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Sustainable Industrial Policies and Industrial Upgrading: The Southeast Asian Experience

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Abstract

The latecomer industrialization thesis has acted as a powerful instrument in promoting industrialization. However, there is insufficient research to explain why some economies that attempted to industrialize are facing premature deindustrialization while others have managed to not only catch up economically but also shape the technology frontier in a number of industries. This paper problematizes and assesses industrial policies and industrialization in Southeast Asia, focusing on the United Nations Sustainable Development Goals (SDGs). Geographic areas of interest include Timor-Leste; the market economies of Brunei Darussalam, Indonesia, Malaysia, the Philippines, Singapore, and Thailand; and the transition economies of Cambodia, the Lao People's Democratic Republic (PDR), Myanmar, and Vietnam. Driven by an agile state, Singapore managed to become a developed economy through strong industrial upgrading. By 2024, Malaysia had launched four national industrial policies, while Indonesia, the Philippines, and Thailand introduced ad hoc strategies to support industrialization. Foreign transnational corporations have played a major role in stimulating manufacturing expansion in these economies. Meanwhile, Singapore's deindustrialization has been accompanied by strong technological upgrading, while Indonesia, Malaysia, the Philippines, and Thailand have embarked on developing strategic high-technology industries, such as aerospace, to raise value added after years of premature deindustrialization. If governed effectively using a carrot-and-stick approach, it is possible for these countries to break out of the middle-income trap and reach developed status. Brunei Darussalam has shown promise in its efforts since 2018 to stimulate petroleum-related downstream processing. Vietnam has industrialized the most among the transition economies; its gross domestic product per capita has grown rapidly to join Indonesia and the Philippines in lower middle-income

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status. While Cambodia, Lao PDR, and Myanmar have industrialized considerably, they remain at a crossroads, with little effort to build the science, technology, and innovation infrastructure required to stimulate industrial upgrading. Timor-Leste is still pegged in primary processing activities.

Introduction

Past research on industrial policy helped establish the steps latecomers took to industrialize successfully (e.g., Gerschenkron, 1952; Abramovitz, 1956; Chang, 2003; Reinert, 2007). However, the literature lacks an explanation of why several other economies that attempted to industrialize are facing premature deindustrialization. Meanwhile, growing concerns over dirty, dangerous, and demeaning industries have attracted sustainability as an unavoidable condition to industrialize. Indeed, these developments have attracted a focus on the promotion of industrialization that impacts the emergence of egalitarian economies propelled by digitalization and climate resilience. The United Nations Sustainable Development Goals (SDGs), especially SDGs 7, 8, 9, and 13, emphasize this shift.

Focusing on Southeast Asia, this paper argues for the need for sustainable industrial upgrading alongside initiatives to strengthen climate resilience. Southeast Asia is a suitable region to examine because, apart from Timor-Leste, the region's countries have launched industrial policies as a key instrument of development. Yet, only Singapore has managed to sustain rapid growth to enjoy a per-capita income (current prices) of USD 90,674 in 2024, which was 2.7 times that of Brunei Darussalam (USD 33,418), 7.6 times that of Malaysia (USD 11,867), 12.3 times that of Thailand (USD 7,345), 18.4 times that of Indonesia (USD 4,925), and 22.8 times that of the Philippines (USD 3,985). Against the transition economies and Timor-Leste, Singapore's gross domestic product (GDP) income in 2024 was 19.2 times that of Vietnam (USD 4,717), 34.5 times that of Cambodia (USD 2,628), 42.7 times that of the Lao People's Democratic Republic (PDR) (USD 2,124), 66.7 times that of Myanmar (USD 1,359), and 67.5 times that of Timor-Leste (USD 1,343) (World Bank, 2025).

Unlike the experiences of Japan, South Korea, and Taiwan, where industrialization was propelled by national firms, foreign transnational corporations (TNCs) (including joint ventures) have played a major role in stimulating manufacturing expansion in the Southeast Asian economies. Foreign firms were attracted to the export processing zones of Masan and Incheon (South Korea) and Kaohsiung (Taiwan), but both countries' dramatic expansion as

exporters of manufactured goods relied on national firms. In South Korea, these included:

- LG Corporation and Samsung Electronics Co. (electronics)
- Hyundai Motor Company, Kia Corporation, and Genesis Motor (automobiles)
- POSCO Holdings, Hyundai Steel Company, Dongkuk Steel Mill Co., and Kumkang Kind Co. (steel manufacturing)
- HD Hyundai Heavy Industries Co., Samsung Heavy Industries Co., and Hanwha Ocean Co. (shipbuilding-led industrial upgrading)

In Taiwan, these included:

- Taiwan Semiconductor Manufacturing Company, MediaTek, United Microelectronics Corporation, ACES Electronics Co., and ASUSTeK Computer (electronics)
- Victor Taichung Machinery Works Co., Tongtai Machine and Tool Co. (part of TTGroup), and Goodway Machine Corp. (computer numerical control machines and machine tools)
- China Steel Corporation (steel manufacturing)
- Nan Ya Plastics Corporation, Formosa Plastics Corporation, USI Corporation, Wapo Corporation, King Yuan Fu Packaging Co., Everplast Machinery Co., and Toford Plastic Manufacturing Co. (plastic and rubber machinery manufacturing)

This paper attempts to explain the state of industrial development in Southeast Asia with a focus on stimulating upgrading to the frontier and anchoring the SDGs. Specifically, it addresses the achievement of SDGs 7, 8, 9, and 13. SDG 7 refers to the transition to affordable and clean energy; SDG 8 promotes inclusive, sustainable economic growth, full and productive employment, and decent work for all; SDG 9 calls for building resilient infrastructure, promoting inclusive and sustainable industrialization, and fostering innovation; and SDG 13 addresses climate action.

The rest of the paper is organized as follows. The next section introduces key theoretical arguments. This is followed by a discussion on the manufacturing expansion experience of the Southeast Asian countries. The next section focuses on the evolution and implementation of digitalization and greening policies in these countries, and the last section presents conclusions.

Theoretical Considerations

Southeast Asia's industrialization did not follow the paths begun by latecomers such as the US, Germany, Japan, South Korea, and Taiwan. The early introduction of industrialization to the market economies of Indonesia, Malaysia, the Philippines, Singapore, and Thailand was largely an attempt to diversify exports to reduce dependence on a narrow range of commodities and to avoid the problem of the fallacy of composition (see Prebisch, 1950; Singer, 1950).

The initial focus was on the promotion of light, labor-intensive manufactured goods to generate employment through the stimulation of foreign direct investment (FDI). Indonesia, Malaysia, the Philippines, and Thailand introduced import-substitution industrialization, a strategy that failed to contribute significantly to rapid economic growth. This was because it paid insufficient attention to technological upgrading and was not accompanied by a quick switch to export orientation. In contrast, Singapore enjoyed massive growth and structural change by switching completely to export orientation in 1965 and focusing on technological upgrading since 1979.

Smith (1776) and Young (1928) argue over the differentiation and division of the labor potential of manufacturing to produce dynamic increasing returns. Industrial expansion through technological upgrading can be traced to latecomer strategies. The latecomer thesis on industrialization originally focused on broad-brush approaches that simply documented how Britain industrialized and subsequently on the catch-up experiences of the US, Germany, and other countries (Gerschenkron, 1952; Abramovitz, 1956). This thesis was later extended by Kaldor (1967), Chang (2003), and Reinert (2007).

It is pertinent to distinguish between:

- **Active industrial policy:** Industrialization strategies that are actively pursued to target industrial upgradation, often by identifying strategic industries, to spur rapid structural change
- **Passive industrial policy:** Industrialization strategies that take advantage of foreign firms' efforts to seek labor-surplus sites to relocate labor-intensive operations

Active industrial policies are those where governments promote industrialization, targeting industries, identifying strategies, and monitoring industrial performance. Japan, South Korea, and Taiwan launched active

industrial policies led by national firms that eventually reached the technology frontier. Indeed, active industrial policies under the aegis of national firms drove the catching up and technological leapfrogging of manufacturing in South Korea and Taiwan. More than a focus on infrastructure, governments actively supported upgrading in South Korea and Taiwan (Amsden, 1989; Wade, 1990; Chang, 2003; Reinert, 2007). Although Ireland and Singapore adopted the export-processing zone approach, their governments intervened to ensure that incentives and grants were strictly tied to industrial upgrading through the use of leveraging strategies and an active pursuit of human capital. Brunei Darussalam's forays into manufacturing since 2018 (which drove rapid manufacturing growth) were also pivoted by leveraged interventions (see Ahmed, 2024).

The active industrial policies of Singapore, South Korea, and Taiwan sought to create desired endowments rather than leaving industrial strategies to be dictated by existing relative endowments. Neoclassical economists (e.g., Helleiner, 1973; Bhagwati & Brecher, 1980; Krueger, 1980) have argued that some government interventions are proscriptive, i.e., designed to correct past government failures and infrastructure shortcomings.

Rasiah (2025) used a stylized framework based on specialization emerging from factor endowments defined by relative prices of the neoclassical school. This shows that labor-intensive foreign firms from capital-surplus and labor-scarce developed countries relocate to labor-surplus and capital-scarce middle-income countries (MICs) and low-income countries (LICs).

MICs are expected to focus on attracting firms that require literate and trainable labor, while LICs are expected to attract the most labor-intensive firms. Through proscriptive interventions, host governments are encouraged to offer basic infrastructure, security, and simplified customs handling. Tariff exemptions and tax holidays are also recommended to lower the risk of relocating to underdeveloped sites. Once this process is set in motion, capital is expected to relocate labor-intensive operations to MICs and LICs, which is then expected to raise interest rates (r1) and lower wages (w1) at high-income country (HIC) sites, while lowering r2 and raising w2 at MIC and LIC sites. Meanwhile, with the use of flexible exchange rates, the LICs and MICs export highly labor-intensive and moderately labor-intensive goods to the HICs, while the HICs are expected to export capital- and technology-intensive goods to the MICs and LICs. The continued flows of investment from HICs to MICs and LICs (and also MICs to

LICs) are expected to result in an equalization of r and w across the countries, as would be the case with GDP per capita.

Apart from Singapore, most of the Southeast Asian economies have followed passive industrial policies by developing basic infrastructure, incentives, and security to attract foreign firms. Malaysia, the Philippines, Thailand, Indonesia, and Vietnam (MICs) have grown through the export processing route (Rasiah, 2020), while Cambodia and Lao PDR (LICs) have enjoyed similar growth experiences since the turn of the millennium (Rasiah & Yun, 2009). Myanmar and Timor-Leste, which sought to follow the same route, have achieved little manufacturing expansion since 2020 owing to political instability and poor infrastructure. In addition, Myanmar has faced economic sanctions since 2003 (Rasiah & Myint, 2013).

In this context, the World Bank (1993) glorifies the passive industrial policy approaches undertaken by Indonesia, Malaysia, the Philippines, and Thailand as having fewer policy failures and being well-positioned to follow global trade practices under the World Trade Organization. However, Rasiah (2020) argues that these countries have not yet succeeded in breaking out of the middle-income trap.

Amsden (1989, 1991) and Kim (1997) offer empirical evidence to support the latecomer catch-up thesis by focusing on the diffusion of innovation from abroad using specific host-site firms in South Korea. Following Johnson (1982) and Wade (1990), they extend developmental state arguments on how industrial policy was used successfully to stimulate economic development. In this tradition, Mazzucato (2013) frames their mission-oriented and smart intervention industrial policy arguments. Ocampo (2020), then, is able to connect policy with technological learning and upgrading through incremental innovations. Rasiah (2018) goes further by incorporating Schumpeter's (1934, 1942) concepts of incremental and radical innovations using the experience of firms in South Korea (e.g., Samsung Semiconductors) and Taiwan (e.g., Taiwan Semiconductor Manufacturing Company). Samsung took leadership of the flash memory market in 2002 (Park, 2021), overtaking firms like Texas Instruments in the integrated circuits industry. This is an example of how South Korea and Taiwan, despite contrasting industrial policies, successfully caught up with and leapfrogged over incumbents (Rasiah & Yap, 2019).

South Korea and Taiwan had also begun integrating into the world economy in the same way as the Southeast Asian economies. However, they then began to focus on the latecomer catch-up model in the early 1970s by prioritizing domestic ownership in strategic industries (Amsden, 1989; Wade, 1990). In addition, South Korea and Taiwan introduced monetary policies to ensure that volatile fluctuations in capital and trade flows did not destabilize their industrialization initiatives. Prudent monetary policies ensured that the new Taiwan dollar exchange rate against the US dollar did not fluctuate sharply. Similarly, South Korea imposed controls on foreign exchange from 1961 until the 1970s. This included controlling private entities' borrowings from abroad and maintaining state ownership of banks until the 1980s. South Korea also fixed its currency, the won, against the US dollar between 1974 and 1979 to stem the negative impact of a growing balance-of-payments problem and debt service issues when oil prices rose by four times in 1973–1975. Targeted firms, especially the *chaebols* (family-owned conglomerates), enjoyed subsidized interest rates. Simultaneously, the government imposed high arbitrage interest rate differentials between borrowing and lending to gradually reduce external debt while supporting the *chaebols* (Amsden, 1989; Chang, 1994).

National capital dominated industrialization through massive technology flows from foreign multinationals (licensing and acquisitions played a significant role) and industrial catch-up in Japan, South Korea, and Taiwan. However, the Southeast Asian economies demonstrated the strong role of FDI. For example, Singapore's Economic Development Board (EDB) stimulated industrial upgrading to high value-added activities in both multinationals and national firms through a leveraging strategy (Rasiah, 2020b).

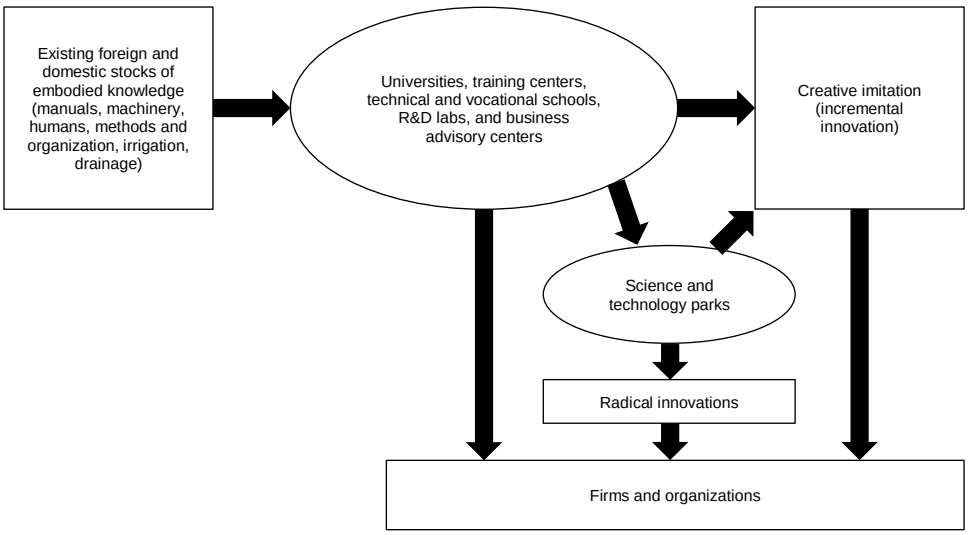
A stylized model of industrial policy can be developed by combining the key arguments of the manufacturing experiences of Japan, Singapore, South Korea, and Taiwan. The generation and adaptation of knowledge, incentive systems, and the appropriation of knowledge flows were critical to stimulating individuals, firms, and organizations to connect and coordinate with knowledge nodes that create synergies for technological catch-up. Given the public good characteristics of the knowledge necessary to stimulate innovation, its governance should prioritize innovation-driven technological upgrading. However, the ecosystem embedding and supporting firms and organizations must be anchored to four systemic pillars (Rasiah, 2019). The emphasis on innovation in such a network of pillars should range from incremental (minor) to radical (major) innovations,

including interactive learning, to support the generation and appropriation of innovations. In such a framework, machinery and equipment (both domestic and from abroad) and embodied knowledge in humans should be continuously adapted to raise industrial productivity (Figure 1). The organizational setup can vary between countries because how initial conditions and economic structures are shaped is of considerable importance.

Institutions must be structured to pursue macroeconomic policies that provide the financial incentives and grants essential to both supporting innovative economic activity and insulating against external shocks. Institutions require strengthening to meet stringent appraisal standards to check unproductive rent-seeking. Amsden (1993) and Kim (1997) provide a lucid account of innovation appropriation and economic catch-up from foreign sources in South Korea and Taiwan. In addition, the public good characteristics of knowledge creation and appropriation (innovation) were harnessed effectively in South Korea and Taiwan. To ensure that countries achieve even regional development, effective institutional coordination between federal, provincial, and local governments becomes essential (see Rasiah & Zhang, 2015).

Critical organizations relevant to institutionalizing knowledge creation and appropriation on a national scale (universities, public labs, standards organizations, and incubators at science parks) must play an active role in stimulating incremental and radical innovations with a focus on evolving experiential and tacit knowledge (see Penrose, 1959; Polanyi, 1966; Dosi, 1995; Rasiah, 1995). Collectively, these instruments can be referred to as science, technology, and innovation (STI) infrastructure. While first movers initiate cycles of innovation, latecomers engage in incremental innovation (Schumpeter, 1942). As countries graduate from least developed to middle income, governments should ensure that gross expenditure on research and development (R&D) gradually rises. Instead of simply seeking a gradual displacement of government expenditure with business expenditure in gross domestic R&D, there should be a focus on non-business public expenditure to address STI infrastructure funding. Unfortunately, while the STI infrastructure has evolved strongly with connectivity and coordination between STI organizations, firms, and individuals since 1991, it has not done so in the remaining Southeast Asian countries.

Figure 1: Innovation networks and knowledge synergies



Adapted from Rasiah (2007).

Knowledge is a special public good. It is both non-excludable and non-rivalrous. Therefore, governments should support R&D as public returns exceed private returns in such circumstances. This also applies to regulatory mechanisms where technologies and their application enhance societies, digital platforms, and climate resilience (Figure 1). Climate resilience is often portrayed by economists as a negative externality that is also a global common, as its non-excludability and non-rivalrousness affect all countries (Marshall, 1890; Pigou, 1932; Samuelson, 1954; Baumol & Oates, 1988; see also Hardin, 1968). In contrast to knowledge, basic infrastructure is a public utility, as it is rivalrous.

Within public goods, resources are deployed to undertake research that generates knowledge, some of which is converted back to resources, including those with pecuniary value, with the uptake of intellectual property. A considerable part of the knowledge generated in the process seeps through and is appropriated by other economic agents to produce resources that are not appropriable by the creators of that knowledge (Rasiah, 2025). This notion of free riding (which benefits society) makes the case for governments to take charge, as public returns exceed private returns. The regulatory framework not only needs to support economic synergies but must also support social synergies, including climate resilience.

Having addressed the key structures that countries should construct and renew to stimulate innovation and economic synergies, the next section discusses Southeast Asian industrial policies in the 1990s and 2000s.

Industrial Policy

The Southeast Asian market and transition economies underwent industrialization without a significant focus on building climate resilience. Climate resilience and digitalization emphasis only reached these countries in the 1990s and from the turn of the millennium. Timor-Leste is still engrossed in agriculture without a clear industrial master plan (Courvisanos et al., 2025). Hence, this paper focuses on industrialization efforts in the Southeast Asian economies since 2000.

Singapore achieved high-income status with a transition to scope-based designing and small-scale, but intensive manufacturing. Indonesia, Malaysia, the Philippines, Thailand, and Vietnam, instead, focused on large-scale industrialization with a specialization in low and medium value-added industrial activities (Rasiah, 2020b). Cambodia, Lao PDR, and Myanmar are specializing in low-value industrial activities. Brunei Darussalam has mounted strategies using digitalization to complement its mining sector. Timor-Leste is still very focused on downstream processing and low-technology consumables to substitute for burgeoning imports (Rasiah & Zhang, 2015; Courvisanos et al., 2025).

Market Economies

Given their considerable exposure to capitalist relations, the market economies of Singapore, Indonesia, Malaysia, the Philippines, Thailand, and Brunei Darussalam are examined first, followed by the transition economies. Industrial export orientation in Southeast Asia began with Singapore. Malaysia and the Philippines followed suit. Thailand and Indonesia embarked on export-oriented industrialization (EOI) from the 1980s and 1990s, respectively. Although this paper focuses on industrialization initiatives from the late 1980s and 1990s and after 2000, Figures 2–5 present data from the 1960s (where available) because manufacturing began growing strongly in some of the countries during that period.

Singapore

Being the first mover to promote export orientation in Southeast Asia and located strategically as an entrepôt, Singapore enjoyed the room to promote industries relevant to its economic development from 1965 (Rasiah, 2020). The prime

instruments used to promote exports were financial incentives and discouraging incompatible industries through the withdrawal of incentives. Strategic industries, such as shipbuilding, petrochemicals, semiconductors, and biotechnology, were offered R&D grants and facilities as they evolved strategically to support the massive trade in petroleum and the island's status as a major port (Singapore Economic Development Board, 2019; Maritime and Port Authority of Singapore, 2019; Rasiah, 2020b).

The EDB's leveraging role has often accounted for Singapore's endowments and changes in TNC strategies to sustain technological upgrading (see also Wong, 2001; Rasiah, 2016). Three clear strategies can be observed in the EDB's approach. First, Singapore took advantage of its halfway-house role in trade to develop shipbuilding and launch oil refineries that expanded into petrochemicals.

Second, Singapore's agile industrial policy allowed the EDB to replace incompatible industries with compatible ones. For example, Singapore phased out disk drive firms in 1989–1990 once it became clear the industry was labor-intensive.

Third, Singapore launched its science park to stimulate successful commercialization.

Singapore's attempt to transform the economy from low to high value-added activities by offering R&D grants and lowering corporate taxes to 17 percent attracted regional TNCs. Similarly, the government's promotion of shipbuilding and downstream petrochemical industries allowed the country to become a leader in these industries. Both offered Singapore strategic positioning as the country gradually rose to refine imported oil, create petrochemical industries, and move beyond repairing ships to building them, alongside oil rigs and platforms (Singapore Economic Development Board, 2019; Maritime and Port Authority of Singapore, 2019; Association of Singapore Marine Industries, 2018).

Indonesia

Indonesia abandoned its import-substitution policies following an International Monetary Fund-imposed structural adjustment package after the Asian financial crisis in 1997. It focused instead on infrastructure development (Nofrian et al., 2025). The restructuring included the closure of the Timor-KIA joint venture and aircraft manufacturing (Rasiah, 2009). Although Indonesian manufacturing was

not seriously affected by the 2007–2008 global financial crisis owing to its trade being decoupled from exports to the US, a combination of cumbersome administrative procedures and a lack of technological upgrading restricted the country to low and medium value-added industries (Rasiah, 2020).

In 2021, the Indonesian government announced new interventions in manufacturing to correct shortcomings associated with strengthening ecosystem instruments to support manufacturing firms (Indonesia, 2020). In addition to climate resilience and Industry 4.0 (IR 4.0) systems, the government identified strategic industries for promotion. Nofrian et al. (2025) argue that manufacturing remained important largely because of the spread of labor- and resource-intensive industries to the islands outside Java and the assembly of components and parts (including nickel processing for electric vehicles) in Java.

Malaysia

After 2000, as Malaysia turned its focus to climate resilience and digitalization, manufacturing began to contract gradually, owing to slow industrial upgrading and a lack of strong backward linkages. Hence, not only did manufacturing wages grow very little in the period 2000–2024 (Rasiah & Zhang, 2024), but workers were also often exposed to retrenchments during economic downswings.

Consequently, the government announced plans to limit financial incentives to capital- and technology-intensive TNCs while offering R&D incentives to stimulate technological upgrading. Parastatals were launched to create and strengthen the country's STI infrastructure. The Human Resource Development Council, Malaysian Industry-Government Group for High Technology, Multimedia Development Corporation, and Multimedia Super Corridor were launched in the 1990s for this purpose (Ali, 1991). The Malaysian Institute of Microelectronics Systems was corporatized, and science and technology parks were built in the western corridor to house incubators. However, the lack of stringent performance standards resulted in these meso-organizations underperforming (Rasiah, 1996).

The government changed its emphasis to focus on industrial upgrading and chip design under the New Industrial Master Plan 4. However, a lack of human capital and strong domestic linkages continued to restrict upgrading in strategic industries. Hence, manufacturing's contribution to GDP and employment fell gradually from the turn of the millennium.

While selected firms were given incentives to undertake R&D, there was little monitoring, and non-performers were not penalized. In addition, the selection process for the leadership of STI parastatals and designated technology firms excluded consideration of Malaysian professionals possessing experiential and tacit knowledge in their respective industries. The preference was for extending the legacy of creating Bumiputera (indigenous Malays) chief executive officers, an important government goal since the promulgation of Permodalan Nasional Berhad (Malaysia's largest state-owned fund management company) in 1978 and its active pursuit since 1981. The ethnic focus of industrial policy resulted in performance taking a backseat, which rendered the STI parastatals ineffective, while the firms created for support failed to compete in export markets. Perwaja, Proton, and Silterra were three examples of national firms that drained the national economy. Proton was finally taken over by China's Geely in 2017 (Zhang et al., 2018). Silterra was also sold to Chinese interests (Rasiah et al., 2024).

The Philippines

The Foreign Investment Act of 1991 opened foreign equity ownership to 100 percent in non-export processing zone industries. Tariffs on raw materials and finished products were reduced, which helped decrease external debt (Menardo, 2004). Although largely ineffective, the generous incentives attracted FDI in electrical and electronics and automotive components and completely knocked-down parts manufacturing. However, smuggling and the lack of strong STI infrastructure and proactive promotion of technological upgrading restricted manufacturing expansion; its share in overall exports reached just 21 percent in 2011 before falling.

In 2020, the Philippine government announced its intention to correct shortcomings associated with the strengthening of ecosystem instruments to support manufacturing firms (Philippines, 2020). The government also identified strategic industries for promotion, which included aerospace, but as argued by Ofreneo (2024), the Philippines continued to lack a productively interventionist industrial policy to stimulate industrial upgrading. Most of the policy instruments implemented were designed to enable markets.

Thailand

While manufacturing value-added expanded over the period 1988–2007, a lack of technology policies undermined the capacity of manufacturing to sustain wage

increases and technological upgrading from low to high value-added activities. Minor ad hoc incentives and high-technology facilities were offered to large firms in the automobile (including an automobile university) and electronics industries (Intarakumnerd & Chaoroenporn, 2013; Intarakumnerd et al., 2015). However, the lack of STI infrastructure to support incremental and radical innovations resulted in manufacturing value-added plateauing. Its contribution to GDP has been declining since 2010.

Despite political uncertainty, the Thai government announced in 2021 that it would correct shortcomings associated with the strengthening of ecosystem instruments to support manufacturing firms (Thailand, 2021). The government also identified strategic industries for promotion, which included aerospace. Teerawat and Yot (2025) offer an incisive account of the efficacy of Thailand's industrial policies, which focus on feeble efforts to stimulate technological upgrading.

Brunei Darussalam

Much of Brunei Darussalam's economic history has been focused on petroleum drilling. Consequently, manufacturing did not emerge strongly until 2018 in petroleum-based and information technology products. Manufacturing's contribution to GDP then rose sharply through leveraging strategies to stimulate industrial upgrading (Ahmed et al., 2025).

Aggressive promotion of industrialization led to manufacturing's share in GDP rising in trend terms among the Southeast Asian free market economies. Expansion had been ongoing since import substitution industrialization (ISI) was launched in the 1950s and 1960s. However, growth was fastest during EOI due to the use of labor-intensive technologies and firms' access to larger export markets compared to small domestic markets. EOI reduced the government's burden on the foreign exchange required to promote ISI and address balance-of-payment problems. Indonesia, Malaysia, the Philippines, and Thailand's experience with ISI required them to use foreign exchange to import intermediate inputs and capital machinery, which drained their economies. In addition, a lack of competition undermined performance. Powerful liberalizing initiatives through Asia-Pacific Economic Cooperation and the World Trade Organization decreased the significance of ISI policies, particularly since the formation of the Association of Southeast Asian Nations (ASEAN) Free Trade Area in 1992. However, it was the

lack of effort to pressure ISI industries to shift to EOI that caused manufacturing to stagnate.

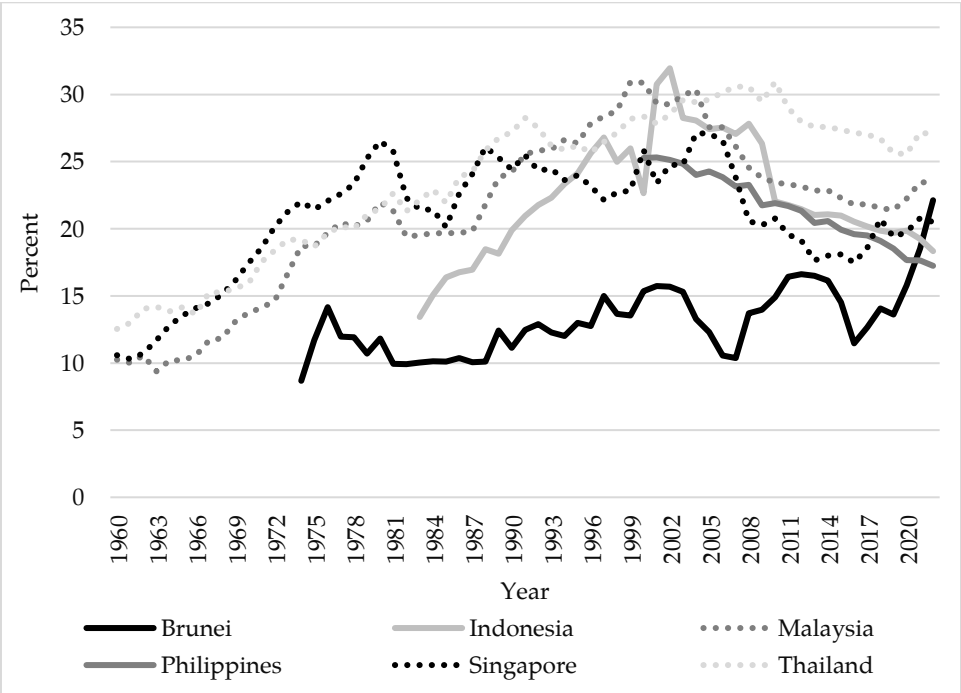
Although EOI became the dominant industrial strategy, all five Southeast Asian market economies examined in this paper have begun to deindustrialize. At its peak, manufacturing contributed over 30 percent of GDP in Indonesia, Malaysia (1999–2000), and Thailand (2008–2009). It began to slow down and contract when FDI-led light manufacturing firms could not upgrade to stay ahead of emerging low-value sites, such as China, Bangladesh, and Indochina. On the other hand, heavy industries, such as iron and steel, cement, and automobiles, have remained viable owing to preferential tariffs and incentives, and ASEAN Economic Community benefits. The primary benefit stems from a rule-of-origin condition that states that firms can enjoy liberal access to ASEAN markets if they meet a 40-percent value-added requirement.

Manufacturing Expansion

This section comparatively analyzes manufacturing value-added in GDP, manufactured exports in merchandise exports, and manufacturing employment as a percentage of total employment in the Southeast Asian countries.

Thailand enjoyed the highest share of manufacturing value-added in GDP in Southeast Asia in 2022 (Figure 2). Indonesia's share showed a trend rise until its peak in 2002 (32 percent) before falling sharply, while Malaysia's rose in trend terms until its peak in 2000 (30.9 percent). Singapore enjoyed its peak in 2005 (27.1 percent). Brunei Darussalam showed a sharp rise from 2016 to 2022, while the Philippines showed a trend fall from 2002. Apart from Brunei Darussalam, the remaining Southeast Asian market economies showed trend falls in the share of manufacturing in GDP. However, Malaysia, Singapore, and Thailand showed signs of reindustrialization from 2017 to 2018.

Figure 2: Manufacturing value added as a share of GDP (market economies) (1960–2022)

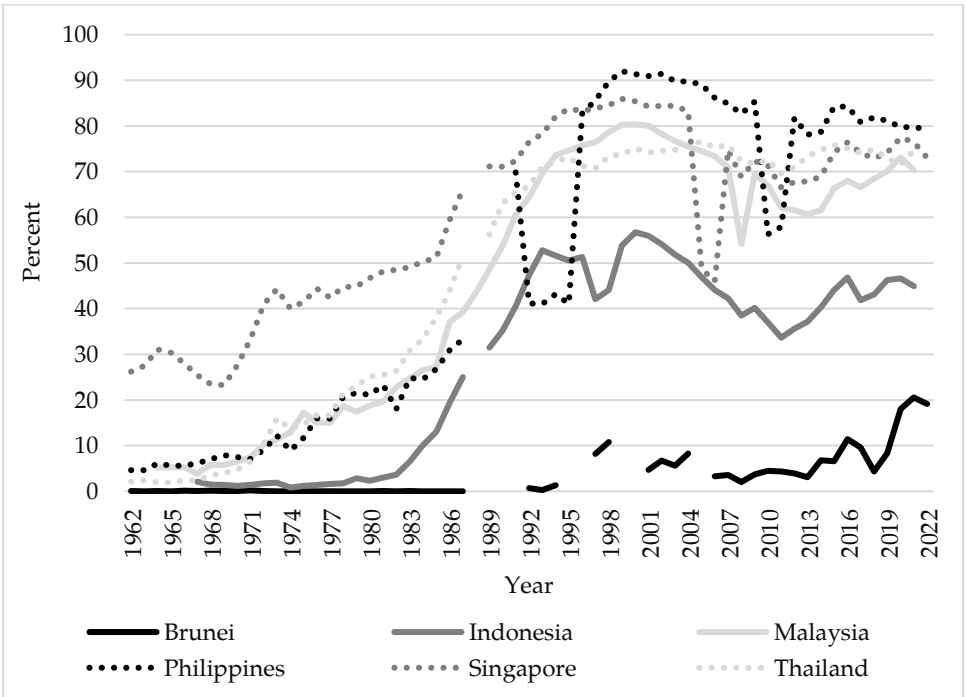


Source: Plotted using World Bank (2023) data.

Manufactured Exports

The trade structure of the five Southeast Asian market economies quickly shifted towards manufactured goods as liberalization and incentives propelled exports of electronics, automotive components, and textiles and garments. Apart from declines caused by external crises, manufactured export shares in the total exports of Indonesia, Malaysia, the Philippines, and Singapore peaked in 1998–2000 (Figure 3). Thailand enjoyed its highest export share in 2005. The rapid expansion of manufacturing, including diversification within sectors, helped the Southeast Asian economies avert problems caused by the fallacy of composition.

Figure 3: Manufactured exports as a share of total merchandise exports (market economies) (1962–2022)

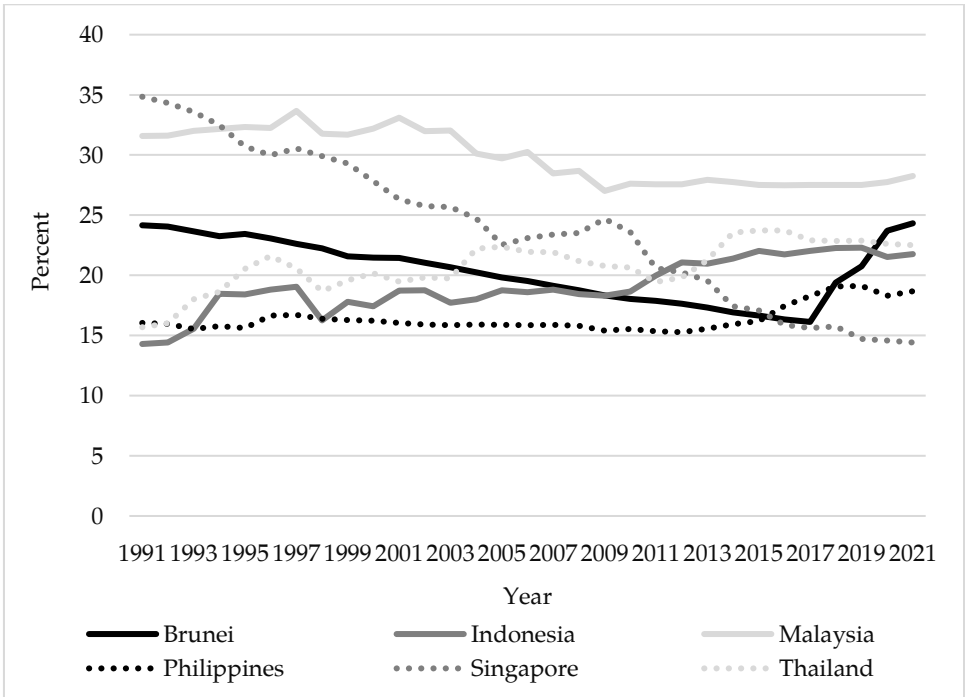


Source: Plotted using World Bank (2023) data.

Industry Employment

Singapore showed a trend fall in the manufacturing employment share of total employment over the period 1991–2021 (Figure 4). After a trend fall until 2009 in Malaysia and 2012 in the Philippines, the manufacturing employment share of total employment in these countries showed a trend rise until 2021. As with the rapid expansion of the manufacturing value-added share in GDP, industry employment as a share of total employment in Brunei Darussalam rose sharply during the period 2017–2021. Meanwhile, Thailand showed a fluctuating trend with a higher contribution since 2012.

Figure 4: Industry employment as a share of total employment (market economies) (1991–2021)



Note: Industry employment, which includes mining and construction, was used here in the absence of a sufficiently long manufacturing employment series.

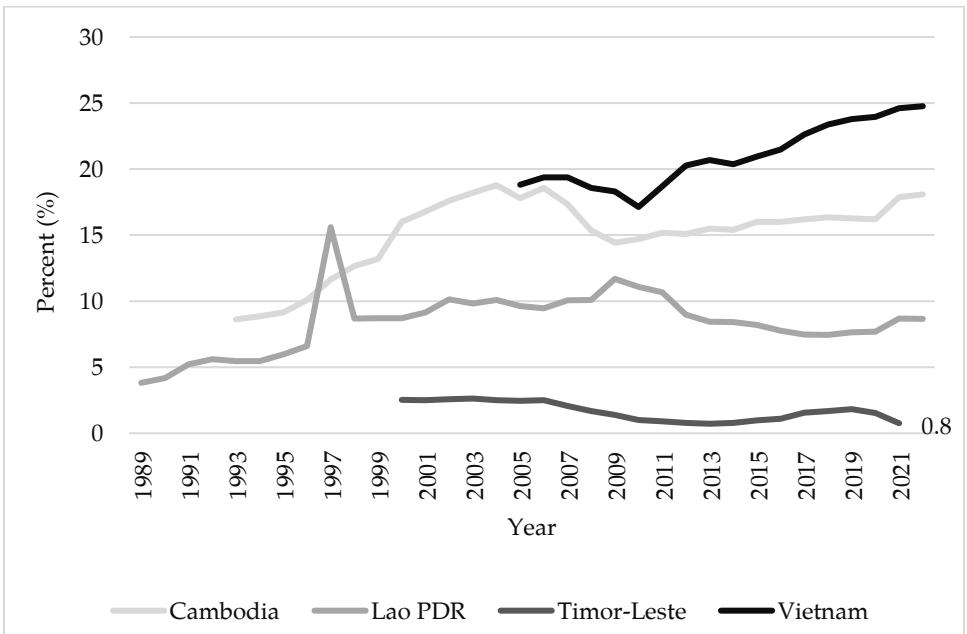
Source: Plotted from World Bank (2023) data.

Transition Economies

Among the transition economies, Cambodia and Lao PDR enjoyed early expansion, especially in the manufacture of clothing, as their least developed country status offered them 'everything-but-arms' access to Europe and free trade access to the US in return for observing International Labor Organization covenants. Myanmar has faced US economic sanctions since 2003, and more countries have extended sanctions since 2017. Nevertheless, in 2021, its contribution of manufacturing value added to GDP rose to the largest share among CLMV (Cambodia, Laos, Myanmar, and Vietnam) countries (24.8 percent) and Timor-Leste (Figure 5). Cambodia's share of manufacturing value added in GDP rose over the period 1993–2004 before falling in trend terms from 2005 until 2009. It rose again gradually during the period 2010–2022.

The manufacturing value-added share in GDP of Lao PDR reached a peak in 1997 owing to clothing exports manufacturing. However, it declined within a year. It remained somewhat steady during the period 1998–2022 with a focus shift to agro-processing (see Rasiah et al., 2011). The export-oriented manufacturing of Vietnam caused manufacturing's value-added contribution in GDP to rise to 24.8 percent in 2022. Timor-Leste is the least industrialized country in Southeast Asia, with its manufacturing share of GDP being just 0.8 percent in 2021.

Figure 5: Manufacturing value added as a share of GDP (transition economies) (1989–2022)

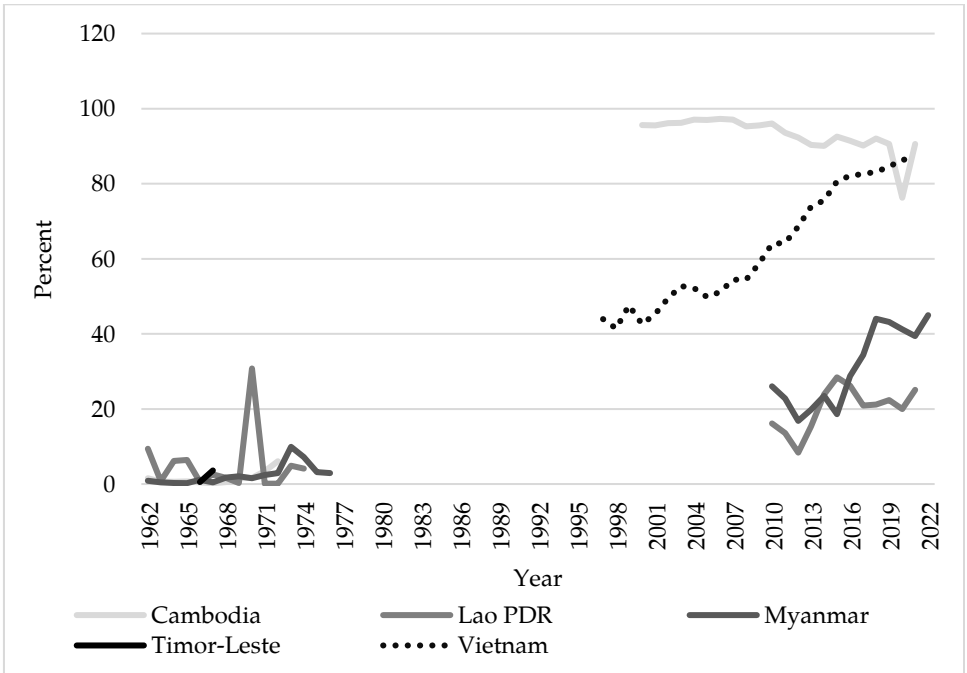


Source: Plotted using World Bank (2023) data.

Manufactured Exports

Led by clothing exports, Cambodia enjoyed the highest share of manufactured exports (90.6 percent) as a share of overall exports in 2021 despite gradually falling since its peak in 2006 (97.1 percent) (Figure 6). Vietnam's share rose sharply, reaching 86.4 percent in 2021. Myanmar's manufactured exports share of total exports rose in trend terms to 45 percent in 2022. While Lao PDR's manufactured exports share reached 30.8 percent in 1970, Timor-Leste recorded manufactured exports of 0.5 percent in 1966 and 3.6 percent in 1967. Manufactured exports were negligible in the rest of the years.

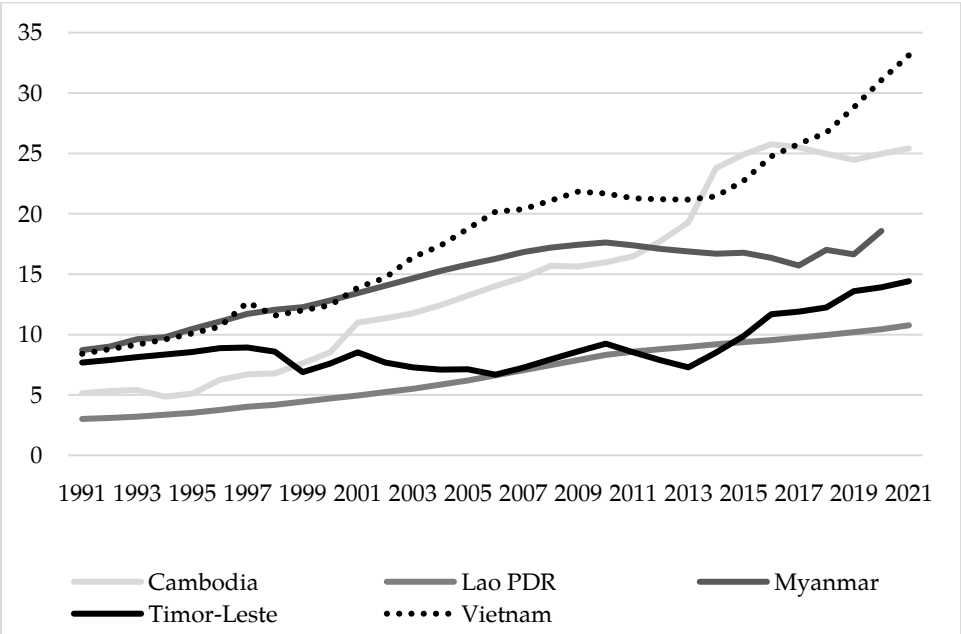
Figure 6: Manufactured exports as a share of total merchandise exports (transition economies) (1962–2022)



Source: Plotted using World Bank (2023) data.

Data on manufacturing employment for the transition economies and Timor-Leste was scarce, so we included mining and construction to constitute industry as a whole. All countries showed a trend rise. Vietnam enjoyed the highest industry share in overall employment with 33.1 percent in 2021, followed by Cambodia at 25.4 percent (Figure 7). The corresponding figures for Lao PDR and Timor-Leste were 10.8 percent and 14.4 percent, respectively. Myanmar's stood at 18.6 percent in 2020.

Figure 7: Industry employment as a share of total employment (transition economies) (1991–2021)



Source: Plotted using World Bank (2023) data.

Pursuit of Sustainability through Digitalization and Climate Change Mitigation

Some countries had already initiated policies to promote digitalization and climate resilience, but it was not until 2015 when the United Nations launched the SDGs that the Southeast Asian countries began to take action. They established formal structures to alleviate poverty (SDG 1), expand employment and quality jobs (SDG 8), and strengthen climate resilience (SDG 13).

SDGs 7, 8, and 9 were particularly focused on (Rasiah & Vijayaraghavan, 2025; Rasiah, 2025). All sectors of the Southeast Asian economies, including manufacturing, came under scrutiny, which is why the United Nations Industrial Development Organization (2024) emphasizes SDGs 7, 8, and 9. Since the 2015 Paris Accord at the 21st Conference of Parties, national policies have increasingly been coordinated by the United Nations Convention on Climate Change (UNFCCC).

Circular economies offer the potential for environmental sustainability through the deployment of efficient tools for economic development. The linear

economy model of production follows a take-make-waste approach. In contrast, the circular economy model can adopt product designs and production processes to keep materials in use for extended periods and promote the regeneration of natural systems. Key aspects of the circular economy include reducing natural resource depletion, reusing and recycling, and enhancing resource productivity. Strategies include graduating from medium- to high-value activities, using renewable energy, creating longer product lifespans, and promoting product sharing (World Bank, 2022).

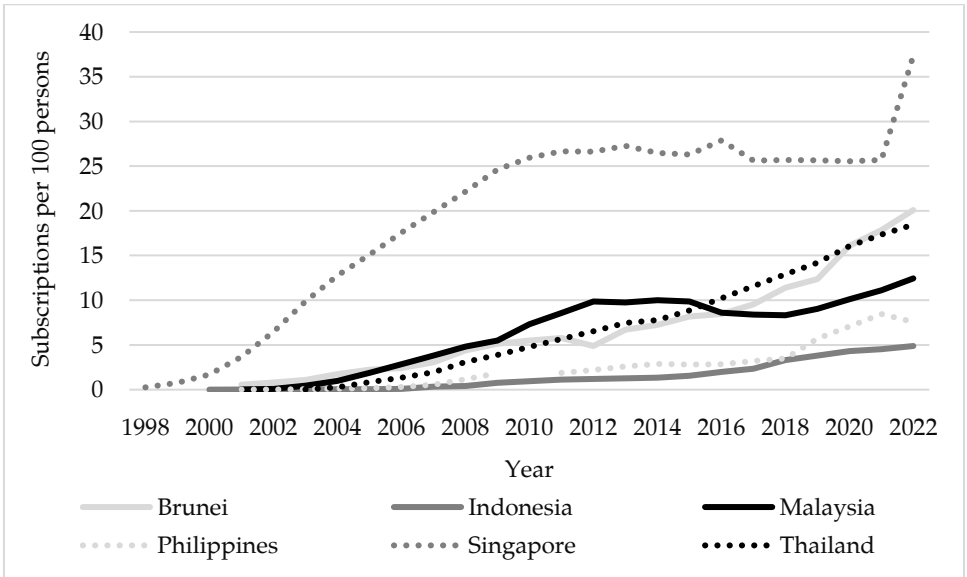
Other macro and sectoral policies that have already been implemented can diminish the feasibility and effectiveness of carbon taxes and emission trading systems. For instance, if current fuel subsidies (petrol, diesel, and cooking gas) in Malaysia remain, the impact of markets in driving the demand for renewable energy is reduced. Therefore, removing current price caps and subsidies would be part of the introduction of effective carbon pricing in the Southeast Asian countries (World Bank, 2023).

As is the case for Singapore, carbon pricing can raise revenues for the development of abatement technologies in other Southeast Asian countries. Carbon taxes can generate revenues for public budgets among all Southeast Asian countries. Emission trading systems can also generate revenues if governments auction traded allowances. The revenues from these methods can be used to fund climate policies for vulnerable households and trade-exposed industries, policies to reduce other taxes, support public expenditure, and reduce national debt levels, and policies to offset the negative impacts of carbon pricing. Therefore, the question of how the revenues are used is crucial for determining the socioeconomic impact of carbon pricing.

Figure 8 shows the proliferation of broadband subscriptions among market economies in Southeast Asia, while Figure 9 shows the transition economies and Timor-Leste.

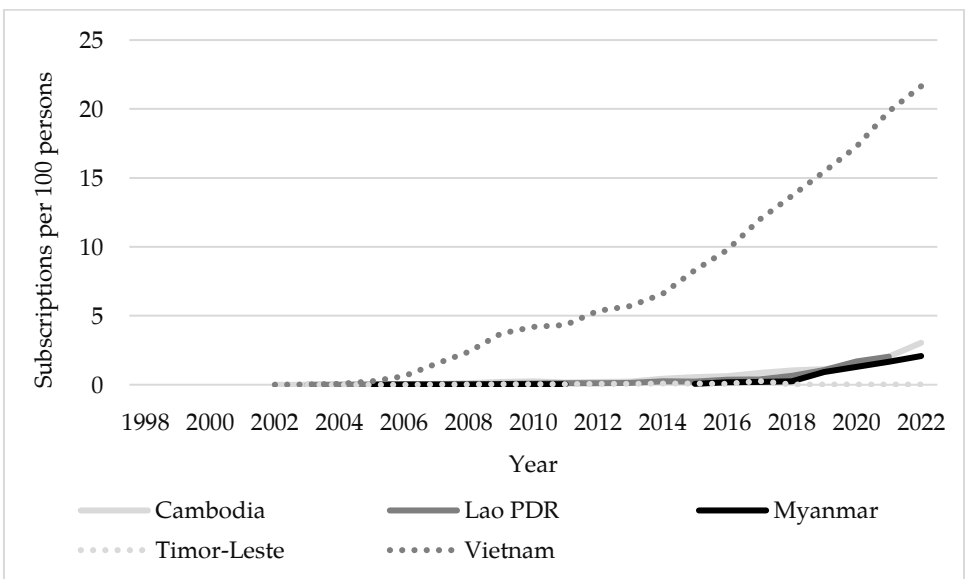
Broadband cable access by itself does not mean that economic agents (individuals and organizations) have acquired IR 4.0 instruments or are using autonomous, artificially powered vehicles to raise productivity, precision, and reach. Nevertheless, it points to the potential for the use of robots and drones powered by big data analytics, IoT, and centralized and decentralized computer control systems.

Figure 8: Fixed broadband subscriptions per 100 persons (market economies) (1998–2022)



Source: Plotted using World Bank (2023) data.

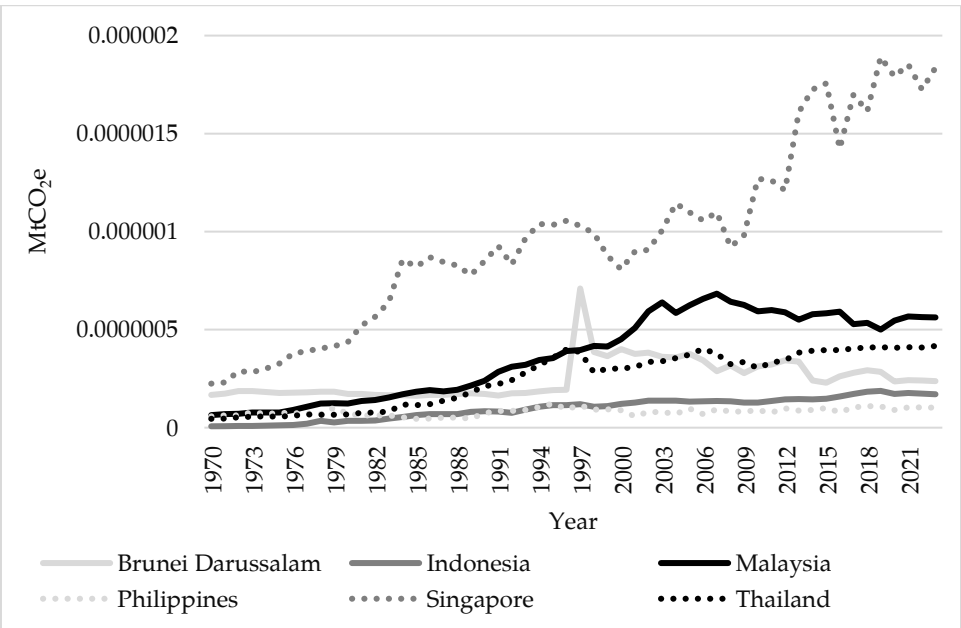
Figure 9: Fixed broadband subscriptions per 100 persons (transition economies) (1998–2022)



Source: Plotted using World Bank (2023) data.

Figures 10 and 11 show carbon dioxide (CO_2) emissions in the Southeast Asian market economies and the transition economies, respectively, which are used here to represent hazardous emissions. Singapore's per-capita CO_2 emissions from industrial processes are the highest in the region, with the trend still rising in the 2020s. The next highest is Malaysia, which has shown a falling trend since 2007. Thailand follows with a slightly rising trend. Brunei Darussalam comes fourth with a falling trend since 1998, followed by Indonesia. The Philippines show the lowest per-capita emissions, but the country has also faced the most drastic deindustrialization (see also Ofreneo, 2025).

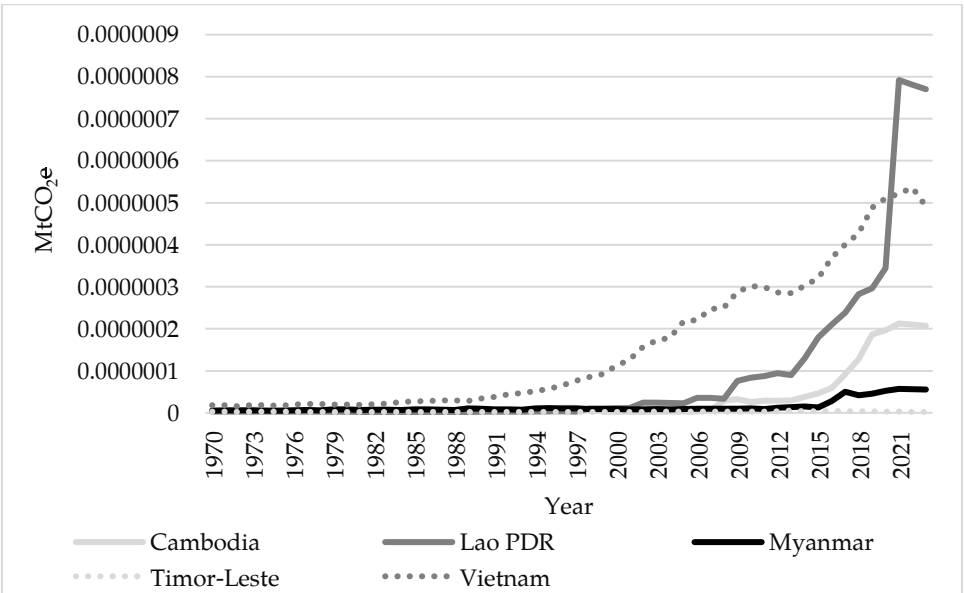
Figure 10: Per-capita CO_2 emissions from industrial processes (market economies) (1970–2023)



$MtCO_2e$ = Million metric tons of CO_2 equivalent.
Source: Calculated from World Bank (2024) data.

Among transition economies, Lao PDR's per-capita industrial process CO_2 emissions grew rapidly from 2007, rising sharply in 2018 and overtaking Vietnam in 2021 to become the highest emitter (Figure 11). Vietnam has since ranked second, followed by Cambodia and Myanmar. Timor-Leste, which has not yet experienced modern industrialization, shows virtually no emissions.

Figure 11: Per-capita CO_2 emissions from industrial processes (transition economies) (1970–2023)



$MtCO_2e$ = Million metric tons of CO_2 equivalent.
Source: Calculated from World Bank (2024) data.

Table 1 shows the carbon net-zero targets of the Southeast Asian market economies and transition economies. Nationally determined contribution carbon net-zero targets are not available for the Philippines and Timor-Leste. The remaining countries demonstrate an active pursuit of achieving carbon net-zero targets.

Table 1: South Asian nationally determined contributions (2024)

Country	Nationally determined contributions	Net-zero target
Brunei Darussalam	Reduce emissions by 20 percent by 2030 (relative to BAU levels)	2050
Cambodia	Increase mitigation ambition with an emission reduction target of 41.7 percent by 2030 (relative to BAU levels)	2050
Indonesia	Unconditionally reduce emissions by 31.9 percent by 2030 (relative to BAU levels), and conditionally by 43.2 percent with foreign aid	2060
Lao PDR	Unconditionally reduce emissions by 60 percent by 2030 (relative to the baseline scenario)	2050

Country	Nationally determined contributions	Net-zero target
Malaysia	Unconditionally cut carbon intensity against GDP by 45 percent by 2030 (compared to 2005 levels)	2050
Myanmar	*Aspirational conditional target:* Achieve net emission reductions of 50 percent by 2030, and net-zero emissions from the forestry and other land-use sector by 2040	2050
Philippines	Reduce and avoid emissions by 75 percent, with 2.71 percent being unconditional (2020–2030)	NA*
Singapore	Reduce emissions to around 60 $MtCO_2e$ by 2030, and aim for net-zero emissions by 2050	2050
Thailand	Unconditionally reduce emissions by 30 percent and conditionally by 40 percent by 2030 (relative to BAU levels)	2065
Timor-Leste	Refraining from setting a quantified emission reduction target	NA*
Vietnam	Increase unconditional contribution from 9 percent to 15.8 percent, and conditional contribution from 27 percent to 43.5 percent by 2030	2050

*The Philippines and Timor-Leste have not yet submitted plans for their nationally determined contributions to the UNFCCC. However, the general discussion internally is on meeting carbon net-zero targets by 2050.
Source: UNFCCC and countries' national policies. See Rasiah & Vijayaraghavan (2025).
BAU = business as usual, GDP = gross domestic product, $MtCO_2e$ = million metric tons of CO_2 equivalent.

Conclusions

Singapore's foreign multinationals led industrialization and participated in high value-added activities through the country's successful use of leveraging strategies (Rasiah, 2020). Other Southeast Asian countries are entrenched in low and medium value-added activities, leaving them trapped as LICs and MICs. Meanwhile, Indonesia, Malaysia, the Philippines, and Thailand have begun to experience premature deindustrialization, with manufacturing value-added shares in GDP falling before sectors can shift to high value-added activities. As a share of value added in GDP, Thailand and Malaysia enjoyed the highest expansion of manufacturing among the countries examined in this paper. However, they have been unable to stimulate upgrading to high value-added activities and have not succeeded in developing national firms capable of reaching the technology frontier.

Singapore has specialized in the high value-added segments of shipbuilding and petrochemicals, where it now enjoys a relative comparative advantage. It has also attracted export-oriented manufacturing driven by TNCs by quickly shifting its industrial specialization to sustain industrial upgrading. Indonesia and the Philippines continue to specialize in low and medium value-added activities, while the transition economies have yet to demonstrate the capacity to move from low to medium value-added activities.

Though Vietnam's industrialization is nascent, it appears to be following the same pattern as Indonesia, Malaysia, and Thailand, which explains why the country has reached middle-income status. While Cambodia, Lao PDR, and Myanmar have shown considerable manufacturing expansion, they are still entrenched in low value-added activities. Timor-Leste is still engaged in sedentary activities with little growth in manufacturing.

The Southeast Asian market economies largely overcame the twin troubles of the fallacy of composition and Dutch Disease. However, the lack of effective policy coordination to avert such problems cost Indonesia, Malaysia, the Philippines, and Thailand considerable resources.

Singapore did not allow such problems to become chronic. Its sophisticated petrochemical, biotechnology, and shipbuilding industries evolved to become world leaders. The lack of scale, as well as related research in its universities, allowed Singapore to reach critical limits in electronics manufacturing. However, the remaining four market economies have populations and land space exceeding that of South Korea and Taiwan. Therefore, the contraction of the manufacturing sector since the turn of the millennium suggests that they are facing premature deindustrialization. While Singapore's textile and clothing, electrical and electronics, and vehicle manufacturing were declining, the 'mission-oriented state' (Mazzucato, 2013) removed their incentives and quickly moved them away from the country. It gradually replaced them with new compatible industries, such as biotechnology, while retaining the shipbuilding and petrochemical industries.

Indonesia, Malaysia, the Philippines, and Thailand have been unable to create an integrated STI infrastructure that can push the transformation of their manufacturing sectors toward the global technology frontier in the manner of South Korea and Taiwan. Singapore remains ahead of these countries through a sophisticated STI infrastructure and the use of a flexible strategy that has continuously renewed the industries required to support a rise in value-added production.

Cambodia, Lao PDR, Myanmar, and Timor-Leste are quite low on the industrialization ladder as their embedding ecosystems remain underdeveloped. Timor-Leste requires an industrial policy focused on rural industrialization and high value-added, scope-based activities, including coffee processing. Cambodia, Lao PDR, and Myanmar can still invest to develop their STI infrastructure. However, Timor-Leste requires external support similar to that of the Pacific Islands Nauru Agreement Concerning Cooperation in the Management of Fisheries of Common Interest (United Nations Industrial Development Organization, 2024). As with tuna fishing, such an agreement can be extended to fish and animal processing and animal feed processing in Timor-Leste.

Overall, industrial policy in the Southeast Asian countries (with the exception of Singapore) should focus on upgrading from low and medium value-added activities to high value-added activities. These countries should emphasize the achievement of SDG 7 (affordable and clean energy), SDG 8 (employment and decent incomes), SDG 9 (industry, infrastructure, and innovation), and SDG 13 (combating climate change).

More specifically, the emphasis on SDG 7 should be on clean renewable energy. The SDG 8 emphasis should be on employment growth and improvements in wages and working conditions, and the SDG 9 emphasis should be on industrial upgrading that strengthens infrastructure, including digital infrastructure, to raise value added in production and accelerate innovation (see also Rasiah, 2025). Emphasis on elements of environmental and social governance and the circular economy to combat climate change (SDG 13) is critical. It would ensure that the Southeast Asian countries restructure their manufacturing and fuel consumption to emphasize the circular economy while replacing fossil fuel and hazardous materials with renewable and clean energy.

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