# EE482 Industrialization: Role of Public and Private Sectors (Section 046401)

# Academic Year 1/2023

## Chapter 10

## Industrial Development in Thailand and Development Directions (Analysis Results by ADB)

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## Introduction

This section presents the results of the analysis on the industrial development in Thailand, summarizing key points from the research conducted by the Asian Development Bank (ADB). The analysis utilizes various tools and methods, such as the use of indices in the form of TiVA, RCA, PRODY, and network analysis, largely aligning with the analytical tools introduced in the previous sections. Therefore, the obtained results serve as a good example of applying these tools to analyze the economic structure of Thailand.

The content predominantly focuses on the issue of technological development, a crucial weak point in the industrial development of Thailand. The analysis includes case studies on the automotive and electronics industries, along with policy recommendations for upgrading the technology of the Thai industry. The details of the content will be presented in the following sequence.

## 10.1 Technological Progress and Limited Technology Transfer in Thailand

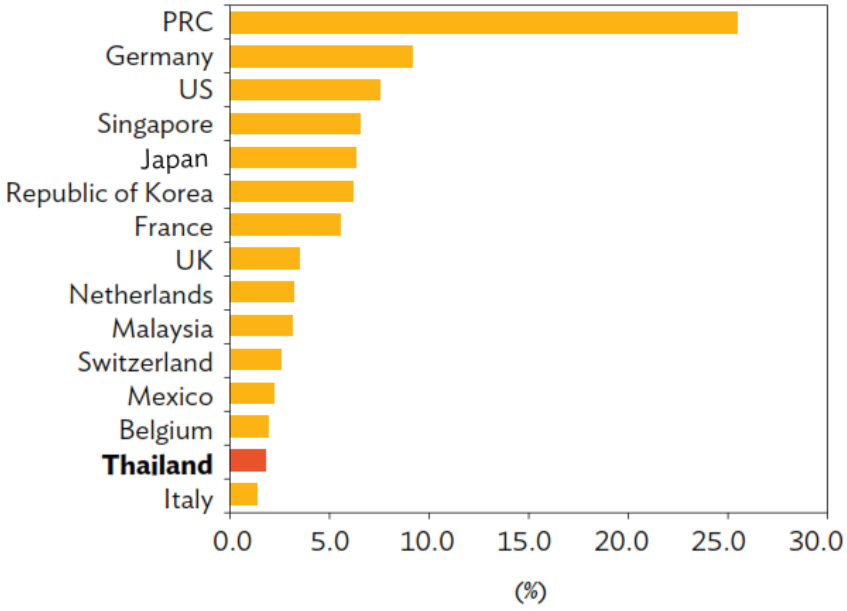
### 10.1.1 Thailand's Dependence on Technology Borrowing Compared to Technology Transfer

According to the analysis by the Asian Development Bank (ADB) in 2015, international companies, including entrepreneurs and component manufacturers, have introduced technology into Thailand for use in the electronics and automotive industries. However, since these technologies result from Foreign Direct Investment (FDI) without backward linkage, they are not considered technology transfer. This means that the acquisition of technology by companies in the country follows the pattern of "technological lending" between the headquarters of the company and its subsidiaries in Thailand. The technological complexity in Thailand is thus based on the technological lending format established by the network linkage nature of production. In the early years of the automotive industry, not only was there a lack of technology transfer, but technological borrowing was also weak. This was due to the simple assembly nature of Completely Knocked Down (CKD) Kits import activities, which involved low-level technology.

### 10.1.2 Case of Thailand in Acquiring Technology and Innovation

In one aspect, Thailand is a leading producer of high-tech products, particularly in automobiles and electronics. It is a major global manufacturer, ranking 12th in the world for expertise in small-sized trucks (or pickup trucks) and is a leading producer of hard disk drives globally. Therefore, Thailand is a significant exporter of high-tech products, ranking 14th in the world (Figure

10.1). International companies contribute significantly by providing technology for this production, dating back to 1980, leading to the utilization of low-cost labor and large domestic markets to develop production clusters.




PRC = People's Republic of China, UK = United Kingdom, US = United States.
Note: The data indicate a country's total share of world exports in high-tech goods.
Source: World Bank. World Development Indicators. http://data.worldbank.org/data-catalog/world-development-indicators (accessed on September 2015).

**Figure 10.1:** Proportion of High-Technology Utilizing Exported Goods

**Source:** ADB (2015)

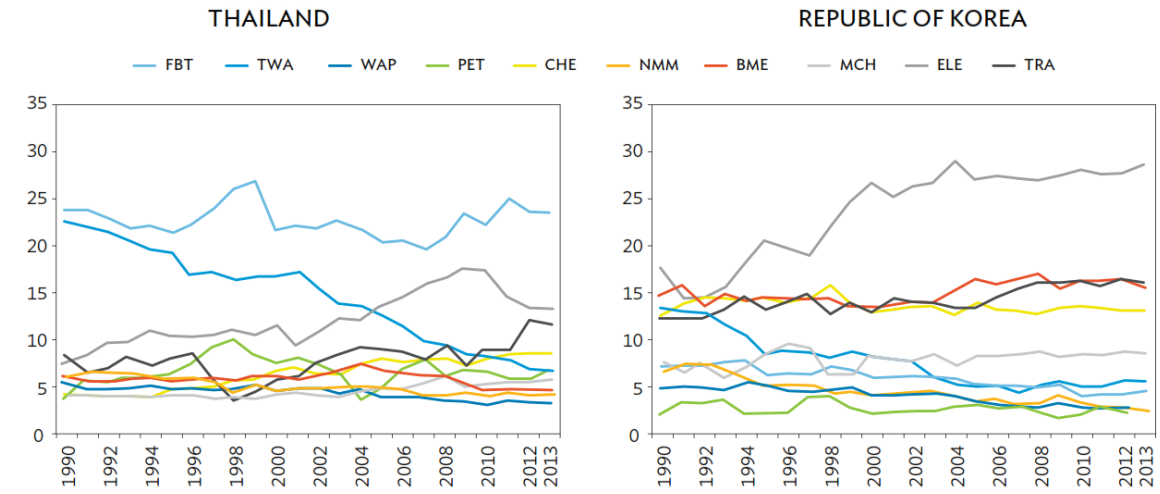
The issue of innovation management needs continuous improvement and development. The technology provided by foreign companies is not widely disseminated to other companies in the country. Meanwhile, businesses in the country invest relatively little in innovation, and research and development are weak. There are few patents registered. The government has established innovation systems through science parks, research funds, and public research institutions, covering various fields from metallurgy and food processing to nanotechnology and biotechnology. However, the impact of these efforts has not been significant.

When measuring the level of technology in Thailand's manufacturing sector, several precautions must be taken. A crucial issue is that the level of technology is not a physically observable or tangible entity. Therefore, there are various attempts to measure this level. In many studies, export data is a vital source for

indicating a country's technological potential internationally. However, export data may not precisely reflect the technology level of domestic operators, as:

1. Technology for exporting goods may be generated and used only by foreign-owned companies.
2. Complex international production processes may result in exported values being mixed with the imported value of technology embedded in raw materials or intermediate goods (as discussed in the topic of Trade in Value Added).

Looking back at the changes in Thailand's economic structure, the structure of industries reflects significant transformations towards high-value-added products. The decreasing proportion of agriculture indicates the increasing complexity of production in Thailand, as illustrated by the changing trend in value-added components in the manufacturing sector (Figure 10.2). The share of labor-intensive manufacturing sectors, such as food and textiles, has continuously declined. Meanwhile, the share of technology-intensive sectors, such as electronics and automobiles, has increased. In 2013, food processing had the highest value-added proportion, accounting for 24% of total production, followed by electronics (13%), transportation (12%), chemicals (9%), and petroleum products (7%).




BME = basic metal and metal fabrication; CHE = chemical products; ELE = electrical and electronic products; FBT = food, beverage, and tobacco; MCH = machinery; NMM = non-metallic materials; PET = petroleum and coal products; TRA = transport equipment; TWA = textile and wearing apparel; WAP = wood and paper products.
Sources: For Thailand: National Economic and Social Development Board. Gross Regional and Provincial Product Database. http://eng.nesdb.go.th/Default.

**Figure 10.2:** Changes in the Industrial Structure of Thailand and South Korea

**Source:** ADB (2015)

The share of the textile and food industries, which are labor-intensive, reached its peak in the mid-1970s and has steadily decreased by less than 5% since then. Currently, although the pattern of structural changes in production may not

significantly differ from other countries, it is worth noting that South Korea still maintains a high proportion of the textile industry until the mid-1980s. This was a crucial mechanism that continuously increased the proportion of labor in the industry. The share of labor-intensive sectors in South Korea rapidly declined later and was replaced by sectors such as electronics, chemicals, and increased automotive production. Simultaneously, the production structure of South Korea changed from attracting labor from low-value-added branches to emphasizing high-value-added branches. Therefore, compared to South Korea, the rapid decline in the proportion of labor-intensive industries in Thailand happened over a shorter period, driven by the expansion of industries in China and Vietnam, putting pressure on Thailand to quickly adjust by reducing the importance of labor-intensive industries.

The significant transformation towards high-value-added products and the reduction of the share from agriculture and basic resources can be observed in export data using the Standard International Trade Classification (SITC). The share of agriculture and raw materials (SITC 1-4) decreased from 61.4% in 1980 to 18.2% in 2013 (Table 10.1). Although Thailand still focuses on exporting agricultural products, it is noticeable that the share of SITC 7 (relatively complex industrial products) is 46.8%, indicating a shift towards more complex industrial products. This is in contrast to South Korea and Taiwan, which developed exports by changing the major export products from light industries (SITC 6 and 8) to heavier and more complex industrial products (SITC 7).

The presented data shows that the current structure of exported products manufactured in Thailand has undergone significant development. When considering income levels that correspond to those of South Korea and Taiwan, in the early 1980s, on the one hand, it may be due to the growth of Thailand's export industry through expanding global production networks. On the other hand, the decline of the textile industry, pressured by competition from other countries with lower labor costs, has also played a role. Textiles and clothing had a proportion of approximately 9.2% and were among the top exported products of Thailand in 1991 but decreased to 5.9% in 2000 (Table 10.2). Nevertheless, in the subsequent period, the textile and clothing industry lost its share of exports to the automotive, machinery, and electronics industries, disappearing from the top 10 industries for exports in 2013.

| SITC Description | Thailand | | Republic of Korea | | Taipei,China | |
|---|---|---|---|---|---|---|
| | 1980 | 2013 | 1980 | 2013 | 1980 | 2013 |
| Food, beverages, and tobacco (0,1) | 44.0 | 11.9 | 7.1 | 1.0 | 9.7 | 0.8 |
| Crude materials and animal oils (2,4) | 17.4 | 6.3 | 2.1 | 1.3 | 2.0 | 1.1 |
| Mineral fuels (3) | 0.1 | 1.2 | 0.5 | 0.9 | 0.6 | 0.2 |
| Chemicals (5) | 1.2 | 10.6 | 3.4 | 12.2 | 3.0 | 10.6 |
| Manufactured goods and miscellaneous articles (6,8) | 31.4 | 21.3 | 70.3 | 22.5 | 60.4 | 29.4 |
| Machinery and transport equipment (7) | 5.6 | 46.8 | 15.8 | 60.9 | 23.8 | 63.6 |
| Unclassified (9) | 0.3 | 1.9 | 0.7 | 1.1 | 0.5 | 1.2 |

SITC = Standard International Trade Classification.
Note: The items are aggregated into 1-digit level based from the 4-digit levels of the SITC revision 2.
Source: Estimates using data from UN Comtrade Database. http://comtrade.un.org/ (accessed June 2015).

**Table 10.1:** Share of Agriculture and Raw Materials in Exports (SITC 1-4)

**Source:** ADB (2015)

| 1990 | | 2000 | | 2013 | |
|---|---|---|---|---|---|
| Seafood | 10.4 | Office machines | 15.1 | Road vehicles | 11.5 |
| Garments | 9.2 | Electrical machinery | 13.8 | Office machines | 11.4 |
| Other manufactures | 7.7 | Telecommunications, etc. | 6.8 | Electrical machinery | 10.9 |
| Electrical machinery | 7.0 | Seafood | 6.1 | Telecommunications, etc. | 5.0 |
| Office machines | 6.8 | Garments | 5.9 | General machinery | 4.9 |
| Vegetables and fruit | 6.7 | Other manufactures | 4.4 | Artificial resins and plastic | 4.7 |
| Non-metallic minerals | 5.1 | Road vehicles | 3.3 | Crude rubber | 4.0 |
| Cereals | 4.7 | Non-metallic minerals | 3.2 | Other manufactures | 3.9 |
| Telecommunications, etc. | 4.4 | General machinery | 3.2 | Rubber products | 3.3 |
| Crude rubber | 4.3 | Artificial resins and plastic | 3.1 | Seafood | 3.0 |

Source: Estimates using data from UN Comtrade Database. http://comtrade.un.org/ (accessed June 2015).

**Table 10.2: S**hare of Textiles and Clothing in Total Exports

**Source:** ADB (2015)

The trend of Revealed Comparative Advantage (RCA), as indicated by Thailand's export structure (Figure 10.3), reflects the potential of production sectors. Experiences in East Asia show that the general pattern of export development begins with light industries that are labor-intensive. This occurs concurrently with the rapid decline of agricultural or natural resource products, shifting towards more complex products. However, it can be observed that even Japan maintained a comparative advantage in SITC 6 and 8 until the mid-1980s, while South Korea and Taiwan continued to retain comparative advantages in these categories until the 1990s.

Comparing Thailand's export development in terms of RCA with these three countries, it is evident that Japan, South Korea, and Taiwan underwent rapid changes in exports in SITC 6 and 8, while Thailand began experiencing changes in the 1980s. However, Thailand's export development in the RCA dimension differs from the other three countries. While Japan, South Korea, and Taiwan quickly changed their exports in the SITC 6 and 8 categories, Thailand took a different path. The country's export development in terms of RCA started in the

1980s but differed from the other three countries, which experienced rapid changes in the export structure in SITC 6 and 8. Meanwhile, Japan, South Korea, and Taiwan retained their comparative advantages in SITC 6 and 8 for a more extended period.

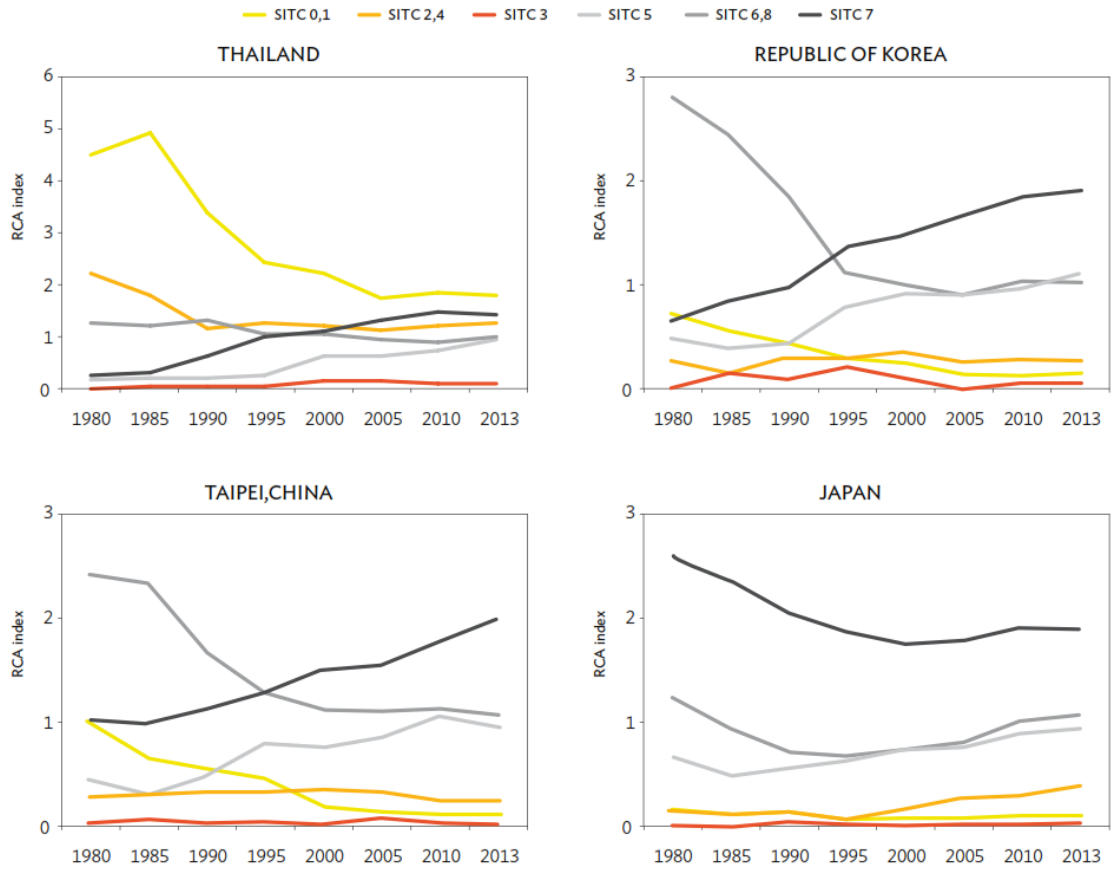



**Figure 10.3** Changes in Export Structure by Assessing RCA

**Source:** ADB (2015)

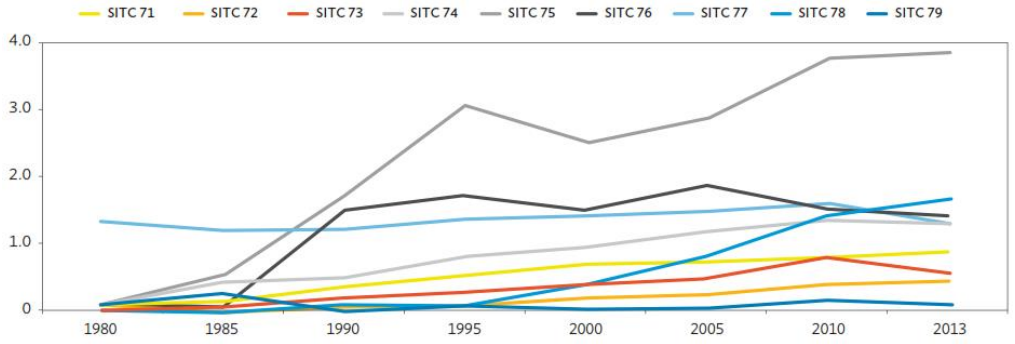
The fact that Japan, South Korea, and Taiwan have maintained their exports in SITC 6 and 8 for a more extended period allows them to continuously expand job creation in the manufacturing sector for a more extended period compared to Thailand. Another distinctive feature of Thailand is the increase in SITC 7 stimulated by foreign direct investment (FDI). The RCA of major items in SITC 7 indicates that Thailand has a comparative advantage in office equipment and transportation. Japan has a comparative advantage in most items in SITC 7, except for office machinery and other transport equipment. When considering the details of products in SITC 7, South Korea has a significant comparative advantage in SITC 76 and 77 due to the mobile phone industry and household appliances.

**Table 10.3:** Proportion of Category 7 Exports for Thailand, South Korea, and Japan

| SITC Code | Commodity Classification | Thailand | Republic of Korea | Japan |
|---|---|---|---|---|
| 71 | Power-generating machinery and equipment | 0.86 | 0.79 | 1.97 |
| 72 | Machinery specialized for particular industries | 0.39 | 1.38 | 2.85 |
| 73 | Metalworking machinery | 0.58 | 1.58 | 4.68 |
| 74 | General industrial machinery and equipment | 1.35 | 1.14 | 1.74 |
| 75 | Office machines and automatic data processing equipment | 3.84 | 0.92 | 0.54 |
| 76 | Telecommunications, sound recording, and reproducing equipment | 1.35 | 2.80 | 0.89 |
| 77 | Electric machinery, apparatus, and appliances | 1.29 | 2.88 | 1.74 |
| 78 | Road vehicles | 1.62 | 1.67 | 2.99 |
| 79 | Other transport equipment | 0.06 | 1.15 | 0.70 |

SITC = Standard International Trade Classification.
Note: The items are aggregated into 2-digit levels based from 4-digit levels in SITC revision 2.
Source: Estimates using data from UN Comtrade Database. http://comtrade.un.org/ (accessed June 2015).

**Source:** ADB (2015)




SITC = Standard International Trade Classification.
Note: Commodity classification of SITC 71–79 provided in Table 2.3.
Source: Estimates using data from UN Comtrade Database. http://comtrade.un.org/ (accessed June 2015).

**Figure 10.4:** Changes in export structure by assessing the RCA value of category 7

**Source:** ADB (2015)

In Thailand's SITC 7 product categories, including office equipment and electronics (SITC 75) and transportation, including pickup trucks (SITC 78), there is a rapid increase in terms of RCA values (Figure 4). It can be observed that RCA in the export of machinery and general industrial equipment continuously rises. The trend of export development correlates with the increasing income level of the country, indicating the expansion of export quantity and the diversification of products into new items in SITC 7, aligning with Thailand's normal trend of increasing the role of new industries in production and employment.

In the manufacturing sector, there is evidence that Thailand has shifted from exporting components to producing higher-value final products. Figures 10.5 and

10.6 illustrate the evolution of components and parts of final products as a share of trade in goods produced. In the 1990s, as Thailand was establishing industries assembling automobiles and electronics, the proportion of exported components and parts increased accordingly. However, this component and part share started declining again in the late 2000s as the country shifted towards producing higher-value final products. While measuring the overall complexity of an economy is not a straightforward task, researchers have recently developed techniques using export data at the industry level to create representative indices for a country's production capabilities.

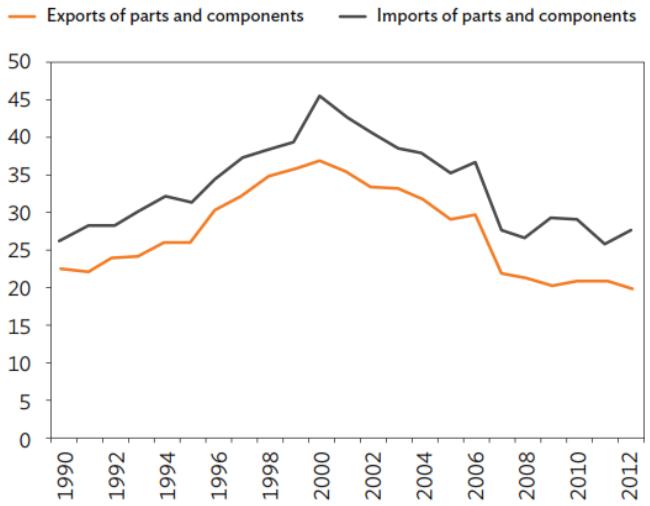



**Figure 10.5:** Export and import of automotive components

**Source:** ADB (2015)

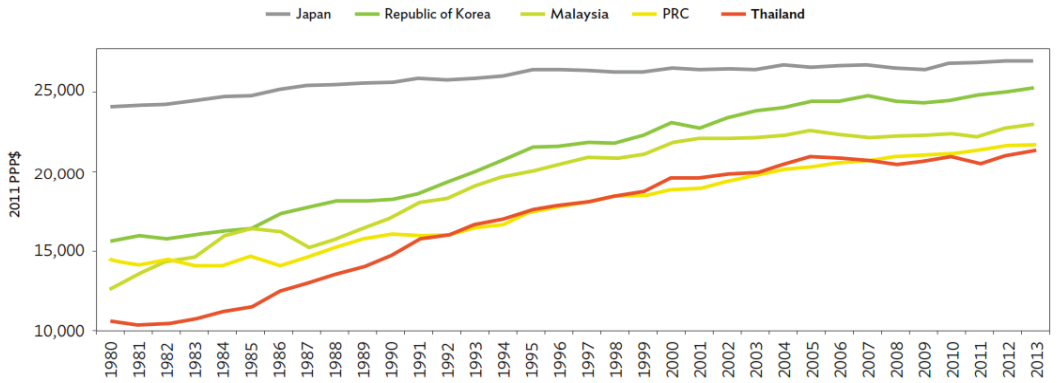

**Figure 10.6:** Export and import of automotive components

**Source:** ADB (2015)

These indicators demonstrate the complexity of each product, considering comparisons based on the income level of successful exporting countries. The underlying assumption is that countries with higher incomes export more technologically advanced and complex products. The Product Complexity Index (PRODY) is calculated as the GDP per capita divided by the RCA value for each country. The PRODY index for a particular country can be estimated, representing the weighted sum of PRODY for all products that the country exports. This overall complexity score provides in-depth information about a country's production capabilities. A higher score indicates greater complexity and a higher level of economic advancement.

Thailand's export complexity has been consistently increasing since the 1980s (Figure 10.7). However, in the mid-2000s, this growth rate started to decline due to intensified competition from China's exports and increased volatility from high-income countries, particularly during the global financial crisis. In reality, Thailand's export complexity began decreasing from the year 2008 onward. Although there was a slight increase from 2013 onward, it remained close to that of China, indicating that Thailand may have lost some factors or potential for cost reduction and economic growth during this period. Export complexity in Thailand still lags behind other Asian economies with moderate to high income levels.

**Figure 10.7:** Product Complexity Index (PRODY) of exported goods




PPP = purchasing power parity, PRC = People's Republic of China.
Note: Figures represent trends in the (PRODY) index.
Source: Estimates using data from UN Comtrade Database. http://comtrade.un.org/ (accessed June 2015).

**Figure 10.7:** Product Complexity Index (PRODY) of exported goods

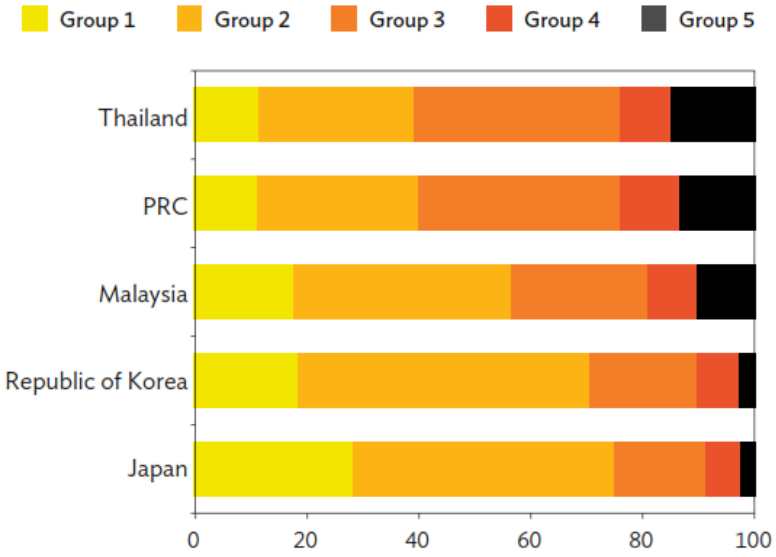
**Source:** ADB (2015)

While Thailand's overall export sector has become more technologically sophisticated, the country still emphasizes exporting industrial products with less advanced technology. More than 60% of Thailand's exports fall into PRODY index groups 3, 4, and 5, which are close to China but less technologically complex than Malaysia. Thailand has seen a significant increase in the export of

high-tech products (groups 1 and 2) since 1980 (see Figure 10.9). The trade imbalance of high-tech products in Thailand has significantly decreased (see Figure 10.10). In general, these facts indicate that Thailand has the potential to elevate its export of high-tech products.

However, data suggests that Thailand faces challenges competing with China, which has a much larger economy. Thailand has increased the diversity of exported goods since 1980, but its export variety still lags behind other East Asian countries, especially Japan and South Korea. Among the top five countries, Japan has the highest diversity of exported goods (see Figure 10.11). Export diversity is an indicator of technological competitiveness, implying that countries capable of efficiently applying technology can maintain their competitive edge internationally.

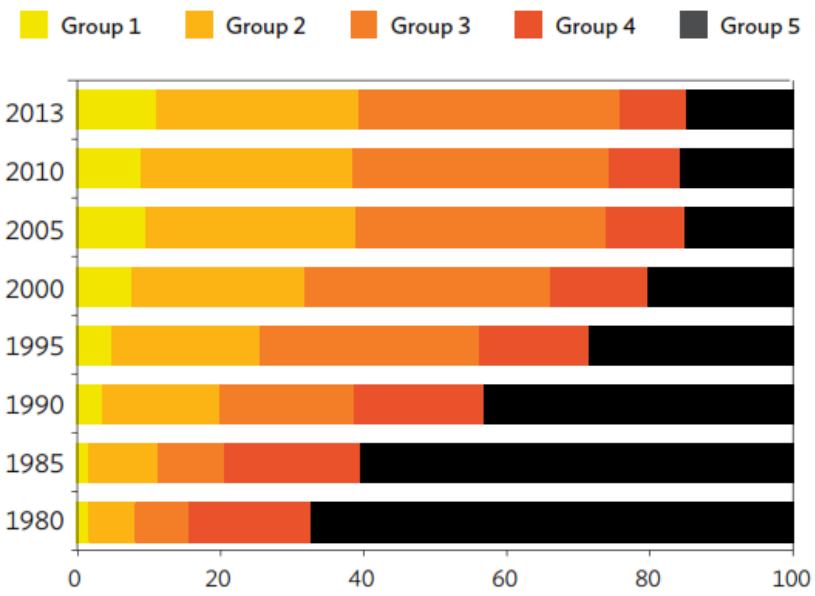
One of the indicators for export diversity and international competitiveness is the number of products with at least a 1% market share globally. Thailand has tripled the number of products with a 1% market share since 1980, especially between 1985 and 1995.




PRC = People's Republic of China.
Note: Groups are based on quintiles of sophistication level of products (PRODY). Group 1 = PRODY ≥ 28,900; Group 2 = 28,900 > PRODY ≥ 23,100; Group 3 = 23,100 > PRODY ≥ 17,600; Group 4 = 17,600 > PRODY ≥ 10,730; and Group 5 = PRODY < 10,730.
Source: Calculations using data from UN Comtrade Database. http://comtrade.un.org/ (accessed June 2015).

**Figure 10.8:** The potential in technology and export analysis using the PRODY index

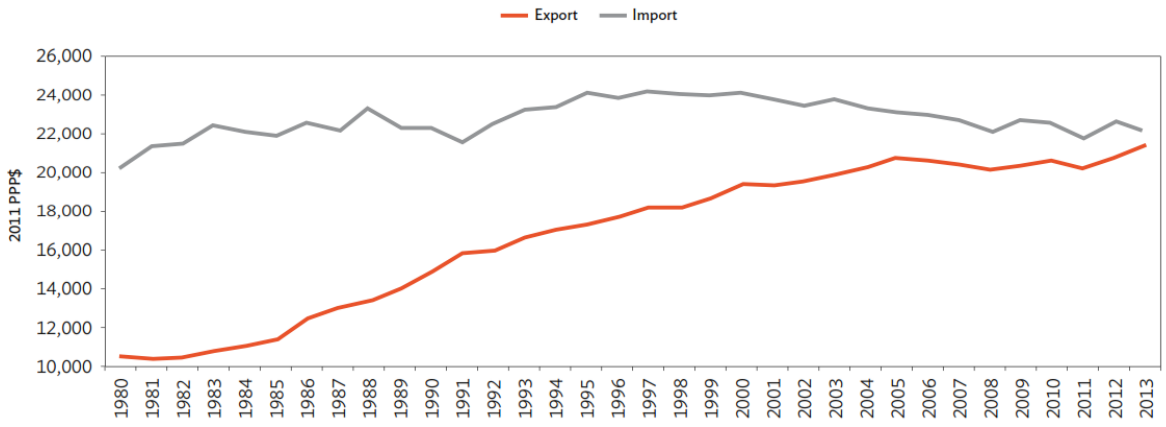
**Source:** ADB (2015)




Note: Groups are based on quintiles of sophistication level of products (PRODY). Group 1 = PRODY ≥ 28,900; Group 2 = 28,900 > PRODY ≥ 23,100; Group 3 = 23,100 > PRODY ≥ 17,600; Group 4 = 17,600 > PRODY ≥ 10,730; and Group 5 = PRODY < 10,730.
Source: Calculations using data from UN Comtrade Database. http://comtrade.un.org/ (accessed June 2015).

**Figure 10.9:** Thailand's Technological Potential and Export Analysis using the PRODY Index

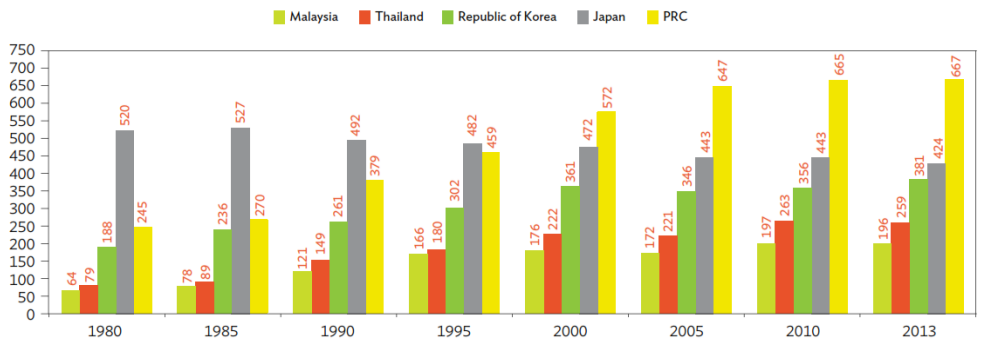
**Source:** ADB (2015)




PPP = purchasing power parity.
Source: Calculations using data from UN Comtrade Database. http://comtrade.un.org/ (accessed June 2015).

**Figure 10.10:** Thailand's Technological Potential and Export-Import Analysis using the PRODY Index

**Source:** ADB (2015)




PRC = People's Republic of China.
Source: Calculations using data from UN Comtrade Database. http://comtrade.un.org/ (accessed June 2015).

**Figure 10.11:** Number of Products with at Least a 1% Market Share Globally

**Source:** ADB (2015)

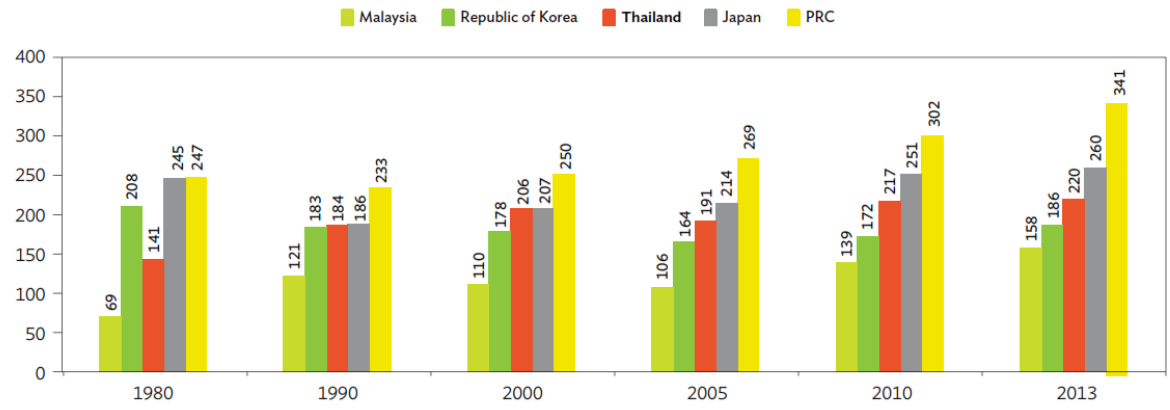
In terms of the diversity of exported products by each product group (Table 10.4), Thailand has the highest diversity in the export of food and live animals (SITC 0). However, the level of diversity in the export of manufactured materials, including machinery and transport equipment (SITC 7), remains significantly lower compared to other countries. This indicates opportunities for Thailand to promote exports in these areas. Thailand demonstrates good diversity in exported products in SITC 5 and SITC 8 (which includes consumer goods in light industries) even though the number of products is less than that of Japan and Korea, which are significantly important. In this context, investing in exports in other industrial sectors, such as the chemical industry (SITC 5) and light industry (SITC 6 and 8), is an important option to help increase the diversity of exported products, focusing on industries with intensive capital and advanced technology in other SITC categories.

**Table 10.4** Diversity of exported products by counting the number of products with a global market share exceeding 1%

| | | Number of Goods with 1% Global Market Share | | |
|---|---|---|---|---|
| SITC Code | SITC Description | Japan | Republic of Korea | Thailand |
| 0 | Food and animals | 8 | 12 | 31 |
| 1 | Beverage and tobacco | 1 | 3 | 2 |
| 2 | Crude materials | 22 | 20 | 23 |
| 3 | Mineral fuels | 9 | 7 | 7 |
| 4 | Animal oils and fats | 3 | 0 | 5 |
| 5 | Chemicals | 80 | 63 | 31 |
| 6 | Manufactured materials | 128 | 126 | 78 |
| 7 | Machinery and transport equipment | 126 | 112 | 55 |
| 8 | Miscellaneous manufactured articles | 45 | 36 | 26 |
| 9 | Unclassified | 2 | 2 | 1 |
| | Total | 424 | 381 | 259 |

SITC = Standard International Trade Classification.
Note: Commodities are classified at the 4-digit SITC.
Source: Calculations using data from UN Comtrade Database. http://comtrade.un.org/ (accessed June 2015).

**Source:** ADB (2015)

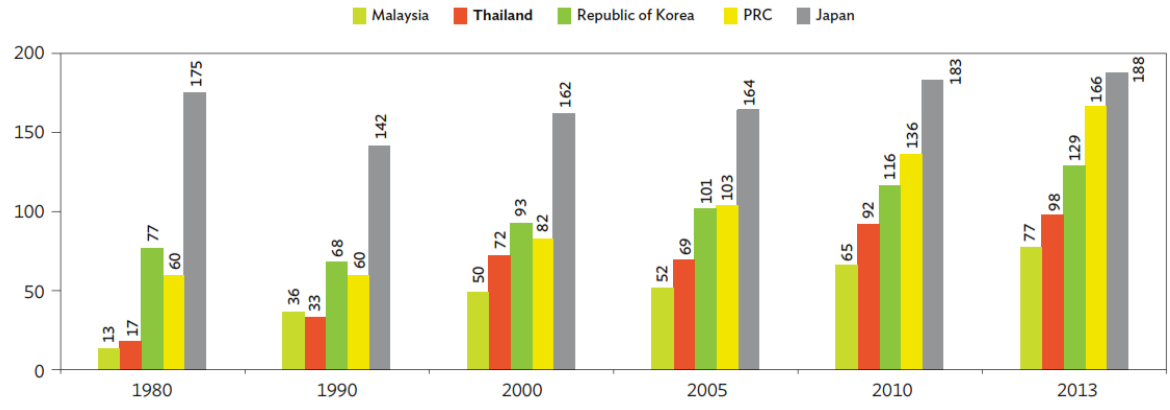



PRC = People's Republic of China, RCA = revealed comparative advantage.
Source: Calculations using data from UN Comtrade Database. http://comtrade.un.org/ (accessed June 2015).

**Figure 10.12:** Number of products with RCA greater than 1.0

**Source:** ADB (2015)

The indicator for the level of diversity of exported products and competitiveness on the international level is the number of products with a Revealed Comparative Advantage (RCA) greater than 1.0. Between 1980 and 2013, Thailand was able to increase the number of products with an RCA greater than 1.0 from 141 to 220 types. Although Thailand still lags behind China and Japan, it surpasses Malaysia. The main products for Thailand, including machinery, chemicals, and textiles, saw a sixfold increase in RCA between 1980 and 2013. However, the RCA remains lower than that of China, Japan, and Korea (Figure 10.13)




PRC = People's Republic of China, RCA = revealed comparative advantage.
Notes: Core products include machinery, chemicals, and metallurgy. Most of these products have high technological sophistication.
Source: Calculations using data from UN Comtrade Database. http://comtrade.un.org/ (accessed June 2015).

**Figure 10.13:** Number of products with RCA greater than 1.0 (specifically industrial products using advanced technology)

**Source:** ADB (2015)

Thailand has made satisfactory progress, starting as a subcontractor for international companies. It is evident that borrowing technology from foreign manufacturers has helped Thailand develop industries and become a significant exporter of high-tech products. However, there are limitations to technology transfer from foreign investors:

1. The first limitation is that borrowing technology from foreign investors has led to limited development in industries, confined to a narrow scope. This means the country has a few industries using advanced technology, while the overall economy does not extensively adopt high-tech.
2. The second limitation is that foreign investors may withhold technology transfer or withdraw investments in industries using advanced technology if they decide to relocate production to countries with lower costs.
3. The final limitation is that Thailand may fail in research and development to increase the value of its products.

The first and third limitations are challenges faced by Thailand currently, while the second limitation is becoming a reality. However, limitations may still exist in low-value-added manufacturing due to the ASEAN Free Trade Area and economic cooperation plans in the Greater Mekong Subregion, as evident from Figures 10.14 and 10.15. The economic structure of Thailand has continuously changed, with an increasing proportion of industrial output. Nevertheless, as shown in Figure 10.16 and Table 10.5, the proportion of Domestic Value Added (DVA) has consistently decreased, indicating a continuous reduction in the value created within the country.

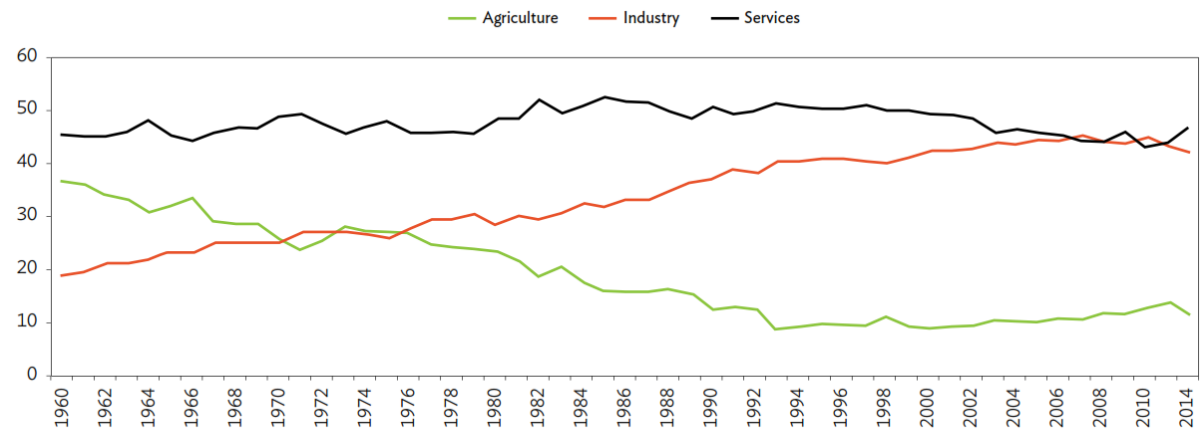



**Figure 10.14:** Changes in the structure of Thailand's economic system.

**Source:** ADB (2015)

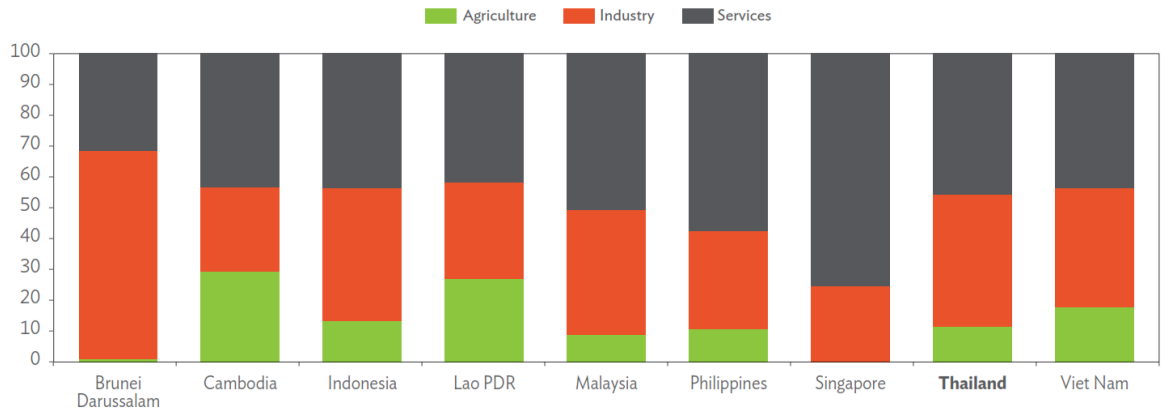
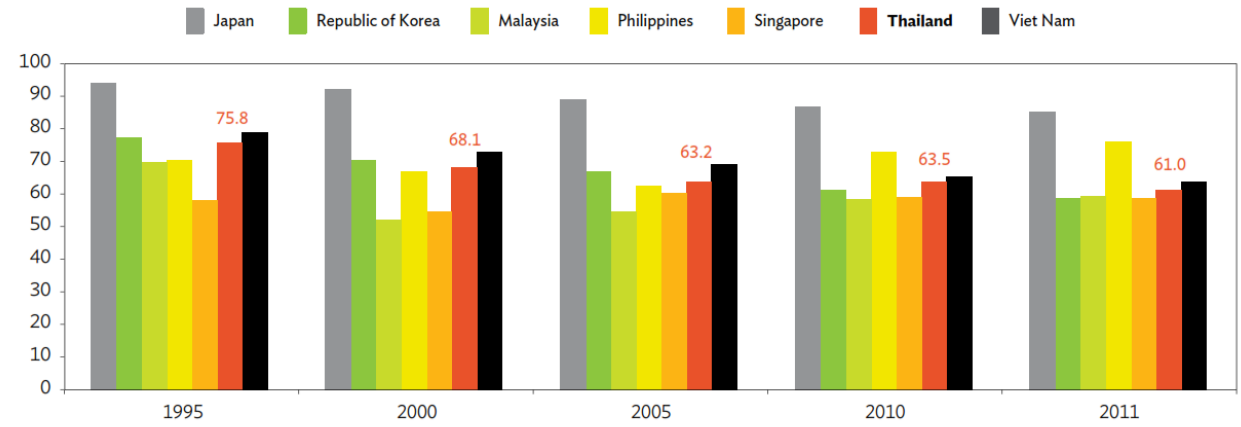



**Figure 10.15:** Changes in the structure of the economic system of countries in ASEAN.

**Source:** ADB (2015)




Source: OECD.iLibrary. OECD.Stat. http://www.oecd-ilibrary.org/economics/data/oecd-stat_data-00285-en (accessed August 2015).

**Figure 10.16:** Proportion of Domestic Value Added (DVA) to the export value.

**Source:** ADB (2015)

**Table 10.5:** Proportion of Domestic Value Added (DVA) to Thailand's export value.

| Industry | 1995 | 2000 | 2005 | 2010 | 2011 |
|---|---|---|---|---|---|
| **Total** | **75.71** | **68.08** | **63.16** | **63.43** | **61.01** |
| **Agriculture, hunting, forestry, and fishing** | **90.44** | **86.76** | **83.53** | **83.64** | **81.91** |
| **Mining and quarrying** | **89.92** | **89.12** | **84.15** | **84.78** | **82.48** |
| **Total Manufactures** | **68.23** | **60.35** | **55.52** | **55.16** | **51.66** |
| Wood, paper, paper products, printing, and publishing | 75.52 | 75.90 | 70.28 | 66.49 | 61.40 |
| Chemicals and non-metallic mineral products | 71.24 | 64.14 | 59.32 | 60.05 | 55.41 |
| Coke, refined petroleum products, and nuclear fuel | 70.44 | 53.37 | 38.51 | 44.02 | 40.56 |
| Rubber and plastics products | 72.76 | 67.68 | 64.79 | 66.05 | 62.60 |
| Other non-metallic mineral products | 74.88 | 70.69 | 61.51 | 65.24 | 59.90 |
| Basic metals and fabricated metal products | 52.94 | 56.54 | 43.89 | 42.46 | 37.23 |
| Machinery and equipment, nec | 51.69 | 53.28 | 47.95 | 51.59 | 44.38 |
| Electrical and optical equipment | 51.40 | 40.66 | 39.88 | 41.68 | 37.51 |
| Computer, electronic, and optical equipment | 51.05 | 39.09 | 37.36 | 39.27 | 34.75 |
| Electrical machinery and apparatus, nec | 52.90 | 45.87 | 46.78 | 50.02 | 46.58 |
| Transport equipment | 51.81 | 48.75 | 49.44 | 50.58 | 45.12 |
| **Electricity, gas, and water supply** | **82.54** | **77.39** | **63.23** | **67.21** | **62.49** |
| **Construction** | **71.80** | **64.17** | **54.27** | **58.04** | **52.67** |
| **Total Business Sector Services** | **88.53** | **84.25** | **80.72** | **82.12** | **80.44** |
| Transport and storage, post, and telecommunication | 83.86 | 75.18 | 69.45 | 71.58 | 68.96 |
| **Community, social, and personal services** | **80.15** | **75.72** | **74.74** | **75.00** | **71.30** |

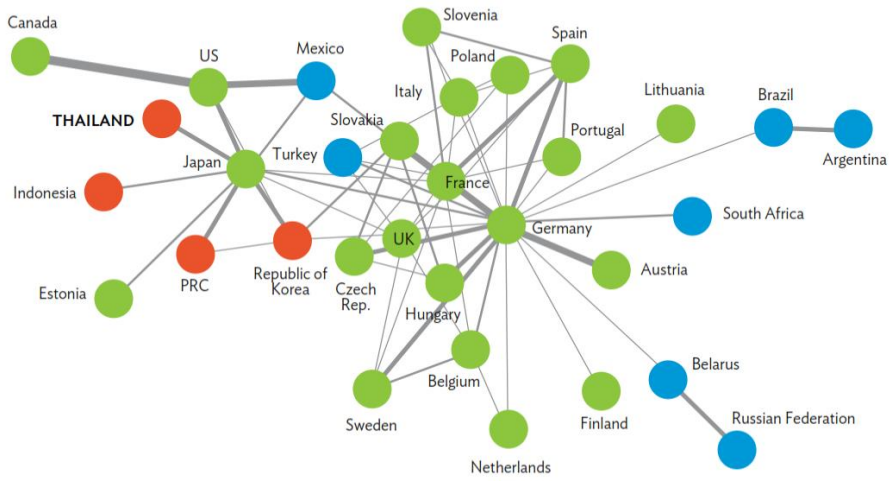
...nec = not elsewhere classified.
Source: OECD iLibrary. OECD.Stat. http://www.oecd-ilibrary.org/economics/data/oecd-stat_data-00285-en (accessed August 2015).

**Source:** ADB (2015)

## 10.2 Case Study: Automotive Industry

The automotive industry in Thailand possesses several distinctive features. There are a total of 18 contract manufacturing companies for automobiles in the country, all of which are foreign-owned, with no domestically-owned automotive companies (Board of Investment, 2015). Thailand produces 1.5 million cars annually, with half being cars from Japanese automotive manufacturers. Of the total car production, 54% are pickup trucks (Tractus Thailand, 2014).

Thailand initially served as a center for automotive assembly for foreign companies, supported by the government to promote exports and direct foreign investment. The automotive industry utilizes both components produced domestically and those imported from abroad. Unlike the electronics industry, Thailand is more involved in exporting and manufacturing electronic components rather than being the final assembler of electronic products. Figure 10.17 (Ferrarini, 2011) illustrates Thailand's position in the global and regional automotive industry, indicating a significant relationship with Japan.

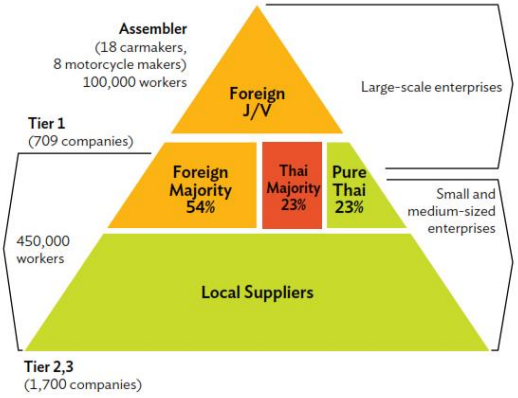



PRC = People's Republic of China, UK = United Kingdom, US = United States.
Source: B. Ferrarini. 2011. Mapping Vertical Trade. *ADB Economics Working Paper Series* No. 263. Manila: Asian Development Bank.

**Figure 10.17:** Global Production Network of the Automotive Sector

**Source:** ADB (2015)

Due to the complexity of the automotive industry, which requires a large and diverse array of components, maintaining quality and trust with component manufacturers is crucial for the production of complete cars. In Thailand, tier 1 automotive component manufacturers are primarily foreign-owned, with foreigners holding the majority of shares in 54% of the total 709 companies. Meanwhile, in 23% of the total 709 companies, Thai nationals are the majority shareholders. However, Thai-majority-owned companies often have partnerships with foreign shareholders who provide technology transferred from parent companies.




J/V= joint venture.
Source: Thailand Board of Investment. 2015. Thailand: Global Green Automotive Production Base. http://www.boi.go.th/upload/content/BOI-brochure%202015-automotive-20150325_70298.pdf

**Figure 10.18:** Structure of the Automotive Sector.

**Source:** ADB (2015)

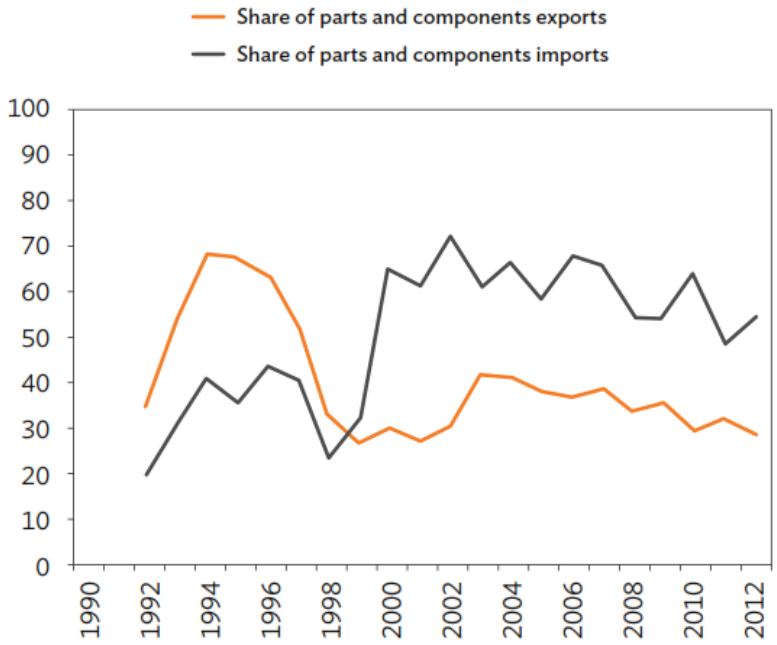



**Figure 10.19:** Proportion of Imports and Exports of Automotive Components.

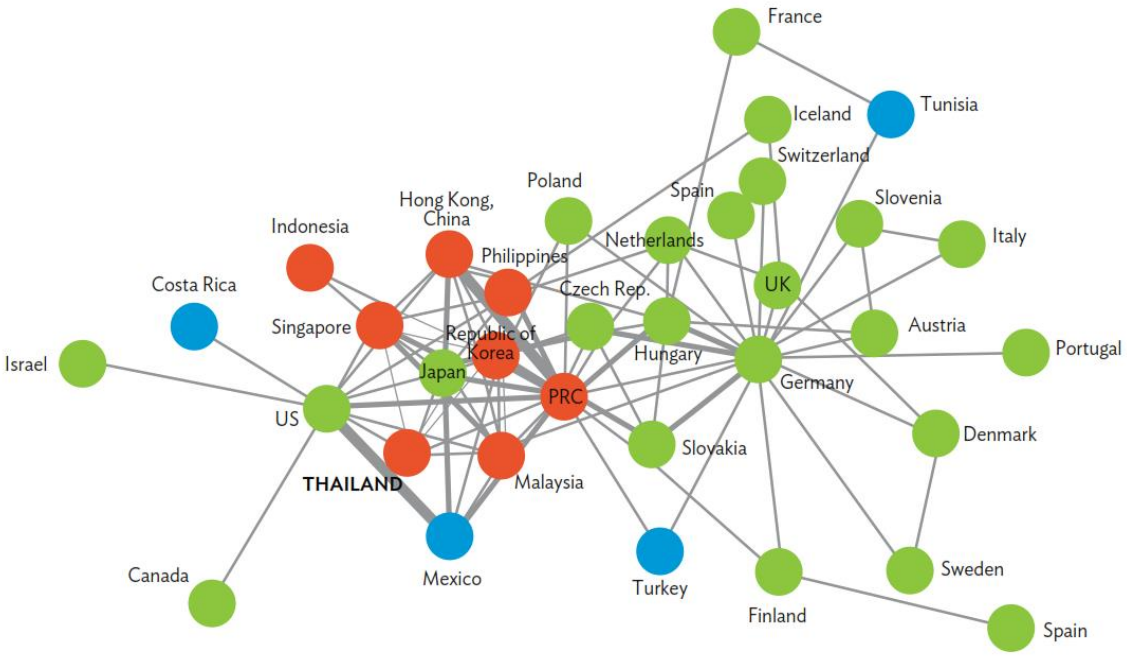
**Source:** ADB (2015)

Remaining manufacturing companies, comprising 23%, are entirely Thai-owned. Some companies have successfully elevated themselves to become reputable Tier 1 automotive component manufacturers with the capability to export to other countries. Examples include AAPICO Hitech and the Summit Group. Companies that supply basic components at a lower technological complexity level to higher-tier suppliers (Tier 2 companies) are all Thai-owned. The typical pattern in Thailand's automotive industry is that contract manufacturing companies choose to collaborate with a few high-quality component manufacturers located in the same or nearby industrial estates. Product development follows a top-down system, where automotive component manufacturers respond to the requirements of higher-tier suppliers. This management approach often results in a lack of collaborative innovation or internal innovation within the companies.

Product development in the automotive industry in Thailand tends to involve minor adjustments based on the innovations of parent companies to suit the local market's demands. Therefore, research and development in Thailand's automotive industry are significantly limited. Foreign contract manufacturers and Tier 1 automotive component manufacturers do not typically share or assist in developing technological capabilities with Thai companies. Thai-owned companies, even those with majority Thai ownership, often have partnerships with foreign shareholders who transfer technology from the parent companies.

## 10.3 Case Study: Electronics Industry

Technology in Thailand's electronics industry is operated by foreign nationals, similar to the automotive industry. Foreigners lend technology for high-level production to Thailand. Electronics products, like automotive ones, are highly complex, necessitating the formation of production networks at regional and global levels. Thailand's electronics industry is closely linked to production processes at the regional level, particularly with China and Japan. There are clear connections at a lower level with South Korea, Malaysia, Singapore, and the United States. Thailand has the potential to increase the complexity of electronics production further. Over the past three decades, Thailand has seen a rise in the complexity of electronics production, mainly due to foreigners "lending" high-level technology through internal corporate networks




PRC = People's Republic of China, UK = United Kingdom, US = United States.
Source: B. Ferrarini 2011. Mapping Vertical Trade. *ADB Economics Working Paper Series*. No. 263. Manila: Asian Development Bank.

**Figure 10.20:** Global Production Network of the Electronics Sector

**Source:** ADB (2015)

However, high-value components in the value chain are produced elsewhere and imported from foreign countries. In Thailand's electronic equipment sector, the production of hard disk drives has become the world's number one, hosting major global players. The industry was established when Seagate moved its labor-intensive assembly focus from Singapore to Thailand in 1983, taking advantage of lower labor costs. This trend, seen with other international companies operating in Thailand, resulted in an increase from 5 companies in the mid-1980s to 74 companies in the mid-2000s (Kohpaiboon and Poapongsakorn, 2011).

Unlike the automotive sector, the government has not set a minimum proportion of domestic component usage for the electronics sector. Coupled with a continuous policy of reducing import taxes on components, this allows components to be freely imported and exported. High-value components are manufactured elsewhere, especially in the surrounding areas of Singapore (e.g., Johor, Malaysia), and are then imported to be assembled into finished hard disk drives. These drives are further exported to other countries to be components of computers and other finished electronic products. Based on estimates calculating the value-added proportions following TiVA principles, Thailand's domestic value-added in the electronics sector is approximately 30-40% of exports. Thai manufacturers operate at the lower technological level of the global value chain, with minimal involvement in innovation and design creation.

The issue of Thailand's role in the value chain, particularly at a low level, raises significant concerns. Therefore, there must be efforts to jointly develop innovation through collaboration between the private sector and the government. The Hard Disk Drive Institute, established in 2005, consists of entrepreneurs in the hard disk drive industry. The institute operates to support skill development in medium and small-sized Thai organizations to meet standards, including skills for large foreign companies. While there is an effort to promote innovation for Thai companies to participate more fully in the value chain of hard disk drives, there is limited information showing the effectiveness of these efforts.

Similarly, as observed in the automotive industry, the share of components and parts in the export of information technology and communication technology products has decreased since the 1990s. This indicates a concentration of exported products in data and information technology. The import of related components and parts has also decreased (Figure 10.21).

## 10.4 Challenges in transitioning to high-income country status

Thailand's progress towards becoming a high-income country depends on two main factors:

i. The ability to drive advancement in the global value chain and support investment in innovation for the design and production of increasingly sophisticated products and services.
ii. The ability to expand investment and development widely across all regions of the country, especially in the larger areas, notably the northern, northeastern, and southern regions, which have lower development levels and have not fully benefited from Thailand's development in the past.

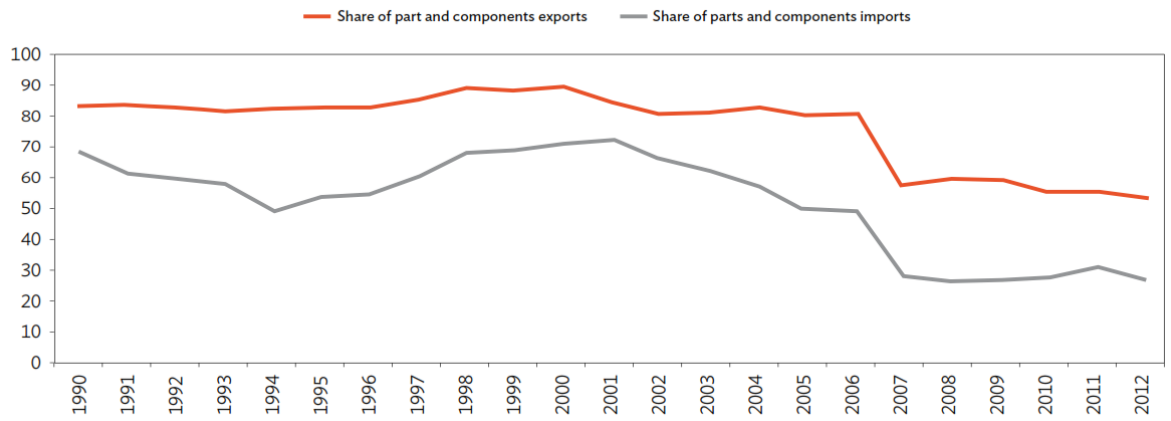



**Figure 10.21:** Proportions of imports and exports of electronic components

**Source:** ADB (2015)

The ability to innovate is crucial for growth and driving improvements in production efficiency, enabling the production of more complex products and services with higher added value. Economic advancement depends on the utilization of technology by various companies and their capacity for technological development and innovation. Both of these factors are essential in the development process of a country transitioning to a high-income status.

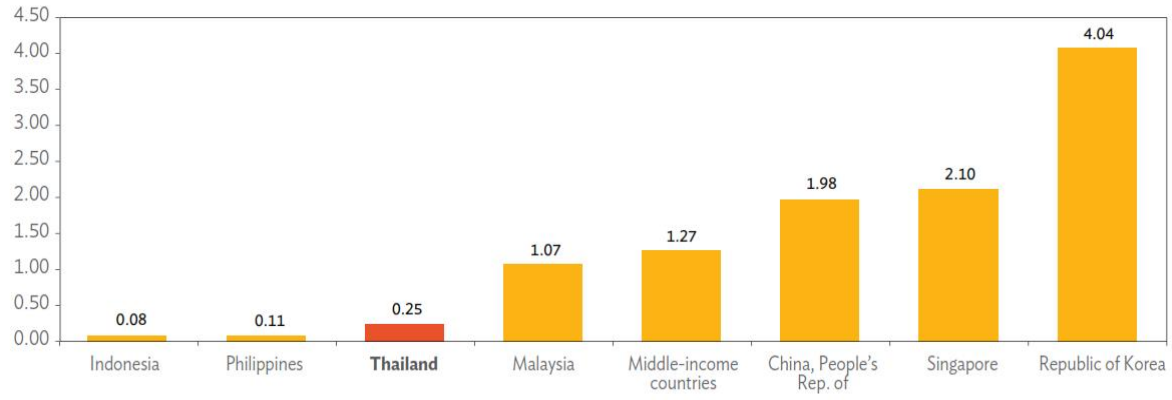
High-income economies in East Asia, such as Hong Kong, China, Japan, Korea, Singapore, and Taiwan, have successfully utilized advanced technology in economic activities. They have achieved this by importing, adapting, and developing innovation themselves. Governments in several countries have recognized the importance of technology and have employed various strategies to attract companies to develop their technological capabilities. Currently, China is undergoing the 'East Asian Miracle' process, not only attracting advanced technology through foreign companies but also leveraging strategic partnerships with these companies to develop technology and innovation domestically.

Thailand is growing in an environment different from the high-growth economic period. Asia has become more integrated economically, with production chains at the regional level driven by large international companies both within and outside the region. These companies have relocated production bases and technologies to countries in East and Southeast Asia, benefiting from low labor costs and other production cost advantages. Since the late 1980s, part of Thailand's economy has joined this trend and benefited from the growth of 'Factory Asia' to maintain its status and gain advantages from the economic integration in Asia. Thailand needs to develop its technological and innovative capabilities.

While Foreign Direct Investment (FDI) remains crucial for acquiring advanced technology and innovation in Thailand's industrial sector, it is necessary to promote domestic efforts to ensure that technology has a widespread and not limited impact on various parts of the economy. However, Thailand's research and innovation capabilities remain weak due to the lack of interest from businesses and insufficient investment budgets for technology development. Additionally, the country still relies on foreign investment for critical technological factors. Thailand ranks 55th out of 141 countries in the 2015 Global Innovation Index, indicating the need for improvement in its innovation landscape.

Effective research operations require an adequate infrastructure (e.g., laboratories, testing systems, standard certification systems, legal patent systems, human resources, etc.) to facilitate continuous development and process improvement.

Insufficient innovation capabilities can be observed from the index reflecting scientific and technological development. Currently, Thailand's research and development expenditures are considered lower than high-income countries and even some medium-income countries. While research and development spending in Thailand is higher than in Indonesia and the Philippines, it remains lower than the average of medium-income countries and China, which achieved similar per capita income in 2014, establishing themselves as medium-income countries. (Figure 10.22)




GDP = gross domestic product.
Note: Data for the Republic of Korea and middle-income countries are for 2011; data for the People's Republic of China and Singapore are for 2012.
Source: World Bank. World Development Indicators. http://data.worldbank.org/data-catalog/world-development-indicators (accessed September 2015).

**Figure 10.22:** Proportion of R&D expenditure to GDP in 2014

**Source:** ADB (2015)

Thailand allocates approximately 0.25% of its GDP for research and development (R&D), which remains lower than India, where R&D budget is less than 1% of

GDP, as shown in Table 10.6. When compared to other countries, South Korea invests over 4% of its GDP in R&D, Japan around 3.4%, and China nearly 2%. Furthermore, private sector R&D expenditure in Thailand is the second lowest after India. The commitment to research and development is a crucial driver for technological transformation. The progress in science and technology is evident in the increased intensity of national-level research and development. In China, for instance, R&D expenditure has grown from nearly 1% of GDP in the late 1980s to close to 2-3% of GDP (Jefferson & Su, 2006).

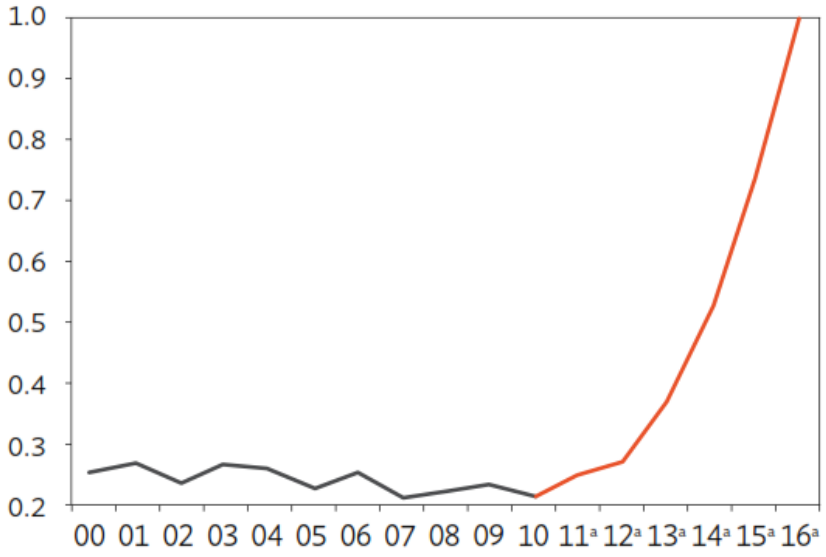
**Table 10.6:** Proportion of Research and Development (R&D) Expenditure to GDP

| Economy | Total Research and Development Expenditure | By Business Enterprises | By Government | By Higher Education | By Private Nonprofit Organizations |
|---|---|---|---|---|---|
| PRC | 1.980 | 1.509 | 0.323 | 0.150 | ... |
| India | 0.810 | 0.288 | 0.490 | 0.033 | ... |
| Republic of Korea | 4.040 | 3.091 | 0.473 | 0.408 | 0.065 |
| Malaysia | 1.070 | 0.607 | 0.154 | 0.309 | ... |
| **Thailand** | **0.250** | **0.103** | **0.082** | **0.062** | **0.003** |
| Germany | 2.920 | 1.953 | 0.432 | 0.534 | ... |
| Japan | 3.390 | 2.610 | 0.285 | 0.447 | 0.051 |
| United States | 2.790 | 1.947 | 0.343 | 0.385 | 0.112 |

**Source:** ADB (2015)

The average ratio for the 23 countries in the Organization for Economic Co-operation and Development (OECD) is 2%, while non-OECD countries stand at 0.7%, which is considered very low. Among the largest OECD countries, the intensity of research and development is at 2.4%, while the smaller 16-country sample in the OECD is at 1.8%. Thailand's expenditure on research and development has remained low over the past decades. The 11th National Economic and Social Development Plan of Thailand set a target for research and development expenditure at 1% of GDP by 2016, indicating that the government recognizes the current inadequacy of technology and innovation to stimulate economic growth.

However, achieving this goal remains a significant question, as spending is at 0.25%, even after more than a decade (Figure 10.23). Even China, which acknowledges the importance of technology and innovation for crossing the middle-income trap, has struggled to increase its research and development budget to 2% by the end of the 10th five-year plan. The Thai government hopes that the proportion of private sector research and development spending will increase to 70% by 2016, up significantly from the current level of approximately 40-45%.




[a] Ministry of Science and Technology targets.
Source: Oxford Business Group (OBG). 2011. *The Report: Thailand 2014*. London: OBG.

**Figure 10.23:** Proportion of R&D Expenditure to GDP for Thailand

**Source:** ADB (2015)

A survey by the National Research Council in 2010 predicted that only 24.9% of companies had budgets for innovation, with 15.8% seeing no change in budgets for the next 5 years, 8.9% anticipating an increase, and 0.2% expecting a decrease. Most companies with budgets for innovation spend on in-house research and development, with approximately 1 in 5 of these budgets used for purchasing equipment and tools (Table 10.7). Spending on innovative activities is expected to be valued at 9.8 billion baht in 2010, accounting for only 0.1% of GDP. This figure has decreased from the estimated value of 13.2 billion baht in 2009, or 0.15% of GDP. Thailand still needs to increase efforts to recruit and train more researchers, as the current ratio is only 0.57 researchers per 1,000 working-age population, which is significantly lower than other countries. For comparison, China has 1.75 researchers per 1,000, South Korea has more than 10, and Malaysia has 3.8.

**Table 10.7:** Details of R&D Expenditure Proportions

| Innovation Activities | 2009 | 2010 |
|---|---|---|
| Intramural research and development | 57.5 | 51.6 |
| Extramural research and development | 5.0 | 9.8 |
| Acquisition of machinery and equipment (including computer hardware) for product or process innovation | 20.2 | 18.1 |
| Acquisition of other external knowledge such as licenses to use intellectual property or specialized services (such as consultants) | 0.6 | 0.5 |
| Training | 5.4 | 6.0 |
| Marketing of innovations | 3.5 | 3.7 |
| Design and other preparations | 2.5 | 3.0 |
| Marketing of improved services (market research and launch advertising) | 4.9 | 3.7 |
| Others | 0.5 | 0.4 |

**Source:** ADB (2015)

Allocation of research and development is also an interesting issue because there is relatively little private sector research and development in key manufacturing sectors, namely the automotive and electronics industries, accounting for only 8.4% and 2.0%, respectively. In reality, research and development in electronics have a higher proportion than textiles, as the textile industry has a private sector research and development ratio of 1.9% (Figure 10.24). This may reflect the imbalance in the proportion of research spending compared to export proportions. In Thailand, this consists of three sectors accounting for half (52%) of all private sector research expenditures: petroleum, food, and chemicals, which are also supported by the government.

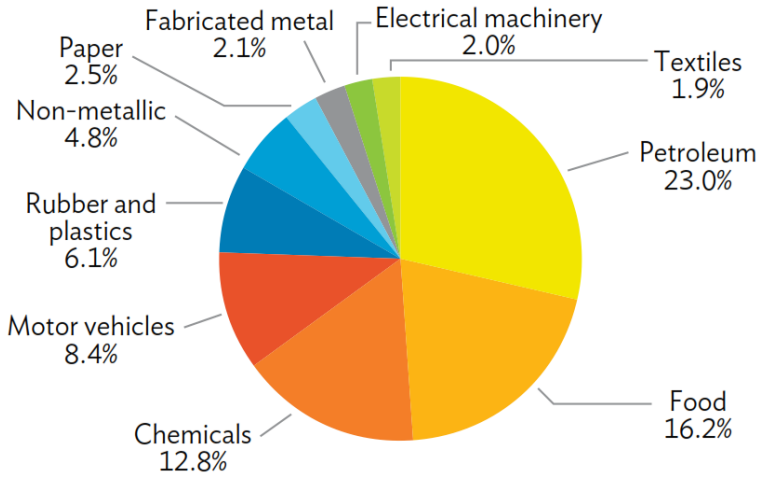



**Figure 10.24:** Proportion of R&D Expenditure in Thai Industries

**Source:** ADB (2015)

From Thailand's past activities, it is found that the collaboration between educational institutions and the manufacturing sector is not sufficient to promote innovation rapidly. Additionally, there are only a few collaborative research projects for the development of innovative processes and products. Universities have limited participation in research leading to commercially viable innovations and provide minimal consultancy for businesses to transform research into commercially usable products.

## Conclusion

This section has presented the results of the analysis of the structure of the Thai industry. Firstly, it is evident that the Thai industry has undergone a structural transformation from labor-intensive and low-tech product manufacturing, such as food and textiles, to the production of high-tech products, such as automobiles and electronics. The process of transformation bears similarities to Japan, South Korea, and Taiwan, starting with labor-intensive and low-tech product manufacturing in the early stages but eventually maintaining production in labor-intensive sectors for several decades to accommodate agricultural labor and continuously elevate the industrial sector's contribution to the economy. However, in Thailand's case, the rapid transformation has limited the increase in industrial employment share and hindered the absorption of labor from the agricultural sector, leading to a high agricultural labor share despite entering the upper-middle-income level.

The analysis using other tools, such as the PRODY index, reveals that Thailand experienced rapid technological upgrading in the 1980s and 1990s. Still, the growth rate slowed down after 2000, while China demonstrated swift technological advancement during that period. Changes in the export structure show an increasing focus on technology-intensive products. Analyzing the number of products with a market share exceeding 1% and the RCA value exceeding 1.0, Thailand's exports have consistently increased in both categories, surpassing the case of Malaysia.

In-depth analysis of the automotive industry illustrates a pyramid-like structure, comprising car assemblers at the top, tier 1 component manufacturers, which are predominantly foreign companies or joint ventures between Thai and foreign companies, in the second tier, and all Thai tier 2 component manufacturers. In the tier 3 level, there is an overall lack of technology transfer and self-initiated technology development, preventing a significant increase in the value-added share or moving up the value chain. The Ministry of Industry established the Automotive Institute to foster collaboration between Thai and foreign businesses in developing human resources and technology. However, the outcomes have not been substantial as intended.

Further analysis of the electronics industry reveals low-level technology development in Thailand, where foreign companies dominate technology importation. Thailand has become the world's leading hard disk manufacturer, yet the value-added share generated within the country is low. There is also a high proportion of imports of high-level components. The Ministry of Industry established the Hard Disk Drive Institute to coordinate the development of technology in Thailand. Still, the results have been limited, similar to the case of the Automotive Institute.

The final part of the content presents details of research and development, including the innovation system in Thailand. It indicates the low proportion of research and development expenditure to GDP and the low ratio of researchers to the population, both lower than the average of developing countries (and higher than China, which is higher than Thailand). While OECD countries have significantly higher proportions, it also highlights the high proportion of government-funded research and development. Private sector research and development remain insufficient, lacking diversification across main export sectors. The government's attempts to establish research organizations and allocate more funding have not been adequate to stimulate increased research and development. This issue is a crucial and persistent problem preventing Thailand from upgrading and producing high-tech products independently. Solving this problem and enhancing the private sector's ability to innovate could be a key factor in lifting the country beyond the upper-middle-income level and into high-income status, similar to Japan, South Korea, and Taiwan.

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