



# Comparative Advantage Analysis of Electrical and Electronic Equipments (HS 85) in ASEAN+6

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**Abstract.** Technology advancements have the ability to boost productivity and create new markets. High-tech products will occupy a significant role in international trade along with the advancement of technology. Therefore, studying the comparative advantages of countries over technological commodities is essential. This study discusses the pattern of comparative advantages of electrical, electronic equipment (HS 85) ASEAN+6 in 2004–2019. This study uses the Harmonized System (HS) codes to delineate groups of export commodities, namely products with HS code 85. Data and observations are taken from UN COMTRADE. This study was conducted 1) to depict exports and imports of electrical, electronic equipment products (HS 85), 2) to know the position of a country whether it is a net-exporters or net-importers with Trade Balance Index (TBI) 3) to analyze the dynamics of electrical comparative advantage, electronic equipment products (HS 85) with Revealed Symmetric Comparative Advantage (RSCA) Index, and 4) to overview product mapping of electrical, electronic equipment (HS 85). This study finds that there are shifts in comparative advantage and trade balance index of electrical and electronic equipment (HS 85) in ASEAN+6. The Philippines, Singapore, and South Korea are countries that are net exporters and have a comparative advantage for HS 85 products. From 2004–2019, some countries have shifted their position quite far. In 2019, China is a net exporter and has a comparative advantage in electrical, electronic equipment (HS 85). Meanwhile, Japan has a lower position compared to 2004. Thailand also experienced a decline, become net-importers, and has a comparative disadvantage on HS 85 products.

**Keywords:** Comparative advantage · Electrical · Electronic equipment · Product mapping

## 1 Introduction

Technological advancements have the ability to boost productivity and create new markets. Future commerce will be influenced by technologies such as artificial intelligence (AI) and blockchain as they can increase the aggregate supply across many industries, leading to lower prices and higher output. Technological advancements aid nations in economic growth and the bolstering of their trading positions in highly competitive international markets (Sabir, 2010). High-tech products will play a significant role in global trade as a result of the advancement of technology.

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The issue of technological progress is important to study, one of which is for the purpose of sustainable growth. The global electronics industry is a fast-growing sector, playing an important role in encouraging consumers to buy innovative and smart electronic products. With such huge future market potential, the electronics industry has always been at the forefront of the latest technological innovations to reduce costs and increase efficiency. In 2008, the Indonesian government established electronic devices as one of the six manufacturing objectives in the rapidly expanding industrial sector under the Presidential Regulation on National Industrial Policy. In order to face the problems of future industrial development, the government names electronics as one of the key industrial areas that need to be developed. Yet, many SMEs find it difficult to keep up with trends/changes as technology has advanced at a faster pace. Opportunities, as well as challenges, can arise due to trade liberalization. Trade liberalization can be a threat to the domestic economy. According to Hecksher-Ohlin's factor abundance model hypothesis, a nation will use plentiful factors of production to export its goods.

High-tech products will take a significant role in international trade as a result of the advancement of technology. Therefore, studying the comparative advantages of countries over technological commodities is essential. This study discusses the pattern of comparative advantages of electrical, electronic equipment (HS 85) ASEAN+6 in 2004–2019. This study uses the Harmonized System (HS) code to see groups of export products, namely products with HS code 85. Data and observations are taken from UN COMTRADE. This study was conducted 1) to depict exports and imports of electrical, electronic equipment products (HS 85), 2) to know the position of a country whether it is a net-exporters or net-importers with Trade Balance Index (TBI) 3) to analyze the dynamics of electrical comparative advantage, electronic equipment products (HS 85) with Revealed Symmetric Comparative Advantage (RSCA) Index, and 4) to overview product mapping of electrical, electronic equipment (HS 85).

## 2 Literature Study

### 2.1 Theory of Comparative Advantage

The era of globalization has changed various sectors in people's lives, especially in the field of an increasingly open economy, and has resulted in intense competition. Here, each nation is vying for the right to produce goods that can compete on the world market. The outcome of this competition will decide a country's standing in world trade. However, a country's input of production elements, which depends on the resources it has, influences the competitiveness of production factors owned by a country, depending on the resources it has. According to Porter (2011), a commodity's competitiveness is determined by its ability to join overseas markets and maintain its position there. A commodity's comparative advantage in international trade can be used to determine how competitive it is. According to the Hecksher-Ohlin Theory, a country will export goods whose production requires more factors of production, which are comparatively inexpensive, and import goods whose production requires more factors of production, which are more expensive and scarce in that nation.

There are several ways to measure comparative advantage. The first use of "Revealed Comparative Advantage" was put forth by Bela Balassa in 1965. (RCA). Since then,

the metric has been used in several papers and scholarly works (e.g. UNIDO 1986; OECD 2011). An alternative to Balassa's analysis of "revealed comparative advantage" is offered by Laursen (2015). As a result, it follows that RCA must be set up symmetrically around its neutral value. The "symmetrical revealed comparative advantage" is the name given to the suggested adjusted index (RSCA).

Specialization in export or import (net-exporter or net importer) of certain product groups can be analyzed using the Trade Balance Index (TBI) (Lafay, 1992). Widodo (2009) states that a product can be said to be superior if (1) from the domestic side, the product is said to be superior if it is an export product that can provide greater foreign exchange for the economy. (2) products with a significant comparative advantage on the global market are considered export superior products in terms of global competition. When a certain export product's share of global exports is dominant, it can perform exceptionally well. However, it's also feasible for some goods to be competitive internationally even if they do not make a significant contribution to foreign exchange earnings. The product mapping method is used to map the position of the superiority of a country's products by combining RSCA and TBI.

## 2.2 General Overview of ASEAN+6

International trade deals have developed rapidly in recent years, with China as the largest economy. For Japan and Korea, both RCEP and CJK FTA will benefit all countries involved. As for India, which has sadly withdrawn from the RCEP negotiations, China's RCEP and FTA have been studied to have a positive effect on the countries involved (Li, 2016). ASEAN-5 countries achieved strong economic growth over the past decades largely due to increased foreign trade and investment.

Technology and innovation are sources of competitive advantage (Wang, et al, 2011). Japan's growth in the technology industry is admirable. Japan and several other Asian countries enjoy regional prosperity and have been dubbed the "wonder of East Asia" by the world bank. The success of the development model is referred to as "flying geese" (Ozawa, 2001). This model is conceptualized on the distribution of capital, technology, and management capabilities from Japan as a developed country in the East Asia region to other countries in the same region.

The output of electronic equipment is anticipated to expand significantly through global value chains in East and Southeast Asia, according to Lee & Itakura's (2018) analysis of how MRTAs can affect economic welfare and sectoral output adjustments in ASEAN countries. The success of the current regional integration structures in Asia, which have significantly lowered tariff and non-tariff rates of protection in the majority of the countries in recent years. Value chain integration can be significantly boosted through mega-regional trade agreements (Shepherd, 2019).

In recent years, China has grown to become a major force for innovation and investment, as well as technology development. China can benefit from domestic and international supply chains, leverage patent methods, and maximize its early competitive advantages in addition to general variables like entrepreneurship, absorption capacity, acceptable market size, and sufficient financial resources (Li et al, 2020).

In the global market, the competitiveness of the ASEAN-5 economies—Malaysia, Indonesia, Philippines, Singapore, and Thailand—is measured by Bashir et al. (2021).

The Revealed Comparative Advantage Index (RCA), the LnRCA, the Vollrath index (RCA#), and the Revealed Symmetric Comparative Advantage index (RSCA) are the four Revealed Comparative Advantage indexes used in the study. The statistics of the UN-COMTRADE international trade center for the export of electrical machinery for this chosen economy from 2003 to 2020 served as the source of the data for the analysis. The analysis findings show that Indonesia has competitive and comparative advantages in electrical machinery in the global economy, but Malaysia, the Philippines, Singapore, and Thailand do not. The comparative advantage analysis will be useful for policymakers to promote the development of human resources, increase technology transfer, and increase innovation to increase a country's competitiveness.

### 2.3 Electrical and Electronic Equipment

Industry 4.0 research has been conducted, integrating the newest technologies to produce Cyber Physical Systems (CPS) and smart factories. These technologies include information management systems, artificial intelligence, robotics, sensors, wireless networks, and the Internet of Things (IoT) (Jang, 2016; Kang et al., 2016; Lee et al., 2015; Kagermann, 2015). The rapid economic growth among ASEAN countries has created a demand for electronics in this area. Despite the potential for economic growth from this sector, the use of electronic goods also has a negative potential for the environment, which is a contributor to global greenhouse emissions and causes environmental degradation (IEA, 2009, Lin et al 2022, Yilmaz et al 2022). As a result of polychlorinated biphenyl (PCB), batteries, etc., electronic waste also contains halogen materials (bromine, chlorine, etc.) and heavy metals (arsenic, mercury, chromium, cadmium, lead, etc.) (Jia et al, 2022). Studies have found a link between technical innovation and renewable energy and carbon emissions that is unfavorable, thus it is important to perform research and development to increase the number of technology patents that aid in preventing environmental deterioration (Suki et al, 2022).

The main challenge for sustainability in ASEAN-5 is due to the rapid growth in demand, but there are opportunities for ASEAN countries to strengthen regional collaboration for sustainability in the electricity industry. During and after the global financial crisis, Japan's exports of electronic parts and components decreased in value, whereas electronic parts and components exports from Taiwan and South Korea increased. The export quantities thereof slightly decreased as a result of the yen's strengthening (Thorbecke, 2019).

Since 2001, there has been less rivalry between ASEAN and China for labor-intensive goods. The increase in exports has also contributed to the development of ASEAN technology which is supported by global supply chains that are intertwined between countries. The link between imports and re-exports is especially strong in Malaysia, the Philippines, Thailand, China, Japan, and South Korea (Thorbecke, 2018). A large number of foreign direct investments and the weak exchange rate deepened the electronics value chain in ASEAN countries. To maintain an important supply chain for trade countries, especially ASEAN. Meanwhile, the growth of the electronics industry must be balanced with maintaining a green environment and sustainability. The formation of industrial clusters that allow the movement of workers between companies between countries will accelerate the transmission of technology from more developed countries.

Instead of catching up, Chiu et al (2019) found that there was a technological lag in the electronics industry between Indonesia and China, as well as between Vietnam and China, since China's productivity growth skyrocketed after joining the World Trade Organization (WTO). Indonesian companies show better productivity than Vietnamese companies.

### 3 Methodology

This study analyzes the dynamics of the comparative advantage of ASEAN+6 electrical, electronic equipment products (HS 85) from 2004–2019. ASEAN+6 consists of ASEAN-5 (Indonesia, Malaysia, Philippines, Singapore, and Thailand) plus 6 neighboring countries (Australia, China, India, Japan, New Zealand, and South Korea). ASEAN-5 was chosen because these countries have complete data that is useful for this research. The research period is from 2004 to 2019 because during this period, technology-based products develop quite rapidly.

The United Nations Commodity Trade Statistics Database provided the information for this study (UN COMTRADE). Exports and imports of goods are categorized using the Harmonized Commodity Description and Coding System (HS), the Standard International Trade Classification (SITC), or Broad Economic Categories (BEC). This study uses a 2-digit HS (code 85), electrical, electronic equipment.

#### 3.1 Trade Balance Index (TBI)

To determine whether a nation specializes in exports (as a net-exporters) or imports (as a net-importers) for particular product groups, The Trade Balance Index (TBI) is utilized (Lafay, 1992). TBI is formulated as follows:

$$TBI_{ij} = \frac{x_{ij} - m_{ij}}{x_{ij} + m_{ij}}$$

$TBI_{ij}$ : trade balance index of country  $i$  for product group  $j$

$x_{ij}$  and  $m_{ij}$ : exports and imports of product group  $j$  by country  $i$ , respectively

Index values range from -1 to +1. In the extreme, TBI equals -1 if a country only imports, conversely, if a country only exports, TBI equals +1. When a nation neither exports nor imports, the index is effectively undefined. Due to the fact that this product category may be exported or imported, we choose to utilize zero because the product group may be exported or imported. Any values in -1 and +1 imply that the country is exporting and importing them at the same time. Where the TBI value is negative and the TBI value is positive, a country is referred to as a “net-importer” in that particular product group and as a “net-exporter” in that same product group.

### 3.2 Revealed Symmetric Comparative Advantage (RSCA)

This study uses Revealed Symmetric Comparative Advantage (RSCA) proposed by Laursen (1998) to analyze comparative advantages of product group. RSCA is a modification of the previously used index, Revealed Comparative Advantage (RCA) by Balassa (1965). The RCA and RSCA indices are expressed by:

$$RCA_{ij} = \frac{(x_{ij}/x_{in})}{(x_{rj}/x_{rm})} \quad (1)$$

$$RSCA_{ij} = \frac{(RCA_{ij} - 1)}{(RCA_{ij} + 1)} \quad (2)$$

$RCA_{ij}$ : index of revealed comparative advantage of country  $i$  product group  $j$

$RSCA_{ij}$ : index of revealed symmetric comparative advantage of country  $i$  product group  $j$

$x_{ij}$ : total exports of country  $i$  product group  $j$

$x_{in}$ : total exports of country  $i$  product group  $n$  (except product  $j$ )

$x_{rj}$ : total exports of countries other than  $i$  product group  $j$

$x_{rm}$ : total exports of countries other than  $i$  product group  $n$  (except product  $j$ )

RSCA index ranges from -1 to +1. When the RSCA index is higher than 0, it indicates that country  $i$  has a comparative advantage in item  $j$ . If the RSCA is less than 0, it indicates that country  $i$  has a comparative disadvantage in product  $j$ .

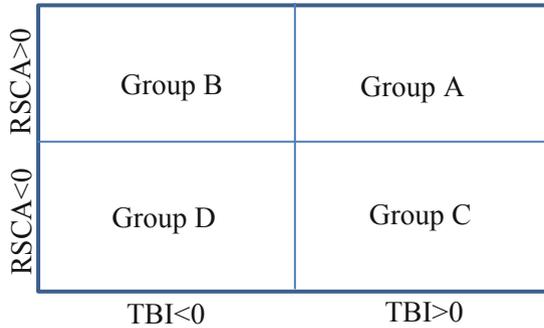
### 3.3 Product Mapping

Product mapping is used to identify a country's position on its trade and comparative advantage. Product mapping is drawn by combining the results of the RSCA and TBI calculations. As shown in Fig. 1, there are four groups into which products (SITC) can be divided. Products in group A have both a comparative advantage and an export specialization, Group B has neither an export specialization nor a comparative advantage, Group C has neither an export specialization nor a comparative advantage, and Group D does not have either.

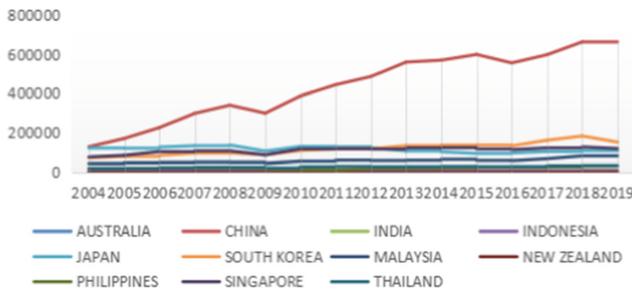
## 4 Results and Discussion

### 4.1 Export and Import of Electrical, Electronic Equipment (HS 85)

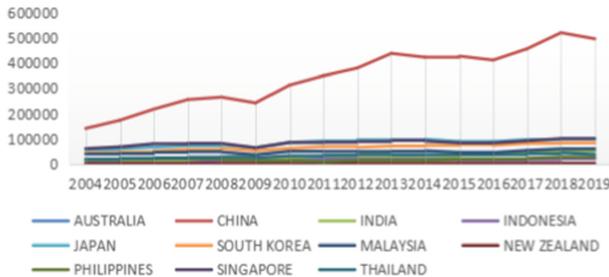
The export and import value of electrical, electronic equipment increased by 3 times in 2019 compared to 2004 (Fig. 2 and Fig. 3). China led the way in the number of exports and imports of these products from 2004 to 2019, with the export and import values of 10 other countries far behind. On average, the increase in exports and imports went hand in hand, dominated by China. with the export value of electrical and electronic goods higher than import (Fig. 4).



**Fig. 1.** Product mapping



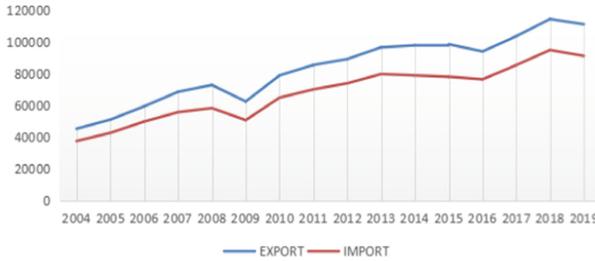
**Fig. 2.** Export value of electrical, electronic equipment (HS 85) 2004–2019 (US Dollar, Million). Source: UN COMTRADE, author’s calculation.



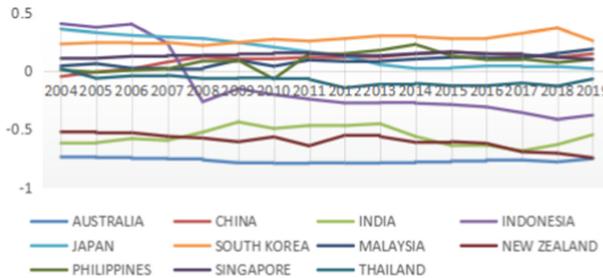
**Fig. 3.** Import value of electrical, electronic equipment (HS 85) 2004–2019 (US Dollar, Million). Source: UN COMTRADE, author’s calculation.

**4.2 Trade Balance Index (TBI)**

Figure 5 shows the trade balance index (TBI) of electrical, electronic equipment (HS 85) of ASEAN+6 countries in 2004–2019. From Fig. 5, the value of Indonesia’s trade balance is decreasing. In 2008, Indonesia switched from being a net exporter to being a net importer, and the Trade Balance Index continued to decrease until 2019. Countries that remained as net exporters of electrical, and electronic equipment (HS 85) in 2019 were China, Japan, South Korea, Malaysia, the Philippines, and Singapore. Australia,



**Fig. 4.** Average export and average import value of electrical, electronic equipment (HS 85) 2004–2019 (US Dollar, Million). Source: UN COMTRADE, author’s calculation.



**Fig. 5.** Trade balance index (TBI) of electrical, electronic equipment (HS 85) 2004–2019. Source: UN COMTRADE, author’s calculation.

India, New Zealand, and Thailand are net importers of electrical, electronic equipment (HS 85).

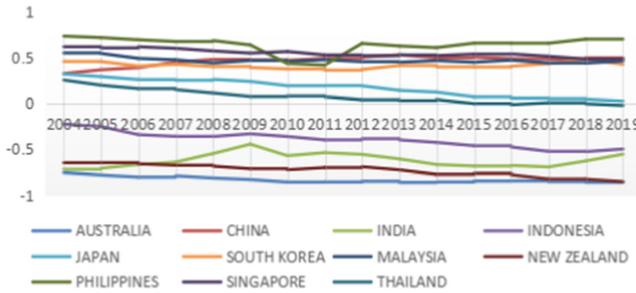
### 4.3 Revealed Symmetric Comparative Advantage (RSCA)

Figure 6 shows the revealed symmetric comparative advantage (RSCA) from 2004–2019. It can be seen that China, Japan, South Korea, Malaysia, the Philippines, and Singapore have comparative advantages, while other countries suffer comparative disadvantages in electronic, electronic equipment. (HS 85).

### 4.4 Product Mapping

Figure 7 shows countries’ mapping of electrical, electronic product in 2004. From Fig. 7, in 2004, the Philippines, Singapore, Malaysia, South Korea, Japan, and Thailand are in group A, which are countries that have comparative advantage and export specialization on HS 85 products. China is in Group B with products having a comparative advantage but does not have export specialties (net-importer), while Indonesia is in Group C which has products that have export specialties (net-exporter) but do not have a comparative advantage. Meanwhile, Australia, New Zealand, and India are in Group D which have neither comparative advantage nor export specialization.

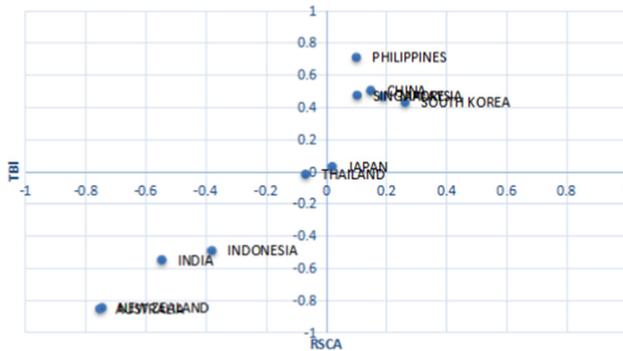
Figure 8 shows that in 2019, the Philippines, Singapore, and South Korea remained in group A, which are countries that are net exporters and have a comparative advantage



**Fig. 6.** Revealed symmetric comparative advantage (RSCA) index of electrical, electronic equipment (HS 85) 2004–2019. Source: UN COMTRADE, author’s calculation.



**Fig. 7.** Countries’ product mapping of electrical, electronic equipment (HS 85) 2004. Source: UN COMTRADE, author’s calculation.



**Fig. 8.** Countries’ product mapping of electrical, electronic equipment (HS 85) 2019. Source: UN COMTRADE, author’s calculation.

for HS 85 products. Some countries have shifted their position quite far. In 2019, China is included in group A, a net exporter, and has a comparative advantage. Meanwhile, Japan, although still in Group A, has a lower position compared to 2004. Thailand also experienced a decline, becoming Group D along with Indonesia, India, Australia, and

New Zealand, which are net importers and have a comparative disadvantage on HS 85 products.

#### 4.5 General Discussion

The product mapping results in Figs. 7 and 8 show the trade balance and comparative advantage have a positive relationship. The probability of a country is a net exporter increased with a particular product's comparative advantage in accordance with the theory of comparative advantage. countries shall export goods that have a comparative advantage.

Change is unavoidable. there are shifts in comparative advantage and trade balance index of electrical and electronic equipment (HS 85) in ASEAN+6. The demand to adapt or be left out of the competition is the main choice. In order to meet customer and global demands, businesses must be agile and quickly adapt to modern and innovative technologies, which are essential for every sector of the electronics industry. Developing countries' electronics industry still has room to grow, supported through the involvement of stakeholders and proper government policies and strategies. The government must take the required action in this regard, including enhancing the environment for investment, enhancing physical infrastructure such as highways, and supporting R&D initiatives. Companies that produce electrical equipment strive to meet the evolving and changing needs of customers in line with developing technological advances and increasingly fierce global competition (Millson et al., 1992). It is important to conduct research and development of new electronic products that are tailored to the needs of society and other factors that influence the success of new products (Ries and Ries, 2004, Milson and Wilemon, 2002).

### 5 Conclusion

There are shifts in comparative advantage and trade balance index of electrical and electronic equipment (HS 85) in ASEAN+6. The Philippines, Singapore, and South Korea are countries that are net exporters and have a comparative advantage for HS 85 products. From 2004–2019, some countries have shifted their position quite far. In 2019, China is a net exporter and has a comparative advantage in electrical, and electronic equipment (HS 85). Meanwhile, Japan has a lower position compared to 2004. Thailand also experienced a decline, become net-importers, and has a comparative disadvantage on HS 85 products.

Every country must be able to adapt to technological development. The demand to adapt or be left out of the competition is the main choice. In order to meet customer and global demands, businesses must be agile and quickly adapt to modern and innovative technologies, which are essential for every sector of the electronics industry.

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