Chapter 10

Electronics as a Driving Force for Viet Nam's Economic Development

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The electronics industry emerged in the 20th century and is today one of the largest global industries. It comprises a variety of products, ranging from aerospace products; lamps and light fixtures, including light-emitting diodes; consumer electronics, such as television sets and electrical household appliances; electronic medical equipment; and microelectronic components; as well as automotive software and electrical and electronic components, such as on-board diagnostics (OBD), in-car touch screens, cameras, and navigation systems, which are used and applied in many economic and social activities, especially in the context of the fourth industrial revolution. Global electronic value chains have been led by a small number of multinational enterprises, but these have developed and expanded all over the world, with the involvement of both developed and developing countries.

In Viet Nam, the electronics industry has become an increasingly important sector of the country's economy and continues to grow despite the negative impact of the COVID-19 pandemic. The industry emerged about 3 decades ago but has grown rapidly, becoming the highest exporting industry in Viet Nam and positioning the country as one of the world's key electronics exporters. Viet Nam has made big steps into the global electronic value chain since 2010 through Samsung's investment in Viet Nam to produce smartphones for exporting all over the world. Viet Nam has participated in global electronic value chains mainly downstream, characterised by simple and labour-intensive assembling activities with lower added value. To take full advantage for further development of the industry, Viet Nam needs to solve the remaining issues in the industry. Comprising the largest share of the country's exports, however, the greater the increase in the export value of the industry, the lower the share of domestic value added. This essentially requires electronics enterprises to shift and undertake more capital, technology, and knowledge-intensive functions within the global electronic value chains. Another issue is to complete regulation and legislation to address issues on electronic waste and the related matters on labour safety and sustainable development.

1. Overview

1.1. Definitions, Scope, and Data of Electronics and ICT

According to the United Nations' International Standard Industrial Classification of All Economic Activities (ISIC) revision 4, the electronics and ICT sector has the definition: *'the production (goods and services) of a candidate industry must primarily be intended to fulfil or enable the function of information processing and communication by electronic means, including transmission and display'*. This study uses this definition and scope of electronics and ICT to collect statistical data and conduct analysis, including the following ISIC 4-digit codes (Table 10.1).

Table 10.1. Scope of the Electronics and ICT Sector Defined by ISIC Rev. 4

Electronics and ICT manufacturing industries	
2610	Manufacture of electronic components and boards
2620	Manufacture of computers and peripheral equipment
2630	Manufacture of communication equipment
2640	Manufacture of consumer electronics
2651	Manufacture of measuring, testing, navigating and control equipment
2652	Manufacture of watches and clocks
2660	Manufacture of irradiation, electromedical and electrotherapeutic equipment
2670	Manufacture of optical instruments and photographic equipment
2680	Manufacture of magnetic and optical media
Electronics and ICT services industries	
4651	Wholesale of computers, computer peripheral equipment and software
4652	Wholesale of electronic and telecommunications equipment and parts
5820	Software publishing
6110	Wired telecommunications activities
6120	Wireless telecommunications activities
6130	Satellite telecommunications activities
6190	Other telecommunications activities
6201	Computer programming activities
6202	Computer consultancy and computer facilities management activities
6209	Other information technology and computer service activities
6311	Data processing, hosting and related activities
6312	Web portals
9511	Repair of computers and peripheral equipment
9512	Repair of communication equipment

Source: ISIC Rev. 4 (2008).

Trade data for electronics and ICT are also separated between goods and services. To collect the data, this study uses a conversion key developed by the Organisation for Economic Co-operation and Development (OECD) to select HS codes for electronic goods/commodities that are equivalent to the above ISIC codes, including the HS 4-digit codes in Table 10.2. For data on services, this study uses BPM6, a classification system of services in international trade. The data may not cover all service activities with the ISIC codes listed above, because there is no conversion key between ISIC and BPM6, where electronic and ICT services are equivalent to telecommunications, computer, and information services (S9), including three sub-sectors: telecommunications services (9.1), computer services (9.2), and information services (9.3). These sub-sectors can be divided at the 3-digit level, however data for Viet Nam are only available at the 2-digit level.

Table 10.2. HS codes for Electronic Commodities

ISIC Codes	Equivalent HS Codes
261	8532 8533 8534 8540 8541 8542 8536
262	8469 8471 8473 9009 8443
263	8517 8525 8529 8531
264	8518 8519 8520 8521 8522 8527 8528 9504
265	8526 9012 9014 9015 9016 9017 9024 9025 9026 9027
	9028 9029 9030 9031 9032 9033 9101 9102 9103 9104
	9105 9106 9107 9108 9109 9110 9111 9112 9114
266	9018 9021 9022
267	9002 9005 9006 9007 9008 9010 9011 9013
268	8523

Source: OECD. HS to ISIC to End-use Conversion Key. https://www.oecd.org/sti/ind/ConversionKeyBTDIxE4PUB.xlsx (accessed 20 June 2022).

1.2. Development Trends in Electronics and ICT in the Context of Industry 4.0

The electronics industry has been changing rapidly over the past few years thanks to the fourth industrial revolution (or Industry 4.0). A major feature of this change is the combination of physical manufacturing operations with Internet of Things (IoTs), big data, artificial intelligence (AI), and machine learning, along with other technologies that support real-time automation and information gathering. Annual reports on the electronics industry have identified different development trends for each year depending on the situation and market demand. Some of the common trends in the sector that will occur throughout the next decade include: (i) IOTs that enable predicted maintenance, smart manufacturing, autonomous mobility, and real-time management; (ii) big data that require a new generation of data-processing devices and software; (iii) AI that initiates the development of

AI-based software and AI-powered platforms; (iv) advanced materials that require more efficient and environment-friendly uses; and all of these new trends lead to another one, (v) restructured supply chains that drive investment and cooperation with strategic partners in producing core parts, especially semiconductors, for more resilience, reliability, transparency, and responsibility. In the future, software and services in the electronics and ICT sector will play a major role because by linking and merging the virtual with the real world, manufacturers will ensure reaching their maximum production potential. As such, trade in services in the electronics and ICT sector will also accelerate accordingly.

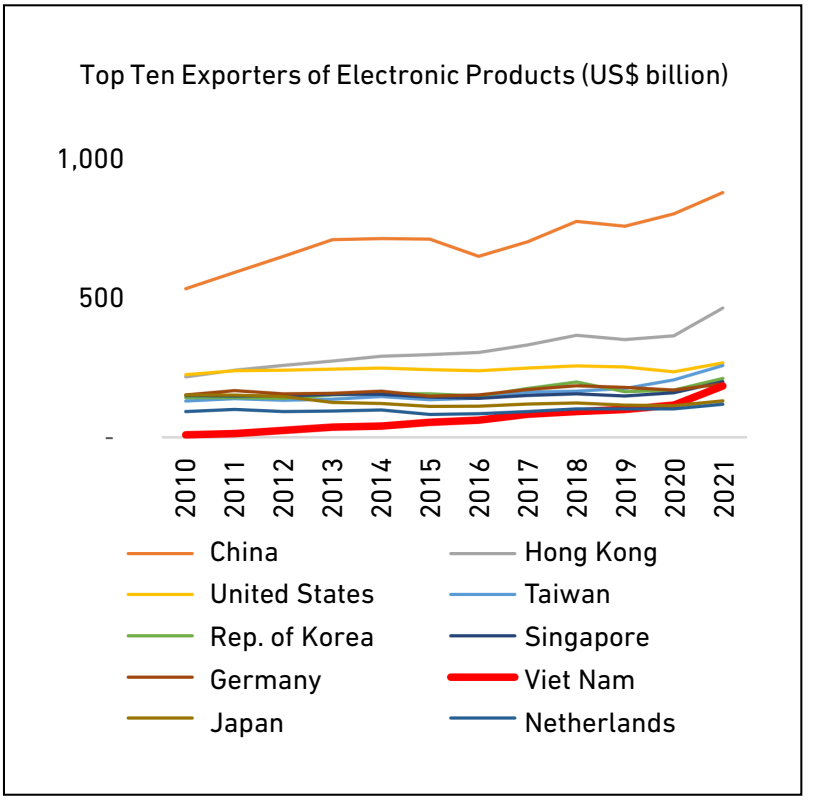
1.3. Review of International Trade in Electronics and ICT

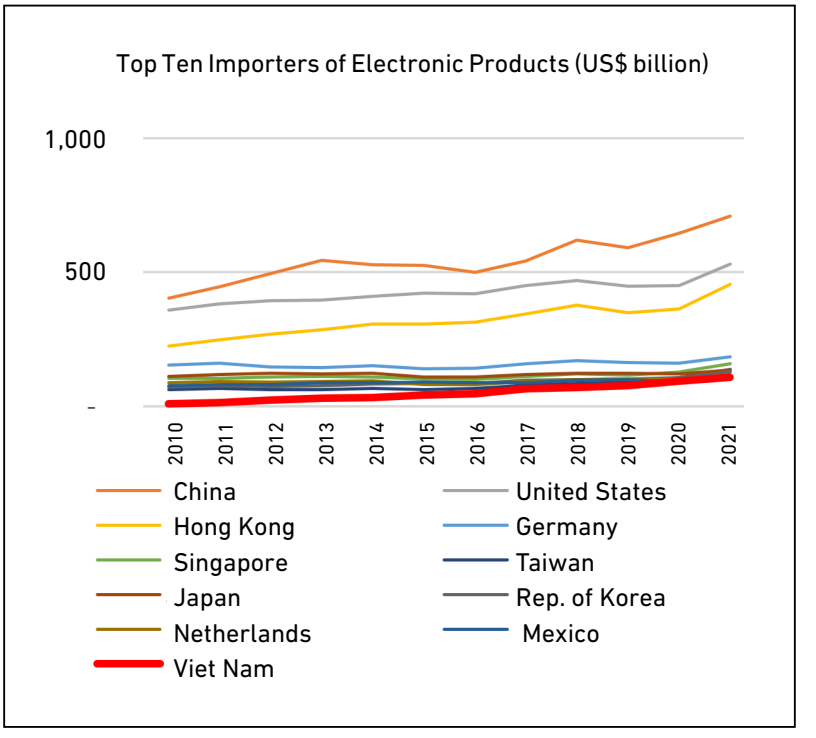
1.3.1. Trade in Commodities

According to the International Trade Centre's (ITC) 'Trade Map - Trade Statistics for International Business Development', since 10 years ago, electronics has been the largest exporting sector, with a share in the world's total export ranging from 14% to 18%. As illustrated in Figure 10.1, the export value of electronic commodities increased from US$2,429 billion to US$3,710 billion during 2010-2021, with an average growth rate of 4%. China has maintained its position as the largest exporter, with a share in the world's total electronic exports ranging from 22% to 26% during the last decade. Hong Kong and the United States (US) followed as the second and third largest exporters, but the share of the US fell from 9% to 7% in the same period. The Republic of Korea (hereafter, Korea), Singapore and Germany have kept their positions in the top 10 largest exporters and their shares of 5%–6%. Japan is still positioned in the top 10 largest exporters but dropped from fifth to ninth, and the country's export declined in terms of both share (from 6% to 3%) and value (from US$149 billion to US$129 billion). Viet Nam has become an emerging exporter of electronics. It has ranked amongst the top 10 largest exporters since 2019, with the world's fastest average growth rate of 31% and export value increasing from US$7 billion to US$129 billion.

As for imports, China, the US, and Hong Kong are also the top three players, with export values of US$708 billion, US$530 billion, and US$456 billion, accounting for 18%, 13%, and 11% of the world's total imports in 2021, respectively. The list of top 10 electronics importers has not changed during the last decade, but the positions of Taiwan and Japan have. Whilst Taiwan climbed up from 10th to 6th, Japan dropped from 5th to 7th. Viet Nam ranked 11th in 2021 so was not on the list of the top 10 yet, but sooner or later will do so with the world's highest average growth rate of 24% in the period 2010–2021.

Figure 10.1. Top 10 Exporters and Importers of Electronics Products

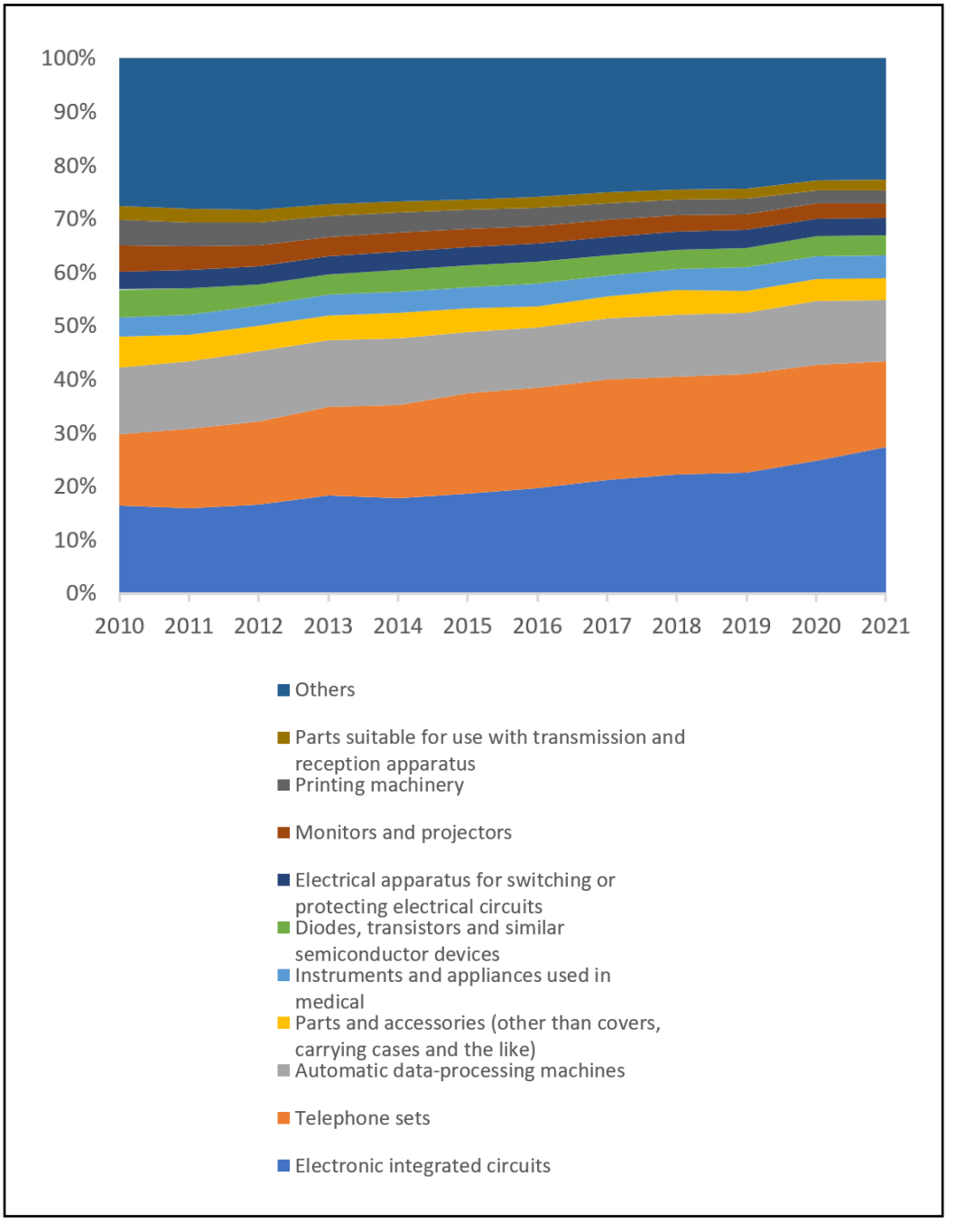




Source: ITC Trademap (www.trademap.org).

By product, the sector has high product intensity. As shown in Figure 10.2, the top three exported products, comprising electronic integrated circuits (EIC) (HS8542), telephone sets (HS8517), and automatic data-processing machines (HSD8471), have doubled their export values in the last decade, from US$1,025 billion in 2010 to US$2,032 billion in 2021, and increased their shares in the world's total electronics exports from 42% to 55% in the same period. Hong Kong, Taiwan, China, Singapore, and Korea are the top five exporters of EIC with export values exceeding US$100 billion in 2021. For telephone sets, China is the champion, with more than one-third of the world's total exports. Two other key exporters include Viet Nam and Hong Kong, with export values in 2021 of US$85.5 billion and US$76.6 billion. China's exports of automatic data-processing machines in 2021 reached US$204.5 billion, accounting for more than half of the world's total exports. China was followed by Mexico, Hong Kong, and the US, but their shares were only about one-sixth of China's. The international trade data illustrates China's dominance in all key electronics commodities.

Figure 10.2. Top Ten Traded Electronics Products

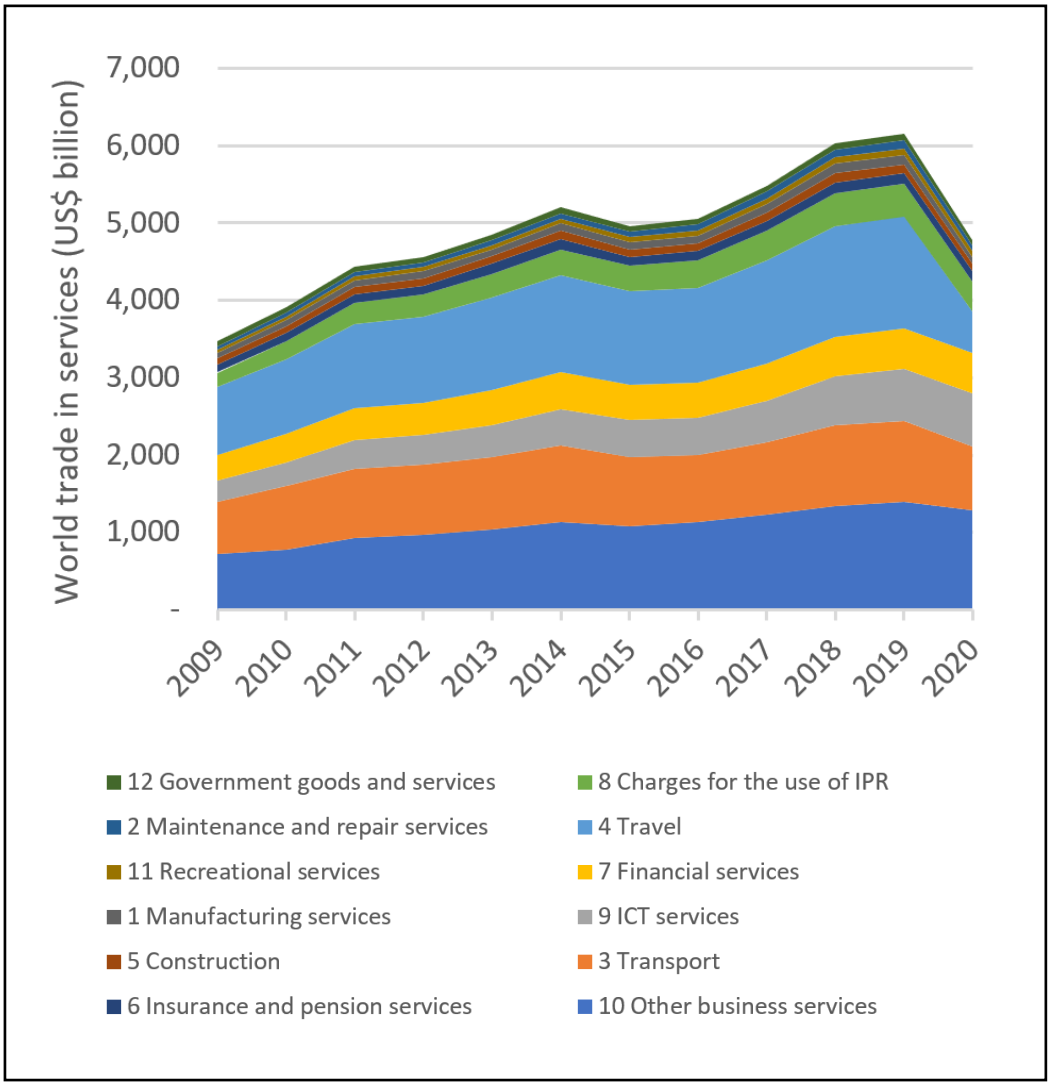


Source: ITC Trademap (www.trademap.org).

1.3.2. Trade in Services

Statistic data from the ITC shows that global trade in services is still small, with an annual export value of US$5,000 billion, equivalent to about one-third of the annual trade in commodities. Trade in telecommunications, computers, and information services has grown fast in the last 10 years, with export values increasing from US$311.6 billion in 2010 to US$683.3 billion in 2020, and their share in the world's total services exports has also increased from 8% to 14% in the same period (Figure 10.3). Computer services comprise the majority of ICT services, accounting for more than two-thirds of total ICT services exports. By country, Ireland, India, China, the US, and Germany are the top five exporters of ICT services, whilst Germany, the US, China, France, and Japan are the top five importers of ICT services.

Figure 10.3. Trade in Services



Note: The number in the category label is the BPM6 2-digit code of the service.
Source: ITC Trademap (www.trademap.org).

2. Industrialisation and the Electronics and ICT Industry in Viet Nam

2.1. Overview of Electronics and ICT in Viet Nam

Electronics is a late but fast-growing industry in Viet Nam. Ten years ago, the number of electronics enterprises was just over 500, but this increased five times by 2020 to nearly 2,500 enterprises. Nevertheless, this number is still modest, accounting for less than 0.5% of the total number of enterprises and about 2.5% of the manufacturing enterprises in Viet Nam. The number of employees in the sector has also grown fast, increasing almost seven times in the same period, accounting for 6% of total employees and about 12% of employees in the manufacturing sector (Figure 10.4). Comparing the development trend of employment and that of enterprises in the electronics sector, we can see that although the sector is supposed to be a high-tech, technology- and capital-intensive sector, in Viet Nam, it is rather a labour-intensive one.

Figure 10.4. Number of Enterprises and Employees in the Electronics Industry in Viet Nam

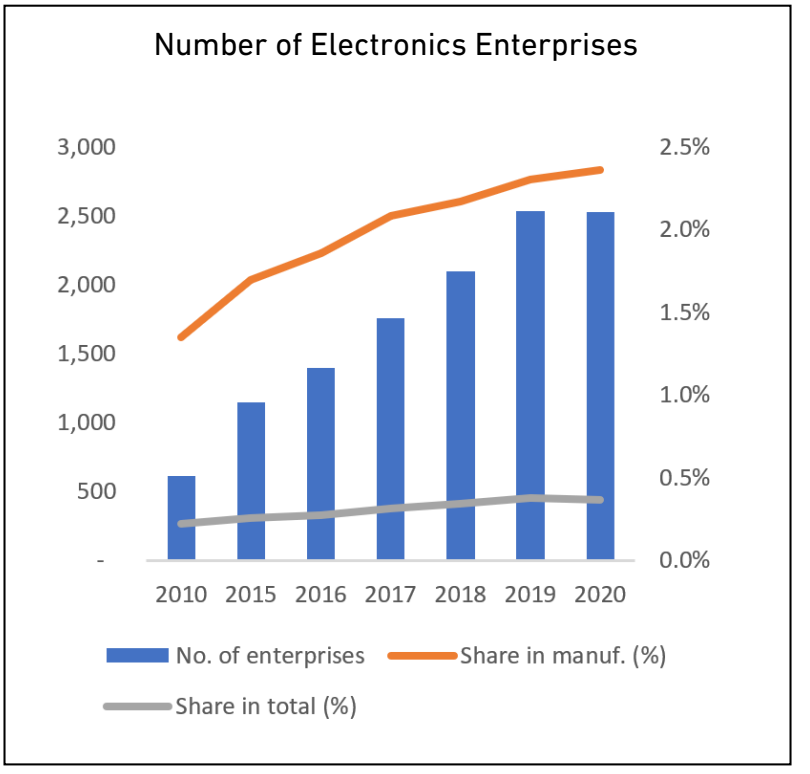
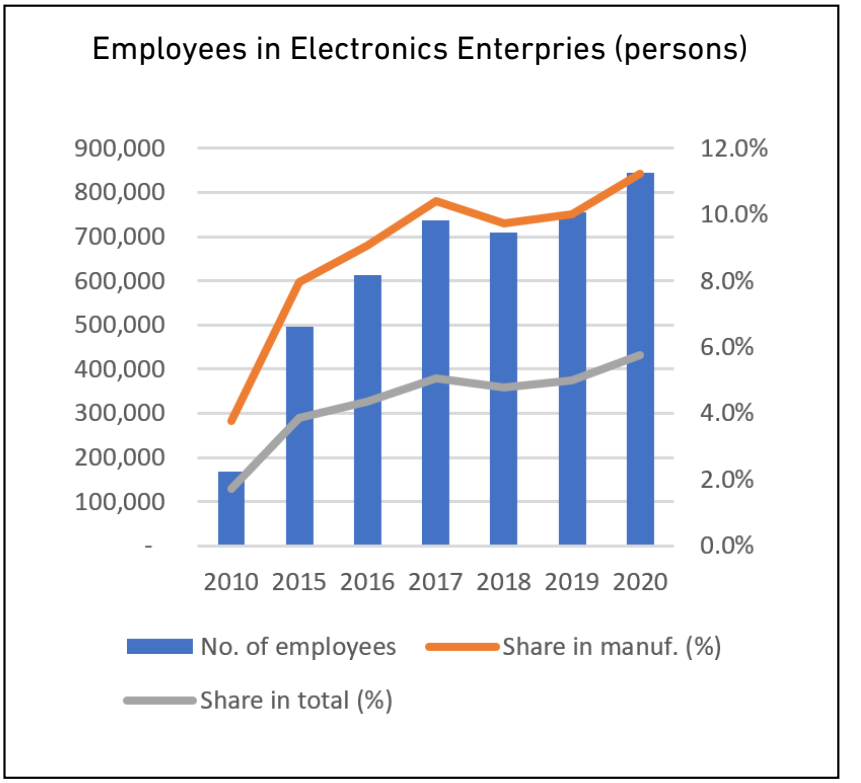


Figure 10.4. *Continued*

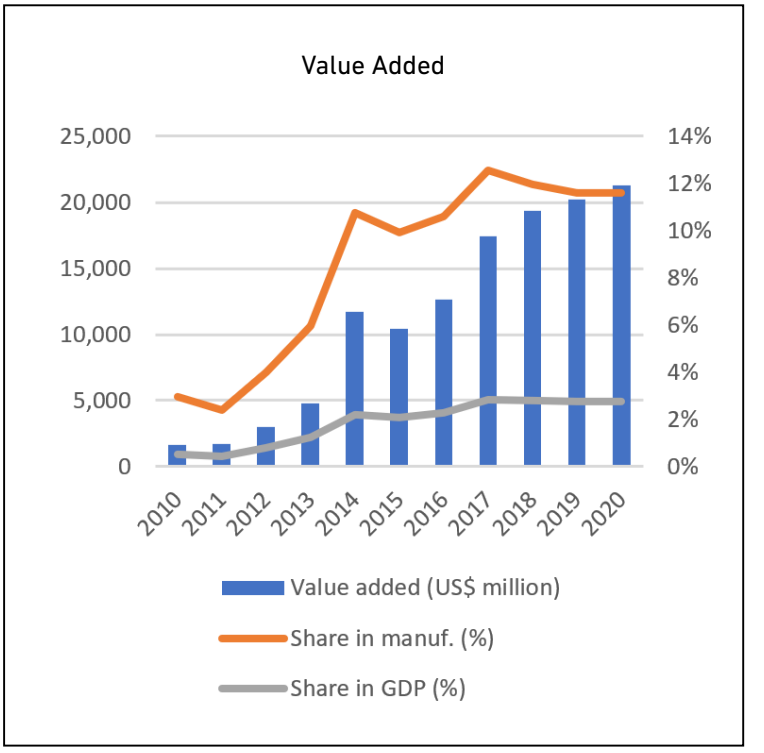


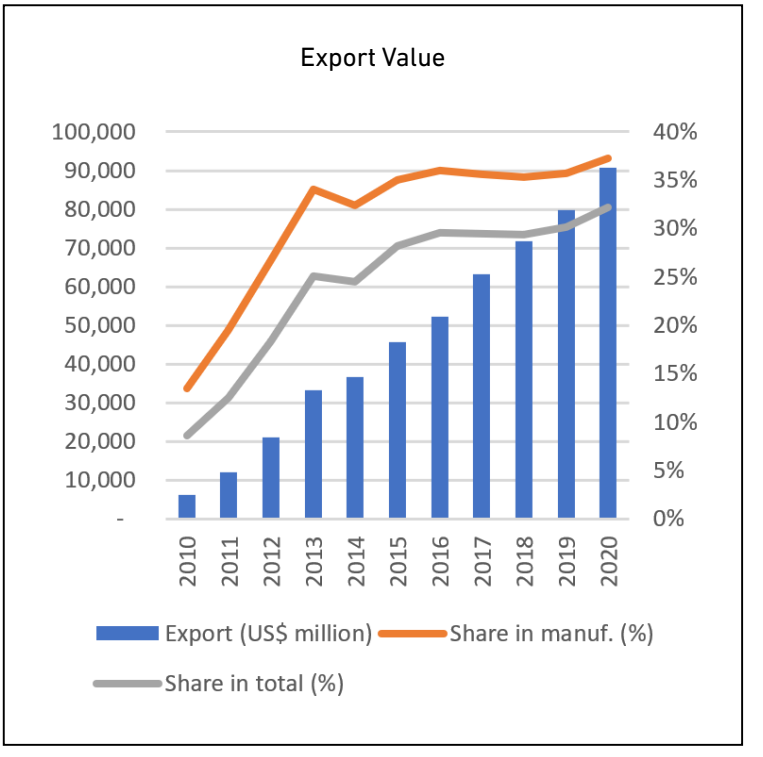
Source: General Statistics Office of Viet Nam (GSO).

As illustrated in Figure 10.5, the added value of the electronics industry also grew strongly in the period 2010–2020, increasing from US$1.6 billion to US$21.2 billion. Meanwhile, the contribution to GDP increased from 0.5% to 2.8%, and the contribution to manufacturing value added (MVA) increased from 2.9% to 11.6%.

Similarly, the export value of Viet Nam's electronics industry also grew strongly in the same period, increasing from US$6.2 billion to US$90.7 billion. The contribution to total export turnover increased from 9% to 32%, and the share in exports of manufactured goods increased from 14% to 37%.

Figure 10.5. Value Added and the Export Value of the Electronics Industry in Viet Nam

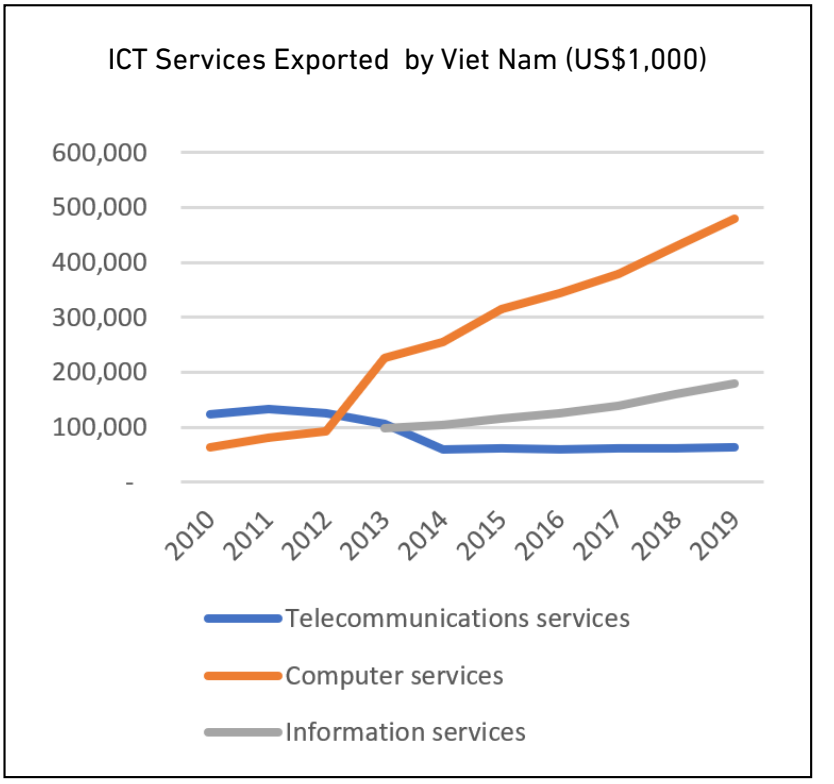


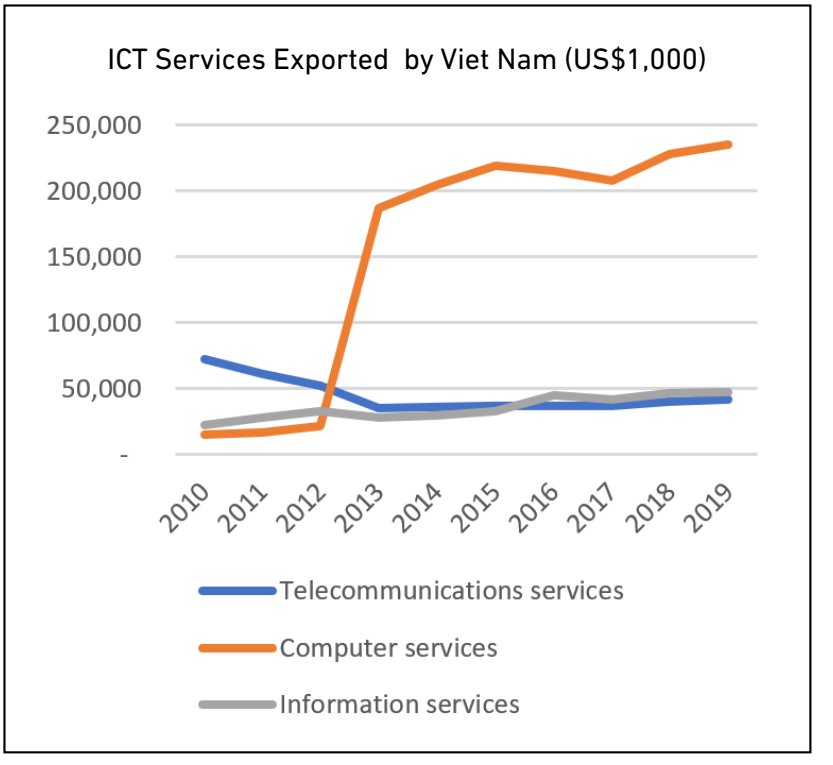


Source: Indstat Unido (for value added data) and ITC Trademap (for export data).

In Viet Nam, trade in ICT services accelerated by 16% for exports and 13% for imports in the period 2010–2019, contributing about 3% of total services exports and 2% of total services imports (Figure 10.6). Computer services played major roles in the trade of ICT services. A major component of computer services is software that is classified as system software and application software. Software does not have its own HS code, so declaring when importing software as well as applying a tariff rate depend on the machinery/equipment or carrier media the software is embedded in. Viet Nam is considering becoming a world manufacturing centre, and the demand for importing machinery and equipment for production is increasing. Along with that is the need to use the software that comes with these devices. In the future, Viet Nam's trade in services, especially computer services, will grow even faster.

Figure 10.6. Viet Nam's Trade in ICT Services





Source: ITC Trademap (www.trademap.org).

In a breakdown by the type of enterprise, as an emerging industry, Viet Nam's electronics industry depends largely on foreign-invested enterprises (FDI). Statistics show that, by 2020, amongst more than 2,500 electronic enterprises, FDI enterprises accounted for 41% of the number of enterprises, 95% of the number of employees, and 99% of the export value. By enterprise size, 85% of electronics enterprises are small and medium-sized enterprises (SMEs) with 300 or fewer employees, lower than the national average of 98%. However, SMEs in FDI enterprises account for only 66%, whilst this rate of domestic enterprises is 99%. These data suggest that FDI enterprises are mainly large-scale and labour-intensive. Although considered a high-tech, capital- and technology-intensive industry, electronics brands have separated their supply chains and moved labour-intensive and low-value-added segments to developing countries, including Viet Nam, where they can take advantage of the abundant land and labour whilst retaining knowledge- and technology-intensive and high-value-added segments. If this situation does not change, developing countries will be at risk of being trapped in a low value-added trap, another form of a middle-income trap, which will hinder economic growth and progress towards becoming high-income countries.

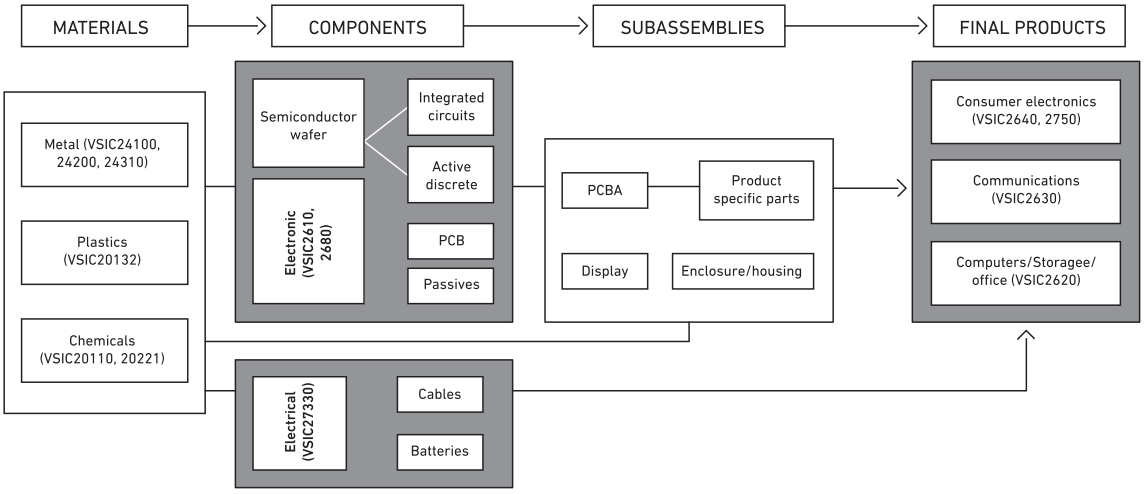
2.2. Electronics and ICT in Viet Nam's Economic and Industrial Strategy

The electronics industry has been identified as a priority industry in Viet Nam's economic and industrial development strategies. Specifically, Decision 879/QD-TTg, dated 9 June 2014, approving the strategy on Viet Nam's industrial development through 2025 with a vision towards 2035 identified: *'For the period up to 2025, priority is to be given to the development of computer equipment, telephones and components. In the period after 2025, priority is to be given to the development of software, digital content, information technology services and medical electronics.'* Electronics is also on the list of industries eligible for investment incentives under the Investment Law. Investment projects that produce electronic products will enjoy tax incentives and land access. Comparative advantages of geographic location, labour costs and access to land, as well as investment incentives, have helped Viet Nam become a hub of production and export of electronic products in recent years and a destination for many large electronics corporations, such as Samsung, LG, Canon, and Panasonic. Disruptions to the supply chain due to a variety of reasons, such as the US-China trade war, COVID-19, and the Russian-Ukrainian war, have forced electronics corporations to restructure their supply chains in a safer, more stable, reliable, and sustainable manner.

Derived from the US trade policy, the current wave of production migration out of China, mainly related to electronics products such as smartphones and tablets, is becoming more obvious and has been further accelerated by strict social distancing measures in many Chinese cities. Association of Southeast Asian Nations (ASEAN) countries are often seen as ideal destinations. Amongst ASEAN countries, Viet Nam is considered one of the countries benefiting the most from this wave. However, when deciding to invest in technology- and capital-intensive industries or segments, investment locations will be screened and selected differently, not only based on static advantages, such as geographical location, labour cost, or land availability, but more importantly, dynamic advantages will be considered thoroughly. There is an ecosystem that can facilitate the development of such investment projects, including the availability of qualified human resources, a network of qualified domestic suppliers who can replace the existing ones, a convenient logistics and financial system, the availability of technology partners, and so on. These factors for Viet Nam are not competitive compared to other countries in the region. These are obstacles that Viet Nam needs to overcome to catch up with others and to become a high-income country.

Electronic products are diverse in size, type, and quality requirements. However, in general, the supply chain of the electronics industry can be divided into four main segments, including raw materials (mainly plastic, rubber, metals, chemicals, etc.) to create single components, which are then assembled into subassemblies and finally assembled into finished products to be distributed to consumers (Figure 10.7). Each segment has different characteristics: it can be labour-intensive or capital-, technology-, or knowledge-intensive. Electronics corporations will divide their production into independent segments, locating each in appropriate places where they can bring the most benefits and be suitable for the characteristics of the stage. Recently, Viet Nam is home to the final assembly stage of large electronics corporations because it is a stage that requires a lot of labour and a large area of land to set up large-scale factories. The presence of these corporations in Viet Nam will also be an advantage if Viet Nam can connect them with domestic suppliers, gradually replacing imports to form a complete domestic supply chain and improve domestic value added throughout the value chain of electronic products made in Viet Nam.

Figure 10.7. Supply Chain of the Electronics Industry



Source: World Bank (2019).

The statistics data do not allow for the classification of enterprises according to the above four segments. However, based on their ISIC codes, electronic enterprises can be statistically divided into two segments. One includes final electronic goods producers, such as computers, communication equipment, consumer electronics, and so on, and the other one is a group of electronic components producers. The number of enterprises, employees, and the added value of each segment are quite different, sketching the overall picture of Viet Nam's electronics industry. As shown in Table 10.3, the sub-segment of communication equipment has a small number of enterprises (466 enterprises) but attracts more than 276,000 employees, and creates US$13 billion in added value. The segment of electronic components has the largest number of enterprises (1,365 enterprises) but creates lower jobs and added value. The majority of electronic enterprises are concentrated in the north. More than 80% of enterprises and employees in the electronic components segment are concentrated in the northern provinces, including Ha Noi, Bac Giang, Vinh Phuc, Bac Ninh, Hai Duong, and some southern

provinces such as Dong Nai, Binh Duong and Ho Chi Minh City. Final electronics producers are concentrated in the northern provinces, including Ha Noi, Thai Nguyen, Bac Giang, Bac Ninh, and Ho Chi Minh City, accounting for 76% in terms of the number of enterprises and 79% in terms of labour. The main activities of this segment are the assembling of final products from different imported subassemblies or components, whilst a complex local supply chain has not been developed yet.

Table 10.3. Electronics Industry in Viet Nam by Subsector, 2020

ISIC Code	Number of Enterprises	Number of Employees (persons)	Number of Female Employees (persons)	Value Added (US$ million)	Annual Average Wage per Employee (US$)
2610	1,365	266,899	178,227	3,201.63	4,805.58
2620	109	78,187	53,513	1,085.91	5,143.40
2630	466	276,138	192,670	13,002.94	6,165.13
2640	306	105,636	71,483	2,701.95	4,246.40
2651	193	7,527	3,474	70.41	4,316.52
2652	22	335	160	1.59	2,862.15
2660	8	26	9	0.43	4,421.77
2670	41	15,258	10,877	102.61	4,333.35
2680	22	5,792	3,549	60.39	6,304.47

Source: Indstat Unido.

3. Viet Nam's Position in the Global Value Chain

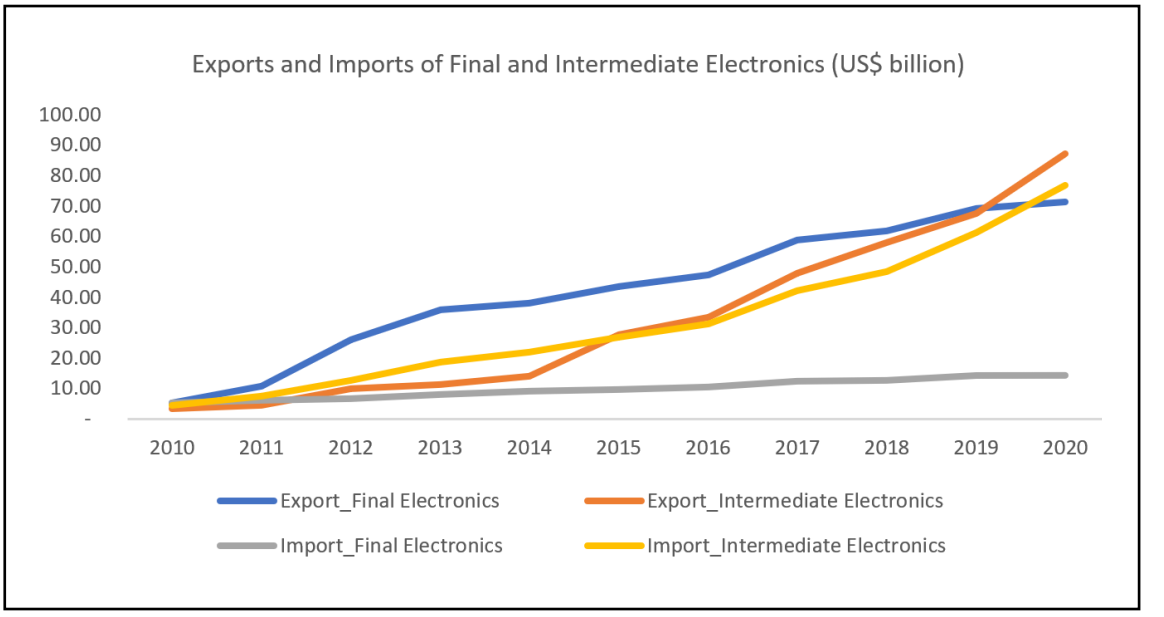
3.1. Mapping the Electronics Global Value Chain and Viet Nam's Position

The level of participation in the global value chain of a country is reflected in the import and export values of the products in each segment of the chain. At the global level, key players in the electronics global value chain include China, Germany, Hong Kong, United States, and Viet Nam as top exporters of final electronics, whilst Hong Kong, China, Taiwan, Korea, and Singapore are top exporters of electronic intermediate goods.

From 2010, Viet Nam's trade in intermediate electronic goods increased in both exports and imports, but trade in the final electronic goods only increased sharply in terms of exports, whilst imports remained unchanged (Figure 10.8). Amongst the final electronic products, mobile phones are the items with the largest export value, at over US$30 billion and accounting for 27% of the total export value of electronic products in 2020. Amongst the intermediate electronic products that Viet Nam exports the most are parts of telephone sets, which in 2020 reached a value of US$21 billion (accounting for 18%), and electronic integrated circuits, which reached US$13 billion (accounting for 11%). These two items were also the most imported ones, with an import value of electronic integrated circuits in 2020 of US$21 billion, equivalent to 23%, and parts of telephone sets at US$16

billion (17%). These figures illustrate again the fact that the growth of Viet Nam's electronic industry has been derived from external resources, not only FDI but also imported inputs.

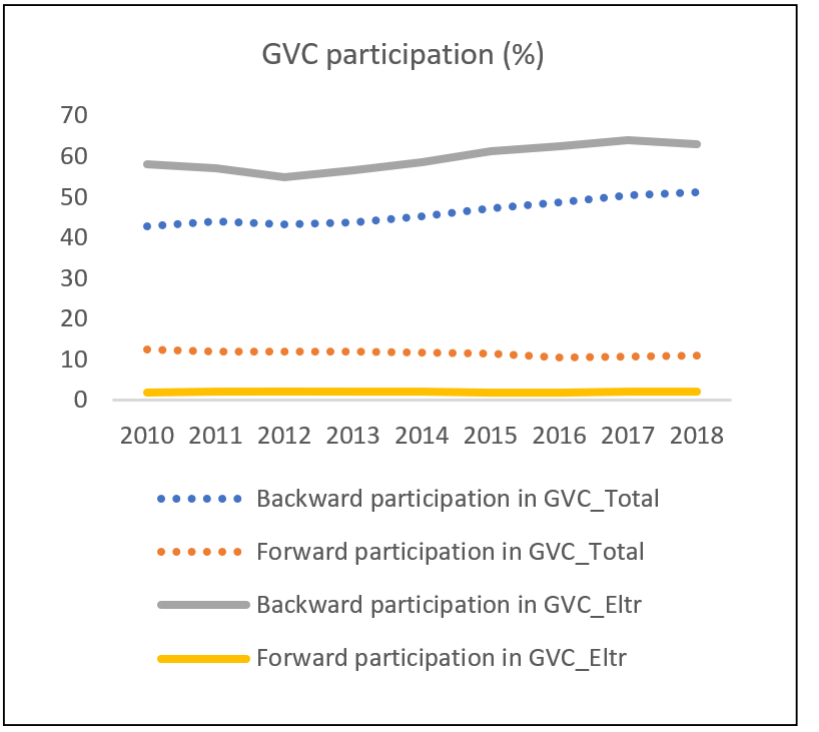
Figure 10.8. Trade Value of Viet Nam's Electronics Products by Supply Chain Segment

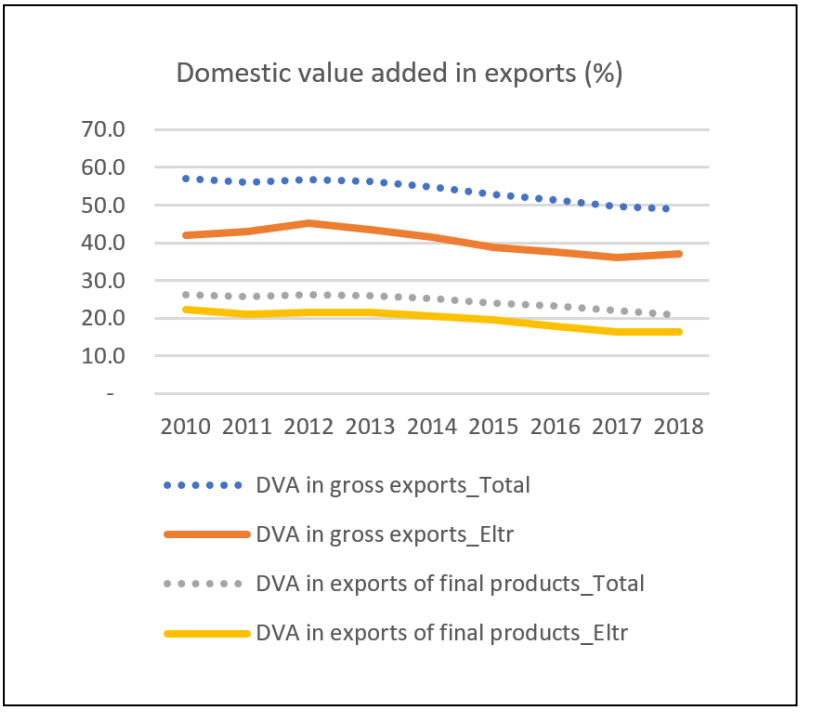


Source: UNComtrade.

Looking at the level of global value chain participation, it can be seen that the electronics industry has a very high level of backward linkage, whilst the level of forward linkage is low. Compared to the average level of total exports, the electronics industry has a higher level of backward linkage and a lower level of forward linkage. The domestic value added of the electronics sector is also lower than the average level in both gross exports and final products (Figure 10.9). Again, these data confirm that the industry is highly dependent on imported components (shown by a high level of backward linkage), but its contribution to the global supply chain (reflected through a low level of forward linkage) and to the domestic supply chain (reflected by the domestic value added in exports) is still quite low.

Figure 10.9. GVC Participation of Viet Nam's Electronics Industry





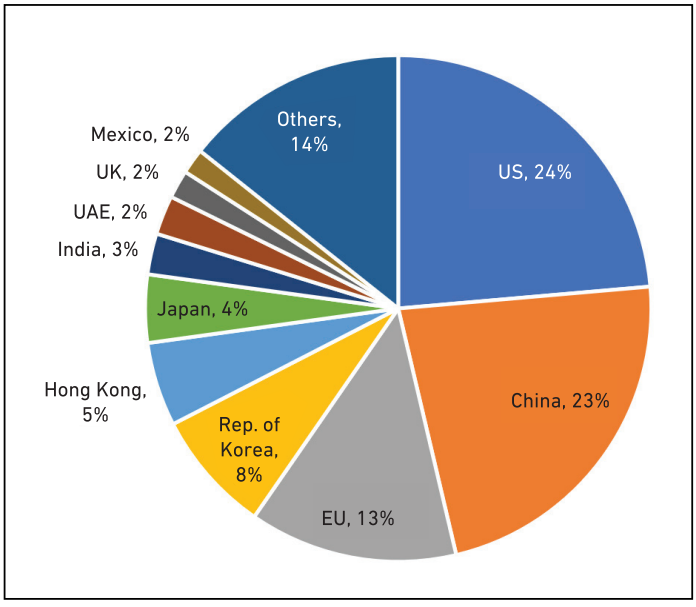
DVA = domestic value added, eltr = electronics.
Source: Organisation for Economic Co-operation and Development (OECD)'s Trade in Value Added (TiVA) Database.

Semiconductors and electronic integrated circuits are the most important parts for electronic equipment and devices. They are increasingly being used in various industries, especially in the current context of the fourth industrial revolution, with the popularity of IoT devices and the digital transformation taking place in all industries. Electronic integrated circuits can be found in any electronic device, and, thus, its share in the total trade of electronic products is high, at about 30%. In the export structure of Viet Nam's electronic products, electronic integrated circuits account for 13%, and they also account for a large share in the import structure of Viet Nam, at 41%, mainly for assembling export-oriented electronic products. Developed countries, such as the US, the EU, and Japan, may not have a large share of semiconductor and electronics integrated circuits exports but play an important role in technologies, inventions, core components, materials, and equipment, whilst developing countries, such as China and Malaysia, have large export values but comprise mainly assembled products with low added value.

3.2. Free Trade Agreement Commitments Related to Electronics and ICT

Viet Nam has signed 15 free trade agreements (FTA), including seven agreements joining as an ASEAN member, six bilateral agreements, and two multilateral agreements, and it has been negotiating two other agreements. Regarding tariffs, since the most favoured nation (MFN) tariff rate for electronic products was already 0%, the FTAs had no room for further reductions, except for a few specific electronic products that still maintain a relatively high MFN tariff rate, such as watches, electronic bells (MFN rate of 20%), and television camera tubes (MFN rate of 10%), although these tariff rates have been committed to being reduced to 0% in the next few years. Viet Nam's largest trading partners in the electronics sector include the US, China, the EU, Korea, Hong Kong, and Japan. In 2020, the export value of electronic products to the US accounted for 24%, followed by China at 23%, the EU at 13%, Korea at 8%, Hong Kong at 5%, and Japan at 4%.

Figure 10.10. Export Markets for Viet Nam's Electronics, 2020



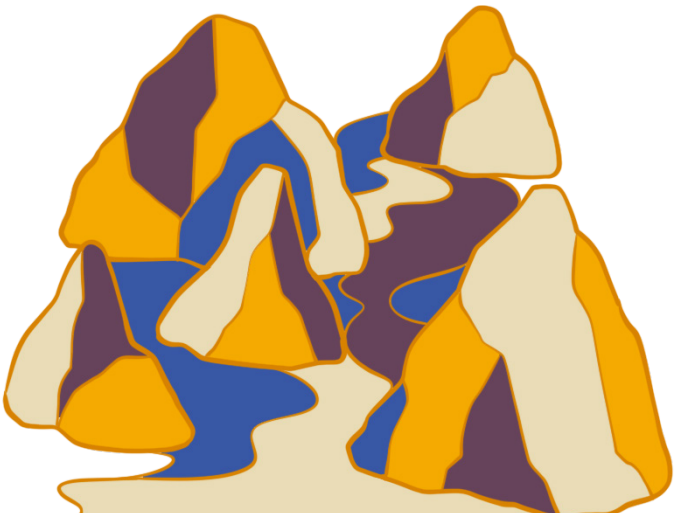
Source: ITC Trademap (www.trademap.org).

Amongst these markets, except for the US, which does not have any FTAs with Viet Nam yet, all the other countries have at least one FTA signed with Viet Nam, each with different provisions on non-tariff measures, of which the most notable measure is rules of origin (Table 10.4). Since the sector has become fully open, with MFN rates of most electronic products being 0%, the sector has not gained any benefit from the removal of tariff barriers from FTAs. However, comparing the provisions of rules of origin, the sector may enjoy less strict regulations from the EVFTA than other FTAs, in both regulations on change in tariffs and regional value content.

Table 10.4. Rules of Origin for Electronic Products Exported from Viet Nam to Major Markets

	ACFTA RVC 40%	RCEP CTSH or RVC 40%	EVFTA CTH or RVC 30%	AKFTA CTSH or RVC 40%	VKFTA CTSH or RVC 40%	AJCEP CTH or RVC 40%	VJEPA CTSH or RVC 40%	CPTPP CTSH
United States								
China	x	x						
European Union			x					
Korea		x		x	x			
Japan		x				x	x	x

RVC = regional value content; CTSH = change in tariff subheading; CTH = change in tariff heading; ACFTA = ASEAN China Free Trade Area, RCEP = Regional Comprehensive Economic Partnership; AKFTA = ASEAN Korea Free Trade Agreement; AJCEP = ASEAN Japan Comprehensive Economic Partnership; VJEPA = Viet Nam Japan Economic Partnership Agreement; CPTPP = Comprehensive and Progressive Agreement for Trans-Pacific Partnership.
Source: Rules of Origin Facilitators (findrulesoforigin.org).



Box 10.1. Malaysia's Experience in Electronics Industry Development

In the ASEAN region, Malaysia is considered a successful country in the development of its electronics industry. The industry has been established and developed since the early 1970s, when foreign electronic corporations took their first steps toward investment in Malaysia. Until now, the electronics sector continues to be the key player in Malaysia's exports, with its export value accounting for 39.4% of total exports (MIDA, 2021). Malaysia is one of the world's hubs for manufacturing and exporting electronic products. Most of the large electronic multinational companies from the US, Japan, Taiwan, Korea, and the EU have set up their production bases in Malaysia in the early stages, such as Intel, HP, AMD, Bosch, Hitachi, Litronix, brought in opportunities for the formation and development of domestic electronic supply chains. Some Malaysian electronics enterprises positioned themselves in the electronics global value chain, such as Pentamaster, Vitrox, Globetronics, Inari Amertron, BCM Electronics, and so on. Each decade of development of the Malaysian electronics industry has had its own distinctive characteristics, with featured products that have demonstrated an ever-evolving level of technology and kept pace with the development trends of the global electronics industry.

- In the 1970s: Malaysia attracted investments in electronics through labour-intensive projects aimed at reducing unemployment, supported by a business-friendly government. Manufacturers concentrated on simple electronics components, semiconductor parts, and semi-knocked-down electrical products. Key products in this decade included simple components, semiconductor parts assembly and semi-knocked-down electrical products.
- In the 1980s: As the local companies matured and gained experience, the industry's sophistication in machining equipment grew in tandem. The companies began to manufacture consumer electronics parts and components and took on assembly-related work. The surge in demand for consumer electronics ensured that electronics manufacturing was on an upward trajectory. Key products of this decade were spread from consumer electronics parts to full assembly products.
- In the 1990s: Companies began to establish design and development (D&D) centres to engage in semiconductor packaging development, manufacturing process development, and design activities. Amongst the manufactured goods that dominated the era were office and computer equipment – including disks – to cater to the booming PC market demand. Key products of this decade were office and computer equipment (including hard disk drives).
- From the 2000s to the 2010s: Malaysia moved up the value chain. To stay competitive, electronics factories evolved from high-volume, low-mix operations to high-mix, low-volume operations. Wafer fabrication companies continued to establish and expand their facilities in Malaysia, further positioning the nation amongst the global top electronics exporters catering to the regional and global demand for semiconductors. Major products of this decade shifted to higher value-added products/activities, R&D, integrated circuit (IC) and system design wafer fab, ingot growing low volume, high complexity and high mixed products

(e.g. instrument, medical, and aerospace), and digital consumer goods (e.g. Blu-ray players, HDTV-LED flatscreens, and e-book readers).

- In the 2020s: The government, through the Malaysian Investment Development Authority (MIDA), has been encouraging manufacturers to establish more R&D and D&D centres, centres of excellence, global procurement centres, logistic centres, and operation headquarters (OHQs) in Malaysia. Electronics manufacturers are currently exploring the business potential that can be derived from new growth areas, such as e-commerce, automation, IoT, and AI, and accelerating the move towards Industry 4.0 by society and industry alike. Today, IoT is pushing demand for more advanced semiconductor devices, such as sensors, resistors, and transceivers, to help the industry to adopt digitisation and digitalisation aimed at improved productivity, profit, and competitiveness. As such, the key products of this decade shifted to sensors, Internet of Things, cloud computing, wireless electronics, nano technology, smart electronics, 3D integration, smart grid, advanced energy, storage, fablite, fabless, miniaturisation, and electric vehicles.

Achieving the above results was partly thanks to the appropriate development policies of the Malaysian government to attract large electronics corporations from around the world to invest in Malaysia, forming clusters of the electronics industry across the country. The policies issued by the Malaysian government to attract electronics FDI include: (i) income tax exemption between 70%–100% of statutory income for 5–10 years; (ii) Allowances between 60% and 100% on qualifying capital expenditure incurred within a period of 5–10 years; and (iii) the formation of locally incorporated companies that use Malaysia as a base for conducting regional or global business and operations to manage, control, and support their key functions.

Although it has achieved some achievements that many countries have dreamed of, Malaysia's electronics industry still has many challenges ahead on the way to asserting its position in the global supply chain. Firstly, after half of a century of development, the electronics industry in Malaysia today is still generally labour-intensive. Most of the local electronics companies listed on Bursa Malaysia are involved in the mid-to-lower end of the value chain, serving foreign semiconductor manufacturers, brand owners, and IC developers and fabricators. Malaysia's electronics industry has minimal participation in higher value-added activities such as generating intellectual property (IP) and D&D. Secondly, the talent shortage starts with university graduates. Nowadays, university students prefer software design to hardware design as they can see results faster. Unfortunately, there is a shortage of design talent around the world, let alone Malaysia. There is also a mismatch of skills and competencies to industry needs. Malaysia has insufficient qualified and experienced technical workers to participate in higher-value activities, partly due to the low demand for master's and PhD holders. This trend has discouraged university graduates from pursuing postgraduate studies as most of the job requirements are not knowledge-intensive. In the long run, local engineers cannot progress in their careers without specialist technical knowledge and skills, hampering

Malaysia's ability to climb up the electrical and electronics value chain. Thirdly, all the technology or IP invented by Malaysians belong to the foreign companies they work for. A right ecosystem and incentives are needed to encourage more engineers to explore the entrepreneurial path. Only with a robust entrepreneurial culture and adequate support system, local technology start-ups can compete amongst the fierce regional competitors, such as Singapore, Taiwan, and Indonesia. Malaysia lacks not only hardware design engineers but also engineers with entrepreneurial skills. Local engineers often choose to work for multinational corporations before considering starting up their own tech companies.

As a successful case study for latecomers to learn from, experience in electronics industry development in Malaysia has provided several lessons, including attractive investment incentives for investors to invest in the sector; to be involved in activities directed by the government to adapt to the circumstance of each development stage; and proactive government policy in cluster formation in Penang to support infant industries. Incentives were also provided to encourage industry to invest in training students and academics and to transform from a labour-intensive to a knowledge-based economy. Greater collaboration between government, employers, and unions is also vital to provide a sustainable funding mechanism for supporting continuous upskilling and reskilling of local talents, as well as local technology start-ups.

Source: Author's compilation from MIDA (2021) and 27 Group (2020).

4. Emerging Issues in the Global Value Chain

4.1. Resilience and Restructuring of the Global Value Chain

In recent years, supply chain disruptions in the electronics industry have occurred frequently, affecting the production of many electronic devices. Due to the impact of the US-China trade war and the COVID-19 pandemic, a shortage of semiconductors – an important input for electronic products ranging from mobile phones to computers, vehicles, and electrical and IoT devices – has caused delays to many investment and production plans. The importance of semiconductors has prompted the US government to enact the Competition and Innovation Act to support the US chip industry, including spending US$52 billion to subsidise the research and production of semiconductors. To meet the growing demand for semiconductors, many capacity expansion plans have been announced by leading chip companies since early 2022, such as Intel's US$20

billion investment plan to build a semiconductor factory in Ohio. However, shortages of production equipment and tools to produce semiconductors have exacerbated semiconductor shortages and disrupted electronics industry supply chains.

Even if chipmakers could secure production equipment and tools, the Russia-Ukraine war disrupted the supply of critical raw materials for chip production. Ukraine is an important supplier of neon and argon used in chip production. Ukraine produces 70% of the world's neon supply. Neon is used in lithography, which is an important step in the chip manufacturing process. Argon is used in etching, which is needed to make semiconductors. Besides Ukraine, Russia supplies 35% of US palladium, a rare earth metal used for semiconductors. Finding alternative supplies of neon and palladium will also take time. Some suppliers are developing ways to recycle neon and other materials as an alternative. Besides neon and palladium, a shortage of processing chemicals for semiconductor production is at risk. In retaliation for European sanctions, the Russian state gas company Gazprom cut 60% of flows through the Nord Stream 1 pipeline to Germany. This natural gas crisis is threatening the manufacturing industry of processing chemicals for semiconductor processes, including cleaning, etching, and lithography at Germany-based BASF, the world's largest chemical company. As the war in Ukraine drags on, these material supply disruptions will prolong shortages of many products, triggering an escalation of inflation around the world.

In the future, even if problems such as US-China trade tensions, the COVID-19 pandemic, semiconductor shortages, or the Russia-Ukraine war are resolved, neither the electronic supply chain nor other industries can come back to the original status quo. Electronics multinational corporations have had to restructure their production chains to cut down on intermediaries, increase their domestic procurement, and diversify suppliers to be more flexible, resilient, sustainable, and controllable to achieve better results and avoid similar risks in the future.

4.2. Sustainability in Electronics and ICT and International Regulations and Standards

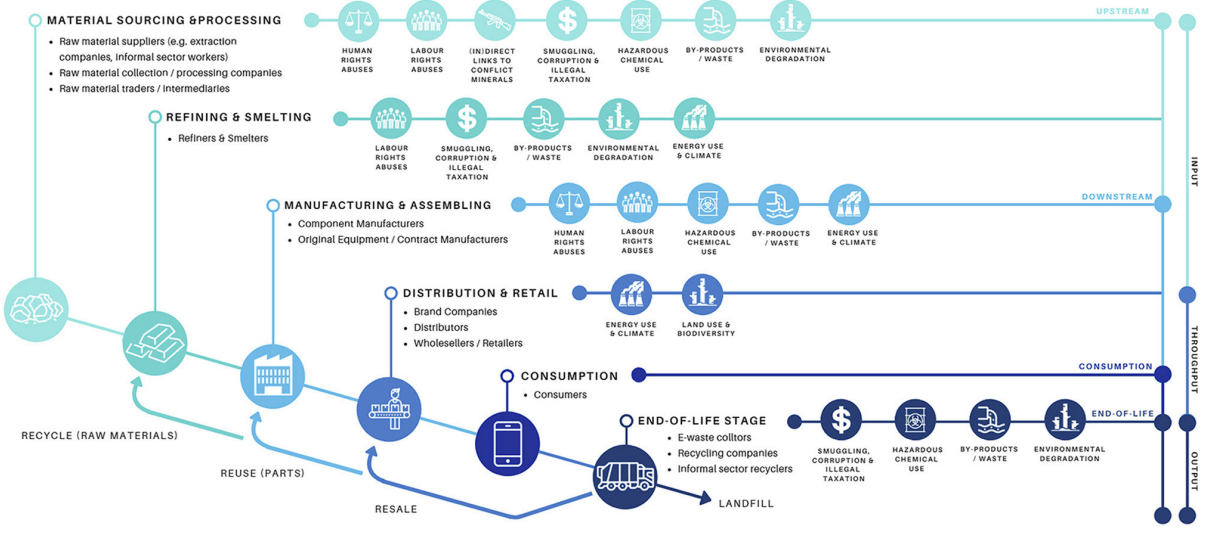
In addition to material shortages, increasingly, supply chain transparency and sustainable regulations in many countries are posing a requirement for traceability across the supply chain. This new requirement also somewhat disrupts the supply chain in the short term. For example, the Uighur Forced Labor Prevention Act came into force and disrupted the export of electronic chips, EV batteries, and apparel from China to the US. The act prohibits the import of goods made in whole or in part at factories in Xinjiang, China, unless companies can prove their production is not linked to forced labour. Under this act, all goods imported from China are presumed guilty until proven innocent. Because global supply chain operations are ambiguous and complex, it will be difficult and costly for a company to prove every transaction along the supply chain has no relationship to forced labour in Xinjiang.

In addition to the US, several EU countries and Japan have also introduced regulations and guidelines on protecting human rights and the environment throughout the supply chain. Countries tend to legislate on labour and environmental requirements across the whole supply chain, rather than on a voluntary basis and on individual firms as in the past. The German Supply Chain Due Diligence Act was passed on 11 June 2021 and officially came into force from 1 January 2023 to

strengthen the protection of basic human rights and environmental standards across the global supply chains of German companies or foreign companies who have their businesses in Germany. The act requires companies the determination and assessments of the risks to and violations of protected legal rights, implementation of preventive and remedy measures, data collection, documentation and reporting obligations, and specific responsibilities in the entire supply chain according to the degree of relevance. Although the responsibilities are not subject to criminal regulations and do not create additional liability under civil law, businesses that fail to comply with the provisions of the act will be subject to administrative fines of up to €800,000 depending on the type and severity of the violation, and exclusion from public procurement bidding packages for a maximum of 3 years, which will damage the reputation and brand of their businesses. Recently, the Government of Japan has also issued guidelines on respecting human rights in responsible supply chains, in line with global trends, to direct Japanese businesses to apply global standards on labour and environmental due diligence. The new guidelines request all companies (including sole proprietors) engaging in business activities in Japan to establish human rights policies, conduct human rights due diligence, and provide remedies when they cause or contribute to adverse human rights impacts. The guidelines are to be applied globally, including in overseas supply chains. They cover all rights included under the International Bill of Human Rights and the principles concerning fundamental rights set out in the International Labour Organisation's Declaration on Fundamental Principles and Rights at Work. In particular, the guidelines set out that even where the laws and regulations or enforcement of a country do not appropriately protect human rights, businesses need to 'seek ways to respect internationally recognised human rights to the greatest extent possible'. In addition, the EU Commission is currently proposing a directive on corporate sustainability due diligence and accountability to apply to all companies in the EU. The directive requires large companies that are either based in member states or have a considerable turnover in the EU to identify, prevent, and mitigate human rights and environmental violations throughout their value chains. Currently, due diligence rules are in place only in a few EU countries, like France, whilst in Germany, companies with more than 3,000 employees will need to carry out mandatory due diligence starting January 2023. The EU proposal would apply to all companies based or operating in the bloc with more than 500 employees and a net €150 million annual turnover but also smaller companies in high-risk sectors, such as textiles, agriculture, and mineral extraction industries. In Viet Nam, with the support of international organisations, the National Action Plan on Policy and Legislation Improvement to Promote Responsible Business Practices in Vietnam in the period 2023-2027 was ennacted in the Prime Minister's Decision No. 843/QD-TTg dated July 14, 2023, in order to identify the gaps between local policies and laws with international due diligence standards to bring about a better understanding and reflection of sustainable development standards in the social and economic development plan, in line with the United Nations Sustainable Development Goals.

Electronics is an emerging industry, and in addition to the general risks like other industries, the electronics industry has its own unique potential risks. Numerous studies on risks throughout the supply chain of the electronics industry have been carried out to identify and assess their impacts on people and the environment and recommend appropriate response measures. Research by Evans, R. and W. Vermeulen (2021) has determined the risks in the entire life cycle of electronic products, from upstream to downstream, i.e. from mining to materials processing, the production of components, assembly of finished products, distribution, sales, consumption, and finally the end of the product life cycle (Figure 10.11). Each process will have different risks related to sustainable development in terms of labour, environment, and governance. Growth in the electronics industry since the 1980s is archetypical of a globalised and technology-centric society. Yet, electronics are linked to a range of negative sustainability impacts or risks throughout their life cycle. These risks occur globally but disproportionately affect developing countries, particularly where weak public institutions and limited state authority allow risks to emerge and establish. Sustainability risks can be attributed to the challenges of governing sustainability in global supply chains, which fragment and disconnect the various stages of the electronics lifecycle across international borders. Within the whole global supply chain, sustainability governance is also undermined by the characteristics of international trade, whereby exchanges between suppliers and buyers are dynamic and kept confidential. Consequently, information regarding the conditions in which electronics are produced and disposed of is often obscured by limited transparency between actors in the global value chains, creating gaps for sustainability. This allows illegally produced or unsustainable minerals, components, and recycled material to enter the global market whilst also resulting in the non-allocation of accountability amongst companies that contribute to (directly or indirectly) unsustainable practices.

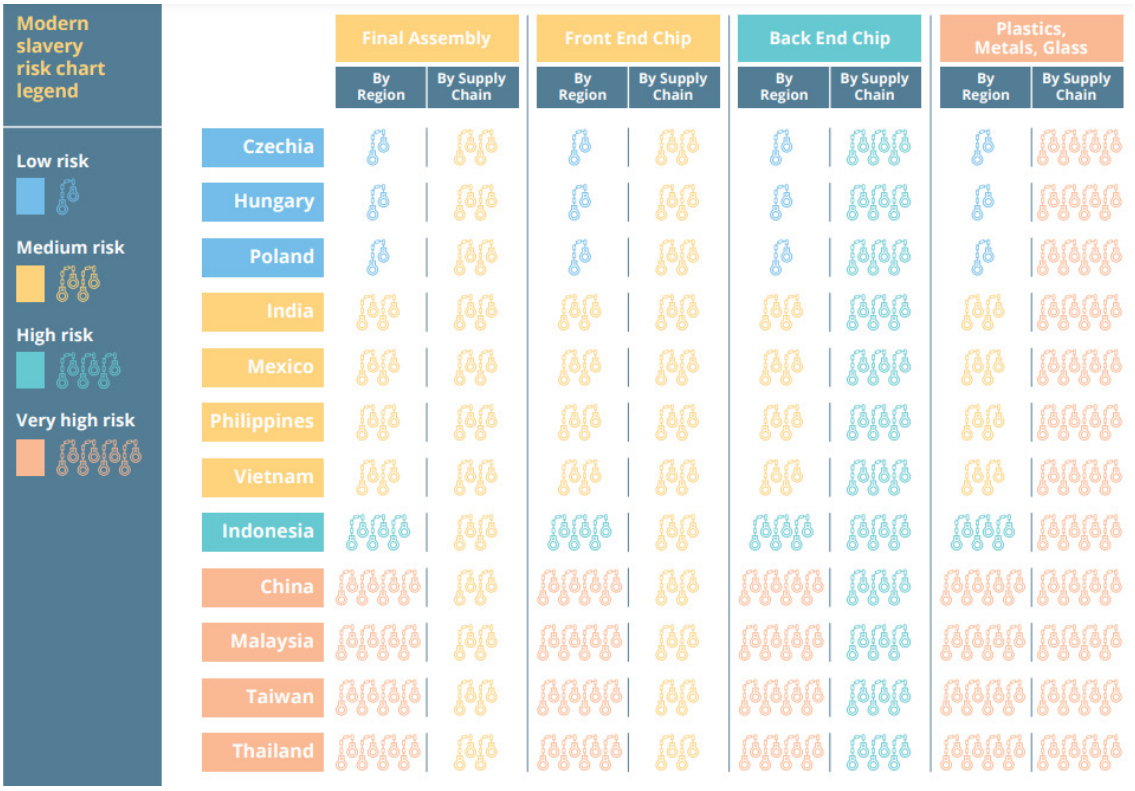
Figure 10.11. Potential Risks on Labor and Environment in the Electronics Industry



Source: Evans, R. and W. Vermeulen (2021).

Assessing the risk of forced labour in the electronics sector, a report by Electronics Watch (2021) has shown that Viet Nam's electronic supply chain has a very high risk in enterprises producing plastic, metal, and glass parts and components, a high risk in back-end chip-producing enterprises, and medium risk in the rest of the chain (Figure 10.12). In general, amongst the comparator countries, labour risks in the electronics supply chain in Viet Nam are assessed as medium. Regarding the risks related to the environment, the report found that the electronics industry was determined to use many toxic chemicals in the production process of electronic parts and components, such as Sn, Co, Cu, and Ni, which are used in the production of semiconductors, batteries, etc., and the working conditions and health protection measures for workers at mining and mineral processing mines were also a concern in the global electronics supply chain.

Figure 10.12. Risk Assessment of Human Rights in the Electronics Industry



Source: Electronics Watch (2021).

The electronics industry, an emerging sector in Viet Nam, has a complex supply chain with a wide range in terms of geography and related sectors, however, lack of corporate supply chain transparency undermines multi-stakeholder interaction, (no specific policy, no protective regime, no development strategy...). Viet Nam has already integrated into the global value chain, cannot avoid these emerging issues but should proactively consolidate its position in the chain. In the coming time, under the pressure of regulations and guidelines on the protection of human rights and the environment, Vietnamese electronics enterprises will have to take specific actions to be able to both meet the requirements of 'traditional' requirements of production such as quality, cost, delivery time, whilst ensuring the 'new' requirements of assessment, preventing labour and environmental risks. These changes will have a strong impact on the formation and relationships between businesses in the global supply chain of the electronics industry.

5. Conclusion

The electronics industry has had rapid growth and is a significant contributor to economic growth and job generation, with a high potential for further development. However, to turn this potential to reality, the industry still has to overcome bottlenecks and challenges ahead, which include excessive dependence on foreign investment and imported components, fierce global competition, and low and decreasing share of domestic value added. The core parts and components of electronic products, characterised by being high-tech, dual-use, and not easy to replace, are only made by the US, EU, and Japanese companies. Local firms can only supply simple parts, exposing fierce competition and unstable and unhealthy business relationships. In addition, more and more new regulations on supply chain sustainable development have been introduced, bringing both challenges and opportunities for local firms to participate in the global value chain. Facing such changes in the operating environment of the global supply chain, the Vietnamese electronics industry needs to build up reliable partnerships in the electronics industry at the macro and micro levels, absorb more investment in electronics to create local supply chains, strengthen FDI-local firm linkages, upgrade skills and local firms' capacity in manufacturing technologies, harmonise legal frameworks with international standards, especially the ones related to sustainability, and raise awareness and change mindsets for strategic policy to consolidate its position in the global value chain.

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