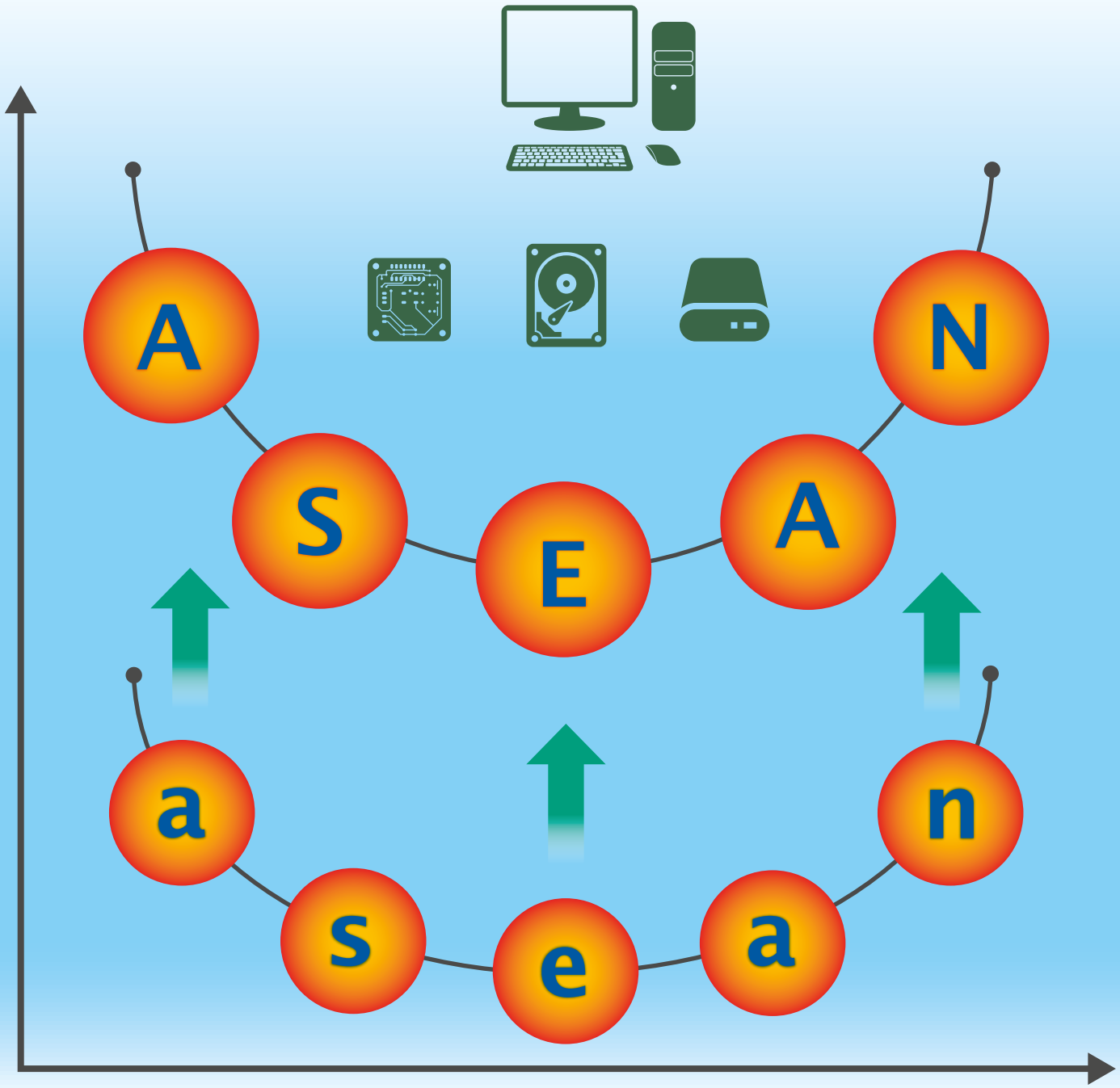
Global Value Chains in ASEAN
Electronics

PAPER 13
MARCH
2021



ASEAN-JAPAN CENTRE

国際機関 日本アセアンセンター

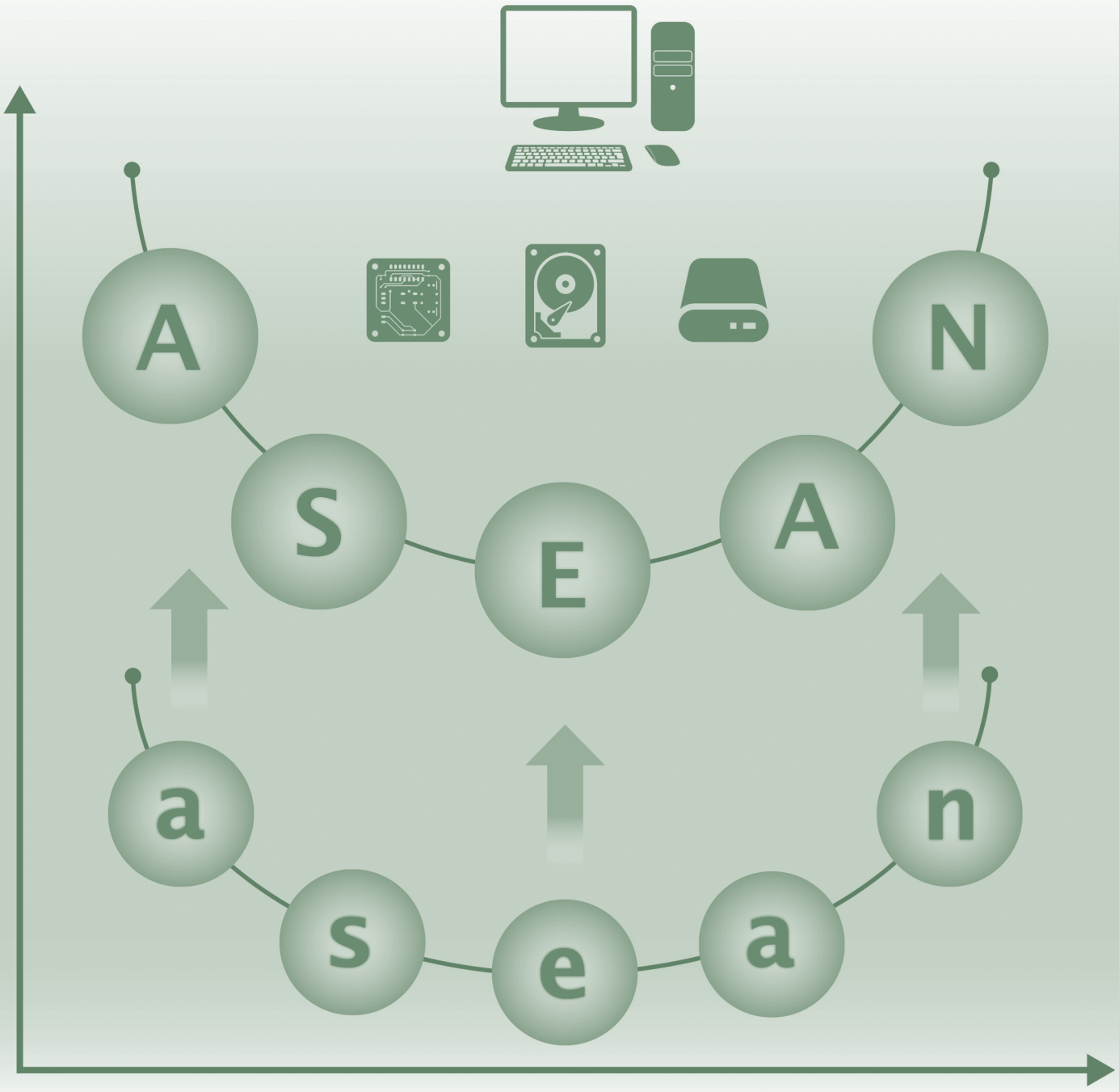
For inquiries, contact ASEAN-Japan Centre
(ASEAN Promotion Centre on Trade, Investment and Tourism)

1F, Shin Onarimon Bldg., 6-17-19, Shimbashi,
Minato-ku, Tokyo 105-0004 Japan
Phone/Fax: +81-3-5402-8002/8003 (Office of the Secretary General)
+81-3-5402-8004/8005 (Research and Policy Analysis (RPA) Cluster)
+81-3-5402-8116/8005 (Capacity Building (CB) Cluster)
+81-3-5402-8006/8007 (Trade and Investment (TI) Cluster)
+81-3-5402-8008/8009 (Tourism and Exchange (TE) Cluster)
+81-3-5402-8118/8003 (PR)
e-mail address: info_rpa@asean.or.jp
https://www.asean.or.jp

Paper 13 / March 2021 / Global Value Chains in ASEAN: Electronics

Global Value Chains in ASEAN
Electronics

PAPER 13
MARCH
2021



ASEAN-JAPAN CENTRE

国際機関 日本アセアンセンター

NOTES

The terms "country" and "economy" as used in this study also refer, as appropriate, to territories or areas. The designations employed and the presentation of the material do not imply the expression of any opinion whatsoever on the part of the ASEAN-Japan Centre concerning the legal status of any country, territory, city, or area or of the authorities, or delimitations of frontiers or boundaries.

The following symbols have been used in the tables:

- Two dots (..) indicate that data are not available or are not separately reported.
- A dash (–) indicates that the item is equal to zero or its value is negligible.
- Use of a dash (–) between dates representing years, e.g., 2015–2016, signifies the full period involved, including the beginning and end years.
- Reference to "dollars" ($) means United States dollars, unless otherwise indicated.

List of papers under the project on global value chains in ASEAN by the ASEAN-Japan Centre (AJC)

The current paper is the 13th of a series of 16 papers on ASEAN GVCs. The other 15 papers have been published or are forthcoming.

Paper 1. A Regional Perspective (first published in September 2017; revised in January 2019)
Paper 2. Brunei Darussalam (published in February 2018)
Paper 3. Cambodia (published in March 2019)
Paper 4. Indonesia
Paper 5. Lao People's Democratic Republic (published in March 2021)
Paper 6. Malaysia
Paper 7. Myanmar (published in February 2021)
Paper 8. Philippines (published in July 2017)
Paper 9. Singapore (published in August 2018)
Paper 10. Thailand (published in March 2019)
Paper 11. Viet Nam (published in May 2020)
Paper 12. Automobiles (published in January 2020)
Paper 13. Electronics
Paper 14. Textiles and clothing (published in March 2020)
Paper 15. Agribusiness (published in March 2020)
Paper 16. Tourism (published in March 2018)

Prepared by Upalat Korwatanasakul (Waseda University) and Patarapong Intarakumnerd (National Graduate Institute for Policy Studies – GRIPS) under the direction of Masataka Fujita (AJC). The authors wish to thank the staff members of the AJC for their contribution. The manuscript was edited by Lise Lingo and typeset by Laurence Duchemin. Errors and omissions are only those of the authors and should not be attributed to their organizations.

ABBREVIATIONS

AJC	ASEAN-Japan Centre
ASEAN	Association of Southeast Asian Nations
DVA	domestic value added
DVX	value added incorporated in other countries' exports
EMS	electronic manufacturing service
EU	European Union
E&E	electrical and electronics
FVA	foreign value added
GVC	global value chain
GDP	gross domestic product
HDD	hard disk drive
IC	integrated circuit
MNEs	multinational enterprises
OBM	original brand manufacturer
OEM	original equipment manufacturer
ODM	original design manufacturer
SEZ	special economic zone
SMEs	small and medium-sized enterprises
SMT	Stars Microelectronics Thailand
SVMC	Samsung Vietnam Mobile Research and Development Centre
R&D	research and development
RFID	radio frequency identification
RVC	regional value chain
TIDI	Thailand IC Design Incubator

KEY MESSAGES

- The Association of Southeast Asian Nations (ASEAN) is a significant hub of electrical and electronics (E&E) production, contributing approximately $268 billion to the regional gross domestic product (GDP), employing more than 2.4 million workers and accounting for the largest share of ASEAN's total exports (27 per cent).
- The E&E industry is characterized by internationally fragmented but well-integrated production networks with geographically extensive and highly modular value chains, which provide opportunities for ASEAN countries to easily participate in the E&E value chain.
- Overall, the E&E industry in ASEAN relies on more foreign inputs and technology than other industries, with 53 per cent of E&E exports coming from foreign value added (FVA). Nonetheless, value added in exports differs across the region, depending on each country's position in the E&E value chain.
- Intraregional trade among ASEAN countries is the largest contributor to ASEAN E&E exports in terms of FVA, accounting for a quarter of total FVA ($43.4 billion) in 2017, while the combined FVA created by China and Japan constitutes more than a third of total FVA.
- During 1990–2017, ASEAN's global value chain (GVC) participation in E&E equipment declined slightly, from 74 per cent to 70 per cent, while its regional value chain (RVC) participation doubled, from 9 per cent to 18 per cent. The contradictory trends are explained by higher regional production capacity and well-established regional production networks.
- With different areas of specialization, ASEAN has become an attractive and important hub for the E&E industry. The region hosts an extensive range of E&E production along the value chain, ranging from labour-intensive and simple activities such as assembly and testing to capital-intensive tasks such as component design and research and development (R&D):
- Brunei Darussalam: Although the technology and creative industry is identified as one of the country's priority business clusters, the E&E industry is not emerging , which thus does not have opportunities to be part of GVCs in this industry.
- Cambodia: Strategically focusing on labour-intensive production activities, the country was able to join the E&E value chain in the early 2010s. Its E&E industry is relatively new compared with those of other ASEAN countries and still needs to take several steps to upgrade.
- Indonesia: The E&E industry focuses mainly on the domestic market and not on export; therefore, it has limited involvement in GVCs.
- Lao People's Democratic Republic: The E&E industry is still in its early stage with much room to expand and upgrade. E&E firms in the country are generally lower-tier suppliers of labour-intensive parts and components, and few engage in the production of electrical appliances.
- Malaysia: The country successfully enhanced the capabilities of local E&E suppliers and thus they have been able to upgrade from simple production to advanced engineering and design of E&E components and subsystems. Penang is a showcase for the development of E&E cluster with cooperation among multinational enterprises (MNEs), local suppliers and the government.
- Myanmar: Even though the country has limited participation in the E&E value chain, its industry has been gradually developing due to recent foreign investment in the country.
- The Philippines: The E&E industry concentrates on the production of labour-intensive and back-end components, and demonstrates a high share of domestic value added (DVA) in exports (54 per cent).

- Singapore: The E&E industry is a good example of one that has leveraged MNEs' knowledge and technology to upgrade and move up the value chain. The industry successfully became an regional and global hub for R&D for E&E equipment.
- Thailand: The country is one of the major manufacturing bases of the global E&E industry and serves as a global production hub of hard disk drive (HDD) makers. However, the pace of upgrading in the industry is rather moderate and needs to speed up.
- Viet Nam: The E&E industry is relatively new but contributes tremendously to the economy. Reliance on foreign inputs and technology induced initial growth in the industry but may hinder its long-run development unless an upgrading strategy is carefully identified and implemented.
- ASEAN has been a long-term trade and investment partner of Japan. Changes in export demand for Japan's E&E products inevitably affect the demand for inputs from the E&E industry in ASEAN countries as well. It is estimated that a $1 million increase in Japan's E&E exports attracted $30,000 in inputs from ASEAN in 2017 to be integrated into Japan's exports
- A common challenge to the E&E industry in most ASEAN countries is the limited capability of labour and local firms, particularly small and medium-sized enterprises (SMEs). National and regional coordination among government agencies at different levels, particularly in the human capital development of local firms, and technology transfer from MNEs, plays an important role in domestic functional upgrading, strengthening the value chains, and in turn further developing the E&E industry in ASEAN. A policy framework encompassing all stakeholders to attract, facilitate and increase investment from abroad and within the country is essential for this industry.

ASEAN is a significant hub of E&E production, contributing approximately $268 billion to regional GDP, employing more than 2.4 million workers, and accounting for the largest share of ASEAN's total exports (27 per cent).

The E&E industry (box 1) has been one of the region's economic driving forces. In 2019, the industry contributed approximately $268 billion to regional GDP and created more than 2.4 million jobs (table 1). Some 12,271 E&E manufacturing companies have been established in ASEAN over the past decades. Moreover, the E&E industry is the largest export industry in the region, accounting for 27 per cent of the region's total goods exports in 2019. As each ASEAN country specializes in different activities and products, the region can offer a variety of E&E activities and therefore attract a large number of foreign investors. Consequently, ASEAN as a whole is a significant regional and global hub of E&E production that delivers a wide range of industrial and consumer products such as integrated circuits (IC), semiconductors, microchips, hard disk drives, computers, mobile phones and televisions.

Among ASEAN countries, Viet Nam enjoys the greatest benefits from the industry in terms of GDP and employment (23 per cent and 908,000 workers in 2018). The industry also significantly contributes to GDP and employment in Malaysia, the Philippines and Thailand (table 1). Even though Viet Nam's E&E industry has developed relatively recently, the number of establishments is high, at 4,366 factories in 2018, when it ranked first among the ASEAN countries. There are also a large number of the establishments in Thailand (3,939 in 2018), Malaysia (1,984 in 2015) and Indonesia (787 in 2016).

The E&E industry's prominence is also observable in exports, as the industry accounts for large shares of total exports from the Philippines (51 per cent), Viet Nam (37 per cent), Malaysia (34 per cent), Singapore (31 per cent) and Thailand (14 per cent). The export value is highest in Singapore, amounting to $121 billion or more than one third of ASEAN's total E&E exports. Viet Nam and Malaysia are among the top ASEAN E&E exporters and rank second and third with export values of $97 billion and $82 billion respectively. Together, their exports account for nearly a quarter of the region's total E&E exports.

Table 1. **ASEAN electrical and electronic industry overview, various years**

Country	GDP (% of the total)	Employment (thousands)	Manufacturing establishments	Exports (% of the total)	Exports ($ millions)
Cambodia	..	0.2[a]	12[a]	4	578
Indonesia	2[c]	337[f]	787[e]	5	8 345
Lao People's Democratic Republic	..	..	..	7	403
Malaysia	10[c]	453[f]	1 984[d]	34	81 944
Myanmar	..	0.3[h]	109[g]	1	178
Philippines	14[b]	274[f]	488[d]	51	35 833
Singapore	5[b]	90[h]	581[f]	31	120 750
Thailand	13[d]	362[d]	3 939[g]	14	33 981
Viet Nam	23[c]	908[g]	4 366[g]	37	97 158
ASEAN total	**8.4**	**2 425**	**12 271**	**27**	**379 205**

Source: AJC, based on ASEAN Secretariat (for employment and manufacturing establishments); Department of Economic Planning and Statistics, Brunei Darussalam, for Brunei GDP; Rynhart, Chang and Huynh (2016) for other countries' GDP; and United Nations Statistics Division for exports.

Note: The statistics of employment and manufacturing establishments cover establishments with total employment of 20 or more. The ASEAN total is estimated from the data of different years. The numbers should not be used for statistical purposes.

[a] = 2011, [b] = 2013, [c] = 2014, [d] = 2015, [e] = 2016, [f] = 2017, [g] = 2018, and [h] = 2019. All export data are from 2019.

Box 1. **Definition of the E&E industry in GVC data**

The E&E industry is broadly defined as an industry that manufactures electrical parts and components, electronic equipment and consumer electronics. It encompasses a wide range of products, e.g. bare circuit boards, mobile phones, passive IC components, personal computers, refrigerators, semiconductors, televisions, wafers, wires and cables, among others.

For a comprehensive analysis of the E&E industry, this study utilizes three main data sources, namely the AJC-UNCTAD-Eora database on ASEAN GVCs, the Input-Output Tables database of the Organization for Economic Co-operation and Development (OECD) and the United Nations Comtrade database. Efforts were made to streamline the data sets to best represent the industry; however, some discrepancies remain among the data sources and countries.

AJC-UNCTAD-Eora database

The GVC data estimated for Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam closely represent the E&E industry in those countries. In contrast, the GVC data estimated for Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar include general machinery and electrical equipment in the industry, which may yield overestimated GVC statistics.

OECD Input-Output Tables

Input and output data are classified according to the United Nations International Standard Industrial Classification of All Economic Activities, Revision 4 (ISIC Rev. 4). The OECD Input-Output Tables provide statistics on the E&E industry under Division 26, Manufacture of computer, electronic and optical products, and Division 27, Manufacture of electrical equipment. Division 26 represents the electronics industry, covering electronic components and boards (261); computers and peripheral equipment (262); communication equipment (263); consumer electronics (264); measuring, testing, navigating and control equipment; watches and clocks (265); irradiation, electromedical and electrotherapeutic equipment (266); optical instruments and photographic equipment (267); and magnetic and optical media (268). Division 27 captures the electrical industry, encompassing electric motors, generators, transformers and electricity distribution and control apparatus (271); batteries and accumulators (272); wiring and wiring devices (273); electric lighting equipment (274); domestic appliances (275); and other electrical equipment (279). The OECD statistics represent the E&E industry well.

UN Comtrade Database

The UN Comtrade Database classifies traded products according to the harmonized commodity description and coding systems. The E&E industry's imports and exports are classified mainly under Header 85, Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles. Therefore, in this study, header 85 is used to roughly represent the E&E industry.

The E&E industry is characterized by internationally fragmented but well-integrated production networks with geographically extensive and highly modular value chains, which provide opportunities for ASEAN countries to easily participate in the E&E value chain.

The E&E industry is a good example of the importance of a GVC, as the industry encompasses a variety of products, players, modules, functions and value added around the globe (table 2). To produce one finished E&E product requires different raw materials, parts and components, and subsystems as well as multiple stages of production, including R&D, product design, wafer fabrication, assembly and testing, branding, marketing, and sales and distribution. The industry's production is thus internationally fragmented but in well-integrated regional and global production networks. The parts and components, subsystems and final products can be manufactured in different locations depending on the production technology and the nature of the products. The colocation of engineers is unnecessary as standardization, codification and computerization allow for the fragmentation of the production process (De Becker and Miroudot, 2013; Sturgeon and Kawakami, 2010). Concurrently, advanced information and communication technology also enables efficient and effective monitoring and information sharing among plants in different locations. Moreover, E&E components and products are generally characterized by a high value-to-weight ratio, implying that long-distance shipment is relatively inexpensive (Rynhart, Chang, and Huynh, 2016). E&E firms can adopt outsourcing and offshoring strategies as long as labour costs in other countries are cheaper than the costs of transportation and monitoring. Lead firms can focus on production activities that yield higher value added, while taking advantage of inexpensive labour in other locations to perform low value added functions. With these characteristics, the E&E value chain is highly modular and geographically extensive. This provides opportunities for developing economies, including ASEAN countries, to easily participate in the E&E value chain.

The structure of the E&E value chain is a modular one, marked by different players, functions, value added and products. Lead firms or original brand manufacturers (OBMs) generally have more market power and control over the value chain as they have their own technology and brands, which are usually globally recognized. Thus, the lead firms are located near the beginning and the end of the value chain, where they focus on high value added and capital-intensive production and services such as R&D, product design, branding, marketing, logistics and sales. The lead firms generally come from advanced economies such as those of the European Union (EU), Japan, the Republic of Korea, Taiwan Province of China and the United States. With the rise of the Chinese-branded mobile phone industry, part of China's E&E industry has recently moved up the value chain from being an electronic manufacturing service (EMS) provider to being an OBM.

Lower value added production activities are outsourced and offshored to global subsidies and contract firms (EMS providers), mainly in developing economies. EMSs cover an intensive range of production activities and therefore deliver different level of value added. EMS providers include players such as original design manufacturers (ODMs), component and subsystem suppliers, and assemblers of different tiers. ODMs specialize in R&D and product design. Their main functions are to turn concepts into products according to given concepts, ideas and specifications. ODMs are usually from developed economies (e.g. Taiwan Province of China and the United States) but located in several countries, including developing ones. Among EMS providers, they create the most value added and therefore are more profitable.

Similar to ODMs, the main functions of component and subsystem suppliers are design and development, but they focus only on components and subsystems instead of finished products. Their products – semiconductors, wafers, passive IC components, bare circuit boards and the like – are of high value added and essential in the production of finished products. Advanced economies, namely

Hong Kong (China), the Republic of Korea, Malaysia, Singapore, and the United States, are the main players in this product segment. Another group of component and subsystem suppliers specialize in labour-intensive production activities such as assembly and testing, which deliver lower value added. In ASEAN, this group of suppliers is concentrated in Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Thailand and Viet Nam. They manufacture electrical products such as wires, cables, switchgear/panel boards and transformers, and perform tasks such as assembly and testing of electronics parts and components.

The last players are contract firms that engage in assembly and testing of final consumer and industrial products. They are located in the middle of the E&E value chain with labour-intensive production activities, generating relatively limited value added. These are indigenous firms from developing economies and can be categorized into different tiers based on their revenues.[1] Producers in tier 3 and tier 4 are from Cambodia, Indonesia, the Lao People's Democratic Republic, Myanmar, the Philippines and Viet Nam. They have less capability in terms of domestic investment, human capital and technology. In contrast, firms in higher tiers (tier 1 and tier 2) are from China, Malaysia and Thailand. They are more capable of delivering large-scale production to meet regional and global market demand, while satisfying international standards and requirements set by leading firms.

[1] Tier 1: > $5 billion; tier 2: $500 million to $5 billion; tier 3: $100 million but less than $500 million; Tier 4: less than $100 million.

Table 2. **Structure of E&E global value chain**

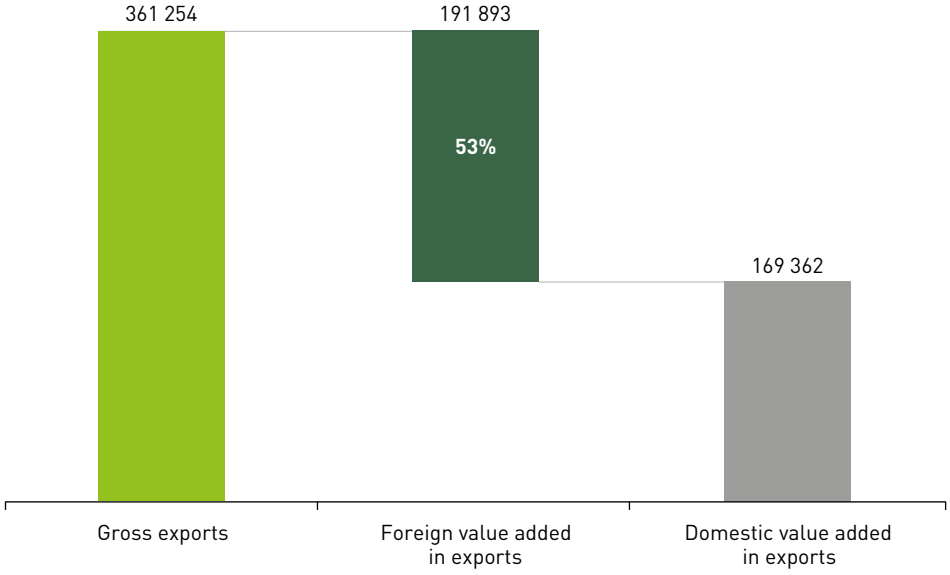
Players/Tiers	Lead firms/ OBMs	EMS providers and global subsidiaries					Lead firms/OBMs
		ODMs	Component and subsystem suppliers		Tiers 3 and 4	Tier 2	Tier 1	
Functions	R&D, design	R&D, design, assembly, testing	Component design and/or R&D, wafer fabrication	Assembly and testing	Assembly and testing			Branding, marketing, manufacturing (for some), sales and distribution
Products	Product concepts, overall design, specifications of product	Product concepts, overall design, specifications of products, finished products	Electronics: 1. Semiconductors and wafers (IC and active discrete) 2. Passive IC components 3. Bare circuit boards Electrical: 1. Wires and cables 2. Switchgear/panel boards 3. Transformers		Consumer and industrial E&E products (Indonesia) Mobile phones (Viet Nam) Office equipment (Philippines) Personal computers (Viet Nam) Storage (Philippines)	Computers (Malaysia, Thailand) Consumer E&E products (Malaysia, Thailand) Storage (Thailand)	Computers Consumer electronics Communications and networking	Aerospace and defence (United States) Automotive (Germany, Japan) Communications (all) Computers/office equipment (Japan, Taiwan Province of China, United States Consumer electronics (China, Japan, Republic of Korea) Industrial E&E products (EU, United States) Medical equipment (United Kingdom)
Producer countries	China, EU, Japan, Republic of Korea, Taiwan Province of China, United States	China, Taiwan Province of China, United States	China, Hong Kong (China), Republic of Korea, Malaysia, Singapore, United States	Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Myanmar, Philippines, Thailand, Viet Nam	Cambodia, Indonesia, Lao People's Democratic Republic, Myanmar, Philippines, Viet Nam	Malaysia, Thailand	China	China, EU, Japan, Republic of Korea, Taiwan Province of China, United States
Value added	High	High	High	Low to Medium	Low to Medium	Low to Medium	Low to Medium	High

Source: Korwatanasakul (forthcoming), based on Frederick and Gereffi (2016).
Note: The EMS industry is divided into tiers based on revenues. Tier 1: > $5 billion; tier 2: $500 million to $5 billion; tier 3: $100 million but less than $500 million; tier 4: less than $100 million.
E&E = electrical and electronics, EU = European Union, IC = integrated circuit, OBM = original brand manufacturer, ODM = original design manufacturer, R&D = research and development.

Overall, the E&E industry in ASEAN relies on more foreign inputs and technology than other industries, with 53 per cent of E&E exports coming from FVA. Nonetheless, value added in exports differs across the region, depending on each country's position in the E&E value chain.

ASEAN's value added exports were estimated at $361 billion in 2017 (figure 1). Domestic value added (DVA) in exports accounted for 47 per cent of this, or $169 billion, while FVA in exports provided the larger share, equivalent to 53 per cent or $192 billion (Figure 1) (for GVC terminology, see box 2). In general, ASEAN's E&E industry depends significantly on imported inputs and technology. The high FVA share – or heavy reliance on foreign inputs and technology – may pose risks to the industry, particularly in terms of domestic capabilities for future upgrading to higher positions in value chains. However, the share also depends on the position of a country in the E&E value chain. Those located relatively near the beginning or the end of a particular value chain (e.g. Malaysia and Singapore) may depend largely on foreign inputs such as raw materials and intermediate products but usually have sufficient technological capabilities to deliver high value added products (for countries' positions on the value chain, see table 2). In contrast, countries located relatively in the middle of a value chain (e.g. the Philippines, Thailand, and Viet Nam) rely excessively on their inexpensive labour and imported technology. Over time, these countries are losing their competitiveness in labour-intensive manufacturing due to rises in wages, while facing difficulties in upgrading to a higher position in the value chain owing to their limited technological capacity. Thus, heavy reliance on foreign inputs poses greater risks to less technologically advanced countries as they may remain locked in low value creating segments for their domestic production.

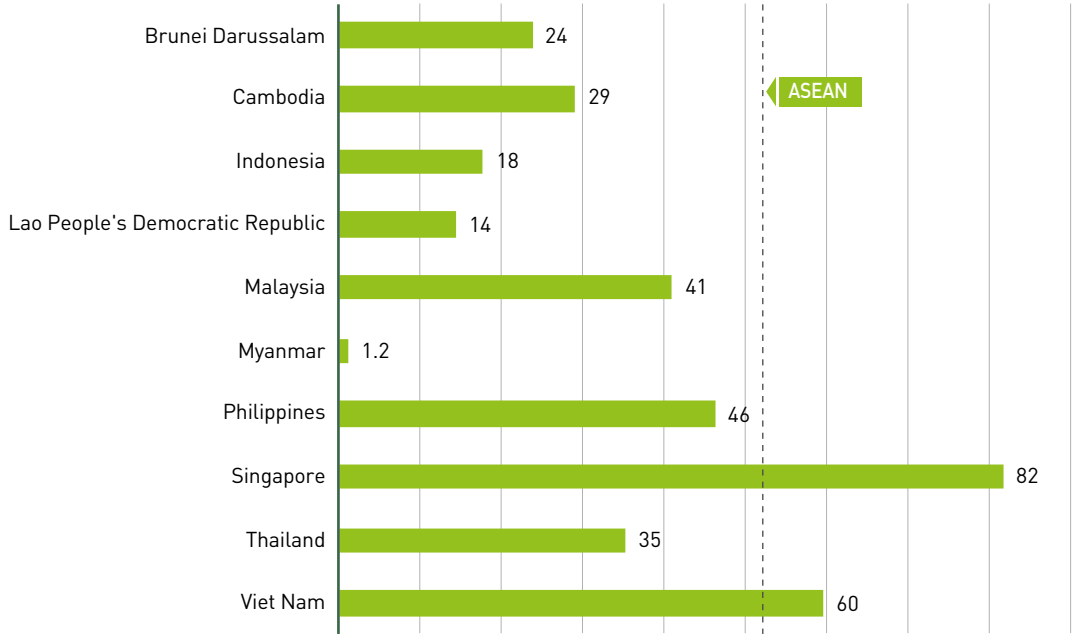
Figure 1. **Value added exports from electrical and electronic equipment, 2017**
(Millions of dollars)



Source: AJC-UNCTAD-Eora database on ASEAN GVCs.
Note: For Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar, the industry includes also general machinery.

Regarding the DVA and FVA shares in value added exports, the FVA share is large for countries engaged in more capital-intensive activities such as Malaysia and Singapore and for countries involved in final assembly such as the Philippines, Thailand and Viet Nam (figure 2). These countries depend heavily on imported components and subsystems from other countries with either less expensive labour (e.g. neighboring ASEAN countries) or higher technology (e.g. Japan). In contrast, a low FVA share is observed in countries that specialize in the production of low value added parts and components, which is typically labour-intensive. These countries include Cambodia, the Lao People's Democratic Republic and Myanmar. Their current production of E&E equipment does not require advanced technology or knowledge imported from abroad (and thus has a low FVA share) but generates DVA through the local procurement of inputs and domestic labour employment. Therefore, DVA occupies the larger portion of their (small) value added exports.

Figure 2. **Share of foreign value added in electrical and electronic equipment, 2017**
(Per cent)



Source: AJC-UNCTAD-Eora database on ASEAN GVCs.
Note: For Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar, the industry includes also general machinery.

Box 2. **GVC terminology used in the ASEAN-Japan Centre paper series**

A country's exports can be divided into domestically produced value added and imported (foreign) value added that is incorporated into exported goods and services. Furthermore, exports can go to a foreign market either for final consumption or as intermediate inputs to be exported again to third countries (or back to the original country). The analysis of GVCs takes into account both foreign value added in exports (the upstream perspective) and exported value added incorporated in third-country exports (the downstream perspective). The indicators used in this paper series are as follows:

1. **Foreign value added (FVA):** Foreign value added indicates the part of a country's gross exports that consists of inputs that have been produced in other countries. The foreign value added share is the share of the country's exports that do not add to its GDP.
2. **Domestic value added (DVA):** Domestic value added is the part of a country's exports created within the country, i.e. the part of exports that contributes to GDP. The sum of foreign and domestic value added equates to gross exports. Domestic value added can be considered in relation with other variables:
   - As a share of GDP, it measures the extent to which trade contributes to the GDP of a country.
   - As a share of global value added trade (the "slice of the value added trade pie"), it can be compared with a country's share in global gross exports (relative value captured in trade).
3. **Value added incorporated in other countries' exports (DVX):** This indicates the extent to which a country's exports are used as inputs to exports from other countries. At the global level, the sum of this value and the sum of foreign value added are the same.
4. **GVC participation** indicates the share of a country's exports that is part of a multistage trade process by adding to the foreign value added used in a country's own exports the value added supplied to other countries' exports. Although the degree to which exports are used by other countries for further export generation may appear less relevant for policymakers, as it does not change the domestic value added contribution of trade, the participation rate is a useful indicator for the extent to which a country's exports are integrated in international production networks.

GVC participation corrects the limitation of the indicators for both foreign and domestic value added, in which countries at the beginning of the value chain (e.g. exporters of raw materials) by definition have low shares of foreign value added content in exports. It gives a more complete picture of the involvement of countries in GVCs, both upstream and downstream.

GVC indicators can also be used to assess the extent to which industries rely on internationally integrated production networks. A number of complex methods have been devised in the literature to measure GVC length; however, the degree of double counting in industries, conceptually, can serve as a rough proxy. Data on value added trade by industry can provide useful indications of the comparative advantages and competitiveness of countries and, hence, form a basis for development strategies and policies.

Source: UNCTAD (2013).

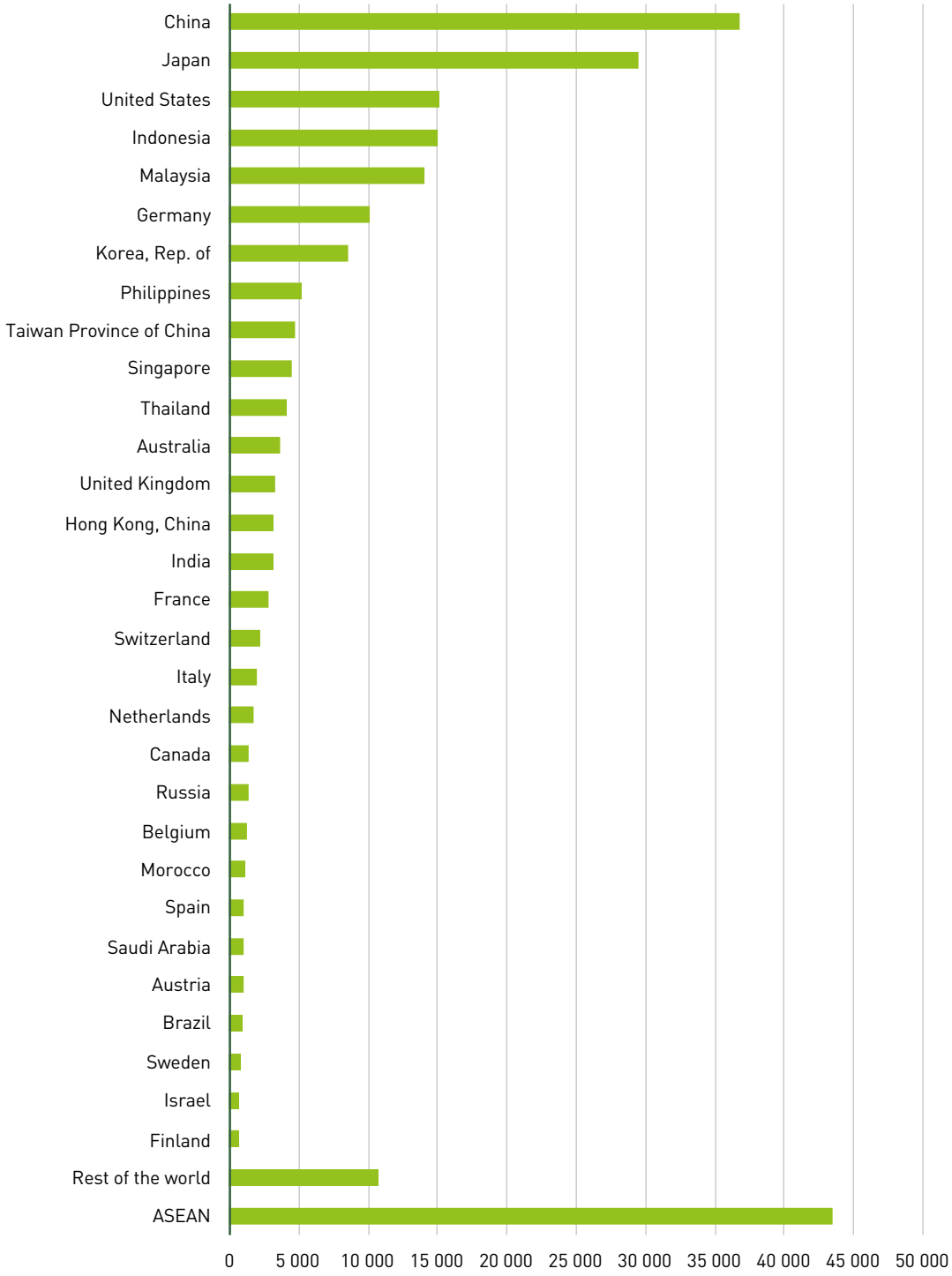
Intraregional trade among ASEAN countries is the largest contributor to ASEAN E&E exports in terms of FVA, accounting in 2017 for a quarter of total FVA, or $43.4 billion, while the combined FVA created by China and Japan constituted more than one third of total FVA.

Thanks to the Japanese E&E production base in China and Southeast Asia, there is a well-established regional production network among China, Japan and ASEAN countries, which explains the largest contribution of intraregional trade in terms of FVA (figure 3). In 2017, intraregional trade within ASEAN alone amounted to $43.4 billion, or a quarter of total FVA in ASEAN's E&E value added exports. Among the top 10 foreign contributors to ASEAN exports of E&E equipment was ASEAN-5 (Indonesia, Malaysia, the Philippines, Singapore and Thailand.

FVA created that year by the leading contributors, China and Japan, totaled $36.8 billion (19 per cent of FVA) and $29.5 billion (15 per cent). The combined FVA of China, Japan and ASEAN countries is as much as three quarters of the total FVA in the industry for ASEAN. Thus, ASEAN's E&E industry depends mainly on foreign inputs and technology created within East and Southeast Asia. Nonetheless, other countries both within and outside these regions are among the top 10 contributors (the United States (third), Germany (sixth), the Republic of Korea (seventh), and Taiwan Province of China (ninth). Their combined FVA accounted for $38.4 billion in 2017, or approximately 20 per cent of the total FVA in ASEAN's E&E exports. This demonstrates that ASEAN is attractive to investors from different corners of the world and capable of being a regional and global hub for E&E production, ranging from low-end and labour-intensive products to advanced and technologically sophisticated products.

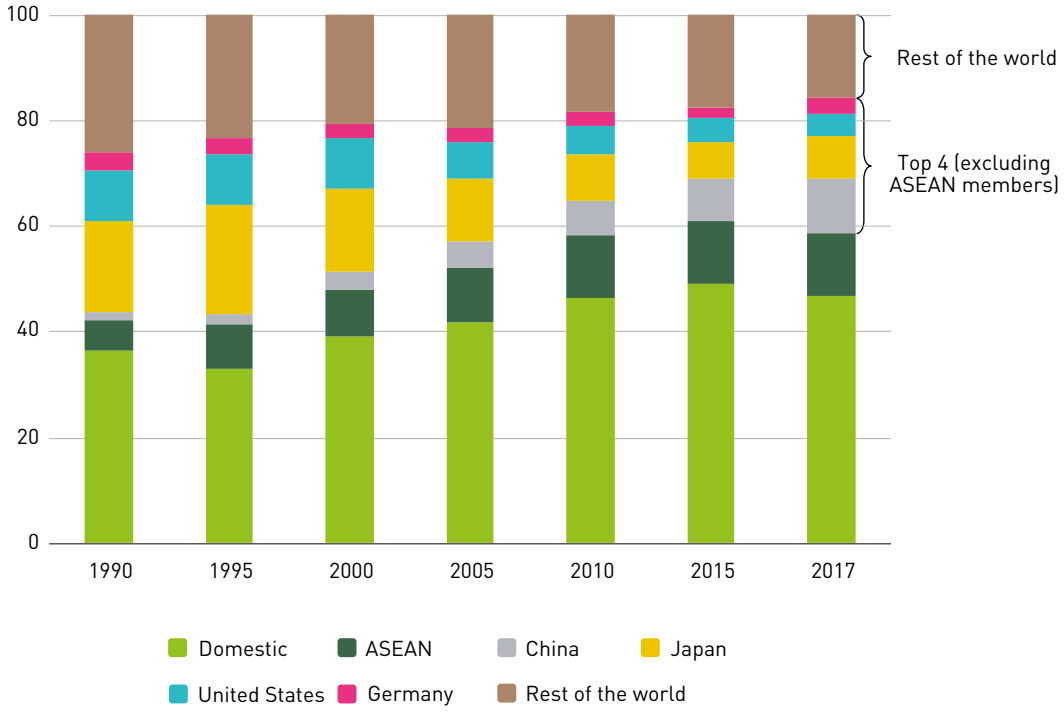
The shares of the top five FVA creators in ASEAN's E&E industry exports changed places during 1990–2017. The shares of China and ASEAN countries increased gradually (figure 4). The share created by ASEAN countries doubled during the past three decades, rising from 6 per cent in 1990 to 12 per cent in 2017, while that created by China increased 10 times (1 per cent to 10 per cent). Meanwhile, the importance of Japan and the United States declined significantly, from 21 per cent to 8 per cent and from 10 per cent to 4 per cent, respectively. The relocation of Japanese E&E manufacturers to China and ASEAN countries at the cost of direct exports from Japan, a move made in response to a loss of international competitiveness, explains the sharp drop of the contribution of Japan and the higher contribution of China and ASEAN intraregional trade in terms of FVA share contributed to ASEAN exports of E&E equipment (Korwatanasakul, 2019). Some foreign inputs originally imported from Japan were replaced by inputs produced in China and ASEAN countries.

Figure 3. **Top 30 creators of foreign value added for ASEAN exports of electrical and electronic equipment, 2017** (Millions of dollars)



Source: AJC-UNCTAD-Eora database on ASEAN GVCs.
Note: For Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar, the industry includes also general machinery.

Figure 4. **Value added exports of electrical and electronic equipment from ASEAN, by domestic, ASEAN and top four non-ASEAN foreign country creators of value added, selected years** (Per cent)



Source: AJC-UNCTAD-Eora database on ASEAN GVCs.
Note: For Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar, the industry includes also general machinery.

During 1990–2017, ASEAN's GVC participation in E&E equipment declined slightly, from 74 per cent to 70 per cent, while its RVC participation doubled, from 9 per cent to 18 per cent. The increasing trend of RVC participation is explained by greater regional production capacity and the well-established regional production network. The decline in GVC participation was caused by an increasing share of domestic value added (DVA) rather than a decrease in global production networks.

Owing to greater value added created domestically as well as regionally, GVC participation in ASEAN's E&E industry has been slightly decreasing, while RVC participation has been gradually increasing over the past decades. As in ASEAN's automobile industry (Korwatanasakul and Intarakumnerd, 2020), both GVC and RVC participation in the E&E industry are characterized by intensive backward linkage participation (high FVA shares) and steadily rising forward linkage participation (increasing value added incorporated in other countries' exports (DVX)) (figure 5). GVC participation slid from 74 per cent in 1990 to 70 per cent in 2017, whereas RVC participation doubled, from 9 per cent to 18 per cent, during the same period (table 3). MNEs, particularly from Japan, have been contributing significantly

to these dichotomic trends. With the reallocation of their production bases to ASEAN countries, they have been enhancing ASEAN's domestic and regional production capabilities through technology transfer and therefore strengthening its regional production networks. In figure 5, column B shows that the FVA created outside ASEAN has been declining, meaning that the DVA created by ASEAN countries has been increasing. In other words, ASEAN countries are relying less on foreign inputs from outside ASEAN but using more domestically produced inputs. Moreover, the FVA created within ASEAN has been growing (column C). This illustrates the significance of the regional production and value creation network within ASEAN.

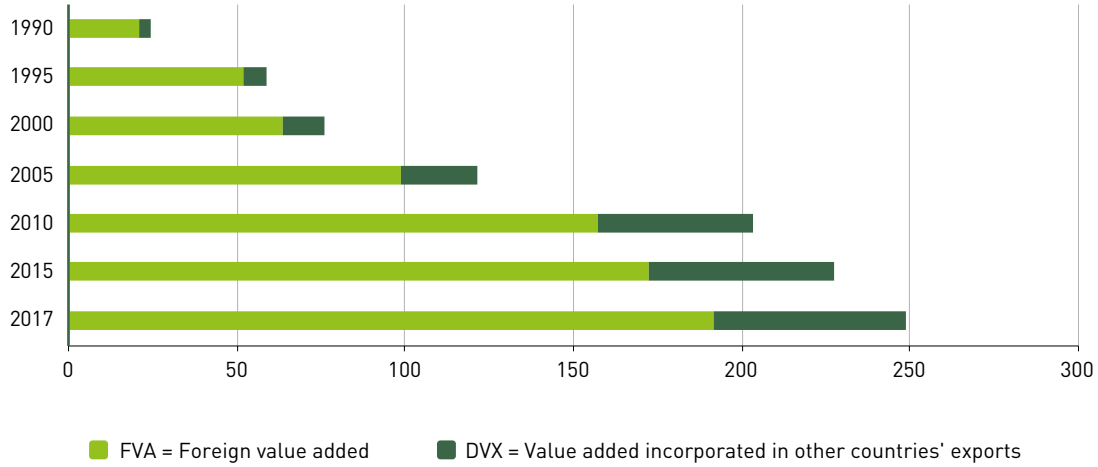
The E&E value chains of Malaysia, the Philippines, Singapore and Thailand are mainly characterized by backward linkage participation (high FVA) owing to their heavy dependence on imports of raw materials, components, subsystems and foreign technology (figure 6). Surprisingly, Singapore's forward linkage participation is relatively small, compared with that of its neighbors, as its technically advanced products are used for final assembly rather than as inputs to further production and export. By contrast, Malaysia has the greatest forward linkage participation (the highest DVX), followed by the Philippines and Indonesia, as their E&E products are used in other countries to produce further exports. This yields positive economic benefits of direct gains from DVA in exports. In contrast, the E&E value chains of countries such as Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar have limited GVC participation as the industry has only recently emerged in those countries (other than Brunei Darussalam) and they therefore produce very limited volumes of E&E exports, implying low DVX. Furthermore, with the comparative advantage of inexpensive labour, production in those countries focuses on labour-intensive manufacturing tasks that do not require advanced and capital technology. Hence, with their relatively small volume of exports, they mainly use existing domestic inputs and technology rather than imported ones (thus, low FVA).

Table 3. **GVC and RVC participation in electrical and electronic equipment, 1990–2017**
(Per cent of total exports)

	FVA: Foreign value added			DVX: Domestic value added incorporated in other countries' exports			Value chain participation	
Year	**Total (A) = (B+C)**	**Created outside ASEAN (B)**	**Created within ASEAN (C)**	**Total (D) = (E+F)**	**Incorporated outside ASEAN (E)**	**Incorporated within ASEAN (F)**	**GVC participation (A + D)**	**RVC participation (C + F)**
1990	63.6	57.6	6.0	10.7	8.1	2.7	74.3	8.7
1995	66.8	58.6	8.1	9.4	5.8	3.6	76.2	11.8
2000	60.9	51.9	9.0	11.7	7.5	4.2	72.6	13.2
2005	58.2	47.9	10.3	13.8	8.8	5.0	72.0	15.3
2010	53.3	41.8	11.5	15.8	10.0	5.7	69.1	17.2
2015	50.9	39.0	11.9	16.2	10.0	6.3	67.1	18.1
2017	53.1	41.1	12.0	15.8	10.0	5.8	68.9	17.8

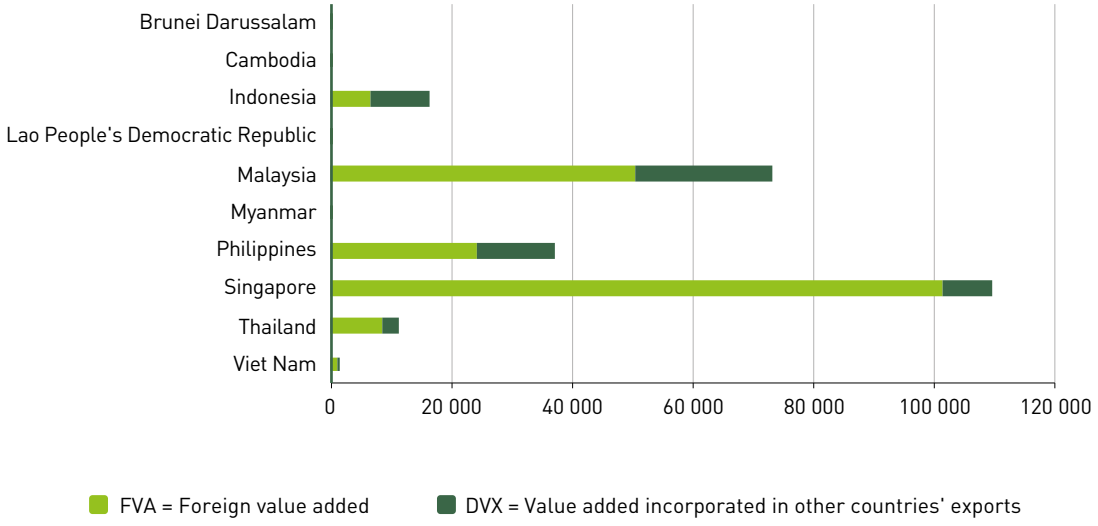
Source: AJC-UNCTAD-Eora database on ASEAN GVCs.
Note: For Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar, the industry includes also general machinery.

Figure 5. **Evolution of GVC participation in ASEAN electrical and electronic equipment, 1990–2017** (Billions of dollars)



Source: AJC-UNCTAD-Eora database on ASEAN GVCs.
Note: For Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar, the industry includes also general machinery.

Figure 6. **GVC participation in electrical and electronic equipment in ASEAN, 2017: value in gross exports of electrical and electronic equipment** (Millions of dollars)



Source: AJC-UNCTAD-Eora database on ASEAN GVCs.
Note: For Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar, the industry includes also general machinery.

With different areas of specialization, ASEAN became an attractive and important hub for the E&E industry, providing an extensive range of production along the value chain, ranging from labour-intensive and simple activities such as assembly and testing to capital-intensive tasks such as component design and R&D.

Brunei Darussalam: Although the technology and creative industry is one of the country's priority business clusters, the E&E industry is not emerging here and thus does not have opportunities to participate in this GVC.

Brunei Darussalam has depended heavily on production of oil and natural gas. To diversify risk, current national efforts are geared towards high value added manufacturing and services. The government has identified five investment priority clusters, namely halal, technology and creative, business services, tourism, and downstream oil and gas (Ministry of Finance and Economy, 2020). Within the technology and creative industry, the focus is on digitalization, information technologies and services innovation, such as data centres, digital media, the Internet of things and biotechnology, rather than on the production of hardware. Thus, the E&E industry was not listed in the country's investment strategy. It contributed only 0.04 per cent to national GDP in 2019 and employed 135 workers in 2017 (Department of Economic Planning and Statistics, 2020).

Cambodia: Strategically focusing on labour-intensive production activities, the country was able to join the E&E value chain in the early 2010s. Its E&E industry is relatively new compared with those of other ASEAN countries and therefore still needs to take several steps to upgrade.

Production in the E&E industry has been rising in the country during the past decade. Chinese and Japanese MNEs moved some of their production activities to Cambodia in the early 2010s because of higher wages in neighboring countries such as China, Thailand and Viet Nam, coupled with the severe flooding in Thailand in 2011. Cambodia is regarded as a strategic location because of its proximity to the production bases in China, Thailand and Viet Nam, and its competitive wage rates. The "Thailand plus one" strategy opens up opportunities to attract foreign affiliates based in Thailand (box 3).

Cambodia's E&E industry specializes in labour-intensive production activities, e.g. assembly and testing, and creates low value added. E&E producers concentrate mainly in special economic zones (SEZs), which are exclusively available to MNEs. This implies a limited role for local producers in the industry. Furthermore, MNEs rarely procure local materials and inputs but rely largely on imported materials from the original production hubs (Hatsukano and Tanaka, 2014). Nevertheless, a high share of DVA in exports can be observed in the E&E industry (figure 2). The production of E&E parts requires low technology but intensive manpower, whereas the value of imported inputs is very low compared with the cost of labour. These characteristics of Cambodia's E&E industry may explain the high DVA.

The government's Industrial Development Policy 2015–2025 (Ministry of Industry and Handicraft, 2020) emphasizes new industries or manufacturing ventures with high value added products, including the E&E industry. It also provides support to the private sector in terms of capacity-building; e.g. the establishment of the National Metrology Center. This centre provides a wide range of services, including calibration, verification, pattern approval, license issuance services, certificate issuance services, consulting services, information services, and training, workshops and seminars.

Box 3. **Cambodia's E&E industry under Thailand plus one strategy**

Yazaki Corporation, Koh Kong

Yazaki Corporation is a Japanese wiring harness manufacturer located in the eastern region of Thailand. In 2012, the company decided to expand its production and build a new factory in Koh Kong, Cambodia. The investment project, worth $6.5 million, was motivated mainly by rising costs of labour in Thailand. The new factory employed 2,000 workers and enabled Cambodia to join the East Asian E&E production networks.

SC Wado, Poipet

NIDEC is a Japanese HDD producer that invests in the eastern and central regions of Thailand. It was severely affected by the flooding in 2011. As a result, the firm tried to diversify its risk by investing in Poipet, Cambodia. NIDEC established an affiliate firm under the name, SC Wado in 2013 with an investment worth ¥5 billion. SC Wado produces HDD parts that are exported back to Thailand. Under this Thailand plus one strategy, 5,000 jobs were created in Cambodia and the country was connected to the E&E regional and global value chains.

Source: Sukegawa, 2014.

Indonesia: The E&E industry is mainly for the domestic market and not for export; therefore, the industry has limited involvement in GVCs.

Despite its long history, the development of the E&E industry has been gradual since its start in the 1970s. In the mid-1980s, similarly to the industrial development path followed in other countries, the Indonesian government encouraged joint ventures between domestic firms and foreign electronics companies while encouraging export promotion instead of import substitution. Products such as air conditioners and refrigerators were produced locally and sold to the domestic market. The E&E industry successfully served its domestic market with local brands under an import substitution policy; however, it failed to meet the government's expectation regarding export promotion. Local brands cannot compete in the international market owing to their weak supporting industries (component electronics) and insufficient technological capabilities and human resources. Most inputs are still imported from abroad, raising the production costs of domestic firms. Moreover, only a small number of companies have the capability for basic modification, design and engineering-based innovation. The few domestic firms that supply products to foreign electronics firms concentrate in the production of low value added inputs, e.g. plastics, packaging and corrugated boxes (ILO, 2019).

Regarding the technological upgrading of local firms, several local brands that started out as producers of air conditioners and refrigerators, have diversified their product range to include 4G smartphones. The consumer electronics segment is now the most developed because of the large domestic market of 62 million households, while the industrial electronics segment has continued to develop because of the expanding communication and telecommunication sector. To address the technological upgrading issue and reduce imports of electronic components, the government introduced regulations requiring a minimum of 20 per cent local content for certain categories of consumer electronics in 2016 and 30 per cent for 4G smartphones in 2017. The local content requirement led to the establishment of smartphone manufacturing factories in Indonesia. During the same period, the government also launched training programmes targeting the E&E industry and set up 19 vocational training centres to improve domestic production capabilities (ILO, 2019).

Lao People's Democratic Republic: The E&E industry is still at its early stage with significant room for expanding and upgrading. E&E firms are generally lower-tier suppliers of labour-intensive parts and components; few firms produce electrical appliances.

Competing with Cambodia, the E&E industry in the Lao People's Democratic Republic also benefited from the recent wave of MNEs' relocation of production in the 2010s because of its low cost of land and labour. MNEs that have production bases in neighboring countries such as China, Thailand and Viet Nam transferred some of their labour-intensive production activities to the Lao People's Democratic Republic. Also attracting MNEs to the country were factors such as proximity, risk diversification (e.g. environmental risk including natural disasters such as flood in Thailand) and electricity production capacity (as the country aims to become a "battery" of Southeast Asia). Nevertheless, the number of suppliers is still very small. In 2017, there were 15, the majority of them Japanese, generally export-oriented and located in SEZs, e.g. Champasak, Savannakhet and Vientiane (Vilavong, 2019). These firms mainly produce parts and components (e.g. Dai-ichi Denshi, Daiwa, Kitani, Mitsubishi Materials, and Nikon); only two produce electrical consumer products. The parts and components segment is driven by intrafirm trade, as they are exported back to the MNEs' own E&E production bases in Thailand and Viet Nam. The Lao industry's participation in the E&E value chain is thus limited to lower value added functions. Lack of domestic capabilities and supporting industries are the main challenges preventing the industry from upgrading. Even though the government has not identified specific policies to address the issues in the E&E industry, it has been strongly emphasizing the improvement of the overall business environment (e.g. basic infrastructure) and the development of SEZs to attract more FDI. The Lao E&E industry still has significant room for improvement and upgrading. Enhancement of domestic labour quality and local firms' technological capabilities can help the industry upgrade processes and, eventually, functions.

Malaysia: The government successfully enhanced the capabilities of local E&E suppliers and thus was able to upgrade from simple production to advanced engineering and design of E&E components and subsystems. Penang is now a showcase for the development of an E&E cluster through cooperation among MNEs, local suppliers and the government.

The E&E industry contributes 10 per cent of national GDP and is the largest driver of exports in Malaysia. As much as 34 per cent of total exports in 2018 came from the E&E industry. Following the opening of free trade zones in 1972, the industry expanded rapidly. With the help of MNEs, particularly those from Japan and the United States, Malaysia first entered the E&E value chain as a producer of labour-intensive products. The industry went through two waves of functional upgrading. First, in the 1990s, the industry moved from simple to skill-intensive production activities. Then, in the 2000s, the relocation of chip design, wafer fabrication and supportive R&D activities from headquarters economies to Malaysia induced a second round of functional upgrading (Rasiah, 2017). Competing with Singapore, Malaysia's E&E industry specializes in high value added functions such as R&D and design of components and subsystems. The high DVA share in E&E exports (59 per cent) indicates that the industry relies significantly on local inputs and technology and therefore gains considerably from value added exports.

Staring from the import substitution policy in 1958, the government launched the Pioneer Industry Ordinance, which identified the E&E industry as one of the key industries. It had already started to develop thanks to FDI from United States and Japanese MNEs. In the 1970s, the government shifted its policy from import substitution to export orientation and established free trade zones.

This shift accelerated the growth of the industry in Malaysia. The country attracted a large amount of FDI and became a strategic E&E production hub in the region and the world. Since 1991, the government has made tremendous efforts, such as through local skill development programmes and R&D grants, to achieve functional upgrading to stimulate the transformation of the industry to high value added operations, such as wafer fabrication, chip design and R&D. Penang is now the epitome of a successful E&E cluster in which skill and technological transfer from MNEs to local firms genuinely occurred (box 4).

Box 4. **Penang electronics cluster**

Penang State in northwest Malaysia has been known as the Silicon Valley of the East. Its E&E industrial cluster, consisting of some 380 firms with a network of 3,000 local suppliers, serves as a strong base of E&E manufacturing. The government has played an important role in promoting the industry and successfully facilitating the upgrading process of both MNEs and local firms from labour-intensive assembly to advanced engineering, product design and R&D. Moreover, the Penang Skill Development Centre helps improve the capabilities of workers and local firms through collaborations between MNEs and local firms as well as a wide range of training programmes, such as operator training, and product and system design.

Source: Avarri (2010) and Invest Penang (investpenang.gov.my).

Myanmar: Even though the country has limited participation in the E&E value chain, its industry has been gradually developing with recent foreign investment.

Myanmar's E&E industry is still underdeveloped and has a low degree of GVC participation. In 1964, the industry was initially promoted to specialize in the labour-intensive production of electrical goods (e.g. lamps, rice cookers, radios, hot plates) for the local market under the import substitution policy and with technical support from Japan (Larkin, 2012). Firms were mainly under state ownership and mostly stand-alone units that did not necessarily require high skills (Kudo, 2002). The lack of basic industrial conditions such as technical capability, supporting industries and domestic competition resulted in low product quality. Thus, the promotion has not been very successful, and the local market still heavily relies on imported E&E consumer goods. In 2018, there were 117 manufacturing establishments employing approximately 4,000 workers. The industry contributed 1 per cent of national GDP with an export volume of $151 million that year. As in Cambodia and the Lao People's Democratic Republic, the E&E industry manifests a higher DVA share in exports (figure 2), which comes largely from the procurement of local raw materials and the contribution of human resources, with a low level of exports. Recently, FDI has been attracted to Myanmar due to its abundance of inexpensive labour and natural resources, its expanding domestic market and the opening of the country. Utilizing this opportunity, Myanmar can participate in the E&E value chain and prepare its domestic suppliers to be ready for future upgrading in the value chain.

The Philippines: The E&E industry concentrates in the production of labour-intensive and back-end components, and demonstrates a high share of DVA in exports (54 per cent).

Since the 1970s, the E&E industry has been the main economic driver for the Philippines, accounting for 14 per cent of its GDP and employing at least 295,000 workers. In 2015 there were 498 firms,

the majority of them belonging to foreign MNEs, which contributed the large portion of FDI in the country. In 2018, the industry accounted for half of total exports, worth $33 billion. The main functions of both domestic suppliers and subsidiaries of global E&E firms lie in labour-intensive activities such as assembly and testing of components and subsystems, particularly semiconductors. Semiconductors account for two thirds of the E&E exports and E&E firms (Department of Trade and Industry, 2017). The Philippines is also involved in the production of electrical and electronics goods; e.g. office equipment and storage. Even though the E&E industry still depends on foreign inputs and technology, the industry shows a high level of DVA in exports at 54 per cent. Overall, having the highest GVC participation in the economy (ASEAN-Japan Centre, 2017), the industry is well integrated into RVCs and GVCs.

The government has been actively promoting the E&E industry and working closely with firms. With the ultimate goal to move up the value chain, the 2016–2030 industrial development road map was formulated, and strategic areas were identified. The priority was to strengthen domestic capability, particularly that of SMEs and domestic workers, through the cooperation of different stakeholders, including the government, industry and academia. Human resource and SME development has been promoted through various programmes in collaboration with domestic and foreign universities, such as those from Taiwan Province of China. The industry players also established the Semiconductors and Electronics Industries in the Philippines, Inc., to improve the industry's competitive advantages through training, research and development, advocacy, information, and networking and services.

Singapore: The E&E industry is a good example of one that leveraged MNEs' knowledge and technology for upgrading and moved up the value chain. Singapore has succeeded in becoming a regional and global R&D hub for E&E equipment.

Singapore is very well integrated in the E&E value chain at the regional and global levels. By leveraging foreign knowledge and technology, the E&E industry upgraded its functions from simple production to advanced design and engineering of E&E components and subsystems. In 2018, the industry contributed approximately 5 per cent of national GDP, while accounting for 31 per cent of total exports, or $129 billion. Some 91,000 workers work in 577 E&E firms. Despite its low DVA share in E&E exports (18 per cent), the industry's DVA value is relatively large ($23 billion), compared with values in other ASEAN countries with similar or larger DVA shares.

In the 1960s, the E&E industry in Singapore started as a manufacturing site for MNEs. The government it had been offering competitive wages to attract FDI. With the aims to increase investment and generate employment, Singapore began to attract MNEs in the 1960s. Apart from improving hardware investment infrastructure, the government also launched incentive programmes to encourage the process of knowledge and technological transfer from MNEs to local firms (Rasiah and Shan, 2016). R&D grants and subsidization of MNEs' managers to work in local firms were some of the key incentive programmes that helped speeding up the upgrading process.

The growing trend of offshoring, coupled with the rise of the global personal computer market in the late 1970s allowed the industry to develop rapidly and became a production hub for computer and related equipment for MNEs of more advanced economies such as Japan and the United States. The government played a significant role in seizing these investment opportunities. It invested significantly in basic infrastructure and created a good investment environment to attract MNEs. During this period, domestic supporting industries emerged, and the main industry was able to upgrade to more complex and technologically advanced products (Wong, 1998). The industry has been continuously upgrading, e.g. shifting from labour-intensive to skill-intensive production activities in the 1980s, moving towards technology-intensive manufacturing operations in the 1990s,

and specializing in high value added functions such as R&D in the 2000s. Singapore became a regional and global hub of creativity, innovation, and R&D in the E&E industry.

Thailand: Thailand is one of the major manufacturing bases of the global E&E industry and serves as a global production hub of HDD makers. However, the pace of upgrading the industry is rather moderate and needs to speed up.

The E&E industry is one of Thailand's strategic industries that contributes significantly to the economy: 13 per cent of national GDP came from the E&E industry in 2018, which had 362,000 employees. E&E exports were $35 billion in 2018; major export markets were the United States, ASEAN, Japan and China. In 2018, there were 3,882 E&E firms, of which 84 per cent were domestic SMEs (Electrical and Electronics Institute, 2019). Despite that large share, MNEs produced 93 per cent of total E&E exports in 2018. They dominated the industry as they were usually larger and had more advanced technology and greater capital. The industry participated smoothly in the E&E value chain in the 1970s when MNEs were searching for new investment locations owing to higher labour costs in Malaysia and Singapore. Thailand specialized in low-skill, labour-intensive activities but has been gradually moving up the value chain. Currently, Thailand relies more on domestic inputs and technology, as shown by a high DVA share in E&E exports (65 per cent in 2017), higher than the FVA share. The industry focuses on skill-intensive production activities; i.e. the assembly and testing of complex and sophisticated components, subsystems and E&E consumer and industrial products, offering low to medium value added.

Subsidiaries of MNEs in Thailand have achieved considerable technical acquisitions and upgrading since the 1980s, but R&D activities for new products or process innovations are still mainly conducted outside Thailand (Hobday and Rush 2007). Research and innovation activities in large Thai firms are small but have been gradually increasing, especially focused on IC and appliance designs (Intarakumnerd, Chairatana and Chayanajit, 2016). Local firms have spent substantial sums on acquisition of foreign machinery and knowledge rather than investing in their own R&D. This reflects the nature of the E&E industry as most knowledge and innovation comes from abroad. However, in some exceptional cases, local firms have successfully moved up the value chain by developing their own design and R&D capabilities (box 5).

In the early 1990s, the National Electronics and Computer Technology Centre began to support Thai microelectronics through the promotion of very large-scale integration design of IC and wafer fabrication. In 1998, Thailand's Electrical and Electronics Institute was established under the Ministry of Industry with the aim to become a focal point in enhancing the country's potential and capability to compete in the global market. Its objectives are (1) to encourage and promote the use of local materials and parts for continuous value added production of electrical and electronics goods, (2) to draw on international standards to improve the quality of Thai electrical and electronics products and their exports and (3) to be a centre for collecting, analyzing and conducting research and updating information on the E&E industry in the aspects of production, marketing and international trade agreements.

Box 5. **Technological upgrading strategies of successful Thai firms**

Stars Microelectronics (Thailand) Public Company Limited

Founded in 1995, Stars Microelectronics Thailand (SMT) is a locally owned original equipment manufacturer (OEM) of computers, electronics, automobiles, communications, safety equipment and entertainment services. It is also a subcontractor and an electronics product designer. Co-founders were an investor with a background in the rice milling industry and a university professor from the industrial engineering discipline. The company headquarters is located in Bangpa In Industrial Estate, Ayutthaya with sales offices in Japan, Germany, the United States and Taiwan Province of China. SMT engages actively in upstream mass production of microelectronics module assemblies and IC packaging. It has 25,500 square meters of factory space.

SMT's core competency is in advanced EMS for microelectronics module assemblies, IC packaging and testing based on on-site and solution-based practice provided by its local engineering teams. Another core factor is operation space management that provides secured and dedicated space where clients' intellectual properties and design are not exposed. Process innovation can be observed from investment in new machines and technologies. In contrast, product innovation is less evident due to the limited nature of EMS or contract manufacturers i.e., producing by orders. External sources of innovation are from suppliers and clients. SMT often requests machine specifications from machine suppliers. It also maintains continuous cooperation with its machine suppliers through communication and technical support provided by their sales representatives and research teams. With a new business opportunity such as a rise in demand for ultra-high radio frequency identification (RFID) chips, SMT was given a chance to co-design new products. It cooperated with its clients through its on-site skills in manufacturing and process engineering. The company also learned to integrate new machinery into its manufacturing process, in response client orders.

Silicon Craft Technology

Silicon Craft Technology was established in 2002 by five Thai co-founders with engineering and IC design backgrounds. The firm was the prime mover in IC design in Thailand. It had an ambition to make itself a showcase of local technopreneurship, encouraging locals to get into the IC design business. Managing Director and Co-Founder Mr. Manop Thamsirianunt used to work as an analog design engineer and IC design manager for semiconductor firms in Silicon Valley. Through a reverse brain drain scheme, he returned to Thailand in 2001 and became the head of the Thailand IC Design Incubator, a unit of the National Electronics and Computer Technology Centre. Subsequently, he left the Incubator and set up an IC design company with other co-founders, some of whom had doctoral degrees in engineering and university professorships.

In the early stage of the firm's establishment, the idea of IC design in Thailand was considered a high-risk and far-fetched ambition. It was very difficult for the co-founders to persuade local investors to jump into the business. The strategy was to spin off leaders from research organizations to be technopreneurs. Some co-founders continued their work as university professors, while some worked as full-time directors at the firm. Later, Silicon Craft developed application-specific IC chips used in electronic devices and RFID chips that were sold in many countries. Public procurement from the National Electronics and Computer Technology Centre to develop a smart RFID chip used for animal identification was as an important "learning event" for the company to gain technological and innovative capabilities. The company came to be internationally recognized as a chip provider. Silicon Craft today has succeeded in gaining more than 20 international customers in chip design and solutions from Australia, the United States, Europe and Japan. The majority of employees have earned engineering or related degrees from leading Thai and international universities.

Source: Intarakumnerd, Chairatana and Chayanajit (2016).

Viet Nam: The E&E industry is relatively new but contributes tremendously to the economy. Reliance on foreign inputs and technology induced the initial growth of the industry but may hinder its long-run development unless an upgrading strategy is carefully identified and implemented.

The development of the E&E industry accelerated after Viet Nam became a member of the World Trade Organization in 2007. The industry was successfully established thanks to the waves of relocation of MNEs' assembly activities in the 2010s, fueled by the increasing number of FTAs concluded by the country. As Viet Nam provided lower wages and land prices, it could attract E&E MNEs to invest in the country. Viet Nam positioned itself well in the middle of the E&E value chain, specializing in labour-intensive activities such as assembly and testing. The industry accounted for 23 per cent of GDP in 2014 and 37 per cent of total exports ($87 billion) in 2018. It is dominated by MNEs, especially from Japan, the Republic of Korea, and the United States, covering over two-thirds of the domestic market and of total exports (Korwatanasakul, forthcoming). They also play a role in undertaking R&D, which has spillover effects on the local economy (box 6).

Nevertheless, the industry is facing difficulty in sustaining its competitiveness and moving up in the value chain. Lacking well-established supporting industries, Viet Nam depends heavily on imported inputs. Moreover, low domestic technological capability exacerbates the problem. In other words, the industry sees a considerably high FVA share in E&E exports, and its upstream and downstream activities remain underdeveloped. In 2017, the FVA share was as high as 60 per cent. To move up the value chain, strengthening the capability of local firms and workers will be a priority.

Most of the government supports for the industry have taken the form of tax incentives for FDI promotion. The industry had been developing without any concrete development plan. In 2007, the government released the first development plan, "Vietnam's EI Development Plan for the period up to 2010, with a vision by 2020" to address issues and challenges in framing policies for the E&E industry (Ngoc and Binh, 2019). The Ministry of Information and Communication, which is the main ministry in charge of the plan, is expected to coordinate with other ministries and stakeholders to solve the existing problems and ensure further development of the industry.

Box 6. **R&D of MNEs in Viet Nam**

Panasonic Vietnam

In 2007, Panasonic established its third ASEAN R&D Center in Viet Nam (the other two are in Singapore and Malaysia). The centre in Viet Nam is responsible for supplying embedded software products to the headquarters in Japan (80 per cent of total output) and the factory in Viet Nam (20 per cent of total output) (Binh and Linh, 2013). Through annual training of Vietnamese engineer staff and research collaboration with local universities and research institutes, Panasonic's hosting of the R&D centre generates spillover effects for Viet Nam's E&E industry.

Samsung Vietnam

After implementing its mega-investment projects in Viet Nam, Samsung founded two R&D centres, in Hanoi in 2012 and Ho Chi Minh City in 2017. In Hanoi, the Samsung Vietnam Mobile Research and Development Centre contributes to 10 per cent of the software used in Samsung's smartphones and tablets, while the centre in Ho Chi Minh City specializes in consumer E&E appliances. The Hanoi facility is Samsung's largest R&D centre in Southeast Asia, with comprehensive R&D units, i.e. hardware, mechanics and software. Similarly to Panasonic's approach, the centre collaborates with the Hanoi University of Technology to cultivate human resources in electronics engineering.

ASEAN has been a long-term trade and investment partner of Japan. Changes in export demand for Japan's E&E products inevitably affect the demand for inputs from the E&E industry in ASEAN countries as well. In 2017 a $1 million increase in Japan's E&E exports attracted inputs from ASEAN worth an estimated $30,000 to integrate into Japan's exports.

Japan's value added trade exports of E&E equipment increased significantly during the period of 1990 to 2017 (table 4). Total E&E exports were $73 billion in 1990 and tripled to $215 billion in 2017. Owing to the rise of fragmentation of production, the structure of value added exports has been changing over time. Moving production activities that create low value added abroad such as to ASEAN countries led to an increase in the FVA share in E&E exports. In 2017, ASEAN supplied 15 per cent of Japan's FVA (or imported content in Japan's gross exports), accounting for $6.6 billion. This signifies the importance of ASEAN's E&E industry in Japan's E&E exports and the long-lasting trade and investment partnership between the two economies. Among ASEAN member states, Malaysia is the largest contributor to Japan's E&E exports, accounting for 29 per cent of the FVA created by ASEAN countries ($1.9 billion). Due to the interconnection among counties on the E&E value chain, any changes in demand for Japan's E&E products inevitably affect the demand for inputs from the E&E industry in ASEAN countries as well. A $1 million increase in exports of Japan's E&E industry was associated with imports worth $30,000 from ASEAN in 2017.

A common challenge in the E&E industry in most ASEAN countries is the limited capability of labour and local firms, particularly SMEs. National and regional coordination among government agencies at different levels, particularly in development of human capital in local firms and technology transfer from MNEs, play important roles in domestic functional upgrading, strengthening value chains and in turn further developing the E&E industry in ASEAN. A policy framework that encompasses all stakeholders to attract, facilitate and increase investment from abroad and within the country is essential for this industry.

ASEAN countries other than Brunei Darussalam have engaged smoothly in the E&E value chain; however, the process of functional upgrading was successful only in Malaysia and in Singapore. In Thailand, the process is rather slow, while in Indonesia, the Philippines and Viet Nam, more efforts are needed to catch up with the leading economies. Cambodia, the Lao People's Democratic Republic and Myanmar still have large room for improvement, as they only recently joined the value chain. Despite the different development stages of the E&E industry in the ASEAN countries, limited domestic capability is a common challenge in the industry. There are four main issues: (1) the low technological capability of local firms, (2) the dominance of low-skilled labour, (3) insufficient supporting industries, and (4) limited transfer of knowledge, skill, and technology transfer from MNEs to local firms. Therefore, the policy framework should emphasize the role of domestic firms in the value chain, particularly that of SMEs, so that they can upgrade their production activities to a higher position along the value chain. In this respect, the ASEAN-Japan Centre has introduced a capacity-building project to establish an industrial linkage programme to foster local SMEs to become a part of value chains created by MNEs. As of the drafting this report, the governments of Cambodia and the Lao People's Democratic Republic have been working with the AJC to build such a programme.

In following the industry development strategies of Malaysia and Singapore, governments should primarily focus on fundamental factors that promote the domestic investment environment. Improving human capital and basic industrial infrastructure are therefore the priorities. With a

Table 4. **Value added exports of Japanese electrical and electronic equipment, 1990–2017** (Millions of dollars)

	1990	1995	2000	2005	2010	2015	2017
Gross exports	72 798	119 670	140 343	168 898	195 351	187 873	215 146
Domestic value added	65 330	109 086	124 779	141 757	162 277	148 057	171 582
Foreign value added	7 468	10 584	15 563	27 141	33 074	39 815	43 563
Of which, ASEAN	733	1 267	1 859	3 677	5 022	6 257	6 553
Brunei Darussalam	9	9	15	29	36	44	46
Cambodia	0	0	0	1	1	1	1
Indonesia	168	354	395	730	1 054	1 302	1 506
Lao People's Democratic Republic	0	0	0	1	1	1	1
Malaysia	230	369	633	1 209	1 523	1 847	1 923
Myanmar	1	1	6	6	9	12	12
Philippines	65	127	245	612	1 117	1 481	1 563
Singapore	125	192	240	438	619	720	601
Thailand	119	196	279	587	619	792	805
Viet Nam	15	19	45	64	44	57	95

Source: AJC-UNCTAD-Eora database on ASEAN GVCs.
Note: For Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar, the industry includes also general machinery.

sufficient investment environment, a country becomes more attractive to MNEs. This enables the exposure of firms to foreign innovation and technology and may eventually enable them to develop their own through technology transfer. Nevertheless, the process is unlikely to occur unless there are policy mechanisms to encourage this development. For example, Malaysia and Singapore used incentive programmes, such as encouraging foreign managers to work in local firms for a limited period and granting R&D funds to both local and foreign firms. Furthermore, greater efforts to promote regional cooperation should be considered, such as a joint database of local suppliers with different functions, personnel exchange programmes and business matching events for suppliers within and outside the region. These programmes help strengthening the GVC and RVC and attract greater FDI into the region. With national and regional coordination among government agencies, local firms and MNEs, all these efforts are likely to alleviate the existing issues and promote further development of ASEAN's E&E industry.

REFERENCES

Avvari, M. (2010), "Linkages for Fostering Innovation Activities – Case Studies of Firms in E&E Sector of Penang Cluster – Malaysia" [Online]. In: P. Intarakumnerd (ed). *Fostering Production and Science & Technology Linkages to Stimulate Innovation in ASEAN*, Jakarta: Economic Institute of ASEAN and East Asia. https://www.eria.org/publications/fostering-production-and-science-technology-linkages-to-stimulate-innovation-in-asean.

ASEAN-Japan Centre (2017), *Global Value Chains in ASEAN: The Philippines*, Paper 8, ASEAN Promotion Centre on Trade, Investment, and Tourism, Tokyo.

ASEAN Secretariat (2020), ASEANstats. https://www.aseanstats.org.

United Nations Statistics Division (2020), UN Comtrade Database. https://comtrade.un.org/data.

Binh, T., and Linh, M. (2013), Supplier System and Knowledge Transfer Within the Production Networks of Electronics MNCs in Vietnam. *Asian Journal of Technology Innovation*, 21(sup1), 119–138.

De Backer, K., and Miroudot, S. (2013), Mapping Global Value Chains. *Organization for Economic Cooperation and Development (OECD) Trade Policy Papers* No. 159, Paris: OECD Publishing, Paris.

Department of Economic Planning and Statistics (Brunei Darussalam) (2020), Data on Gross Domestic Product, Number of Electrical and Electronics Firms, and Employment.

Department of Trade and Industry (Philippines) (2017), The Philippines in the Electronics & Electrical Global Value Chain. *Policy Briefs*, Series 2017-07, 1–8.

Electrical and Electronics Institute (2019), *Industry Report 2019* (in Thai). Bangkok.

Hatsukano, N., and Tanaka, K. (2014), Challenges to Make Cambodian SMEs Participate in Global Value Chinas: Toward Addressing Poverty and Inequality. In: N. Hatsukano and I. Kuroiwa (eds.), *Inclusive Development in the Era of Economic Integration: Policy Implications for LDCs*, 70–92, Bangkok: Bangkok Research Centre.

Hobday, M., and Rush, H. (2007), Upgrading the technological capabilities of foreign transnational subsidiaries in developing countries: The case of electronics in Thailand. Research Policy, 36(9): 1335–1356.

Intarakumnerd, P., Chairatana, P., and Chaiyanajit, P. (2016), Global Production Networks and Host-Site Industrial Upgrading: The Case of the Semiconductor Industry in Thailand, *Asia Pacific Business Review*, 22(2): 289–306.

ILO (International Labour Organization) (2019), The Electronics Industry in Indonesia and Its Integration into Global Supply Chains. *Working Paper No. 330*, Geneva.

Intarakumnerd, P., Chairatana, P., and Chaiyanajit, P. (2016), Global Production Networks and Host-Site Industrial Upgrading: The Case of the Semiconductor Industry in Thailand, Asia Pacific Business Review, 22(2): 289–306.

Korwatanasakul, U. (2019), *Global Value Chains in ASEAN: Thailand*. Tokyo: ASEAN-Japan Centre.

Korwatanasakul, U. (forthcoming), Global Value Chains and the Vietnamese Economic Development: A Path to Perils or Prosperity? Working paper, ISEAS-Yusof Ishak Institute, Singapore.

Korwatanasakul, U., and Intarakumnerd, P. (2020), *Global Value Chains in ASEAN: Thailand*. Tokyo: ASEAN-Japan Centre.

Kudo, T. (2002), Industrial Development in Myanmar (2): Prospects and Challenges. *Joint Studies on Economic Development Policies in ASEAN and Neighboring Countries*, ASEDP No. 60, 64.

Larkin, S. (2012), Myanmar at the Crossroads: Rapid Industrial Development or Deindustrialization [Online]. http://networkmyanmar.org/images/stories/PDF13/Stuart-Larkin.pdf.

Ministry of Finance and Economy (Brunei Darussalam) (2020), 5 Investment Priority Clusters [Online]. http://www.invest.gov.bn/SitePages/Home_180917.aspx.

Ministry of Industry and Handicraft (2020), Industrial Development Policy 2015–2025 [Online]. http://www.mih.gov.kh.

Ngoc, T., and Binh, D. (2019), Vietnam's Electronics Industry: The Rise and Problems of Further Development. *Humanities & Social Sciences Reviews*, 7(4): 1–12.

Rasiah, R. (2017), The Industrial Policy Experience of the Electronics Industry in Malaysia. In: J. Page and F. Tarp (eds.), *The Practice of Industrial Policy: Government-Business Coordination in Africa and East Asia*, 123–144, Oxford: Oxford University Press.

Rasiah, R., and Shan, Y. X. (2016), Institutional Support, Technological Capabilities and Domestic Linkages in the Semiconductor Industry in Singapore, *Asia Pacific Business Review*, 22(1), 180–192.

Rynhart, G., Chang, J. H., and Huynh, P. (2016), *ASEAN in Transformation: Electrical and Electronics: On and Off the Grid*. Geneva: ILO.

Sturgeon, T., and Kawakami, M. (2010), Global Value Chains in the Electronics Industry: Was the Crisis a Window of Opportunity for Developing Countries?. In: O. Cattaneo, G. Gereffi and C. Staritz (eds.), *Global Value Chains in a Postcrisis World*, 245–302, Washington, D.C.: World Bank.

Sukegawa, S. (2014), Trend of Investment and Movement of Japanese Affiliates toward ASEAN Economic Community (AEC) Era. *Japanese Studies Journal*, 30(2): 23–35.

UNCTAD (United Nations Conference on Trade and Development) (2013), *World Investment Report 2013: Global Value Chains: Investment and Trade for Developmen*t. New York and Geneva: United Nations.

United Nations Statistics Division (2020), UN Comtrade Database. 2020. https://comtrade.un.org/data.

Vilavong, B. (2019), Laos in Need of Bolder Reforms for AEC Integration. In: Roderick Macdonald, (ed.), *Southeast Asia and the ASEAN Economic Community*, 333–350, Cham: Palgrave Macmillan.

Wong, P. (1998). Leveraging the Global Information Revolution for Economic Development: Singapore's Evolving Information Industry Strategy. *Information Systems Research*, 9(4): 323–341.

ANNEX TABLES

Annex table 1. **Value added exports of electrical and electronic equipment from ASEAN, by value added creator, 1990–2017** (Millions of dollars)

	Value added creator	Exports from ASEAN						
		1990	1995	2000	2005	2010	2015	2017
Foreign value added (FVA)	**World**	20 890	51 518	63 853	98 339	157 143	172 531	191 893
	Developed countries	13 235	34 050	38 795	53 176	76 005	74 377	81 065
	Europe	3 808	9 287	10 141	17 908	28 608	28 979	30 299
	European Union	3 540	8 459	9 346	16 581	26 014	26 101	27 548
	Austria	120	291	310	590	945	1 034	980
	Belgium	158	432	428	808	1 199	1 304	1 248
	France	408	1 029	1 079	2 008	3 094	3 074	2 862
	Germany	1 118	2 543	2 721	4 780	7 926	6 888	10 089
	Italy	351	776	844	1 479	2 191	2 200	2 041
	Netherlands	273	718	741	1 151	1 900	1 924	1 786
	Spain	101	272	278	695	1 028	1 118	1 079
	Sweden	160	305	262	472	783	836	766
	United Kingdom	577	1 375	1 789	2 851	4 083	4 674	3 354
	Other developed Europe	268	828	795	1 326	2 594	2 879	2 751
	Switzerland	211	682	612	1 032	2 065	2 396	2 203
	North America	3 199	7 610	10 570	12 334	16 827	16 900	16 450
	Canada	116	290	569	894	1 355	1 427	1 349
	United States	3 083	7 321	10 001	11 440	15 472	15 473	15 102
	Other developed countries	6 228	17 153	18 085	22 934	30 571	28 498	34 315
	Australia	382	878	969	1 841	3 427	3 866	3 640
	Israel	67	155	216	333	647	737	719
	Japan	5 744	16 034	16 790	20 557	26 119	23 482	29 542
	Developing countries	7 530	17 224	24 743	44 384	79 536	96 355	108 996
	Africa	96	304	942	1 652	2 370	2 394	2 422
	North Africa	26	94	670	1 126	1 391	1 450	1 375
	Morocco	8	52	599	982	1 107	1 213	1 130
	Other Africa	70	210	272	525	979	943	1 047
	Latin America and the Caribbean	177	487	702	1 190	2 326	2 396	2 642
	South America	114	313	417	743	1 580	1 546	1 843
	Brazil	55	138	170	343	743	720	869
	Central America	58	160	256	405	672	777	717
	Asia	7 253	16 423	23 088	41 523	74 797	91 525	103 886
	West Asia	233	490	754	1 418	2 322	2 795	3 085
	Saudi Arabia	107	207	288	459	705	824	999
	South, East and Southeast Asia	7 020	15 934	22 334	40 105	72 475	88 730	100 801
	East Asia	4 901	9 220	12 267	21 388	35 511	44 929	53 361
	China	429	1 504	3 392	8 268	19 779	26 873	36 759
	Hong Kong, China	519	1 400	1 564	2 148	2 942	4 258	3 223
	Korea, Republic of	678	2 653	2 941	5 574	6 917	8 502	8 548
	Taiwan Province of China	3 273	3 658	4 358	5 379	5 833	5 253	4 748
	South Asia	142	439	614	1 334	3 047	3 532	3 985
	India	90	302	433	988	2 400	2 754	3 139
	ASEAN	1 977	6 274	9 453	17 384	33 917	40 269	43 455
	Brunei Darussalam	4	8	14	29	45	53	47
	Cambodia	0	2	4	6	12	12	13
	Indonesia	312	1 557	2 420	4 267	8 970	10 943	15 058
	Lao People's Democratic Republic	0	1	1	3	7	8	8
	Malaysia	785	2 072	3 580	6 442	11 903	13 878	14 101
	Myanmar	4	8	30	30	61	78	70
	Philippines	128	393	668	1 493	3 978	4 970	5 197
	Singapore	409	1 274	1 541	2 715	5 126	5 686	4 556
	Thailand	321	917	1 107	2 262	3 681	4 479	4 154
	Viet Nam	14	41	88	137	133	161	249
	Transition economies	125	244	315	779	1 602	1 799	1 832
	Commonwealth of Independent States (CIS)	124	243	311	773	1 587	1 786	1 812
	Russian Federation	107	199	250	619	1 282	1 479	1 338
Domestic value added (DVA)		11 957	25 641	40 915	70 740	137 430	166 751	169 362
Gross exports		32 847	77 159	104 767	169 079	294 573	339 281	361 254

Source: AJC-UNCTAD-Eora database on ASEAN GVCs.

Note: All values are estimated. The region/country refers to that to which the value added is attributed. For the GVC terminology, see box 2. For Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar, the industry includes also general machinery.

Annex table 2-1. **Value added exports of electrical and electronic equipment from ASEAN, by value added creator, 1990** (Millions of dollars)

	Value added creator	Electrical and electronic equipment exports from ASEAN			
		Brunei Darussalam	Cambodia	Indonesia	Lao People's Democratic Republic
Foreign value added (FVA)	**World**	2	0	238	0
	Developed countries	1	0	165	0
	Europe	0	0	55	0
	European Union	0	0	52	0
	Austria	0	0	2	0
	Belgium	0	0	2	0
	France	0	0	7	0
	Germany	0	0	16	0
	Italy	0	0	5	0
	Netherlands	0	0	4	0
	Spain	0	0	2	0
	Sweden	0	0	3	0
	United Kingdom	0	0	6	0
	Other developed Europe	0	0	3	0
	Switzerland	0	0	2	0
	North America	0	0	41	0
	Canada	0	0	2	0
	United States	0	0	38	0
	Other developed countries	0	0	69	0
	Australia	0	0	13	0
	Israel	0	0	0	0
	Japan	0	0	55	0
	Developing countries	1	0	71	0
	Africa	0	0	3	0
	North Africa	0	0	0	0
	Morocco	0	0	0	0
	Other Africa	0	0	2	0
	Latin America and the Caribbean	0	0	3	0
	South America	0	0	3	0
	Brazil	0	0	1	0
	Central America	0	0	1	0
	Asia	1	0	65	0
	West Asia	0	0	7	0
	Saudi Arabia	0	0	4	0
	South, East and Southeast Asia	1	0	57	0
	East Asia	0	0	37	0
	China	0	0	7	0
	Hong Kong, China	0	0	2	0
	Korea, Republic of	0	0	8	0
	Taiwan Province of China	0	0	19	0
	South Asia	0	0	3	0
	India	0	0	2	0
	ASEAN	0	0	18	0
	Brunei Darussalam	-	0	0	0
	Cambodia	0	-	0	0
	Indonesia	0	0	-	0
	Lao People's Democratic Republic	0	0	0	-
	Malaysia	0	0	3	0
	Myanmar	0	0	0	0
	Philippines	0	0	1	0
	Singapore	0	0	9	0
	Thailand	0	0	3	0
	Viet Nam	0	0	1	0
	Transition economies	0	0	2	0
	Commonwealth of Independent States (CIS)	0	0	2	0
	Russian Federation	0	0	2	0
Domestic value added (DVA)		4	1	386	1
Gross exports		6	1	624	1

Source: AJC-UNCTAD-Eora database on ASEAN GVCs.
Note: All values are estimated. The region/country refers to that to which the value added is attributed. For the GVC terminology, see box 2.
For Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar, the industry includes also general machinery.

Electrical and electronic equipment exports from ASEAN

Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
4 830	0	4 307	10 650	855	8
3 174	0	2 029	7 218	644	3
955	0	557	2 057	182	1
885	0	528	1 917	157	1
20	0	21	73	4	0
50	0	21	77	7	0
97	0	65	221	18	0
254	0	134	660	52	0
91	0	48	190	17	0
80	0	64	115	9	0
24	0	13	59	4	0
50	0	17	81	9	0
144	0	104	301	22	0
71	0	29	140	24	0
53	0	22	111	22	0
753	0	510	1 748	147	1
33	0	18	56	6	0
720	0	492	1 692	140	1
1 466	0	963	3 413	316	2
133	0	45	176	14	0
12	0	12	41	3	0
1 308	0	900	3 181	298	1
1 615	0	2 258	3 375	205	5
26	0	16	46	5	0
6	0	5	13	1	0
1	0	2	5	0	0
20	0	11	33	4	0
45	0	34	86	9	0
34	0	21	52	4	0
16	0	12	24	2	0
10	0	12	31	4	0
1 543	0	2 207	3 241	192	5
61	0	44	110	12	0
29	0	20	50	5	0
1 482	0	2 164	3 132	180	4
1 034	0	1 804	1 907	115	4
112	0	75	219	15	0
154	0	105	247	11	0
145	0	192	315	18	0
623	0	1 431	1 125	71	3
38	0	21	72	9	0
27	0	8	46	7	0
410	0	340	1 152	56	1
1	0	0	2	1	0
0	0	0	0	0	0
83	0	36	185	8	0
0	0	0	0	0	0
-	0	98	660	23	0
2	-	0	1	1	0
28	0	-	95	3	0
215	0	163	-	21	0
76	0	40	202	-	0
5	0	3	6	0	-
41	0	20	57	6	0
41	0	19	56	6	0
36	0	17	48	4	0
5 337	3	1 262	3 493	1 466	4
10 167	3	5 568	14 143	2 322	13

Annex table 2-2. **Value added exports of electrical and electronic equipment from ASEAN, by value added creator, 1995** (Millions of dollars)

	Value added creator	Electrical and electronic equipment exports from ASEAN			
		Brunei Darussalam	Cambodia	Indonesia	Lao People's Democratic Republic
Foreign value added (FVA)	**World**	2	2	954	0
	Developed countries	1	1	663	0
	Europe	0	0	218	0
	European Union	0	0	203	0
	Austria	0	0	8	0
	Belgium	0	0	10	0
	France	0	0	27	0
	Germany	0	0	64	0
	Italy	0	0	19	0
	Netherlands	0	0	17	0
	Spain	0	0	7	0
	Sweden	0	0	10	0
	United Kingdom	0	0	25	0
	Other developed Europe	0	0	15	0
	Switzerland	0	0	12	0
	North America	0	0	169	0
	Canada	0	0	10	0
	United States	0	0	159	0
	Other developed countries	0	0	277	0
	Australia	0	0	46	0
	Israel	0	0	1	0
	Japan	0	0	227	0
	Developing countries	1	1	284	0
	Africa	0	0	9	0
	North Africa	0	0	1	0
	Morocco	0	0	0	0
	Other Africa	0	0	8	0
	Latin America and the Caribbean	0	0	14	0
	South America	0	0	11	0
	Brazil	0	0	4	0
	Central America	0	0	3	0
	Asia	1	1	260	0
	West Asia	0	0	26	0
	Saudi Arabia	0	0	14	0
	South, East and Southeast Asia	1	1	234	0
	East Asia	0	0	138	0
	China	0	0	40	0
	Hong Kong, China	0	0	10	0
	Korea, Republic of	0	0	45	0
	Taiwan Province of China	0	0	43	0
	South Asia	0	0	12	0
	India	0	0	9	0
	ASEAN	1	0	84	0
	Brunei Darussalam	-	0	0	0
	Cambodia	0	-	0	0
	Indonesia	0	0	-	0
	Lao People's Democratic Republic	0	0	0	-
	Malaysia	0	0	18	0
	Myanmar	0	0	0	0
	Philippines	0	0	4	0
	Singapore	0	0	42	0
	Thailand	0	0	18	0
	Viet Nam	0	0	2	0
	Transition economies	0	0	7	0
	Commonwealth of Independent States (CIS)	0	0	7	0
	Russian Federation	0	0	5	0
Domestic value added (DVA)		7	3	2 398	2
Gross exports		8	5	3 352	2

Source: AJC-UNCTAD-Eora database on ASEAN GVCs.
Note: All values are estimated. The region/country refers to that to which the value added is attributed. For the GVC terminology, see box 2.
For Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar, the industry includes also general machinery.

Electrical and electronic equipment exports from ASEAN

Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
15 328	0	8 755	24 093	2 288	95
10 378	0	4 883	16 398	1 677	49
3 214	0	1 197	4 143	501	13
2 928	0	1 124	3 758	432	12
69	0	49	153	12	0
178	0	50	170	23	0
331	0	141	476	51	3
831	0	280	1 233	131	4
284	0	94	337	40	1
273	0	137	264	27	1
91	0	31	122	21	0
125	0	28	125	17	0
480	0	218	582	68	2
286	0	72	384	69	1
225	0	57	325	62	1
2 568	0	1 027	3 442	396	8
114	0	35	114	17	0
2 454	0	993	3 329	378	8
4 596	0	2 659	8 813	780	28
364	0	89	338	39	1
38	0	26	80	10	0
4 151	0	2 535	8 366	728	27
4 852	0	3 839	7 602	600	45
103	0	33	141	17	1
24	0	9	56	2	0
7	0	5	40	1	0
79	0	24	84	15	0
165	0	72	198	36	1
122	0	48	118	14	1
54	0	26	49	5	0
40	0	23	74	21	0
4 579	0	3 732	7 260	547	44
163	0	77	197	25	1
69	0	34	82	8	0
4 416	0	3 655	7 062	521	43
2 542	0	2 702	3 529	279	29
555	0	188	640	78	4
559	0	268	528	32	3
653	0	774	1 101	73	6
773	0	1 472	1 258	95	16
165	0	48	187	27	1
128	0	23	121	21	0
1 709	0	905	3 346	216	13
3	0	1	3	1	0
1	0	0	1	0	0
467	0	129	896	63	2
0	0	0	0	0	0
-	0	267	1 702	82	3
3	-	0	2	2	0
107	0	-	273	9	1
770	0	400	-	57	5
341	0	101	454	-	3
17	0	6	15	1	-
98	0	33	94	12	1
97	0	33	93	12	1
82	0	27	76	9	1
11 612	7	2 019	6 182	3 358	53
26 940	7	10 775	30 275	5 646	148

Annex table 2-3. **Value added exports of electrical and electronic equipment from ASEAN, by value added creator, 2000** (Millions of dollars)

	Value added creator	Electrical and electronic equipment exports from ASEAN			
		Brunei Darussalam	Cambodia	Indonesia	Lao People's Democratic Republic
Foreign value added (FVA)	**World**	2	4	1 781	1
	Developed countries	1	2	1 081	0
	Europe	0	1	370	0
	European Union	0	1	344	0
	Austria	0	0	12	0
	Belgium	0	0	17	0
	France	0	0	43	0
	Germany	0	0	102	0
	Italy	0	0	32	0
	Netherlands	0	0	28	0
	Spain	0	0	12	0
	Sweden	0	0	14	0
	United Kingdom	0	0	55	0
	Other developed Europe	0	0	26	0
	Switzerland	0	0	18	0
	North America	0	0	301	0
	Canada	0	0	28	0
	United States	0	0	273	0
	Other developed countries	0	1	411	0
	Australia	0	0	78	0
	Israel	0	0	2	0
	Japan	0	1	324	0
	Developing countries	1	2	683	0
	Africa	0	0	24	0
	North Africa	0	0	5	0
	Morocco	0	0	1	0
	Other Africa	0	0	19	0
	Latin America and the Caribbean	0	0	32	0
	South America	0	0	24	0
	Brazil	0	0	9	0
	Central America	0	0	7	0
	Asia	1	2	626	0
	West Asia	0	0	63	0
	Saudi Arabia	0	0	32	0
	South, East and Southeast Asia	1	2	563	0
	East Asia	0	1	339	0
	China	0	0	111	0
	Hong Kong, China	0	0	17	0
	Korea, Republic of	0	0	111	0
	Taiwan Province of China	0	0	99	0
	South Asia	0	0	30	0
	India	0	0	21	0
	ASEAN	1	1	195	0
	Brunei Darussalam	-	0	1	0
	Cambodia	0	-	1	0
	Indonesia	0	0	-	0
	Lao People's Democratic Republic	0	0	0	-
	Malaysia	0	0	57	0
	Myanmar	0	0	1	0
	Philippines	0	0	7	0
	Singapore	0	0	76	0
	Thailand	0	0	42	0
	Viet Nam	0	0	9	0
	Transition economies	0	0	16	0
	Commonwealth of Independent States (CIS)	0	0	16	0
	Russian Federation	0	0	12	0
Domestic value added (DVA)		10	7	5 711	3
Gross exports		12	11	7 492	3

Source: AJC-UNCTAD-Eora database on ASEAN GVCs.
Note: All values are estimated. The region/country refers to that to which the value added is attributed. For the GVC terminology, see box 2.
For Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar, the industry includes also general machinery.

Electrical and electronic equipment exports from ASEAN

Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
16 643	0	11 039	31 410	2 731	243
10 525	0	6 149	19 166	1 761	111
3 165	0	1 429	4 652	490	34
2 911	0	1 350	4 262	446	31
66	0	54	165	12	1
156	0	55	179	21	1
309	0	155	516	49	7
800	0	326	1 350	135	9
278	0	110	377	43	3
253	0	152	281	26	2
83	0	34	131	18	1
97	0	26	109	15	1
574	0	307	770	79	5
253	0	79	390	44	2
183	0	59	314	36	2
2 912	0	1 667	5 188	479	22
184	0	75	250	30	1
2 727	0	1 593	4 938	449	21
4 448	0	3 052	9 326	791	56
360	0	108	383	37	3
45	0	37	108	22	0
3 995	0	2 894	8 796	729	52
6 009	0	4 842	12 120	955	130
157	0	71	665	22	3
64	0	38	555	6	1
38	0	30	526	3	1
92	0	33	111	16	1
215	0	113	293	47	2
147	0	68	159	17	1
59	0	35	61	6	0
58	0	41	121	29	1
5 633	0	4 657	11 157	887	125
201	0	127	322	38	3
73	0	50	122	10	1
5 432	0	4 530	10 834	849	123
3 322	0	3 080	4 891	554	80
1 021	0	410	1 587	249	14
549	0	347	612	31	8
686	0	792	1 228	106	18
1 063	0	1 529	1 459	167	40
209	0	76	264	35	2
166	0	38	179	27	1
1 902	0	1 374	5 680	261	40
4	0	1	6	2	0
1	0	0	1	1	0
560	0	188	1 613	55	5
0	0	0	0	1	0
-	0	473	2 924	114	10
8	-	2	7	12	0
128	0	-	517	15	2
828	0	562	-	59	15
342	0	136	579	-	7
32	0	11	32	3	-
109	0	48	124	15	3
108	0	48	122	15	2
89	0	38	98	10	2
18 842	23	4 501	7 912	3 692	213
35 485	23	15 540	39 322	6 423	456

Annex table 2-4. **Value added exports of electrical and electronic equipment from ASEAN, by value added creator, 2005** (Millions of dollars)

	Value added creator	Electrical and electronic equipment exports from ASEAN			
		Brunei Darussalam	Cambodia	Indonesia	Lao People's Democratic Republic
Foreign value added (FVA)	**World**	2	5	2 756	1
	Developed countries	1	2	1 593	0
	Europe	1	1	629	0
	European Union	1	1	587	0
	Austria	0	0	21	0
	Belgium	0	0	30	0
	France	0	0	76	0
	Germany	0	0	176	0
	Italy	0	0	55	0
	Netherlands	0	0	43	0
	Spain	0	0	25	0
	Sweden	0	0	23	0
	United Kingdom	0	0	81	0
	Other developed Europe	0	0	42	0
	Switzerland	0	0	30	0
	North America	0	0	379	0
	Canada	0	0	40	0
	United States	0	0	339	0
	Other developed countries	0	1	585	0
	Australia	0	0	140	0
	Israel	0	0	3	0
	Japan	0	1	432	0
	Developing countries	1	3	1 130	1
	Africa	0	0	42	0
	North Africa	0	0	9	0
	Morocco	0	0	2	0
	Other Africa	0	0	33	0
	Latin America and the Caribbean	0	0	52	0
	South America	0	0	39	0
	Brazil	0	0	17	0
	Central America	0	0	10	0
	Asia	1	3	1 035	1
	West Asia	0	0	106	0
	Saudi Arabia	0	0	48	0
	South, East and Southeast Asia	1	3	929	1
	East Asia	0	2	527	0
	China	0	1	274	0
	Hong Kong, China	0	0	24	0
	Korea, Republic of	0	0	149	0
	Taiwan Province of China	0	0	80	0
	South Asia	0	0	60	0
	India	0	0	45	0
	ASEAN	1	1	343	1
	Brunei Darussalam	-	0	1	0
	Cambodia	0	-	0	0
	Indonesia	0	0	-	0
	Lao People's Democratic Republic	0	0	0	-
	Malaysia	0	0	94	0
	Myanmar	0	0	1	0
	Philippines	0	0	15	0
	Singapore	0	0	143	0
	Thailand	0	1	75	0
	Viet Nam	0	0	13	0
	Transition economies	0	0	33	0
	Commonwealth of Independent States (CIS)	0	0	32	0
	Russian Federation	0	0	24	0
Domestic value added (DVA)		14	10	9 532	5
Gross exports		17	16	12 287	6

Source: AJC-UNCTAD-Eora database on ASEAN GVCs.
Note: All values are estimated. The region/country refers to that to which the value added is attributed. For the GVC terminology, see box 2.
For Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar, the industry includes also general machinery.

Electrical and electronic equipment exports from ASEAN

Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
26 111	0	16 988	47 429	4 648	397
15 050	0	8 532	25 103	2 701	193
5 575	0	2 474	8 142	1 027	58
5 147	0	2 339	7 507	944	55
129	0	102	307	29	1
286	0	105	335	49	2
584	0	283	942	110	12
1 440	0	568	2 308	271	16
474	0	185	666	94	5
390	0	225	440	50	3
202	0	84	328	53	2
173	0	47	195	33	1
893	0	483	1 241	145	7
428	0	135	635	83	4
316	0	101	513	68	3
3 515	0	1 880	5 966	565	29
284	0	118	395	55	2
3 230	0	1 761	5 571	510	27
5 960	0	4 178	10 995	1 109	106
706	0	210	693	86	6
71	0	60	165	33	1
5 090	0	3 884	10 069	983	99
10 781	0	8 343	22 026	1 901	197
305	0	128	1 121	52	4
121	0	66	914	14	2
67	0	49	855	7	2
184	0	62	207	38	2
374	0	179	497	85	3
267	0	118	281	35	2
120	0	65	127	14	1
94	0	56	197	48	1
10 095	0	8 034	20 401	1 763	190
405	0	242	560	100	5
130	0	84	178	19	1
9 690	0	7 791	19 841	1 663	185
5 593	0	5 161	8 967	1 027	111
2 555	0	1 016	3 788	597	36
746	0	477	835	54	12
1 370	0	1 486	2 311	225	32
916	0	2 179	2 025	148	31
467	0	162	556	84	4
375	0	83	412	70	3
3 630	0	2 468	10 318	551	70
8	0	3	11	6	0
2	0	0	2	1	0
1 025	0	345	2 774	115	9
1	0	0	1	1	0
-	0	886	5 190	253	18
7	-	1	6	14	0
288	0	-	1 153	34	3
1 472	0	955	-	121	24
777	0	260	1 133	-	15
51	0	18	49	5	-
280	0	114	300	46	6
279	0	113	297	46	6
228	0	90	239	33	4
32 472	12	8 696	11 996	7 729	273
58 583	12	25 685	59 425	12 377	671

Annex table 2-5. **Value added exports of electrical and electronic equipment from ASEAN, by value added creator, 2010** (Millions of dollars)

	Value added creator	Electrical and electronic equipment exports from ASEAN			
		Brunei Darussalam	Cambodia	Indonesia	Lao People's Democratic Republic
Foreign value added (FVA)	**World**	6	7	5 119	3
	Developed countries	2	2	2 702	1
	Europe	1	1	1 082	0
	European Union	1	1	994	0
	Austria	0	0	35	0
	Belgium	0	0	49	0
	France	0	0	129	0
	Germany	0	0	311	0
	Italy	0	0	93	0
	Netherlands	0	0	74	0
	Spain	0	0	41	0
	Sweden	0	0	40	0
	United Kingdom	0	0	124	0
	Other developed Europe	0	0	89	0
	Switzerland	0	0	67	0
	North America	1	0	615	0
	Canada	0	0	67	0
	United States	0	0	547	0
	Other developed countries	1	1	1 005	0
	Australia	0	0	276	0
	Israel	0	0	7	0
	Japan	0	1	700	0
	Developing countries	3	5	2 343	2
	Africa	0	0	83	0
	North Africa	0	0	18	0
	Morocco	0	0	4	0
	Other Africa	0	0	64	0
	Latin America and the Caribbean	0	0	112	0
	South America	0	0	89	0
	Brazil	0	0	40	0
	Central America	0	0	18	0
	Asia	3	4	2 146	2
	West Asia	0	0	183	0
	Saudi Arabia	0	0	79	0
	South, East and Southeast Asia	3	4	1 962	2
	East Asia	1	2	1 097	0
	China	0	2	697	0
	Hong Kong, China	0	0	34	0
	Korea, Republic of	0	0	273	0
	Taiwan Province of China	0	0	91	0
	South Asia	0	0	150	0
	India	0	0	122	0
	ASEAN	2	2	715	1
	Brunei Darussalam	-	0	2	0
	Cambodia	0	-	0	0
	Indonesia	0	0	-	0
	Lao People's Democratic Republic	0	0	0	-
	Malaysia	1	0	186	0
	Myanmar	0	0	2	0
	Philippines	0	0	36	0
	Singapore	1	0	347	0
	Thailand	0	1	128	1
	Viet Nam	0	0	14	0
	Transition economies	0	0	74	0
	Commonwealth of Independent States (CIS)	0	0	73	0
	Russian Federation	0	0	55	0
Domestic value added (DVA)		21	12	20 609	13
Gross exports		27	20	25 728	15

Source: AJC-UNCTAD-Eora database on ASEAN GVCs.
Note: All values are estimated. The region/country refers to that to which the value added is attributed. For the GVC terminology, see box 2.
For Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar, the industry includes also general machinery.

Electrical and electronic equipment exports from ASEAN

Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
44 332	0	23 361	76 218	7 583	515
22 622	0	11 459	35 165	3 814	237
9 095	0	3 678	13 083	1 597	70
8 250	0	3 441	11 834	1 429	64
218	0	154	489	48	1
424	0	155	500	68	2
944	0	419	1 418	171	14
2 450	0	873	3 828	445	19
722	0	239	986	145	6
661	0	373	706	83	3
316	0	117	493	58	2
291	0	70	326	53	2
1 251	0	683	1 840	176	8
846	0	236	1 250	167	5
645	0	181	1 027	141	4
4 958	0	2 421	8 042	759	32
450	0	158	601	76	3
4 508	0	2 263	7 442	682	29
8 569	0	5 361	14 039	1 459	136
1 318	0	363	1 312	149	9
145	0	110	327	57	1
6 936	0	4 846	12 269	1 241	125
21 157	0	11 678	40 408	3 675	266
553	0	180	1 461	88	5
197	0	76	1 074	23	2
92	0	45	955	10	1
355	0	104	387	65	3
774	0	298	982	154	5
591	0	204	618	74	4
270	0	108	291	33	1
160	0	86	330	77	1
19 814	0	11 194	37 950	3 430	255
685	0	380	923	144	6
200	0	127	270	27	1
19 129	0	10 814	37 027	3 286	249
10 562	0	6 723	14 987	2 000	139
6 372	0	2 254	8 978	1 409	67
1 023	0	647	1 149	78	10
2 126	0	1 457	2 680	343	38
1 029	0	2 360	2 163	166	24
1 036	0	331	1 329	195	8
860	0	181	1 058	172	6
7 531	0	3 760	20 712	1 091	103
13	0	4	17	9	0
4	0	1	5	2	0
2 118	0	627	5 992	218	15
1	0	0	1	3	0
-	0	1 556	9 658	478	24
15	-	3	13	29	0
751	0	-	3 101	83	6
3 334	0	1 142	-	264	38
1 244	0	411	1 878	-	19
50	0	16	47	5	-
553	0	224	645	94	12
549	0	222	638	93	11
449	0	178	521	71	9
59 146	20	21 319	23 504	12 521	265
103 478	20	44 681	99 721	20 104	780

Annex table 2-6. **Value added exports of electrical and electronic equipment from ASEAN, by value added creator, 2015** (Millions of dollars)

	Value added creator	Electrical and electronic equipment exports from ASEAN			
		Brunei Darussalam	Cambodia	Indonesia	Lao People's Democratic Republic
Foreign value added (FVA)	**World**	6	8	5 674	3
	Developed countries	2	2	2 740	1
	Europe	1	1	1 108	0
	European Union	1	1	1 009	0
	Austria	0	0	38	0
	Belgium	0	0	55	0
	France	0	0	131	0
	Germany	0	0	273	0
	Italy	0	0	97	0
	Netherlands	0	0	78	0
	Spain	0	0	47	0
	Sweden	0	0	45	0
	United Kingdom	0	0	141	0
	Other developed Europe	0	0	99	0
	Switzerland	0	0	79	0
	North America	1	0	636	0
	Canada	0	0	73	0
	United States	1	0	563	0
	Other developed countries	1	1	996	0
	Australia	0	0	322	0
	Israel	0	0	8	0
	Japan	0	1	641	0
	Developing countries	4	6	2 848	2
	Africa	0	0	81	0
	North Africa	0	0	17	0
	Morocco	0	0	4	0
	Other Africa	0	0	64	0
	Latin America and the Caribbean	0	0	117	0
	South America	0	0	92	0
	Brazil	0	0	41	0
	Central America	0	0	21	0
	Asia	3	6	2 647	2
	West Asia	0	0	227	0
	Saudi Arabia	0	0	94	0
	South, East and Southeast Asia	3	5	2 420	2
	East Asia	1	3	1 405	1
	China	1	2	928	0
	Hong Kong, China	0	0	50	0
	Korea, Republic of	0	0	339	0
	Taiwan Province of China	0	0	87	0
	South Asia	0	0	177	0
	India	0	0	144	0
	ASEAN	2	2	838	1
	Brunei Darussalam	-	0	3	0
	Cambodia	0	-	0	0
	Indonesia	0	0	-	0
	Lao People's Democratic Republic	0	0	0	-
	Malaysia	1	1	217	0
	Myanmar	0	0	2	0
	Philippines	0	0	44	0
	Singapore	1	1	398	0
	Thailand	0	1	157	1
	Viet Nam	0	0	16	0
	Transition economies	0	0	86	0
	Commonwealth of Independent States (CIS)	0	0	85	0
	Russian Federation	0	0	66	0
Domestic value added (DVA)		25	16	26 422	16
Gross exports		31	24	32 096	19

Source: AJC-UNCTAD-Eora database on ASEAN GVCs.
Note: All values are estimated. The region/country refers to that to which the value added is attributed. For the GVC terminology, see box 2.
For Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar, the industry includes also general machinery.

Electrical and electronic equipment exports from ASEAN

Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
47 829	0	23 677	86 055	8 716	563
21 809	0	10 453	35 255	3 889	225
9 000	0	3 541	13 593	1 666	68
8 088	0	3 301	12 161	1 476	62
224	0	163	554	52	2
454	0	161	553	77	3
909	0	391	1 452	175	14
2 082	0	704	3 412	400	15
708	0	223	1 015	151	6
664	0	363	728	87	3
332	0	118	553	64	3
303	0	68	357	60	2
1 392	0	745	2 176	209	10
912	0	240	1 432	190	6
731	0	192	1 224	165	5
4 892	0	2 249	8 292	799	30
462	0	156	649	83	3
4 430	0	2 093	7 643	716	27
7 917	0	4 663	13 370	1 424	126
1 446	0	383	1 529	176	10
158	0	119	387	64	1
6 131	0	4 117	11 305	1 172	115
25 407	0	12 985	50 061	4 718	325
519	0	162	1 538	88	5
183	0	70	1 157	22	2
97	0	46	1 055	10	1
336	0	93	381	67	3
767	0	289	1 042	175	5
569	0	188	618	76	4
256	0	99	290	33	1
175	0	93	391	96	1
24 107	0	12 528	47 467	4 452	314
800	0	442	1 134	185	8
226	0	143	325	34	2
23 307	0	12 086	46 333	4 267	306
13 550	0	7 616	19 448	2 728	177
8 623	0	2 848	12 373	2 008	91
1 462	0	899	1 717	116	15
2 540	0	1 714	3 408	451	49
914	0	2 151	1 930	149	22
1 155	0	369	1 591	231	9
953	0	194	1 251	205	7
8 601	0	4 102	25 294	1 307	121
15	0	4	20	11	0
4	0	1	5	2	0
2 440	0	705	7 510	269	18
1	0	0	2	4	1
-	0	1 678	11 392	563	27
17	-	3	16	39	0
891	0	-	3 924	103	8
3 710	0	1 223	-	310	43
1 462	0	468	2 366	-	24
61	0	19	59	6	-
612	0	239	739	109	13
609	0	238	733	108	13
512	0	195	611	85	10
68 865	27	27 354	27 800	15 781	444
116 694	27	51 031	113 855	24 497	1 007

Annex table 2-7. **Value added exports of electrical and electronic equipment from ASEAN, by value added creator, 2017** (Millions of dollars)

	Value added creator	Electrical and electronic equipment exports from ASEAN			
		Brunei Darussalam	Cambodia	Indonesia	Lao People's Democratic Republic
Foreign value added (FVA)	**World**	8	7	6 472	3
	Developed countries	3	2	3 160	1
	Europe	1	1	1 295	0
	European Union	1	1	1 186	0
	Austria	0	0	41	0
	Belgium	0	0	59	0
	France	0	0	140	0
	Germany	0	0	394	0
	Italy	0	0	107	0
	Netherlands	0	0	84	0
	Spain	0	0	55	0
	Sweden	0	0	48	0
	United Kingdom	0	0	132	0
	Other developed Europe	0	0	109	0
	Switzerland	0	0	85	0
	North America	0	0	719	0
	Canada	0	0	84	0
	United States	0	0	635	0
	Other developed countries	1	1	1 147	0
	Australia	0	0	335	0
	Israel	0	0	9	0
	Japan	1	1	777	0
	Developing countries	5	5	3 222	3
	Africa	0	0	88	0
	North Africa	0	0	18	0
	Morocco	0	0	4	0
	Other Africa	0	0	71	0
	Latin America and the Caribbean	0	0	138	0
	South America	0	0	110	0
	Brazil	0	0	51	0
	Central America	0	0	23	0
	Asia	5	5	2 993	2
	West Asia	0	0	250	0
	Saudi Arabia	0	0	103	0
	South, East and Southeast Asia	5	5	2 743	2
	East Asia	2	3	1 726	1
	China	1	2	1 208	1
	Hong Kong, China	0	0	43	0
	Korea, Republic of	0	0	380	0
	Taiwan Province of China	0	0	92	0
	South Asia	0	0	186	0
	India	0	0	149	0
	ASEAN	3	2	831	2
	Brunei Darussalam	-	0	3	0
	Cambodia	0	-	0	0
	Indonesia	1	0	-	0
	Lao People's Democratic Republic	0	0	0	-
	Malaysia	1	0	231	0
	Myanmar	0	0	2	0
	Philippines	0	0	52	0
	Singapore	1	0	350	0
	Thailand	0	1	172	1
	Viet Nam	0	0	20	0
	Transition economies	0	0	90	0
	Commonwealth of Independent States (CIS)	0	0	89	0
	Russian Federation	0	0	64	0
Domestic value added (DVA)		25	16	29 857	19
Gross exports		33	23	36 329	23

Source: AJC-UNCTAD-Eora database on ASEAN GVCs.
Note: All values are estimated. The region/country refers to that to which the value added is attributed. For the GVC terminology, see box 2.
For Brunei Darussalam, Cambodia, the Lao People's Democratic Republic and Myanmar, the industry includes also general machinery.

Electrical and electronic equipment exports from ASEAN

Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam
50 271	0	24 042	101 332	8 742	1 016
23 161	0	10 761	39 580	3 974	423
9 695	0	3 569	13 872	1 740	125
8 761	0	3 338	12 593	1 551	116
225	0	153	506	51	2
454	0	151	510	70	4
889	0	363	1 286	162	23
2 812	0	924	5 403	518	37
715	0	205	853	151	10
646	0	340	626	84	5
386	0	128	436	69	5
307	0	67	284	58	3
1 168	0	615	1 255	171	13
934	0	231	1 278	189	9
724	0	176	1 051	161	7
4 957	0	2 211	7 740	771	52
455	0	142	583	80	5
4 502	0	2 069	7 157	692	47
8 508	0	4 982	17 968	1 463	246
1 382	0	348	1 407	153	15
163	0	119	362	64	2
6 777	0	4 472	16 054	1 233	227
26 515	0	13 052	60 952	4 673	569
544	0	166	1 532	84	8
180	0	66	1 087	21	3
90	0	41	983	10	2
364	0	99	445	63	5
886	0	315	1 112	182	10
679	0	218	745	85	8
319	0	114	343	39	3
180	0	88	331	94	2
25 069	0	12 566	58 290	4 405	551
899	0	480	1 279	164	13
288	0	163	402	38	3
24 170	0	12 086	57 011	4 240	538
14 569	0	7 671	26 299	2 773	318
9 961	0	3 311	19 976	2 117	183
1 136	0	666	1 269	89	19
2 565	0	1 705	3 400	415	82
882	0	1 980	1 615	145	34
1 204	0	417	1 947	214	16
981	0	234	1 575	187	13
8 397	0	3 998	28 765	1 253	204
13	0	4	20	8	0
4	0	1	6	2	0
2 963	0	838	10 922	295	39
2	0	0	2	3	1
-	0	1 681	11 589	553	46
18	-	3	17	29	0
935	0	-	4 090	107	13
2 910	0	986	-	247	61
1 466	0	456	2 015	-	43
87	0	28	105	9	-
596	0	229	799	94	23
589	0	226	791	93	23
453	0	171	565	67	17
72 218	26	27 901	22 608	16 004	687
122 489	27	51 943	123 939	24 746	1 703

Annex table 3. **ASEAN's value added exports of electrical and electronic equipment incorporated in other countries' exports, by region/country, 1990–2017** (Millions of dollars)

	DVX from ASEAN						
Region/country	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2017**
World	3 526	7 269	12 241	23 347	46 434	55 060	56 952
Developed countries	1 271	2 726	4 911	9 059	16 857	19 106	21 226
Europe	737	1 613	2 907	5 655	11 443	12 502	14 780
European Union	726	1 585	2 865	5 559	11 230	12 279	14 476
Austria	17	34	59	128	271	306	348
Belgium	39	82	127	254	509	566	676
France	102	209	368	628	1 119	1 303	1 505
Germany	185	370	677	1 380	2 999	3 052	3 724
Italy	27	63	105	205	411	452	598
Netherlands	91	187	298	616	1 361	1 580	1 838
Spain	15	40	73	160	289	334	432
Sweden	13	25	39	67	134	146	203
United Kingdom	146	320	523	919	1 645	1 646	2 196
Other developed Europe	12	28	42	96	213	223	305
Switzerland	6	14	22	62	138	145	203
North America	262	625	1 192	1 715	2 850	3 266	3 195
Canada	25	72	157	261	441	494	719
United States	237	553	1 036	1 454	2 409	2 772	2 475
Other developed countries	272	487	812	1 689	2 563	3 337	3 252
Australia	3	7	10	24	60	70	102
Israel	6	11	20	37	73	78	59
Japan	261	463	771	1 610	2 393	3 147	3 038
Developing countries	2 251	4 538	7 321	14 267	29 524	35 895	35 617
Africa	5	11	19	38	84	93	128
North Africa	1	3	5	12	26	27	50
Morocco	0	1	1	2	6	7	10
Other Africa	3	8	13	26	58	66	78
Latin America and the Caribbean	19	156	417	744	1 307	1 586	1 984
South America	3	13	28	68	145	185	217
Brazil	1	7	18	44	88	121	154
Central America	15	142	386	672	1 153	1 391	1 753
Asia	2 226	4 370	6 884	13 482	28 128	34 211	33 500
West Asia	10	26	38	78	173	209	328
Saudi Arabia	4	8	11	16	34	33	31
South, East and Southeast Asia	2 216	4 343	6 846	13 404	27 955	34 002	33 172
East Asia	1 333	1 525	2 448	4 884	10 937	12 567	12 125
China	21	171	674	2 182	6 190	6 904	7 600
Hong Kong, China	48	100	132	298	765	922	635
Korea, Republic of	102	287	572	1 256	2 509	3 169	2 495
Taiwan Province of China	1 163	966	1 069	1 146	1 467	1 563	1 389
South Asia	4	12	24	63	158	212	96
India	2	7	16	49	127	173	63
ASEAN	879	2 806	4 374	8 456	16 860	21 222	20 950
Brunei Darussalam	2	3	3	6	16	18	16
Cambodia	0	0	1	2	5	6	3
Indonesia	4	16	30	57	131	164	153
Lao People's Democratic Republic	0	0	0	1	1	2	1
Malaysia	121	478	591	1 090	2 481	3 001	2 668
Myanmar	0	0	0	0	0	0	0
Philippines	159	425	626	1 134	1 649	1 872	1 677
Singapore	460	1 472	2 539	4 916	10 535	13 570	14 107
Thailand	129	401	558	1 205	1 963	2 502	2 189
Viet Nam	4	11	26	45	80	88	137
Transition economies	3	5	9	21	53	59	110
Commonwealth of Independent States (CIS)	3	5	8	20	50	56	105
Russian Federation	1	2	5	10	26	30	68

Source: AJC-UNCTAD-Eora database on ASEAN GVCs. Data for 2016–2018 are projected by UNCTAD and Eora.
Note: All values are estimated. The value refers to that incorporated in exports from the countries listed. For the GVC terminology, see box 2. For Brunei Darussalam, Cambodia, the Lao For Brunei Darussalam, Cambodia, Lao PDR and Myanmar, the industry includes also general machinery.

ASEAN-Japan Centre

ISBN 978-4-910293-21-9

ASEAN Promotion Centre on Trade, Investment and Tourism
www.asean.or.jp/en