Mu & Lee, 2005; Xin & Wang, 2000).

Given its status as a special economic zone (SEZ), Shenzhen City has enjoyed many privileges in various policy initiatives (Yang, 2015). In the most recent case of Tencent, the help of the local government was critical to guarantee funding from venture capital and other financial investors at the initial growth stage (Breznitz &

Murphree, 2011, pp. 175–178). To strengthen the local firm ownership of knowledge, Shenzhen promoted the growth of local firms, such as Huawei and Tencent, by investing in universities and large research institutes (Breznitz & Murphree, 2011; Yang, 2015). The Shenzhen municipal government made efforts to encourage higher education and attracted advanced manpower, where universities and their research institutes, such as Shenzhen University in 1983, Shenzhen Polytechnic in 1993, the THU Shenzhen Tsinghua Research Institute, and the research base of Peking University, CAS, the Chinese Academy of Engineering, and Hong Kong University of Science & Technology, were established by providing incentives or benefits (Chen & Kenney, 2007). These initiatives must have helped a large, diverse pool of human resources from other regions in China and other countries to come to Shenzhen. For example, Huawei runs R&D centers in Beijing, Shanghai, Nanjing, Shenzhen, Hangzhou, and Chengdu.

The above discussion suggests that Taipei in Taiwan and Shenzhen in mainland China have been more active or aggressive in terms of the degree of public intervention than Penang in Malaysia, which might be one of the reasons for the different degrees of local ownership of innovation in the three regions. Whereas the former two cities involved the direct intervention of the public sector in specific R&D projects to help indigenous firms, the role of the public sector in Penang seems to have been more in the matter of human capital development or re-skilling and up-skilling of the workforce, which is used by foreign MNCs.

3.5 SUMMARY AND CONCLUDING REMARKS

This chapter elaborates the importance of local value added, knowledge, and ownership in latecomers' catching up, drawing upon several cases, such as resource sectors in Chile and Malaysia, auto sectors in four countries, and the three regions or IT cluster cities in Asia. As was discussed, in the cases of more successful rises of latecomer firms and sectors, they have all seen the eventual consolidation of

a system for the local creation of value added and knowledge supported by the rise of local ownership, although they have all tended to involve foreign entities and sources at their early stage. As the cases of the auto sector in Thailand, IT sector in Penang and mining sector in Chile show, continued reliance on foreign ownership is a recipe for a mixed success in terms of the limited or slow rise of domestic value added and innovation. In Thailand, this limited success (or upgrading) can be associated with a lack of local ownership under a less consistent industrial policy, which is given up after liberalization and WTO entry.

Continued dominance of foreign ownership corresponds to slow catching up, because it corresponds to lukewarm efforts to build domestic value added (e.g., Thai autos or Chilean mining) or even to hostile measures against the rise of high value-added (processed) palm oil exports from Malaysia. More importantly, foreign MNCs tend to source knowledge from R&D centers in headquarters and thus do not feel a need to cultivate R&D centers abroad, except for some development of skilled human capital (e.g., Penang in Malaysia and Thai autos). Malaysian and Chilean success in resource sectors all involved consistent efforts to build local R&D centers by public resources and initiatives, as shown by the role of catalyzing R&D and technology transfer by the Fundación Chile in the salmon and berry sectors of Chile, as well as R&D initiatives by PORIM or MRB in Malaysia.

The eventual rise of local sources of knowledge and firms is neither easy nor natural, given that they have all relied on foreign firms, technologies, and finances as the initial sources. The point is that this rise was possible owing to the involvement of the state in the various forms of industrial and innovation policies. This intervention is inevitable; otherwise, there will be a continuation of foreign dominance in ownership and knowledge sourcing. In the most extreme cases, such as the palm oil sector in Malaysia, local ownership was obtained by hostile takeovers of foreign firms. In some cases, there were asymmetric regulations and promotion of indigenous firms over foreign firms, such as the auto sector in China. The

relative success in China is related to a combination of restricted foreign ownership, the competitive nature of markets among foreign and national brands, and an explicit firm-level effort to build technological capabilities through in-house R&D and M&A of foreign firms and their technologies.

In other cases, there was a more gradual process of shifting from foreign to domestic entities, which was also possible with a long-term process of cultivation of local forces, which is shown by the cases of resource sectors in Chile, in particular the wine and wood sectors, where there is the coexistence of foreign and domestic firms. However, even in these sectors in Chile, the role of public intervention has been critical, as the government made a strategic bet on nonexistent but suitable and potentially profitable sectors, such as salmon, berries, and radiata pines, which were not natural to Chile. Of course, this cultivation of newly introduced products was made possible by an initial and coordinated inflow of foreign knowledge and skills and overseas learning opportunities.

It is also seen that promotion of locally owned firms and sectors goes together with discipline from global market competition, which is nothing but the principle of carrots and sticks. The failure of national cars in Malaysia points toward this simple principle. The failure of the automotive sector in Malaysia, despite its national brand ownership, is related to the lack of competition in markets and of specific strategies to localize imported parts and components, such as engines.

The cases in this chapter are all from various regions and sectors of different countries. Despite this, they all seem to indicate a common success formula of "learning from foreign sources at the initial stage, leading to the rise of local value added, knowledge, and ownership, owing to firm-level efforts and active industrial policies under market discipline." Overall, one important argument in this book is that managing the global–local interfaces is a key determinant of the successful rise of latecomers.