2 Trade and Global Value Chains

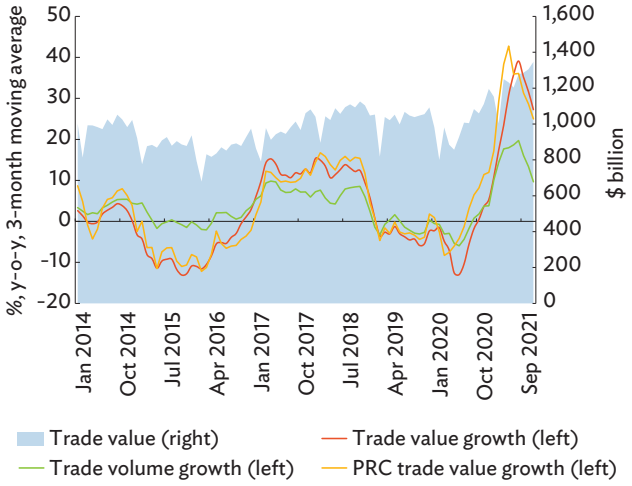
Recent Trends in Asia's Trade

Merchandise trade in Asia and the Pacific demonstrated strong resilience amid the pandemic in 2020 and continued its rapid growth in 2021.

After bottoming out in mid-2020 during the first wave of the coronavirus disease (COVID-19) pandemic, the region's merchandise trade recovered faster than expected, especially over the first half of 2021 (Figure 2.1). When the first wave of the COVID-19 pandemic hit Asia and the Pacific, trade volumes declined rapidly beginning February 2020, hitting the lowest growth at –6.0% in June 2020. The decline began to taper off in July 2020 and trade volumes were growing again by the third quarter of 2020, though plateaued at 3.8% in November and 3.9% in December 2020 before rising rapidly, to 10.2% in January 2021. The recovery saw growth hit 19.1% in June 2021 before settling to 12.7% in August. The fluctuating trade growth partly reflects the patchy path of global economic recovery, which was affected by the phases of the pandemic and the containment measures taken by the governments.

Strong monetary and fiscal support by the governments, the arrival of vaccines, and the relative early success of most of the region's economies in getting the pandemic under control contributed greatly to this steep rebound (WTO 2021). Moreover, Asia and the Pacific became the supply hub for various consumer goods and medical supplies, which drove up its merchandise exports to the world. That said, with most of the region still struggling to secure enough effective vaccines and implement effective large-scale inoculation, resurgent waves due to new coronavirus variants such as Omicron pose a constant threat to the region's trade growth.

Figure 2.1: Monthly Merchandise Trade by Value and Volume—Asia and the Pacific



PRC = People's Republic of China, y-o-y = year-on-year.

Notes: Trade volume growth rates were computed using volume indexes. For each period and trade flow type (i.e., imports and exports), available data include indexes for Japan, the PRC, and aggregate indexes for selected Asia and Pacific economies: (1) advanced economies excluding Japan (Hong Kong, China; the Republic of Korea; Singapore; and Taipei,China); and (ii) emerging economies excluding the PRC (India; Indonesia; Malaysia; Pakistan; the Philippines; Thailand; and Viet Nam). The aggregate index for Asia and the Pacific was computed using trade values as weights.

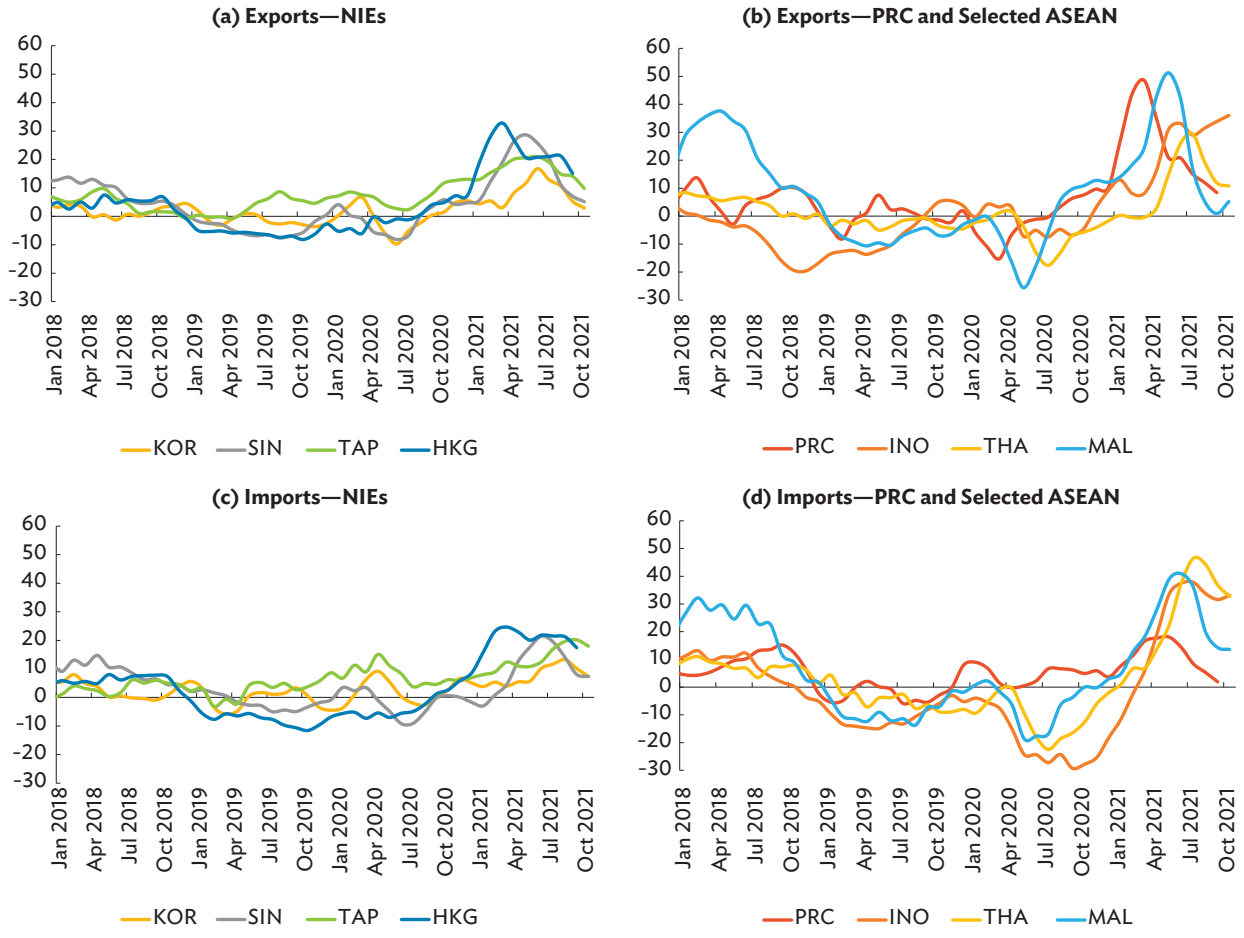
Sources: ADB calculations using data from CEIC Data Company; and CPB Netherlands Bureau for Economic Policy Analysis. World Trade Monitor. https://www.cpb.nl/en/world-trade-monitor-october-2021 (accessed January 2022).

Figure 2.1 also highlights how the trade value growth of the People's Republic of China (PRC) recovered earlier and faster than in Asia and the Pacific overall, reaching double-digit growth rates by November 2020 (11.4%). The sustained rise peaked at 42.8% in April 2021 before moderating to

31.3% in July 2021. Figure 2.2 shows the PRC's export volume growth took a similar trend, peaking at 48.6% on March 2021 before moderating to 22.0% by June 2021 as external support waned (ADB 2021). However, the PRC's import volume grew more gradually, with positive rates beginning July 2020 at 4.8% and reaching 17.4% in May 2021.

Merchandise export volumes in the newly industrialized economies (NIEs) showed a shallower contraction in mid-2020, followed by a return to growth during the second half of the year. Rapid rises in volume growth were observed for the Republic of Korea and Singapore in early 2021. Both economies gained from effective COVID-19 containment. In contrast, volume growth began to decelerate for Hong Kong, China in April 2021, although it demonstrated the fastest recovery in the early months of the year. Merchandise import volume growth also turned positive for the NIEs as early as the third quarter of 2020 although import volumes to Singapore shrank briefly in December 2020 and January 2021. Hong Kong, China's import volume growth, similar to its exports volume growth, increased faster than Taipei,China; Singapore; and the Republic of Korea, but slowed from March 2021.

Figure 2.2: Monthly Trade Volume Growth—NIEs, the PRC, and Selected ASEAN Economies
(%, y-o-y, 3-month moving average)



ASEAN = Association of Southeast Asian Nations; HKG = Hong Kong, China; INO = Indonesia; KOR = Republic of Korea; MAL = Malaysia; NIE = newly industrialized economy; PRC = People's Republic of China; SIN = Singapore; TAP = Taipei,China; THA = Thailand; y-o-y = year-on-year.

Notes: Latest data are for October 2021 for all economies, except HKG and the PRC (September 2021). Data for the PRC refer to the export and import volume index from CPB Netherlands Bureau for Economic Policy Analysis. For the rest, export and import volumes are computed by deflating export and import values by their corresponding price indexes.

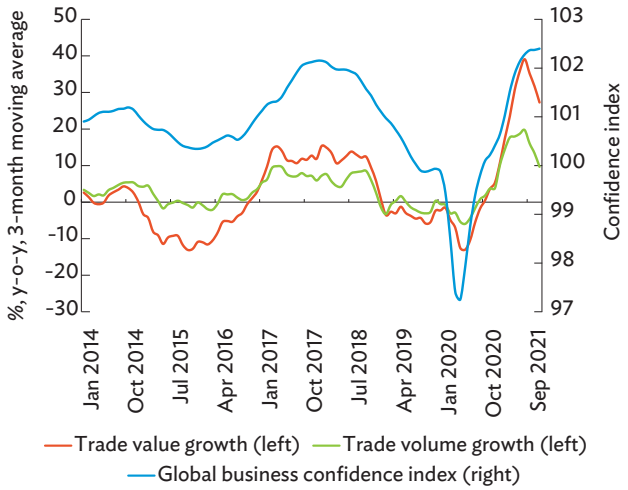
Sources: ADB calculations using data from CPB Netherlands Bureau for Economic Policy Analysis. World Trade Monitor. https://www.cpb.nl/en/world-trade-monitor-october-2021 (accessed January 2022); and Haver Analytics.

Merchandise import and export volumes for the three selected economies in the Association of Southeast Asian Nations (ASEAN) showed deeper and longer contractions in 2020 followed by bigger upswing trends than for the NIEs. They also differ on the timing of recovery. For instance, Malaysia's export volume shrank as much as –25.6% in May 2020, but recorded earlier and higher recovery rates than Indonesia and Thailand. Export volumes for Thailand grew only from 2021. Recovery in imports was relatively slower or delayed, with Indonesia, for instance, only returning to positive import volume growth rates in March 2021. Gains from trade could falter, however, as some ASEAN economies are facing new waves of COVID-19 infection (ADB 2021).

Overall, global business confidence continues to improve as the world recovers from the pandemic and the vaccine rollouts progress gradually, even if unevenly, across the globe. Figure 2.3 shows that Asia's merchandise trade flow moves together with the business confidence index.

Standardized high frequency indicators—such as global shipping and packaging indexes suggest continuing global trade recovery (Figure 2.4). Nevertheless, the recent hikes in global shipping costs in particular for Asia and the Pacific to the United States (US), and Asia and the Pacific to Europe make it difficult to attribute this entirely to trade growth (Box 2.1).

Figure 2.3: Global Business Confidence versus Trade Volume Growth of Asia and the Pacific

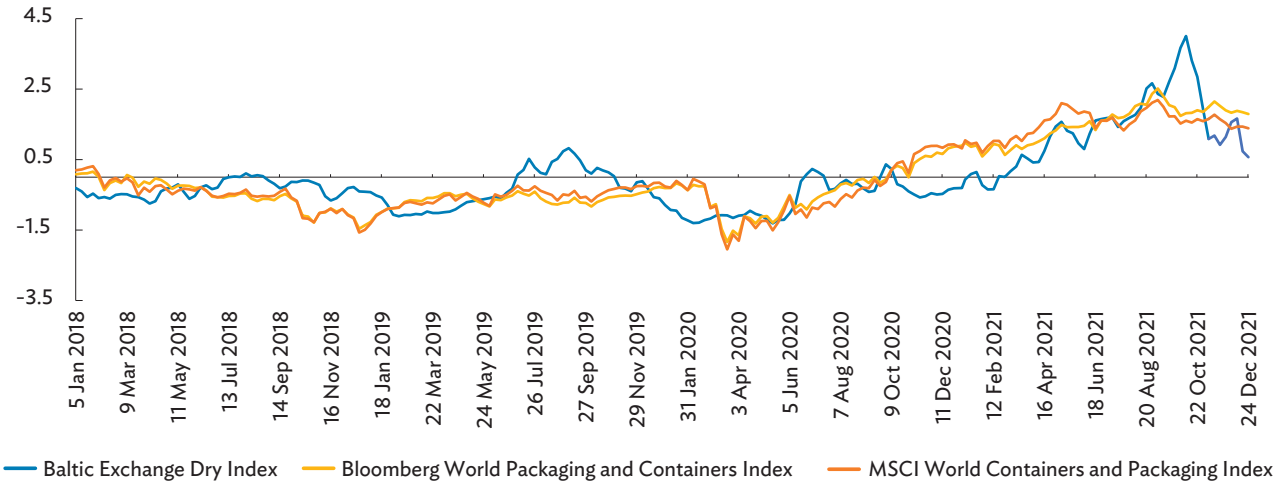


y-o-y = year-on-year.

Notes: Trade volume growth rates were computed using volume indexes. For each period and trade flow type (i.e., imports and exports), available data include indexes for Japan, the People's Republic of China (PRC), and aggregate indexes for selected Asia and Pacific economies: (i) advanced economies excluding Japan (Hong Kong, China; the Republic of Korea; Singapore; and Taipei,China); and (ii) emerging economies excluding the PRC (India; Indonesia; Malaysia; Pakistan; the Philippines; Thailand; and Viet Nam). The aggregate index for Asia and the Pacific was computed using trade values as weights. Global business confidence index represents Organisation for Economic Co-operation and Development (OECD) economies.

Sources: ADB calculations using data from CEIC Data Company; CPB Netherlands Bureau for Economic Policy Analysis. World Trade Monitor. https://www.cpb.nl/en/world-trade-monitor-october-2021; and OECD. Business Confidence Index (indicator). https://doi.org/10.1787/3092dc4f-en (both accessed January 2022).

Figure 2.4: Global Trade—Weekly Indicators

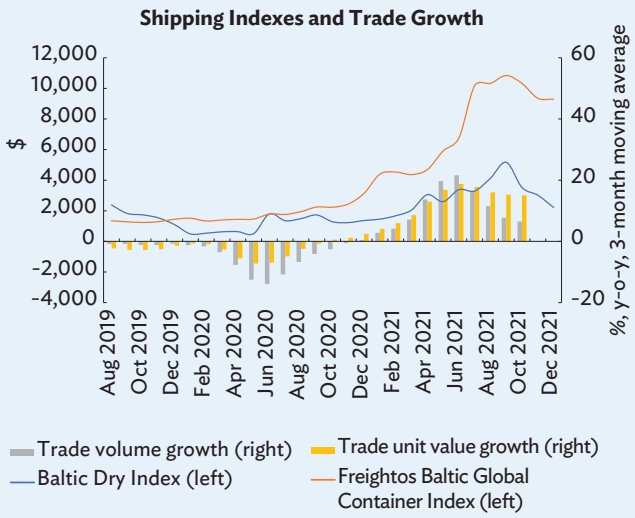


Note: The indexes have been normalized using z-scores. Calculated mean and standard deviation of the indexes were for the period 5 January 2018–24 December 2021.

Sources: ADB calculations using data from Bloomberg; CEIC Data Company; Freightos. Freightos Baltic Index (FBX). https://fbx.freightos.com/ (accessed January 2022); and S&P Capital IQ Pro.

Box 2.1: Rising Global Shipping Costs

Not all the rising trajectory of high frequency data is accounted for by the strength of global trade recovery as it also reflects fast rising global shipping costs lately. Midway through the pandemic, from June 2020, dry bulk and container shipping rates began rising; then, from November 2020, surging at respective rates of 10% and 16% per month on average. In September 2021, the average freight rate for containerized goods was $10,839, and for dry bulk $4,288. During the same month in 2019, these rates were $1,279 and $2,255.



y-o-y = year-on-year.

Notes: The Baltic Dry Index measures shipping costs for dry bulk commodities (including coal, grain, iron ore, finished steel, and other metals, minerals, and similar materials). The Freightos Baltic Global Container Index represents transport spot freight rates for a standard 40-foot, unrefrigerated container, based on rolling tariffs and related surcharges reported by freight carriers, freight forwarders, and shippers.

Sources: ADB calculations using data from CEIC Data Company; and Statista. Freightos Baltic Index. https://de.statista.com/statistik/daten/studie/1270630.

Drivers of Rising Shipping Costs

Shipping costs are determined by a myriad of factors which include (i) inputs for shipping transportation such as bunker fuel and labor; (ii) performance of integrated logistics functions such as ports, containers, storage, and inland transport; (iii) demand for shipping services and relative cost-efficiency of alternative modes of transport (e.g., air freight); (iv) production, consumption, trade flows, and overall economic integration (geography of value chains) (UNCTAD 2015); and (v) regulation in particular quarantine requirements for seafarers during the pandemic.

In light of this, the rise in oil prices, including bunker fuels, port congestions due to delayed manifestation of pent-up demand for manufacturing goods, sporadic lockdowns of ports in some Asian economies during the pandemic, and quarantine requirements for seafarers and port workers all contribute to the recent steep increase in shipping costs.

Impacts

Fast rising shipping costs add to the growing bottlenecks of supply chain disruptions amid the pandemic, slowing down trade flows and making the shipment of goods unable to meet overseas demand in a timely manner. Freightos estimates that average door-to-door shipping time for ocean freight has gone from 41 days a year ago to 70 days (*The Economist* 2021). This is especially consequential for containerized cargo where containers need to be returned and repositioned for succeeding trades. Rising shipping costs, on top of rising commodity prices and wages, are driving inflation to higher-than-expected levels. Affected producers could either squeeze their profit margins or pass the burden, though only partially, to more upstream producers or to consumers.

The direct financial strain from rising shipping costs could push producers to reshore productive activities and find domestic or regional partners increasingly attractive and strategic, especially in the medium to long terms. Incentives might also exist to consolidate parts of value chains to mitigate the risk of costly and inefficient transport. In the short term, however, firms may react by stockpiling inventories and pursue shifting from a "just-in-time" to a "just-in-case" inventory management philosophy (*The Economist* 2021) and building inventories to even higher-than-pre-pandemic levels to hedge against delays and shortages. This will entail higher costs and prompt a vicious inflationary cycle until consumer demand dampens or shipping bottlenecks are eased.

More fundamental and lasting solutions are needed to guard against unchecked increases in shipping costs. Tracking technologies such as the Automatic Identification System and digitized trade and transport records can be used to improve visibility of the global maritime network. This can provide an opportunity to optimize the transportation plan. Encouraging competition and making systemwide investments in the entire logistics chain, from ports to warehouses to inland transport, will also help grow capacity, level rates, and minimize the share of transport costs in total prices.

Source: ADB staff based on UNCTAD (2015) and *The Economist* (2021).

Asia's Intraregional Trade

Asia and the Pacific managed to strengthen intraregional trade linkages during the first wave of the COVID-19 pandemic in 2020.

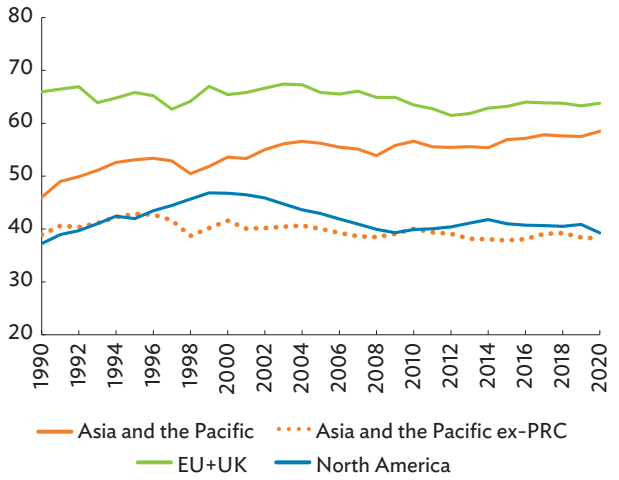
Asia and the Pacific sustained strong intraregional trade linkages amid the pandemic. The region's intraregional trade share even rose to 58.5% in 2020 from 57.5% in 2019, the highest since 1990 (Figure 2.5). This remains higher than for North America (39.3%) and lower than the European Union plus the United Kingdom (EU+UK)(63.8%).[7] The modest increase in the region's intraregional trade share during the pandemic is mainly due to the linkage with the PRC, which was first to ease off its mobility restrictions. Excluding the PRC, Figure 2.6 shows that the region's intraregional share declined marginally to 38.2% in 2020 from 38.4% in 2019. Intraregional trade values for all regions fell for 2 consecutive years in 2019 and 2020 (Annex 2a). The trade of Asia and the Pacific grew 29.6% in the first 3 quarters of 2021, compared with global trade growth of 27.8%. Trade within the region rebounded 31.2% during the same period, following a 3.1% contraction in 2020. By comparison, the region's trade with non-regional trade partners fell 7.0% in 2020 before rebounding by 31.0% in the 9-month period.

The role of the PRC as the region's major trading partner continues to grow—as shown by the increasing gap of intraregional trade share between Asian economies excluding the PRC, and Asia and the Pacific including the PRC (Figure 2.5).

While intraregional trading within Asia and the Pacific (excluding the PRC) has remained relatively stable over the past 30 years, the dynamics of trade linkages with other regions have changed considerably.

In 1990, North America was the most important trade partner of Asia and the Pacific (excluding the PRC)

Figure 2.5: Intraregional Trade Shares by Region (%)



EU = European Union (27 members), PRC = People's Republic of China, UK = United Kingdom.

Notes: Values are expressed as percentage of the region's total merchandise trade (sum of exports and imports). North America covers Canada, Mexico, and the United States.

Source: ADB calculations using data from International Monetary Fund. Direction of Trade Statistics. https://data.imf.org/dot (accessed January 2022).

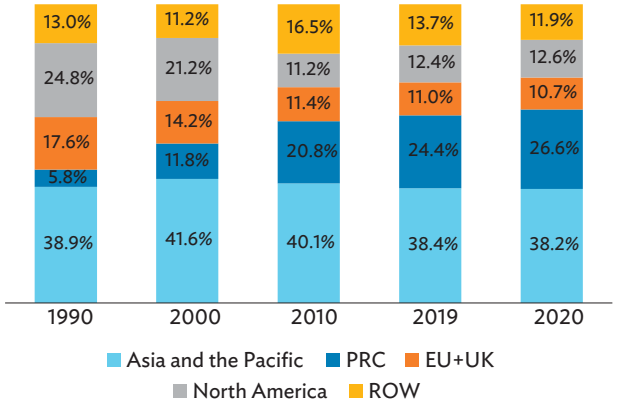
outside the region (with 24.8% of trade), followed by the EU+UK (17.6%), as shown in Figure 2.6. In the past 3 decades, the share of Asia's (excluding the PRC) regional trade with North America and the EU+UK gradually fell by 2020, to 12.6% and 10.7%. In contrast, its share of regional trade with the PRC grew from 5.8% in 1990 to 26.6% in 2020. Intraregional trade, on the other hand, moved within the 38.0% to 43.0% band in the past 3 decades, peaking at 42.7% in 1996 and settling at 38.2% in 2020. In terms of economies, Asia's (excluding the PRC) top 10 leading partners in 2020 are the PRC (26.6%); the US (11.0%); Japan (5.5%); the Republic of Korea (4.2%); Taipei,China (3.8%); Singapore (3.6%); Hong Kong, China (3.2%); Malaysia (2.9%); Viet Nam (2.9%); and Thailand (2.5%).

These strong trade linkages among Asian economies proved an effective buffer during the pandemic. In 2020, the distribution of trade share across major trade partners in Asia and the Pacific was relatively resilient against a black swan event such as the pandemic. For instance, during 2020, the first year of the pandemic,

[7] The EU (27 members) plus the United Kingdom (UK) was used in the analysis. As of 1 February 2020, the UK has withdrawn from the EU. During the transition period that ended on 31 December 2020, the EU law remained applicable to and in the UK, with a few limited exceptions. Thus, for 2020, the information on the EU, unless otherwise specified, continues to cover the UK.

the bilateral trade flow share of Asia and the Pacific (excluding the PRC) with the PRC grew to 26.6% (from 24.4% in 2019) while the share of trade ties with North America remained relatively stable at 12.6%. The share of trade flow with the other regions declined. Trade shares with the EU+UK dipped slightly from 11% to 10.7% while those with the rest of the world fell from 13.7% to 11.9%.

Figure 2.6: Regional Trade Partners Share—Asia-to-Asia and Asia-to-Other Economies



EU = European Union (27 members), PRC = People's Republic of China, ROW = rest of the world, UK = United Kingdom.

Notes: Values are expressed as percentage of the region's total merchandise trade (sum of exports and imports). North America covers Canada, Mexico, and the United States.

Source: ADB calculations using data from International Monetary Fund. Direction of Trade Statistics. https://data.imf.org/dot (accessed January 2022).

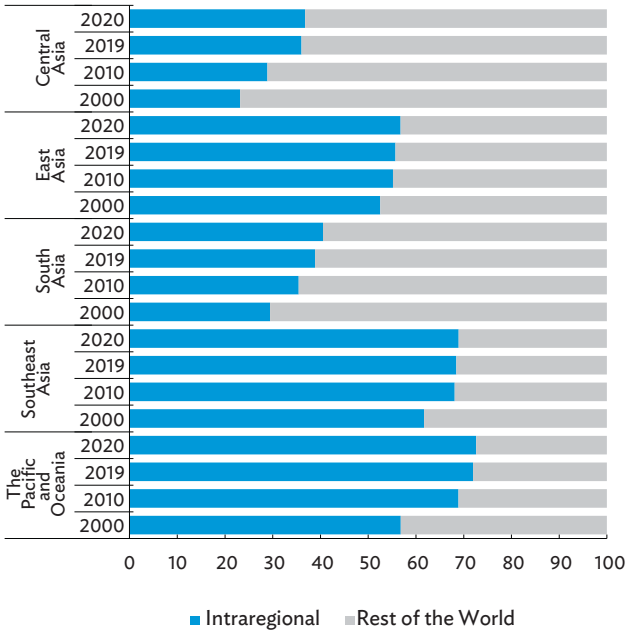
Optimizing regional trade linkages and strengthening regional trade integration could help the region's economies navigate the challenges to sustain trade growth. The region needs to embrace stronger trade liberalization and facilitation regimes, including engaging in regional and bilateral trade agreements and improving trade logistics to continue this momentum.

Intraregional trade linkages further strengthened across all subregions in Asia and the Pacific in 2020.

During the pandemic, intraregional trade linkages tightened the most for South Asia, showing the intraregional trade share's growth from 38.9% in 2019 to 40.5% in 2020 (Figure 2.7). East Asian economies' trade ties with Asia and the Pacific also strengthened modestly, rising from a 55.7% in 2019 to 56.8% in 2020. Intraregional trade for the Pacific and Oceania region remained stable as it moved from 72.0% in 2019 to 72.6% in 2020. Intraregional ties for Central Asia expanded from 36.0% in 2019 to 36.8% in 2020 while that of Southeast Asia rose from 68.5% to 69.0%.

By magnitude, the Pacific and Oceania continue to have the highest intraregional trade share in 2020 (72.6%), followed by Southeast Asia (69.0%) and East Asia (56.8%) (Figure 2.7). Despite having increased the most over the past decade, the intraregional trade share for Central Asia and South Asia remained below 50%.

Figure 2.7: Intraregional Trade Shares by Asian Subregions *(%)*



Note: Timor-Leste was recently classified under Southeast Asia. Until 2019, it was under the Pacific and Oceania.

Source: ADB calculations using data from International Monetary Fund. Direction of Trade Statistics. https://data.imf.org/dot (accessed January 2022).

Across subregions, East Asia continues to have the highest intrasubregional trade share (35.9%), followed by Southeast Asia (21.1%). The other subregions all recorded intrasubregional trade shares below 10%—Central Asia (8.8%), the Pacific and Oceania (5.5%), and South Asia (5.8%).

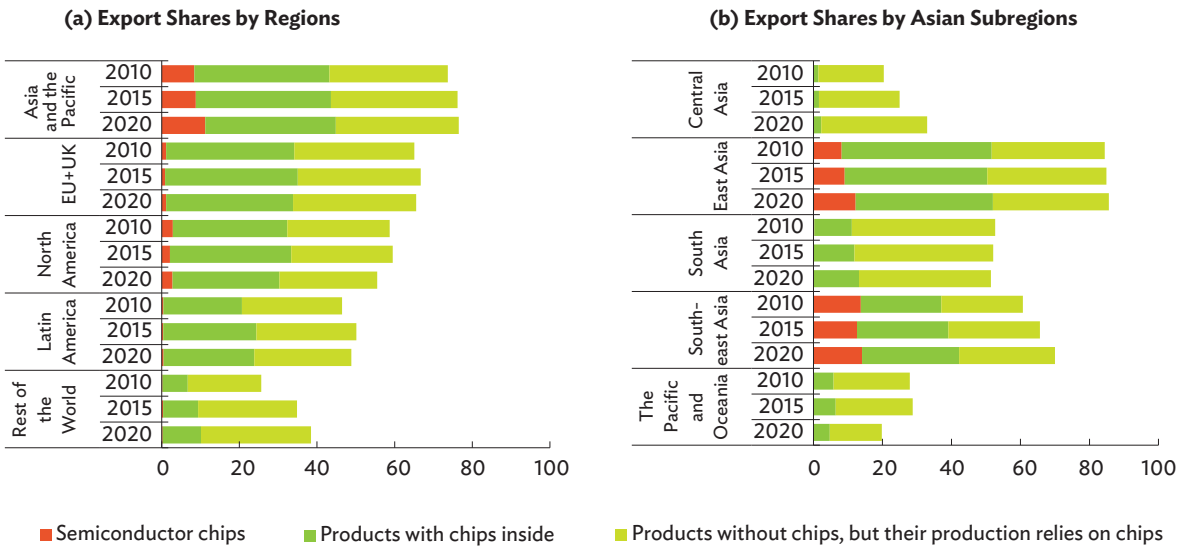
Challenges in Semiconductor Supply Chains

Semiconductors are an essential component of electronic devices, enabling communications, computing, health care, transportation, clean energy, and countless other applications.[8]

Goldman Sachs identified 169 industries that spend at least 1% of their value-added production on semiconductor chips.[9] These include sectors that produce chip-dependent products such as cars, computers, and mobile phones. The list also includes industries making products that do not need chips, but whose machineries do—such as steel, ready-mix concrete, and soap manufacturing.

Using the United Nations Commodity Trade Database 2020 data and the industrial list from Goldman Sachs, about 65% of the world's exports are estimated to depend on semiconductor chips directly and indirectly: 5% are semiconductor chips themselves (semiconductor devices and electronic integrated circuits)[10] while 29% are chip-dependent products and 30% are products that do not have chips inside, but their production runs on them. Among the major regions, Asia's exports rely heaviest on chips, followed by the EU+UK and North America. Among Asian subregions, East Asia's exports rely the most on chips, followed by Southeast Asia. In the import side, all the regions have a fair share of imported goods that rely on chips and in most regions, the share continues to grow. East Asia and Southeast Asia's imports have the highest share of semiconductor chips (Figure 2.8).

Figure 2.8: Share of Exports/Imports for Industries Spending at Least 1% of Value-Added Production on Semiconductor Chips *(%)*



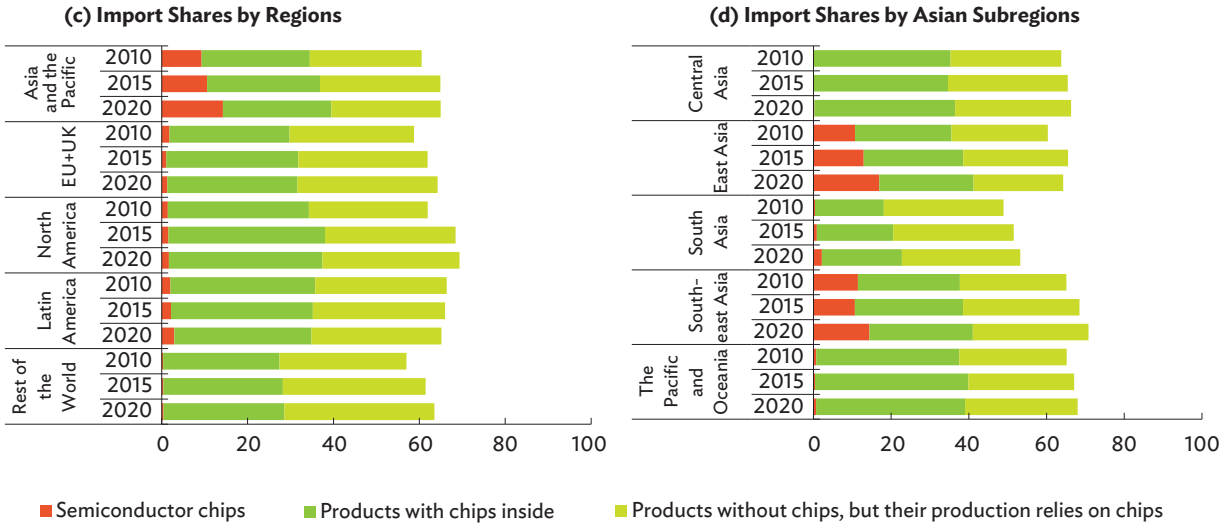
continued on next page

[8] Semiconductor Industry Association. What is a Semiconductor? https://www.semiconductors.org/semiconductors-101/what-is-a-semiconductor (accessed December 2021).

[9] For reference, the automobile sector spends 4.7% of its GDP on semiconductor chips (Howley 2021).

[10] Semiconductor devices cover all commodities under Harmonized System (HS) 8541, which includes diodes, transistors, photosensitive devices, and mounted piezo-electric crystals. Electronic integrated circuits cover all commodities under HS 8542, which include processors and controllers, memories, converters, logic circuits, amplifiers, clock and timing circuits, and others.

Figure 2.8: *continued*



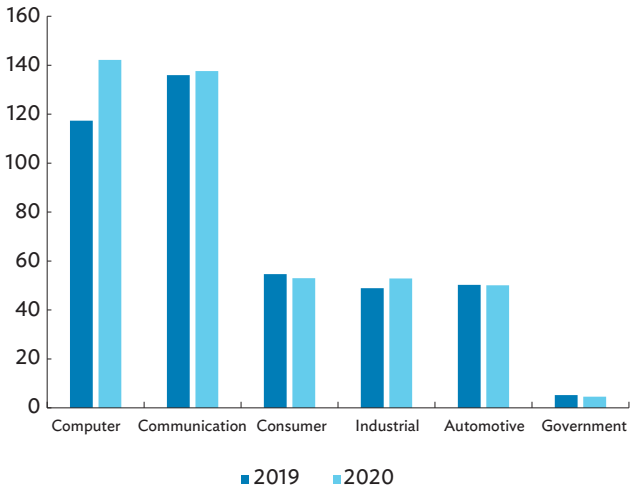
EU = European Union, UK = United Kingdom.

Notes: Red bars represent the share of semiconductor devices and electronic integrated circuits in total exports or imports. Both light green and dark green bars represent the share of exported products under industries that spend at least 1% of their value-added production on semiconductor chips. These industries were classified by Goldman Sachs. The light green bars are exports that do not have chips inside their products, but production such as machineries relies on chips. The dark green bars are exports that have chips inside their products.

Source: ADB calculations using data from United Nations. Commodity Trade Database. https://comtrade.un.org (accessed December 2021).

Most of the semiconductor chips produced were used for computers in 2020, followed by communications, and consumer products, as shown in Figure 2.9.

Figure 2.9: Global Semiconductor Demand by End-Use ($ billion)

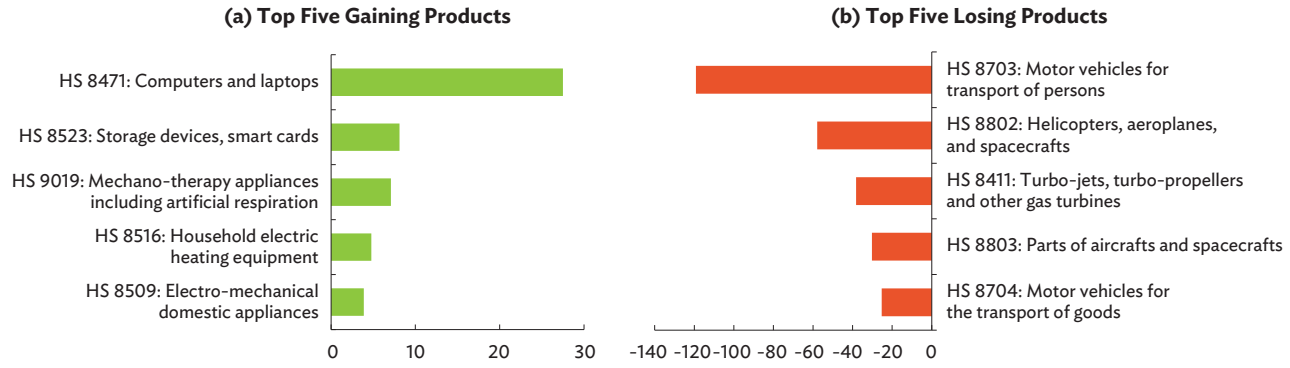


Source: Semiconductor Industry Association (2021a).

Drivers of Demand for Semiconductors and Microchips

Global exports of semiconductor devices grew by 8.7% in 2020, while electronic integrated circuits grew by 19.6%. However, despite the record high exports of semiconductor devices and electronic integrated circuits, especially in Asia and the Pacific, production was insufficient to meet demand. One hypothesis is that manufacturers failed to predict the impact of the pandemic on demand for their products. When the lockdowns were announced, car manufacturers anticipated the decrease in demand and cut production accordingly. Chip manufacturers then shifted their limited production of chips for vehicles to chips for computers and consumer electronics, as people began to work from home. This explains why the biggest-gaining exports in 2020 were computers and laptops ($28 billion increase in exports from 2019 to 2020), while the exports that lost the most were motor vehicles ($119 billion decrease in exports). The pandemic has also increased the demand for mechano-therapy appliances such as artificial respiration (Figure 2.10).

Figure 2.10: World's Top Gaining/Losing Exports that Use Semiconductor Chips, 2020 ($ billion)



HS = Harmonized System.

Notes: The top five commodities that "gained" the most are the products at HS 4-digit commodity code, which increased the most by level of export value out of 186 products that depend on semiconductor chips. The top losers, on the other hand, decreased the most in export value.

Source: ADB calculations using data from United Nations. Commodity Trade Database. https://comtrade.un.org (accessed December 2021).

With the progress of COVID-19 vaccination programs and lifting of lockdown measures, demand for automobiles began to rise slowly. However, even though the chip manufacturers were running at almost full capacity (Semiconductor Industry Association 2021b), car manufacturers found it difficult to purchase semiconductor chips. The production of chips usually takes 2–3 months and orders are usually made at least a year in advance (Jeong and Strumpf 2021). Some manufacturers also stockpiled chips, making chip shortages worse (Ludwikowski and Mjoberg 2021). As supply shortages of chips persist, car makers have experienced serious bottlenecks in rolling out production. This could have encouraged people to buy used cars, which seems to be the case in the US given that car production has declined while sales have increased. Demand for used cars eventually led to a sudden increase in used car prices in the US around May–June 2021.

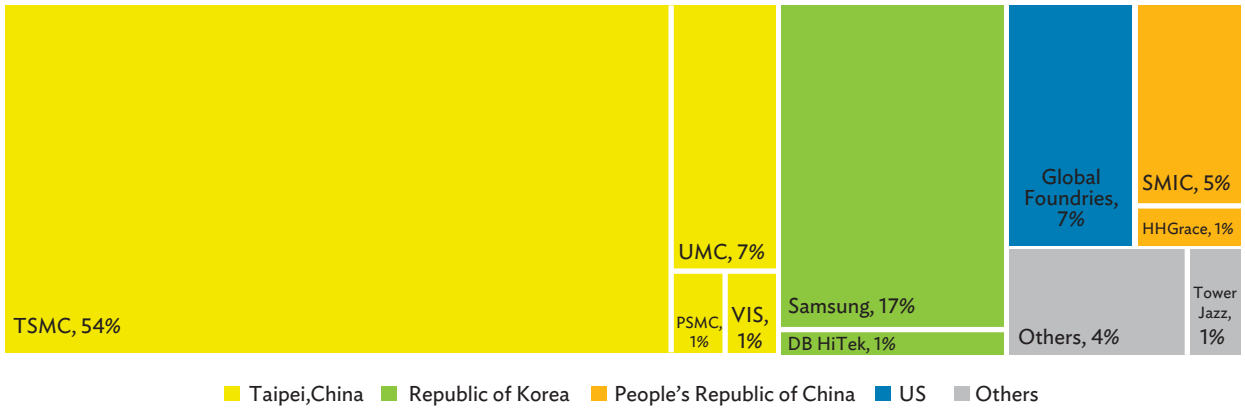
Expanding Semiconductor Production Capacity

It is estimated that globally the semiconductor industry needs $3 trillion of investments in research and development (R&D) and capital expenditure (CapEx) to double capacity by 2030. This is to keep up with the expected 4% to 5% average annual growth in semiconductor demand, according to the Semiconductor Industry Association (Varas et al. 2021). The cost of one lithography machine to produce chips ranges from $25 million to $100 million and it takes 12–15 months to install it, according to ASML Globalfoundries (*Wall Street Journal* 2021).

The huge investment on CapEx and R&D in the semiconductor industry creates a natural barrier to entry for the new firms. The top five fabless firms invested $68 billion in R&D between 2015 and 2019, or an average of $2.8 billion per firm per year, equivalent to 22% of their revenue.[11] Moreover, the CapEx of the top five foundries (or semiconductor fabrication plants) over those 5 years amounted to about $75 billion, or an average of $3 billion per firm per year, equivalent to more than 35% of their annual revenue. To compensate for costs, firms must produce at a large scale, creating supply chains with high geographic concentration. For example, in 2019, Taipei,China had 63% of the world's foundry market, with its biggest producer TSMC capturing a 54% global market share (Figure 2.11).

[11] Fabless firms design the hardware and semiconductor chips but do not manufacture the silicon wafers, or chips, used in their products; instead, they outsource the fabrication to a manufacturing plant or foundry.

Figure 2.11: Foundry Market Share Tree Map, 2020



DB = Dongbu, HHGrace = Shanghai Huahong Grace Semiconductor Manufacturing Corp, PSMC = Powerchip Semiconductor Manufacturing Corporation, SMIC = Semiconductor Manufacturing International Corporation, UMC = United Microelectronics Corporation, US = United States, VIS = Vanguard International Semiconductor Corporation.

Note: TSMC is a semiconductor manufacturing company based in Taipei,China,

Source: Kuo (2021).

Semiconductor Value Chain

Semiconductor chip production has a highly complex value chain with each stage requiring specialization that only certain economies can offer. This results in a high geographic concentration in each stage. The whole process can be divided into eight steps (for vertical specialization analysis of electronic products, see Box 2.2). The first five steps are mostly R&D intensive. These processes take up around 70% of the value chain. US firms contribute most in the first two stages: electronic design automation and core intellectual property. The next two stages—logic; discrete, analog, and optoelectronics and sensors; and memory—are done mostly by companies in East Asia. The fifth stage, manufacturing equipment, is done mostly by US companies (Figure 2.12).

The next two steps are relatively more CapEx intensive: materials and wafer fabrication. These take up 24% of the value chain and are done mostly by East Asian companies. The final step, of assembly, packaging, and testing, takes 6% of the value chain and is done mostly in the PRC and Taipei,China (Figure 2.12). Overall, the US contributes to 38% of the value chain while the four East Asia economies contribute 48%. About half of the manufactured chips were sold in the US and the PRC in 2019.

Risks and Vulnerabilities

Economies of scale have helped decrease the cost of production for semiconductor chips. However, this also causes the high geographic concentration of activities in the supply chain which makes the whole system vulnerable. Single points of failure, especially in East Asian economies, where 75% of global installed capacity is concentrated, could cause large-scale supply interruptions. Moreover, 100% of the global capacity for highly advanced chips is located in Taipei,China and the Republic of Korea.[12] Recent accidents and disasters triggered by natural hazards that have disrupted the semiconductor chip value chain include the following: (i) in December 2020, a power outage affected a memory fab in Taipei,China for just 1 hour, impacting 10% of global dynamic RAM supply; (ii) two fires at a package substrate plant in Taipei,China in October 2020 and February 2021 that affected the global capacity for assembly, packaging, and testing services; (iii) in early 2021, the polar vortex in Texas, US caused widespread power failures which hampered chip production (Williams 2021); and (iv) a fire in a Renesas fabrication plant in Japan in March 2021 exacerbated chip supply shortages, especially for the auto industry (*Yamamitsu* 2021).

[12] Highly advanced chips are logic chips with 7- and 5-nanometer nodes. These are required for computer-intensive devices such as data center or artificial intelligence servers, personal computers, and smartphones (Varas et al. 2021).

Box 2.2: Vertical Specialization in Electronic Products

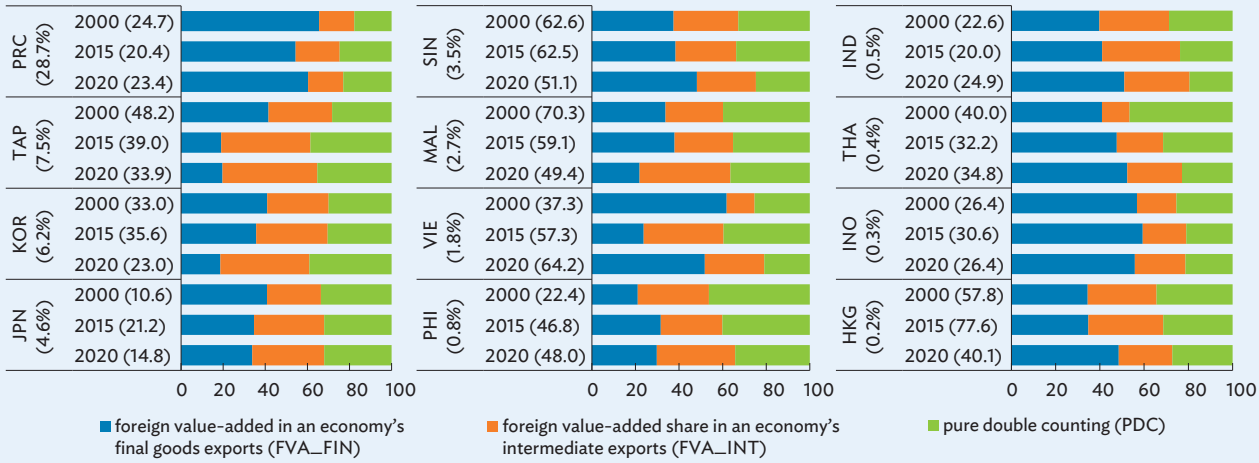
The Asian economy's potential as a hub in semiconductor supply chain can be assessed by looking at its vertical specialization (VS) in electrical products. VS is a summary statistic used to measure international production sharing (Hummels, Ishii, and Yi 2001; Wang, Wei, and Zhu 2013). Over the past 2 decades, several developing economies increased their VS share to gross exports in electrical and optical equipment sector:[a] Hong Kong, China; India; Indonesia; the Philippines; and Viet Nam. Meanwhile, some top exporters saw declining VS such as the People's Republic of China (PRC); the Republic of Korea; and Taipei,China. Their semiconductor exports fell because of increased reliance on domestically produced intermediate goods. Economies such as Malaysia and Thailand also saw declining VS (as described in the box figure).

One of the three components of VS is foreign value-added in an economy's final goods exports (FVA_FIN). The increasing share of FVA_FIN suggests an economy is participating more in final assembling activities based on imported components—the low end of the global value chain. Economies such as Hong Kong, China; India; Singapore; and Thailand saw an increasing share of FVA_FIN in their VS (see box figure).

The second component of VS is foreign value-added share in an economy's intermediate exports (FVA_INT). An increasing FVA_INT may imply the economy is upgrading industry to start producing intermediate goods for other economies, especially when more and more of these goods are exported to third economies for production of final goods. This is a sign that the economy is climbing up the global value chain production ladder in the sector. Top exporters in the sector such as Japan; the Republic of Korea; Taipei,China; and smaller exporters such as Indonesia, Malaysia, the Philippines, and Thailand saw increasing shares of FVA_INT in their VS.

The third component of VS is pure double counting (PDC) terms in an economy's exports. An increasing share of PDC in VS indicates that the economy is deepening its cross-economy production sharing, where intermediate goods cross national borders multiple times before being used in final goods production. Economies such as the PRC; the Republic of Korea; and Taipei,China saw increasing PDC shares in VS in the past 2 decades (as shown in the box figure).

Vertical Specialization of Selected Asia and Pacific Economies in Electrical and Optical Equipment (% share to vertical specialization)



HKG = Hong Kong, China; IND = India; INO = Indonesia; JPN = Japan; KOR = Republic of Korea; MAL = Malaysia; PHI = Philippines; PRC = People's Republic of China; SIN = Singapore; TAP =Taipei,China; THA = Thailand; VIE = Viet Nam.

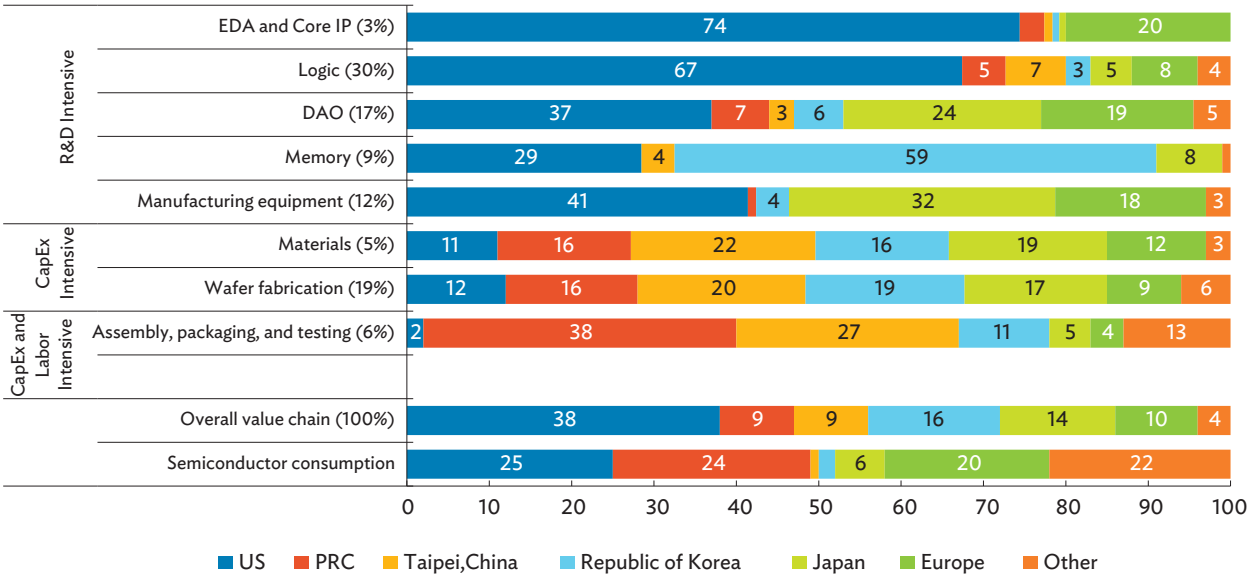
Notes: The economies chosen are the top 12 exporters in the electrical and optical equipment sector, of the 26 Asia and Pacific economies in the ADB Multi-Regional Input–Output Tables. Percentages next to the economies' three-letter codes are the share of the economy's gross export to global export of electrical and optical equipment in 2020. Values in parentheses beside the years are the share of vertical specialization to gross exports in the electrical and optical equipment sector.

Sources: ADB calculations using data from ADB. Multi-Regional Input–Output Tables; and methodology by Wang, Wei, and Zhu (2013, revised 2018).

[a] Among the 35 sectors in the ADB Multi-Regional Input–Output Tables, the electrical and optical equipment sector seems to be the most related to semiconductor industry.

Sources: ADB staff using ADB. Multi-Regional Input–Output Tables; Hummels, Ishii, and Yi (2001); and Wang, Wei, and Zhu (2013, revised 2018).

Figure 2.12: Regional Breakdown of Semiconductor Value Chain Production, 2019 *(%)*



CapEx = capital expenditure; DAO = discrete, analog, and optoelectronics and sensors; EDA = electronic design automation; IP = intellectual property; PRC = People's Republic of China; R&D = research and development; US = United States.

Notes: Regional breakdown on EDA, design, manufacturing equipment, and raw materials is based on company revenues and company headquarters location. Regional breakdown on wafer fabrication and assembly and testing is based on installed capacity and geographic location of the facilities.

Source: Varas et al. (2021).

Another risk for the semiconductor industry in the future is the shortage in skills and talent needed to sustain its highly technical activities. The industry has difficulty hiring workers since it needs graduates with a strong background in science, technology, engineering, and mathematics. In a 2017 survey of executives across different companies in the semiconductor supply chain, 77% believed the industry faced a critical talent shortage, while 14% expected a severe talent shortage in 2018–2020 (Richard, Ramachandran, and Pandoy 2017). In a 2018 survey, 64% of respondents named talent as one of the top threats to their firms' growth. The semiconductor firms also identified "talent development" among the top strategic priorities, next to "innovation" and "mergers and acquisitions" (Zanni et al. 2019). Moreover, in the next 10–15 years, the industry will have to cope with an aging workforce and the retirement of a significant number of employees in technical positions (Varas et al. 2021).

Policy Responses to Global Chip Shortages

Reshoring and self-sufficiency. Hypothetically, if all regions were to seek self-sufficiency, they would have to pay $900 billion to $1,225 billion in upfront investment and $45 billion to $125 billion in incremental recurrent annual operational costs. These could lead to a 35% to 65% increase in semiconductor prices and may result in higher prices of the electronic devices for end users (Varas et al. 2021). Complete self-sufficiency may not be feasible and is not an effective way to solve semiconductor shortages as it entails large-scale national industrial policies and huge costs.

Diversification. An alternative way to address the risk of major global supply disruptions is to achieve a more diversified geographic production of semiconductor products. The semiconductor industry could instead strengthen supply chain resilience by exploring potential economies that could be a part of or increase its participation in the value chain. Enactment of market-

driven incentive programs could expand production in these sites and diversify sources of supply for some critical materials in the industry.

Just-in-case inventory management. Instead of a just-in-time inventory management for semiconductor chips, firms can adapt a "just-in-case" inventory management to reduce the risk of supply shocks. Manufacturers can find a right balance between the cost savings brought by "just-in-time" and the reduction of risk by using "just-in-case" inventory management.

Investment in R&D. In parallel to diversification of the supply chain, policy makers need to step up efforts to stimulate R&D. Asia's talent potential for R&D has been increasing in the past years especially in terms of workers (Varas et al. 2021). To increase the potential for R&D, the relatively high rate of graduates in science and engineering in Asia and the Pacific should be accompanied by an environment that fosters innovation. Governments could craft policies to strengthen protection for intellectual property rights, encourage foreign investment in R&D, and support immigration policies that enable semiconductor hubs to attract talent.

Capital investment. To meet the demand in the next decade, production capacity needs to be increased significantly. However, the huge investment cost of building facilities for the semiconductor sector makes it challenging for firms to expand production. Moreover, this poses an immense barrier to entry for any entity or organization that wants to join the value chain. Policy makers can support the private sector's further investment through incentives within international norms.

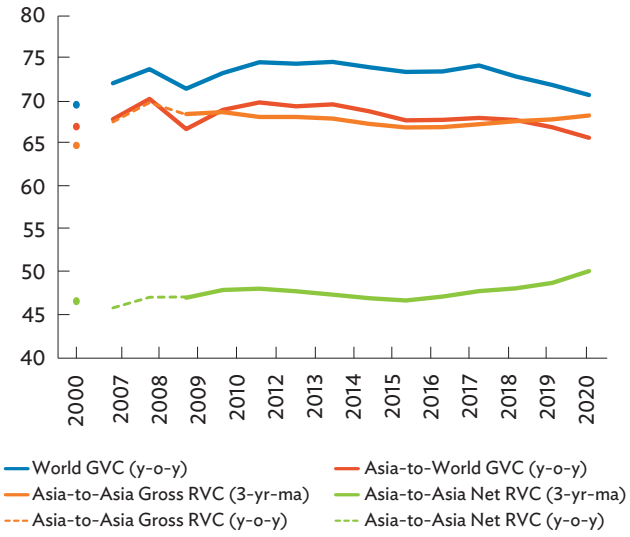
Education and training for engineers. To support the expansion of the sector and diversification of the supply chain, policy makers will have to explore policies that will encourage more graduates in disciplines such as electrical and mechanical engineering, computer science and software engineering, physics, materials science and chemical engineering, and industrial engineering. The government may also partner with academic institutions and private firms to create additional semiconductor-related graduate programs, as well as help fund specialized training for those who will be joining the workforce.

Progress of Global and Regional Value Chains

Asia's value chain linkage with the world shrank in 2020 in tandem with the world's global value chain linkages. Yet, its regional value chain linkages strengthened further during the pandemic.

Global value chain (GVC) expansion has been in gradual decline since 2018 amid growing uncertainties surrounding trade policy environment in many parts of the world and sluggish world demand (Figure 2.13). When the COVID-19 pandemic struck in 2020, the world economy slowed down with lockdowns, constrained mobility, and disrupted supply chains pulling down GVC participation further to 70.7%, lower than the 71.4% recorded in 2009 during the global financial crisis. Asia's GVC participation has also fallen over the same period, with Asia's value linkages with the world dipping to 65.7% in 2020.

Figure 2.13: GVC and RVC Participation Rates *(%)*



3-yr ma = 3-year moving average, GVC = global value chain, RVC = regional value chain, y-o-y = year-on-year.

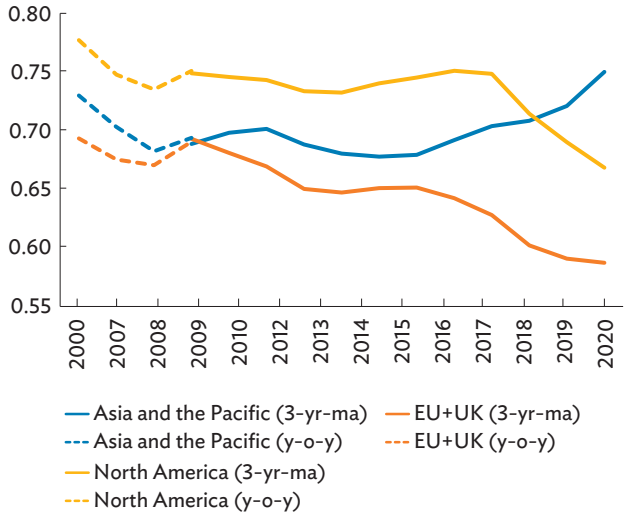
Notes: The GVC participation rate is the share of gross exports that involves production in at least two economies using cross-border production networks. The RVC participation rate, on the other hand, is the same as that of GVC, except that it only involves economies of the same region.

Sources: ADB calculations using data from ADB. Multi-Regional Input–Output Tables; and methodology by Wang, Wei, and Zhu (2013, revised 2018).

This recent trend for both world and Asian GVCs is characterized particularly by a decline in complex GVCs, wherein intermediate exports cross borders at least twice (Figure 2.14a).[13]

Asia-to-Asia value chain participation, on the other hand, proved resilient as was also manifested by a higher intraregional trade share in 2020. Overall regional value chain (RVC) participation (3-year moving average) of economies in the region increased marginally to 68.9% in 2020 (from 68.4% in 2019) while net participation rose from 50.5% in 2019 to 52.3% in 2020, its highest rate since 2000.[14] The continuing trend of deepening regional value chain seems to have been further strengthened during the pandemic. This is further characterized by rising participation in complex value chains and declining share of non-GVC exports and trading of single-border-crossing intermediate exports (Figure 2.14b).

Figure 2.15: RVC–GVC Intensity by Region



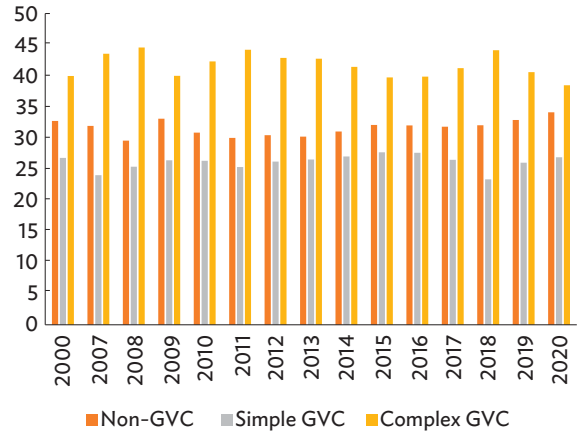
3-yr-ma = 3-year moving average, EU = European Union (27 members), GVC = global value chain, RVC = regional value chain, UK = United Kingdom, y-o-y = year-on-year.

Notes: RVC–GVC intensity is the ratio of RVC participation and GVC participation rates. North America consists of the United States, Canada, and Mexico.

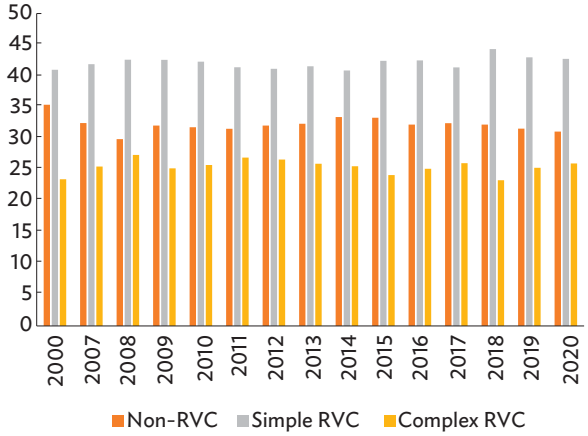
Sources: ADB calculations using data from ADB. Multi-Regional Input–Output Tables; and methodology by Wang, Wei, and Zhu (2013, revised 2018).

Figure 2.14: Asia's GVC and RVC Participation Rate *(%)*

(a) Asia-to-World GVC Participation Rate



(b) Asia-to-Asia Gross RVC Participation Rate



GVC = global value chain, RVC = regional value chain.

Notes: Gross RVC participation is the share of Asia's intraregional value chain exports to its intraregional gross exports, but excluding all non-Asian third economies in gross exports. Non-GVC refers to final goods exports. Simple GVCs are intermediate goods exports that cross borders only once or absorbed by the direct importer economy. Complex GVCs are intermediate exports that cross borders at least twice.

Sources: ADB calculations using data from ADB. Multi-Regional Input–Output Tables; and methodology by Wang, Wei, and Zhu (2013, revised 2018).

[13] Complex GVCs include domestic value-added (DVAs) that are reexported by the direct importer to other economies except to the source economy, foreign value-added, returning DVA, and pure double counting of intermediate exports (Annex 2b).

[14] Asia-to-Asia gross RVC is the ratio of Asia's intraregional value chains to its intraregional total gross exports, excluding non-Asian third economy partners. Asia-to-Asia net RVC is the same except that the denominator of total gross exports includes non-Asian third economy partners.

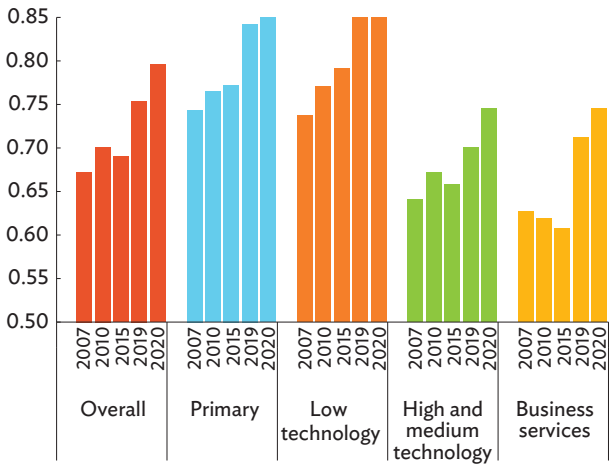
By 2018, Asia's intensity of participation in RVCs in relation to GVCs at 0.70 is already above those of the EU+UK at 0.65 and North America (Figure 2.15) at 0.56. All three regions saw declining RVC–GVC intensity in 2018, but those of the EU+UK and North America declined far more than in Asia and the Pacific. GVC participation has been on a downward trend for all three regions since 2018, while RVC participation fell more for the EU+UK and North America. This implies that the Asia and Pacific economies continue to strengthen value chain linkages within the region even during the pandemic.

Regional value chain linkages relative to global linkages in Asia and the Pacific further intensified for all major sectors, especially in high and medium technology and business services.

All sectors showed higher ratios of RVC participation to GVC participation in 2020 (Figure 2.16). This is partly due to the decline of integration to global production networks across all major sectors in 2020 except for the primary sector—comprising agriculture, mining, and quarrying. The biggest decline was exhibited by the low technology sector, which already has smallest participation rates in international production networks. Its integration with RVCs also slightly weakened in 2020, from 43.5% to 42.8%. Given this is still less than the fall in its GVC participation rate, the sector showed a slight rise in RVC–GVC intensity in 2020.

Integration in regional value chains, on the other hand, expanded across the three other sectors: primary, high–medium technology, business services.[15] The highest RVC expansion takes place in the high–medium technology sector, with intermediate exports trading comprising 51.1% of total gross regional exports in 2020 (from 48.8% in 2019). Combined with a declining GVC participation, the high–medium technology sector has the highest increase in RVC–GVC intensity. The business services sector also showed increasing RVC integration, from 50.7% in 2019 to 52.8% in 2020, while GVC participation slightly declined. The primary sector's participation in RVCs increased more than its GVC participation.

Figure 2.16: RVC–GVC Intensity, by Major Sector—Asia and the Pacific



GVC = global value chain, RVC = regional value chain.

Notes: RVC–GVC intensity is the ratio of RVC participation and GVC participation rates. Sectoral classification is based on ADB (2015). Business services includes personal and public services.

Sources: ADB calculations using data from ADB. Multi-Regional Input–Output Tables; and methodology by Wang, Wei, and Zhu (2013, revised 2018).

Nevertheless, economy-level progress shows persistent heterogeneity depending upon an economy's relative position in regional and global production networks.

Of the 26 Asia and Pacific economies with data in the ADB Multi-Regional Input–Output Tables, 7 economies managed to increase GVC participation in 2020 (Figure 2.17). Cambodia experienced the highest GVC participation increase from 56.0% in 2019 to 69.6% in 2020. Other economies with big increases were the Lao People's Democratic Republic (Lao PDR) (from 69.3% to 78.7%), Kazakhstan (from 83.4% to 87.3%), and Mongolia (from 79.8% to 83.6%). Australia and Malaysia, on the other hand, managed to maintain participation rates. Most of these economies are commodity-exporting economies, with GVC participation rates highest in the primary sector. Moreover, except for Malaysia, their primary sectors comprise the highest share in total GVC trade value. Box 2.3 presents the historical trend of economy level contributions to GVC and RVC.

[15] See Annex 2c for the sectors these major groups comprise. Business services in this analysis includes personal and public services.

Box 2.3: Evolution of Economy-Level Contributions to Global and Regional Value Chains

Charting the evolution of contributions of select economies to world global value chains (GVCs) and Asia-to-Asia regional value chains (RVCs) shows how much the value chain landscape has transformed over the past 2 decades.

World GVC

Box tables 1a and 1b show that the contribution of the People's Republic of China (PRC) to world GVC has more than tripled in the past 20 years while it declined over time for Japan and the United States, among others. India's contribution also more than doubled. Other economies such as the newly industrialized economy of the Republic of Korea and the European Union plus the United Kingdom maintained their status of contribution to the world GVC over the same period. To a lesser extent, the same trend is observed with contributions to complex GVC.

Between 2019 and 2020, the PRC, which has dealt early on with the COVID-19 pandemic during the initial waves significantly expanded its role in world GVC.

Asia-to-Asia RVC

Within Asia and the Pacific, the PRC's rise and Japan's decline in terms of contribution to the region's value chain linkages follow a mirror image. While the PRC's contribution nearly doubled, that of Japan was almost halved from 2000 to 2020 (box tables 2a and 2b). India's contribution to the region also doubled while that of Malaysia and Indonesia declined and the Republic of Korea maintained its position over the same period. A similar pattern is observed for complex RVC. The PRC's contribution to Asian RVC further increased in 2020.

1a: Contributions to World GVC (%)

Year	PRC	Japan	Republic of Korea	United States	European Union + UK[a]	Malaysia	Indonesia	Philippines	India
2000	4.7	10.2	4.6	21.2	35.0	3.2	1.7	0.6	1.4
2010	12.5	7.3	5.0	14.5	33.7	2.4	1.9	0.5	3.0
2015	14.9	6.0	5.9	15.5	33.5	2.0	1.7	0.6	2.5
2019	14.3	5.8	5.2	16.3	35.4	1.9	1.5	0.6	3.7
2020	16.6	5.6	5.3	15.6	35.4	1.9	1.5	0.6	3.6

1b: Contributions to World Complex GVC (%)

Year	PRC	Japan	Republic of Korea	United States	European Union + UK[a]	Malaysia	Indonesia	Philippines	India
2000	4.9	10.3	5.7	21.1	41.6	5.0	1.8	0.8	1.2
2010	13.1	7.4	6.4	13.3	41.2	3.5	1.9	0.6	2.7
2015	14.4	6.2	7.6	14.7	42.9	2.7	1.6	0.6	2.3
2019	12.4	5.3	5.9	15.0	45.2	2.3	1.3	0.7	2.9
2020	14.7	5.0	6.0	14.3	45.8	2.4	1.3	0.7	2.8

European Union = (27 members), GVC = global value chain, PRC = People's Republic of China, RVC = regional value chain, UK = United Kingdom.

[a] The UK withdrew from the EU on 1 February 2020, but during the transition period ending 31 December 2020, EU law remained applicable to and in the UK, with a few limited exceptions.

Note: Economy-level contributions are estimated by taking the difference of world GVC and Asian RVC between the world and a hypothetical world without that economy.

Sources: ADB calculations using data from ADB. Multi-Regional Input-Output Tables; and methodology by Wang, Wei, Zhu (2013, revised 2018).

continued on next page

Box 2.3: continued

2a: Contributions to Asia-to-Asia RVC (%)

Year	PRC	Japan	Republic of Korea	Malaysia	Indonesia	Philippines	India
2000	29.4	52.5	23.8	15.6	12.2	3.7	4.3
2010	48.7	37.1	22.7	5.6	11.8	3.1	9.6
2015	55.3	31.6	25.8	4.6	10.8	3.5	8.2
2019	56.0	26.8	22.0	10.2	10.1	3.5	10.5
2020	57.3	24.7	22.0	9.8	9.0	2.8	9.4

2b: Contributions to Asia-to-Asia Complex RVC (%)

Year	PRC	Japan	Republic of Korea	Malaysia	Indonesia	Philippines	India
2000	32.6	59.2	29.6	29.1	12.6	5.5	4.2
2010	59.0	43.8	33.0	8.9	12.3	4.5	9.4
2015	64.7	40.0	36.8	7.4	10.8	4.7	7.9
2019	63.1	33.1	28.9	16.6	11.1	5.5	10.8
2020	65.3	29.8	29.1	16.1	9.5	4.2	9.3

GVC = global value chain, PRC = People's Republic of China, RVC = regional value chain.

Note: Economy-level contributions are estimated by taking the difference of world GVC and Asian RVC between the world and a hypothetical world without that economy.

Sources: ADB calculations using data from ADB. Multi-Regional Input-Output Tables; and methodology by Wang, Wei, Zhu (2013, revised 2018).

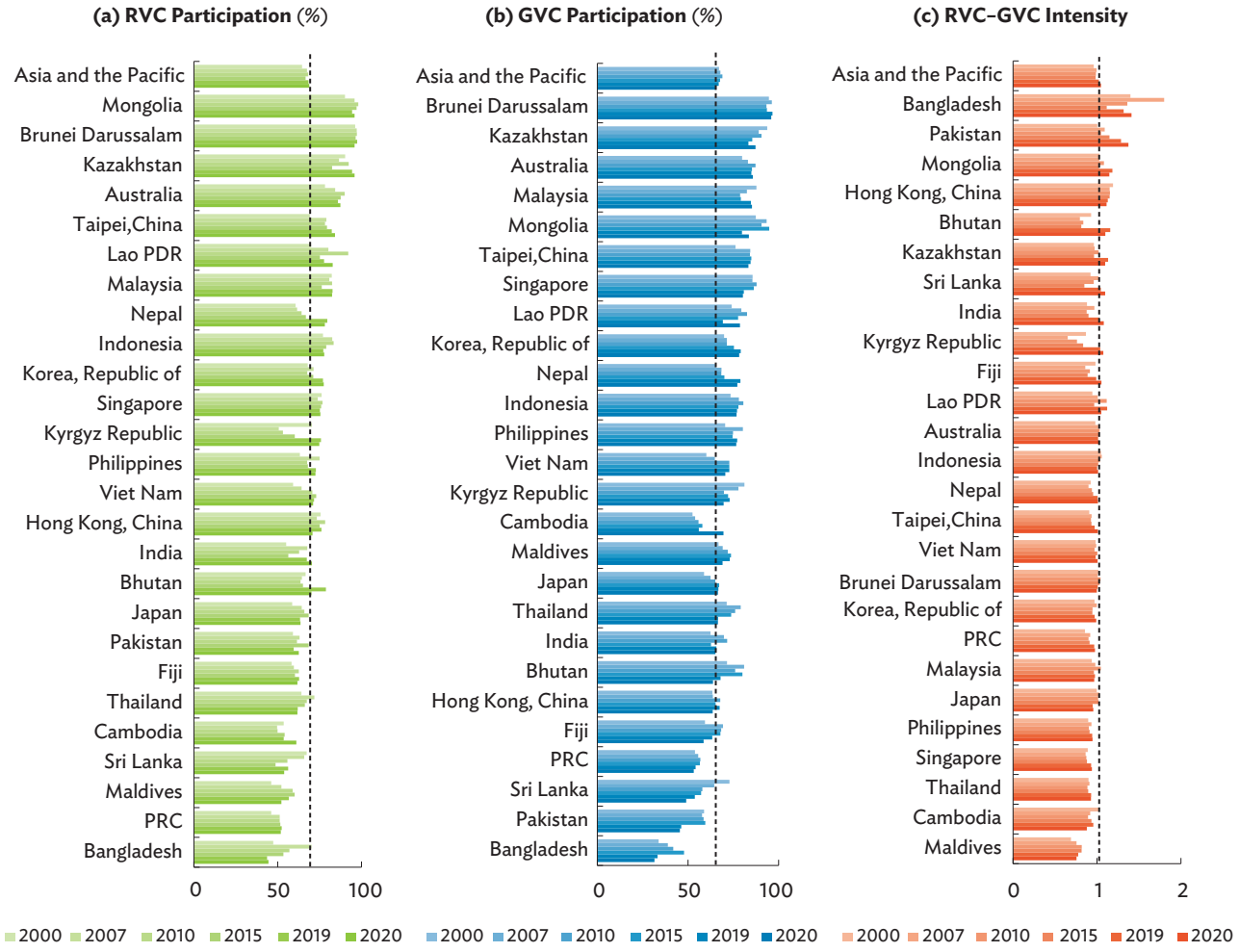
Source: ADB staff.

These same economies also deepened their gross RVC linkages with the region during the pandemic crisis, except for Malaysia: Australia increased gross RVC participation from 89% in 2019 to 87.4% in 2020, Cambodia from 53.6% to 61.1%, Kazakhstan from 94.4% to 95.8%, the Lao PDR from 77.6% to 82.8%, and Mongolia from 94.4% to 95.9%. Other economies that deepened gross RVCs in 2020 are Bangladesh, India, and Pakistan from South Asia; Indonesia from Southeast Asia; and all East Asian economies except Hong Kong, China and the PRC (i.e., Indonesia; Japan; the Republic of Korea; Singapore; and Taipei,China). Net RVC participation, on the other hand, grew in 20 of the 26 Asian economies. Only Bhutan; Hong Kong, China; Maldives; Nepal; the Philippines; and Sri Lanka saw net RVC decline from 2019 to 2020.

Complex regional and global value chains for the region show a different picture. Overall, East Asia and Southeast Asia comprising many manufacturing powerhouses demonstrate relatively higher regional and global value chain linakges. Participation of Asian economies in multi-border trading of intermediate goods declined from 47.2% in 2019 to 39.3% in 2020 (Figure 2.18). Among the 26 Asia and Pacific economies, only Cambodia and Malaysia expanded complex GVCs between 2019 and 2020.

Nevertheless, the region strengthened regional linkages for trading complex RVCs wherein participation in gross complex RVC in the regions increased from 25.3% in 2019 to 26.0% in 2019 while participation in net complex RVC increased from 18.7% to 19.8% over the same period.

Figure 2.17: Overall RVC and GVC Participation—Selected Asia and Pacific Economies



GVC = global value chain, Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China, RVC = regional value chain.

Notes: RVC–GVC intensity is the ratio of RVC participation and GVC participation rates. The overall GVC participation rate is the share of gross exports that involves production in at least two economies using cross-border production networks. The overall RVC participation rate is the same concept as that of GVC, except that it only involves economies of the same region. Economies are ordered by 2020 values from highest to lowest. The vertical dotted line represents the value for Asia and the Pacific for 2020.

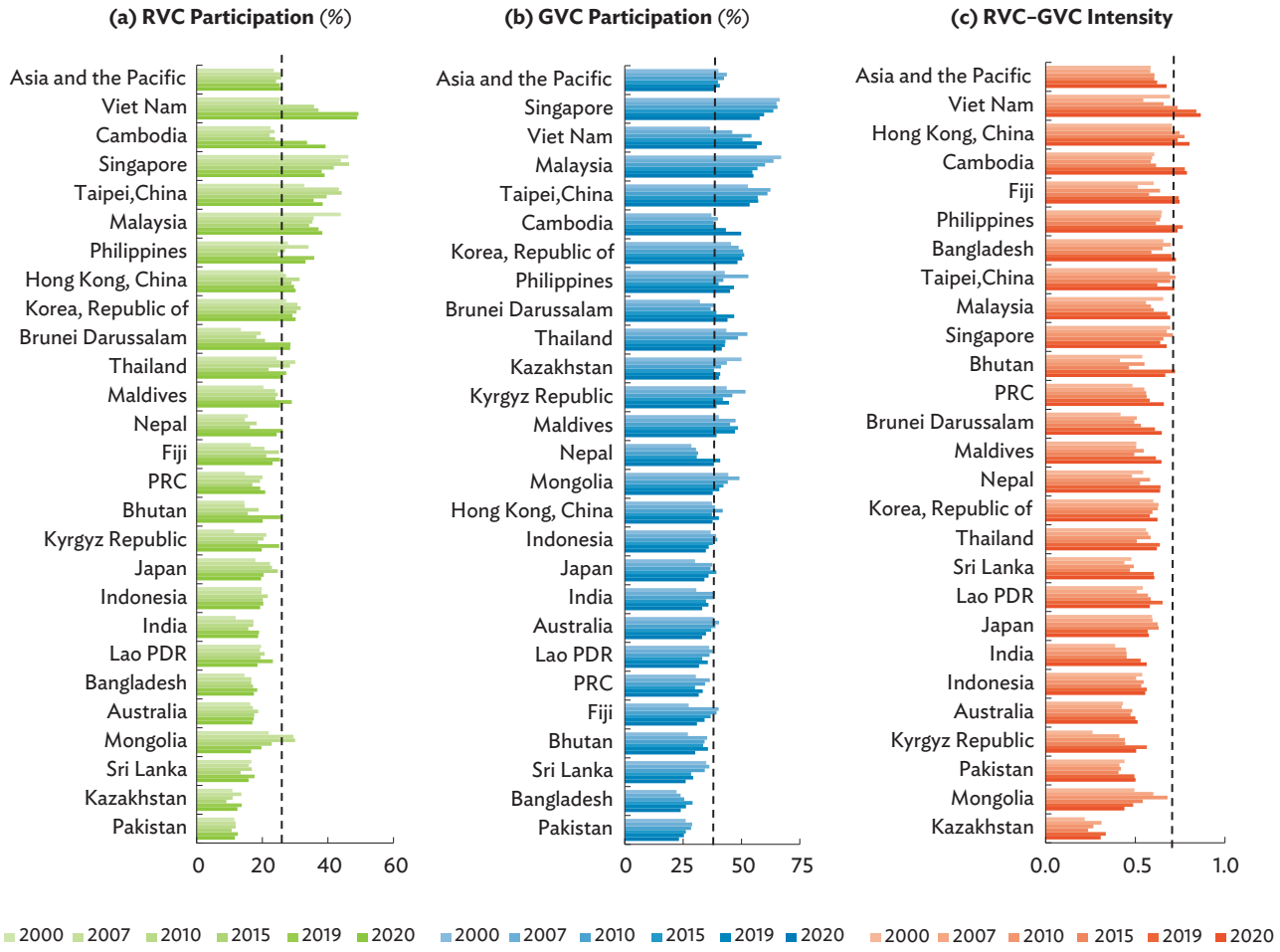
Sources: ADB calculations using data from ADB. Multi-Regional Input–Output Tables; and methodology by Wang, Wei, and Zhu (2013, revised 2018).

Asia's Free Trade Agreement Policy

Interregional Asian free trade agreements (FTAs) are driving trade liberalization and will shape trade patterns in a post-COVID-19 world.

The UK led the formation of 37 FTAs after leaving the EU on 1 January 2021. Five involved Asian economies: Georgia, Japan, the Republic of Korea, Singapore, and Viet Nam. The proliferation of UK FTAs since Brexit has led to the unusually low share of Asian FTAs in the world's FTAs (Figure 2.21). All Asian FTAs that have entered into force in 2021 are interregional: (1) Georgia–UK; (2) Japan–UK (January 2021); (3) Republic of Korea–UK; (4) Singapore–UK (January 2021); (5) Viet Nam–UK (January 2021); (6) PRC–Mauritius (January 2021); (7) Azerbaijan–Turkey Preferential Trade Agreement (March 2021); (8) India–Mauritius FTA (April 2021); (9)

Figure 2.18: Complex RVC and GVC Participation—Selected Asia and Pacific Economies



GVC = global value chain, Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China, RVC = regional value chain.

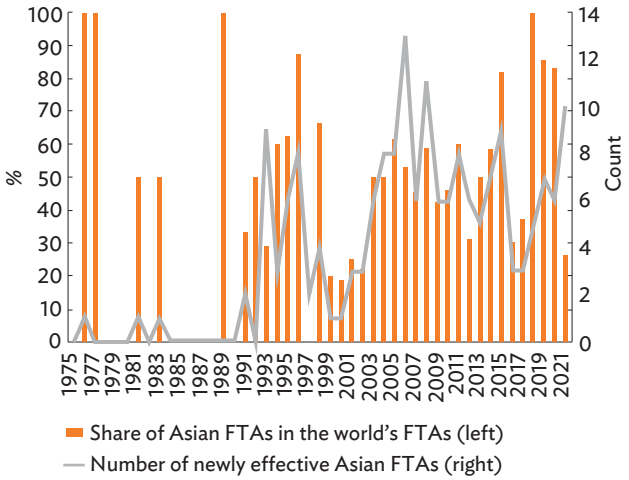
Notes: RVC–GVC intensity is the ratio of RVC participation and GVC participation rates. The complex GVC participation rate is the share of gross exports that involves production in at least two economies using cross-border production networks. The overall RVC participation rate, on the other hand, is the same concept as GVC, except that it only involves economies of the same. Both complex GVC and RVC participation includes only part of the gross exports for which the production entails border-crossing twice or more. Economies are ordered by 2020 values from highest to lowest. The vertical dotted line represents the value for Asia and the Pacific for 2020.

Sources: ADB calculation using data from ADB. Multi-Regional Input–Output Tables; and methodology by Wang, Wei, and Zhu (2013, revised 2018).

Eurasian Economic Union–Serbia (July 2021); and (10) Indonesia–European Free Trade Association (November 2021). In December 2020, the Australia–Singapore Digital Economy Agreement entered into force, marking a major advance in digital trade cooperation (more details are provided in Chapter 7: Theme Chapter—Advancing Digital Services Trade in Asia and the Pacific). The Regional Comprehensive Economic Partnership (RCEP) and the Cambodia–PRC FTA entered into force most recently on 1 January 2022.

Meanwhile, four FTAs were recently signed. Three of them are intraregional: (1) Bangladesh–Bhutan Preferential Trade Agreement (December 2020); (2) Indonesia–Republic of Korea FTA (December 2020); and (3) Cambodia–Republic of Korea FTA (October 2021). The Republic of Korea–Israel FTA was signed in May 2021. FTA negotiations between Australia and the UK were concluded on 15 June 2021, and between the Philippines and the Republic of Korea on 26 October 2021 (Table 2.1). The UK formally applied for membership of the Comprehensive and Progressive

Figure 2.19: Newly Effective Free Trade Agreements—Asia and the Pacific



FTA = free trade agreement.

Sources: ADB calculations using data from ADB. Asia Regional Integration Center. FTA Database. https://aric.adb.org/fta; and World Trade Organization. Regional Trade Agreement Information System. http://rtais.wto.org (both accessed December 2021).

Agreement for Trans-Pacific Partnership (CPTPP) on 1 February 2021. Figure 2.19 shows the total number of FTAs in the region.

Preference erosion resulting from graduation and the proliferation of new FTAs pose new trade policy challenges for developing Asia.

The quest for increased market access is generating layers of bilateral FTAs that overlap with mega regionals such as the RCEP and CPTPP, and plurilateral FTAs such ASEAN+1. Mega regionals can potentially contribute to reduce the complexity of the "spaghetti bowl" of overlapping FTAs that has progressively grown in Asia and the Pacific over the past few decades. However, this potential is conditional on (i) the additional market access provided by new agreements over the existing ones; (ii) their effective implementation; and (iii) their degree of utilization by the private sector.

Table 2.1: Recent Regional Trade Agreements in Asia and the Pacific

Name	Coverage	Type	Status (Date)
	Intraregional		
RCEP	Goods and services	FTA	In force (1 January 2022)
Cambodia–PRC	Goods and services	FTA	In force (1 January 2022)
Cambodia–Republic of Korea	Goods and services	FTA	Signed (26 October 2021)
Indonesia–Republic of Korea	Goods and services	FTA	Signed (18 December 2020)
Bangladesh–Bhutan	Goods	PTA	Signed (6 December 2020)
Philippines–Republic of Korea	Goods and services[a]	FTA	Concluded (26 October 2021)
	Interregional		
Indonesia–EFTA States	Goods and services	FTA	In force (1 November 2021)
EAEU–Serbia	Goods	FTA	In force (10 July 2021)
India–Mauritius	Goods and services	FTA and EIA	In force (1 April 2021)
Azerbaijan–Turkey	Goods	PTA	In force (1 March 2021)
PRC–Mauritius	Goods and services	FTA and EIA	In force (1 January 2021)
Georgia–UK	Goods and services	FTA and EIA	In force (1 January 2021)
Japan–UK	Goods and services	FTA and EIA	In force (1 January 2021)
Republic of Korea–UK	Goods and services	FTA and EIA	In force (1 January 2021)
Singapore–UK	Goods and services	FTA and EIA	In force (1 January 2021)
Viet Nam–UK	Goods and services	FTA and EIA	In force (1 January 2021)
Australia–Singapore	Digital trade	DEA	In force (8 December 2020)
Republic of Korea–Israel	Goods and services	FTA	Signed (13 May 2021)
Australia–UK	Goods and services	FTA	Concluded (15 June 2021)

DEA = digital economy agreement; EAEU = Eurasian Economic Union; EIA = economic integration agreement; EFTA States = European Free Trade Association which includes Iceland, Liechtenstein, Norway, and Switzerland; FTA = free trade agreement; PRC = People's Republic of China; PTA = preferential trade agreement; RCEP = Regional Comprehensive Economic Partnership; UK = United Kingdom.

[a]Trade in services and investment provisions to be further negotiated no later than 1 year after the deal enters into force.

Source: ADB compilation based on information available as of 14 December 2021.

Least developed economies in Asia and the Pacific, such as Bangladesh, Cambodia, and Nepal, that have been relying on unilateral trade preferences such as Everything but Arms or other Duty-Free Quota-Free programs, are progressively exposed to preference erosion. This erosion stems not only from future graduation from least developed economy status,[16] but also from the progressive entering into force of bilateral FTAs with large trading partners such as the EU, and other preference-granting economies that are parties to FTAs in the region. While least developed economies are particularly vulnerable to preference erosion, the phenomenon also potentially concerns any developing economy.

A multiple track strategy is emerging in the region where different FTAs are entered into involving the same partners. As an example, Viet Nam has four FTAs with Japan: ASEAN–Japan, Viet Nam–Japan, CPTPP, and lately RCEP. The majority of FTAs in Asia and the Pacific lack provisions to build on the trade liberalization achieved in previous FTAs among partners. As a result, estimating the additional market access gain from each FTA remains challenging for businesses.

Evaluating the value of incremental trade liberalization with overlapping FTAs requires a detailed analysis of how firms make use of FTAs that are available at the time of exportation to a partner in the region. Such analysis with support and participation by the private sector could guide policy makers in formulating future FTA policies in an informed manner.

Way Forward for RCEP Implementation of Market Access Provisions

RCEP entered into force on 1 January 2022.[17] It represents the most ambitious application of regional cooperation and integration in Asia and the Pacific.[18] Like the CPTPP, RCEP is expected to strengthen the rules-based trading system, improve confidence in markets in Asia and the Pacific and support a more vibrant trade and investment environment in the region. Both agreements have potential to strengthen the region's manufacturing supply chains, raise productivity, and increase wages and employment. The resulting world income gains are estimated to be $188 billion for CPTPP and $263 billion for RCEP (Park, Petri, and Plummer 2021). While the degree of liberalization within RCEP may not be as deep as in CPTPP, and the coverage is less comprehensive, RCEP contains a built-in work plan to deepen its provisions and expand its coverage in the future. Therefore, RCEP policy makers and economic operators will have to work further on implementation to unlock the agreement's potential to create value beyond the network of existing FTAs in Asia and the Pacific. The next subsections examine the key market access provisions of RCEP: tariff reductions and rules of origin.

[16] Bhutan is expected to graduate in 2023 and Solomon Islands in 2024. Bangladesh, the Lao PDR, and Nepal are scheduled to graduate in November 2026. Kiribati is recommended for graduation by the Committee for Development Policies (CDP) but the decision by the United Nations Economic and Social Council has been deferred to 2024. Cambodia is pre-eligible since 2021 and its full eligibility needs to be confirmed in 2024.

[17] The 10 signatory states that have deposited their instruments of ratification, acceptance, or approval are Australia, Brunei Darussalam, Cambodia, Japan, the Lao PDR, New Zealand, the PRC, Singapore, Thailand, and Viet Nam. In the Republic of Korea, the RCEP agreement enters into force on 1 February 2022 (Government of Japan, Ministry of Economy, Trade and Industry 2021a, 2021b).

[18] ASEAN plus Australia, the PRC, Japan, the Republic of Korea, and New Zealand. Kang et al. (2020) provides an overview of the RCEP agreement and its economic impact.

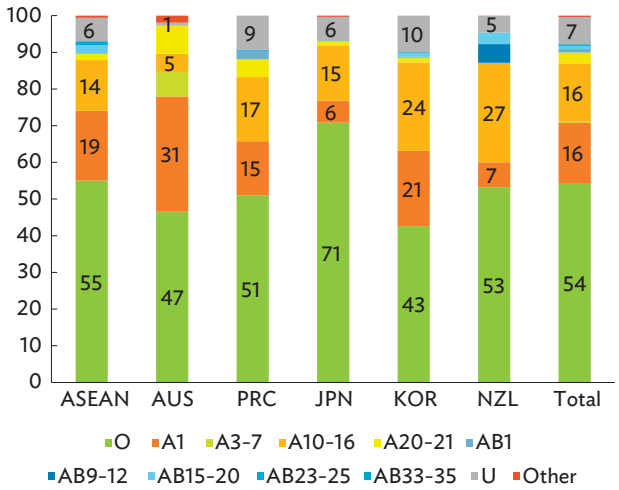
Tariff Reductions: An Initial Assessment

Given the complex network of FTAs in the region, the major challenge of RCEP is to live up to expectations that the agreement will bring improvements in practice, creating impetus for trade liberalization through the most classical form of tariff reductions and streamlined rules of origin. Significant benefits are indeed expected. RCEP has potential to provide not only more market access than existing FTAs but also to create a preferential platform for economies that were not previously engaged in FTAs with each other (e.g., the PRC and Japan). The preliminary analysis of the tariff structure (38 tariff offers) and the phase-out periods (in some cases over 20 years) nevertheless provides sobering expectations (Crivelli and Inama 2022).

The absence of a most-favored nation (MFN) provision for the inclusion of previous tariff liberalizations existing in other FTAs indicates that RCEP will coexist with the ASEAN Trade in Goods Agreement (ATIGA), ASEAN+1 FTAs, and other bilateral FTAs. In addition, many RCEP economies have presented differentiated offers. Some ASEAN economies have made differentiated offers toward other ASEAN members while tariffs have been almost totally eliminated under ATIGA.[19] This tariff structure brings another layer of complexity in implementing the tariff reduction with the introduction of tariff differentials and related provisions.

Most of RCEP intraregional imports (54%) are already MFN-free, ranging between 43% for the Republic of Korea and 71% for Japan (Figure 2.20). Some tariff lines are excluded from the tariff offers, representing about 7% of intraregional imports with a maximum of 10% in the case of the Republic of Korea. Finally, out of the remaining 39% of intraregional imports expected to be liberalized under RCEP, 16% will be fully liberalized in year 1, 16% between 10 and 16 years after entry into force, and 3% only in year 20 or 21. Excluding duty-free tariff lines and focusing exclusively on the trade that could be liberalized though RCEP, (i.e., excluding duty-free tariff lines [category O]), Figure 2.21 shows that 61% of intraregional trade could be fully liberalized after 10 years, 77% after 15 years, and 89% after 20 years. Such long phasing-out periods for many tariff lines and the complete exclusion from tariff liberalization for others, could cast doubt over the real value of such offers in terms of competitive market access.

Figure 2.20: RCEP Intraregional Import Shares by Tariff Phasing Down Type and Economy Group, 2019 *(%)*



ASEAN = Association of Southeast Asian Nations, AUS = Australia, JPN = Japan, KOR = Republic of Korea, NZL = New Zealand, PRC = People's Republic of China, RCEP = Regional Comprehensive Economic Partnership.

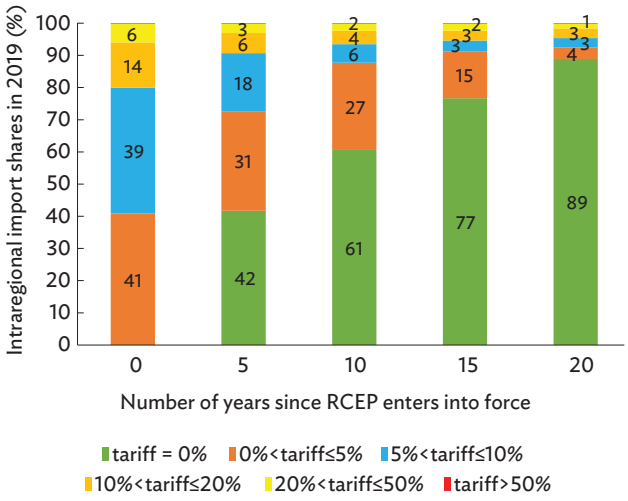
O = non-dutiable goods; A*X* = ad-valorem tariff to be (gradually) reduced to zero in year *X* after entry into force; AB*X* = ad-valorem tariff to be (gradually) reduced to a lower but positive tariff in year *X* after entry into force; U = excluded from any tariff reduction or elimination.

Source: Crivelli and Inama (2022) based on official RCEP tariff commitments and United Nations. Commodity Trade Database. https://comtrade.un.org (accessed October 2021).

In addition, as shown in Figure 2.22, most of the excluded tariff lines had an initial MFN tariff (base rate) exceeding 10% and after the entry into force (excluding group A1), the next significant portion of liberalization (27% of tariff lines on average) will take place between 9 and 15 years after entry into force.

[19] Through ATIGA, Brunei Darussalam, Indonesia, Malaysia, the Philippines, Singapore, and Thailand have eliminated intra-ASEAN import duties on 99.65% of their tariff lines. Other ASEAN economies have reduced their import duties to 0%–5% on 98.86% of their tariff lines.

Figure 2.21: RCEP Intraregional Import Shares in 2019 and RCEP Tariff Phasing Down Over Years



HS = harmonized system, RCEP = Regional Comprehensive Economic Partnership.

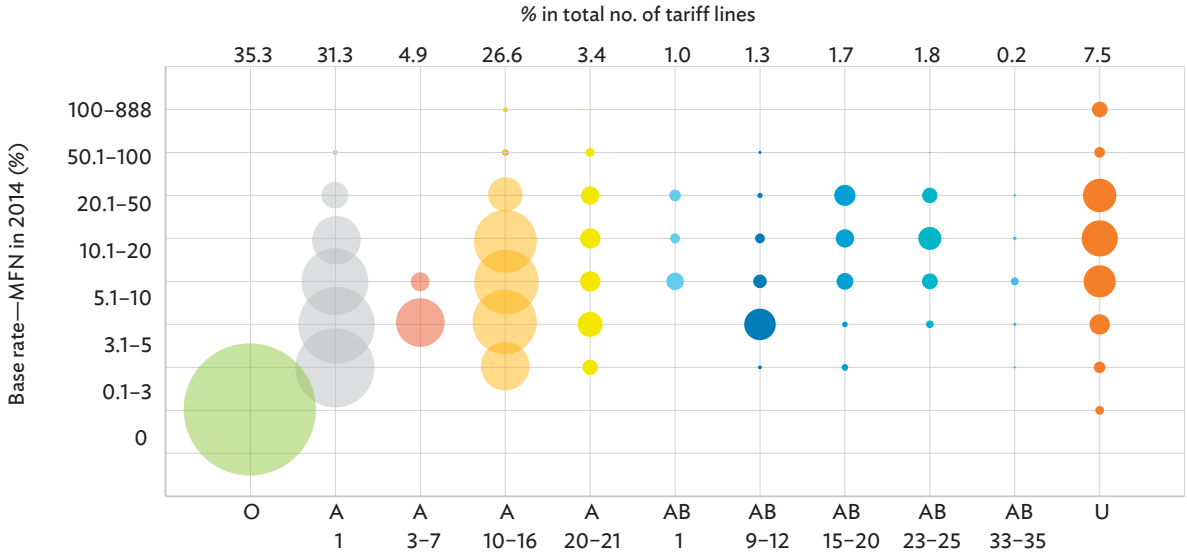
Notes: Tariff lines with a base rate of 0% and tariff lines subject to non-ad-valorem duties are excluded from total imports. Import at the national tariff line level is computed by using the share of tariff line in each HS6 category as a proxy for the proportion of trade of each tariff line within each HS6 category. The HS is an international nomenclature for the classification of products subdivided in chapters at 2-digits level (HS2), headings at 4-digits level (HS4), and subheadings at 6-digits level (HS6).

Source: Crivelli and Inama (2022) based on official RCEP tariff commitments and United Nations. Commodity Trade Database. https://comtrade.un.org (accessed October 2021).

Product-Specific Rules of Origin: A Game Changer?

RCEP has been welcomed as a game changer for Rules of Origin (ROO) thanks to (i) the possibility to cumulate inputs within the whole RCEP region to qualify as an RCEP-originating product, and (ii) bringing under a single FTA the thousands of product-specific rules of origin (PSROs) scattered in many ASEAN FTAs. Initial research points to several issues that temper these expectations (Crivelli and Inama 2021, 2022). A rational profit-maximizing firm uses the available FTA that provides the best combination of tariff offer and ROO advantages. Hence, if the preferential margin is better under a competing FTA with a favorable ROO, the firm might have no incentive to use RCEP and its cumulation provisions. Furthermore, the kind of cumulation provided under RCEP is limited to cumulation of inputs originating in other RCEP economies (diagonal cumulation) but not to working or processing carried out in other RCEP economies and subject to tariff differentials.

Figure 2.22: RCEP Initial MFN Base Rate and Tariff Reduction (% of tariff lines by phasing down type)



MFN = most-favored nation, RCEP = Regional Comprehensive Economic Partnership.

O = non-dutiable goods, A*X* = ad-valorem tariff to be gradually reduced to zero in year *X* after entry into force, AB*X* = ad-valorem tariff to be gradually reduced to a lower but positive tariff in the year(s) *X* after entry into force, U = goods excluded from any tariff reduction or elimination.

Note: The size of each bubble represents the average proportion of the number of national tariff lines within tariff group in the total number of national tariff lines.

Source: Crivelli and Inama (2022) based on official RCEP tariff commitments and United Nations. Commodity Trade Database. https://comtrade.un.org (both accessed October 2021).

In simple words, a product manufactured in Cambodia using inputs from the PRC and exported to the Republic of Korea may be considered as originating from the PRC instead of Cambodia with the consequent application of a less generous tariff schedule unless the provisions for tariff differentials are met. In addition, the RCEP text on administration of the proof of origin (the so-called Certificate of Origin, or CO) does not provide for self-certification but relies, albeit with some flexibility, on the use of COs stamped with the official seals and signatures of the certifying authorities.[20] Finally, as mentioned earlier in this chapter, the new bilateral FTA between Cambodia and the PRC completed in 2021 may also offer competitive preferential margins and lenient PSRO.

Crivelli, Inama, and Pearson (forthcoming) conduct a comparison of the product-specific rules of origin contained in RCEP (Figure 2.23a), ATIGA (Figure 2.23b), and CPTPP (Figure 2.23c), showing the concentration of PSRO by chapters of the Harmonized System (HS) tariff nomenclature and form of PSRO most used in each FTA. Comparison of figures for RCEP and ATIGA show a high similarity on the use of the standard ASEAN PSRO: regional value content of 40% of the free-on-board price or change of tariff heading for many HS chapters.[21] The similarity extends to the wide use of the more liberal PSRO (change of tariff subheading or RVC) in chapters 84 and 85 (machinery and electrical). RCEP makes more use than ATIGA of different forms of PSROs such as change of tariff chapter or RVC that feature in modern FTAs.

The striking difference between ATIGA and RCEP on the one hand and CPTPP on the other is the marked diffusion in CPTPP of different forms of PSROs that are widely used and spread among HS chapters, as depicted in Figure 2.25c. The concentration of change of tariff subheading is noted in organic chemicals (HS Chapter 29) and product of machinery (HS Chapter 84), mirroring to a lesser extent the concentration noted in RCEP.

In terms of restrictiveness, Crivelli, Inama, and Pearson (forthcoming) developed a new methodology and a codification ranking from 1 to 3 (1 = least restrictive, 3 = most restrictive) for PSROs in ATIGA, RCEP, and CPTPP, which shows that ATIGA stands out, with 3,321 least restrictive PSROs (Table 2.2).[22] Most importantly, CPTPP records 2,706 PSROs codified as least restrictive, which ranks better than RCEP (1,774 PSROs).

Leaving category 1 aside, RCEP appears to rank better under the second less restrictive PSRO ("intermediate" category), with 3,292 PSROs, while CPTPP has the higher number of most restrictive PSROs (at 1,111). However, many of the restrictive PSROs of CPTPP are essentially applicable in the textile and garment sector, which accounts for only 5% of intraregional RCEP trade. These initial results from the comparative analysis and coding need to be linked to volume of trade flows, preferential margins, and the RCEP tariff phasing down.

Table 2.2: Comparison of Restrictiveness of Product-Specific Rules of Origin

	Free Trade Agreement		
Restrictiveness Code	**ATIGA**	**RCEP**	**CPTPP**
1: Least restrictive	3,321	1,774	2,706
2: Intermediate	1,807	3,292	1,386
3: Most restrictive	75	137	1,111

ATIGA = ASEAN Trade in Goods Agreement, CPTPP = Comprehensive and Progressive Agreement for Trans-Pacific Partnership, RCEP = Regional Comprehensive Economic Partnership.

Source: Crivelli, Inama, and Pearson (forthcoming).

[20] Some member states have introduced an approved exporters system, and a built-in agenda is contained in Article 3.16, para. 4.

[21] The free-on-board price includes the cost of delivering the goods to the nearest port.

[22] FTAs can have the same number on the same HS6 line if the rule is of the same stringency, and so the totals for 1, 2, and 3 will not add up to the total number of PSROs. This is expected.

Figure 2.23: Product-Specific Rules of Origin by Harmonized System Chapter and Form of PSRO

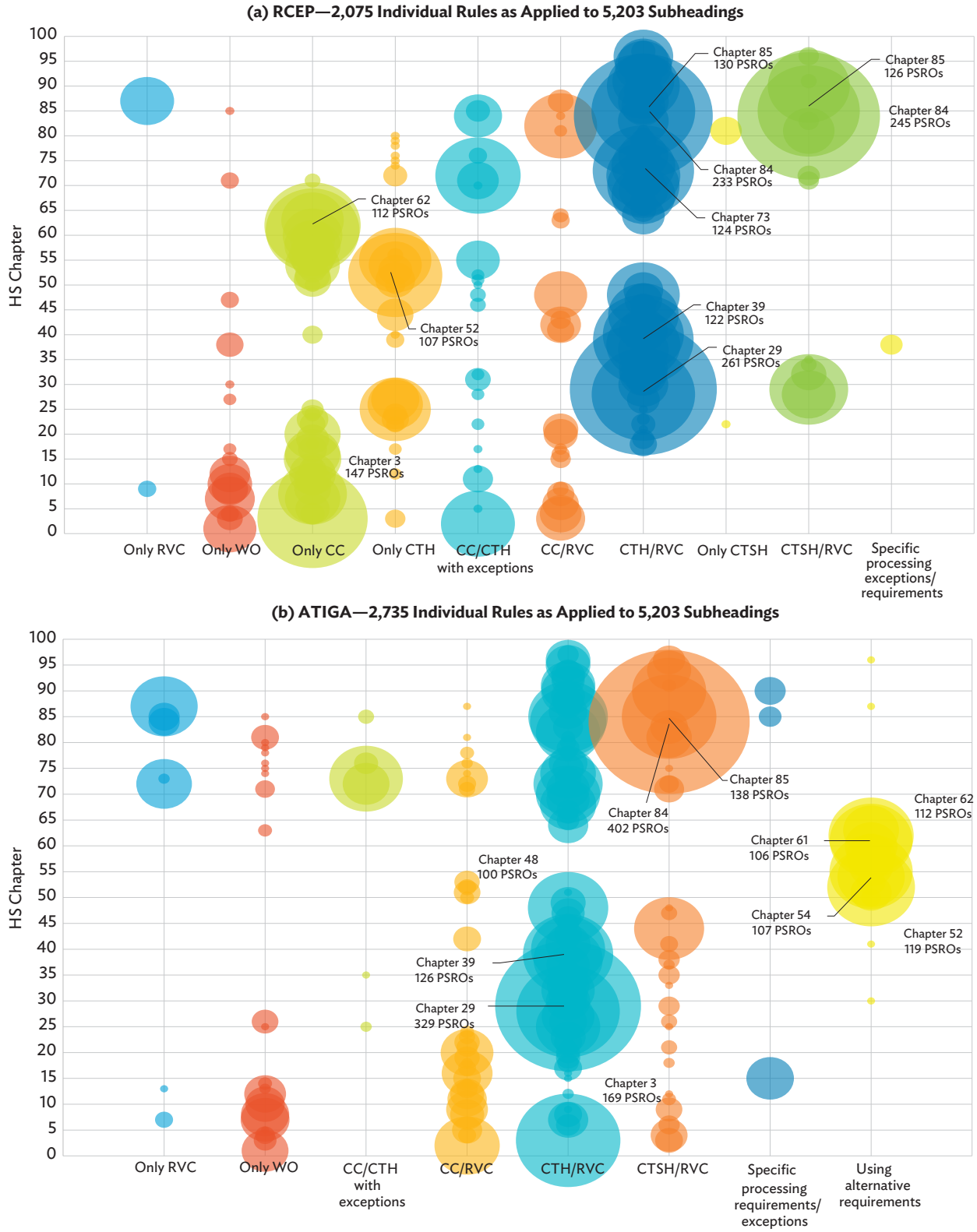


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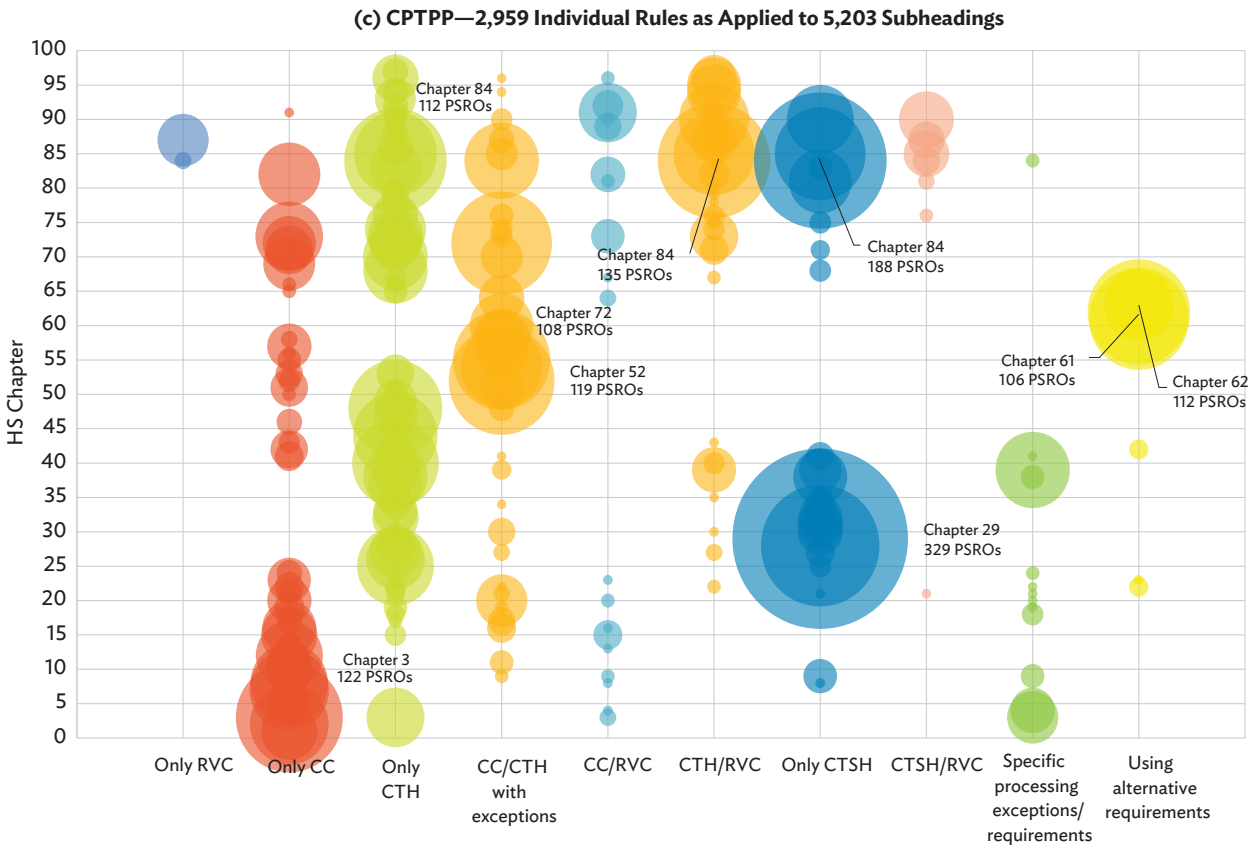
Figure 2.23: continued



ATIGA = ASEAN Trade in Goods Agreement, CC = change of tariff chapter, CPTPP = Comprehensive and Progressive Agreement for Trans-Pacific Partnership, CTH = change of tariff heading, CTSH = change of tariff subheading, HS = Harmonized System, PSRO = product-specific rule of origin, RCEP = Regional Comprehensive Economic Partnership, RVC = regional value content, WO = wholly obtained.

Note: A total of 5,203 HS subheadings are included in the analysis.

Source: Crivelli, Inama, and Pearson (forthcoming).

The most interesting result from a policy agenda perspective is that the three FTAs have shown decisive scope for convergence and simplification of PSROs. Out of 5,203 PSROs comparatively analyzed among RCEP, CPTPP, and ATIGA, 769 PSROs are identical across the three FTAs and 2,340 have shown partial convergence, meaning that two FTAs have similar or identical PSROs while one FTA has a divergent PSRO. This brings the total of convergent PSROs showing great potential for simplification to 3,109.

RCEP can deepen integration by leveraging the built-in agenda on market access. RCEP has adopted a built-in agenda that accords with an ASEAN style of regional governance often defined the *ASEAN Way* of achieving integration by consensus. In order to effectively create a common umbrella that extends above the panoply of proliferating FTAs, policy makers need to quickly activate the built-in agenda so as to leverage the provisions of RCEP.

With regard to tariffs, government and development partners would benefit from further analysis to clearly identify areas and sectors where further negotiations are needed to make RCEP more competitive than the network of existing FTAs. These studies could trigger policy makers and negotiators to consider activating RCEP Article 2.5 on the acceleration of tariff commitments and the sectoral initiatives in Article 2.21 to achieve greater and faster tariff liberalization.[23]

[23] Article 2.5 of the RCEP Agreement provides for the improvement of tariff commitments set out in Annex I, either unilaterally or mutually agreed between two or more parties. Under Article 2.21, the "parties may decide to initiate a work programme on sector-specific issues" (ASEAN Secretariat. RCEP Agreement Legal Text. https:// rcepsec.org/legal-text/ [accessed July 2021]).

Proof of origin and other discrepancies with administrative matters could pose challenges and add to the cost of compliance for businesses. As factual analysis of the text of the agreements shows a number of PSROs converging across FTAs, further convergence on best practices on proof of origin could act as a unifying factor to strengthen the ultimate goals of a regionwide FTA, not only in promoting deeper regional economic integration but in minimizing the administrative costs for ensuring compliance.

References

ASEAN Secretariat. RCEP Agreement Legal Text. https://rcepsec.org/legal-text/ (accessed July 2021).

Asian Development Bank (ADB). 2015. *Key Indicators for Asia and the Pacific 2015.* Manila.

———. 2021. *Asian Development Outlook Supplement July 2021: Renewed Outbreaks and Divergent Economies*. Manila.

———. Asia Regional Integration Center. FTA Database. https://aric.adb.org/fta (accessed December 2021).

———. Multi-Regional Input-Output Tables.

CPB Netherlands Bureau for Economic Policy Analysis. World Trade Monitor. https://www.cpb.nl/en/world-trade-monitor-october-2021 (accessed January 2022).

Crivelli, P. and S. Inama. 2021. Making RCEP Successful through Business-Friendly Rules of Origin. Asian Development Blog. 12 February. https://blogs.adb.org/blog/making-rcep-successful-through-business-friendly-rules-origin.

———. 2022. An Initial Assessment of Regional Comprehensive Economic Partnership Tariff Liberalization and Rules of Origin. *ADB Briefs*. No. 206. January. Manila: ADB.

Crivelli, P., S. Inama, and M. Pearson. Forthcoming. *Product-Specific Rules of Origin of the Regional Comprehensive Economic Partnership—An Initial Assessment.* Manila: ADB.

The Economist. 2021. A Perfect Storm for Container Shipping. 18 September. https://www.economist.com/finance-and-economics/a-perfect-storm-for-container-shipping/21804500.

Freightos. Freightos Baltic Index (FBX): Global Container Freight Index. https://fbx.freightos.com/ (accessed January 2022).

Government of Japan, Ministry of Economy, Trade and Industry. 2021a. The Regional Comprehensive Economic Partnership (RCEP) Agreement Will Enter into Force on January 1, 2022. News Release. 3 November. https://www.meti.go.jp/english/press/2021/1103_001.html.

———. 2021b. The Regional Comprehensive Economic Partnership (RCEP) Agreement Will Enter into Force in South Korea. 6 December. https://www.meti.go.jp/english/press/2021/1206_002.html.

Howley, D. 2021. These 169 Industries Are Being Hit by the Global Chip Shortage. *Yahoo! News*. 25 April. https://ph.news.yahoo.com/these-industries-are-hit-hardest-by-the-global-chip-shortage-122854251.html.

Hummels, D., J.Ishii, and K.-M. Yi. 2001. The Nature and Growth of Vertical Specialization in World Trade. *Journal of International Economics*. 54(1). pp. 75–96.

International Monetary Fund (IMF). Direction of Trade Statistics. https://data.imf.org/dot (accessed January 2022).

Jeong, E. Y., and D. Strumpf. 2021. Why the Chip Shortage Is So Hard to Overcome. *Wall Street Journal*. 19 April. https://www.wsj.com/articles/why-the-chip-shortage-is-so-hard-to-overcome-11618844905.

Kang, J. W., P. Crivelli, M. C. Tayag, and D. Ramizo. 2020. Regional Economic Partnership: Overview and Economic Impact. *ADB Briefs*. No. 164. December. Manila: ADB.

Kuo, S. 2021. Progress in Importation of US Equipment Dispels Doubts on SMIC's Capacity Expansion for Mature Nodes for Now, Says TrendForce. Press Release. 5 March. https://www.trendforce.com/presscenter/news/20210305-10693.html.

Ludwikowski, M. and W. Mjoberg. 2021. Semiconductor Shortage and the US Auto Industry. *Reuters*. 22 June. https://www.reuters.com/legal/legalindustry/semiconductor-shortage-us-auto-industry-2021-06-22/.

Organisation for Economic Co-operation and Development (OECD). Business Confidence Index (indicator) (accessed January 2022).

Park, C. Y., P. Petri, and M. Plummer. 2021. Economic Implications of the Regional Comprehensive Economic Partnership and Recent Trade Policy Developments in Asia and the Pacific. *ADB Economics Working Papers*. No. 639. Manila: ADB.

Richard, C., K. Ramachandran, and I. Pandoy. 2017. *Workforce Development Survey: Looming Talent Gap Challenges Semiconductor Industry*. Deloitte-Global Industry Association Serving the Electronics Manufacturing Supply Chain (SEMI). https://www.semi.org/ko/workforce-development/diversity-programs/deloitte-study#_edn9.

Semiconductor Industry Association. 2021a. *State of the US Semiconductor Industry*. Washington, DC.

———. 2021b. Chipmakers Are Ramping Up Production to Address Semiconductor Shortage. Here's Why that Takes Time. Blog. 26 February. https://www.semiconductors.org/chipmakers-are-ramping-up-production-to-address-semiconductor-shortage-heres-why-that-takes-time/.

———. What Is a Semiconductor? https://www.semiconductors.org/semiconductors-101/what-is-a-semiconductor.

———. Freightos Baltic Index. https://de.statista.com/statistik/daten/studie/1270630 (accessed January 2022).

United Nations (UN). Commodity Trade Database. https://comtrade.un.org (accessed October and December 2021).

United Nations Conference on Trade and Development (UNCTAD). 2015. Freight Rates and Maritime Transport Costs. In D. Barki and J. Rogers, eds. *Review of Maritime Transport*. Geneva.

Varas, A., R. Varadarajan, J. Goodrich, and F. Yinug. 2021. *Strengthening the Global Semiconductor Supply Chain in an Uncertain Era*. Washington, DC: Semiconductor Industry Association and Boston Consulting Group.

Wall Street Journal. 2021. Why the Global Chip Shortage Is Hard to Overcome. Video. youtube.com. 3 June. https://www.youtube.com/watch?v=FP_g-as29x0.

Wang, Z., S. J. Wei, and K. Zhu. 2013 (revised 2018). Quantifying International Production Sharing at the Bilateral and Sector Levels. *NBER Working Paper*. No. 19677. Cambridge, MA: National Bureau of Economic Research.

Williams, O. 2021. How the Polar Vortex Wreaked Havoc on the Automotive Industry. *The New Statesman*. 31 March. https://www.newstatesman.com/business/sustainability/2021/03/how-polar-vortex-wreaked-havoc-automotive-industry.

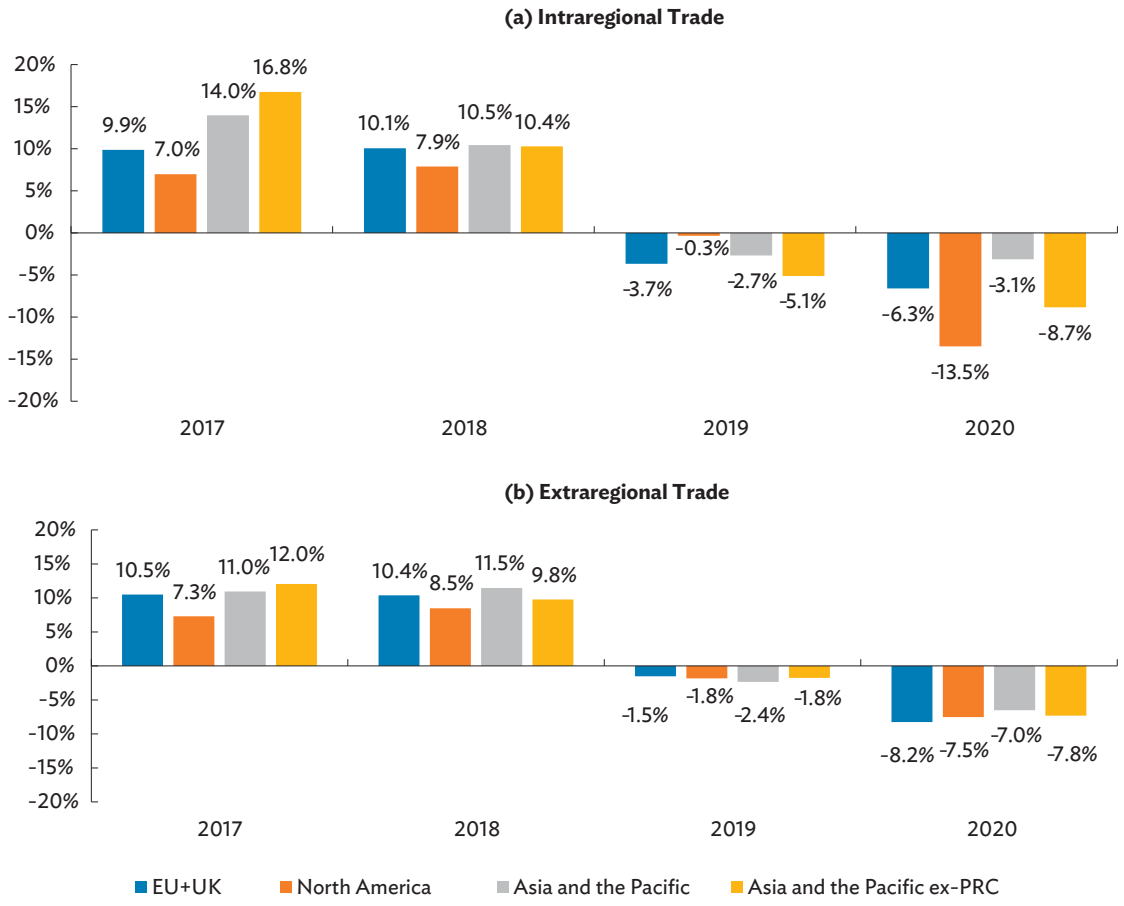
World Trade Organization (WTO). 2021. Report of the TPRB from the Director-General on Trade-Related Developments (Mid-October 2020 to Mid-May 2021). Geneva.

———. Regional Trade Agreement Information System. http://rtais.wto.org (accessed December 2021).

Yamamitsu, E. 2021. Renesas says Normal Production at Fire-Hit Chip Plant to Take 100-120 Days. *Reuters*. 30 March.

Zanni, T., L. Clark, C. Gentle, S. Jones, and S. Lohokare. 2019. *Semiconductors: As the Backbone of the Connected World, the Industry's Future is Bright—Global Semiconductor Industry Outlook 2019*. Amstelveen: KPMG and Global Semiconductor Alliance.

Annex 2a: Intraregional and Extraregional Trade Values Annual Growth Rate by Region



EU = European Union (27 members), PRC = People's Republic of China, UK = United Kingdom.

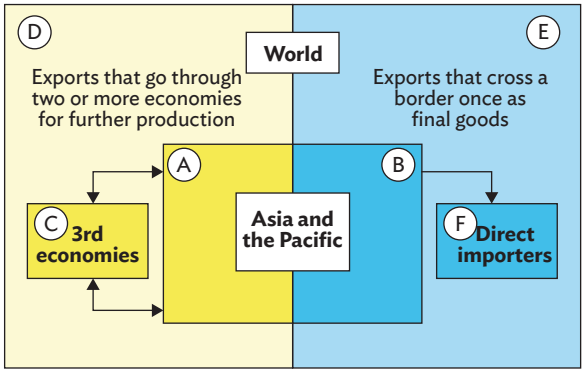
Notes: Values are expressed as percentage of the region's total merchandise trade (sum of exports and imports). North America covers Canada, Mexico, and the United States.

Source: ADB calculations using data from International Monetary Fund. Direction of Trade Statistics. https://data.imf.org/dot (accessed January 2022).

Annex 2b: Analytical Framework of GVC and RVC

A new framework for understanding participation in the global value chain (GVC) and regional value chain (RVC) is introduced to better track Asia and the Pacific's progress in global and regional trade linkages. The world's gross exports can be divided between (i) exports that cross a border once as final goods (represented by the blue area in the figure); and (ii) exports that go through two or more economies for further production (the yellow area). World-to-world GVC is the share of the world's total GVC terms to its gross exports. Asia-to-world GVC is the share of Asia's total GVC terms to its gross exports. Asia-to-Asia gross RVC is the share of Asia's intraregional GVC terms to its intraregional gross exports, excluding all non-Asian third economies.[1] Asia-to-Asia net RVC is similar to gross RVC, except that its denominator, total intraregional exports, includes non-Asian third economies.

Analytical Framework of GVC and RVC



$$(1)\quad \text{World-to-world GVC} = \frac{A + C + D}{A + B + C + D + E + F}$$

$$(2)\quad \text{Asia-to-world GVC} = \frac{A + C}{A + B + C + F}$$

$$(3)\quad \text{Gross RVC} = \frac{A}{A + B}$$

$$(4)\quad \text{Net RVC} = \frac{A}{A + B + C}$$

GVC = global value chain, RVC = regional value chain.

Source: ADB based on Wang, Wei, and Zhu (2013, revised 2018).

[1] Third economies are those that indirectly participate in a GVC transaction. For example, Singapore exports intermediate goods used by the People's Republic of China (PRC) to produce and export final goods to Malaysia. From the point of view of Singapore (the source economy or exporter), the PRC is the direct partner (i.e., the destination economy), while Malaysia is the third economy.

Annex 2c: Economy and Sectoral Coverage of the ADB Multi-Regional Input–Output Tables

List of 62 Economies

Economy	Code	Economy	Code
Australia	*AUS*	Lithuania	LTU
Austria	AUT	Luxembourg	LUX
Bangladesh	*BAN*	*Malaysia*	*MAL*
Belgium	BEL	*Maldives*	*MLD*
Bhutan	*BHU*	Malta	MLT
Brazil	BRA	Mexico	MEX
Brunei Darussalam	*BRU*	*Mongolia*	*MON*
Bulgaria	BGR	*Nepal*	*NEP*
Cambodia	*CAM*	Netherlands	NET
Canada	CAN	Norway	NOR
Croatia	HRV	*Pakistan*	*PAK*
Cyprus	CYP	*People's Republic of China*	*PRC*
Czechia	CZE	*Philippines*	*PHI*
Denmark	DEN	Poland	POL
Estonia	EST	Portugal	POR
Fiji	*FIJ*	*Republic of Korea*	*KOR*
Finland	FIN	Romania	ROM
France	FRA	Russian Federation	RUS
Germany	GER	*Singapore*	*SIN*
Greece	GRC	Slovakia	SVK
Hong Kong, China	*HKG*	Slovenia	SVN
Hungary	HUN	Spain	SPA
India	*IND*	*Sri Lanka*	*SRI*
Indonesia	*INO*	Sweden	SWE
Ireland	IRE	Switzerland	SWI
Italy	ITA	*Taipei,China*	*TAP*
Japan	*JPN*	*Thailand*	*THA*
Kazakhstan	*KAZ*	Turkey	TUR
Kyrgyz Republic	*KGZ*	United Kingdom	UKG
Lao People's Democratic Republic	*LAO*	United States	USA
Latvia	LVA	*Viet Nam*	*VIE*

Note: The 26 economies from Asia and the Pacific are in italics.

Source: ADB. Multi-Regional Input–Output Tables.

List of 35 Sectors

	Sector	Aggregation
1	Agriculture, hunting, forestry, and fishing	Primary
2	Mining and quarrying	
3	Food, beverages, and tobacco	Low technology manufacturing
4	Textiles and textile products	
5	Leather, leather products, and footwear	
6	Wood and products of wood and cork	
7	Pulp, paper, paper products, printing, and publishing	
8	Coke, refined petroleum, and nuclear fuel	Medium-to-high technology manufacturing
9	Chemicals and chemical products	
10	Rubber and plastics	Low technology manufacturing
11	Other nonmetallic minerals	Medium-to-high technology manufacturing
12	Basic metals and fabricated metal	
13	Machinery, not elsewhere classified (nec)	
14	Electrical and optical equipment	
15	Transport equipment	
16	Manufacturing, nec; recycling	Low technology manufacturing
17	Electricity, gas, and water supply	
18	Construction	
19	Sale, maintenance, and repair of motor vehicles and motorcycles; retail sale of fuel	Business services
20	Wholesale trade and commission trade, except of motor vehicles and motorcycles	
21	Retail trade, except of motor vehicles and motorcycles; repair of household goods	
22	Hotels and restaurants	
23	Inland transport	
24	Water transport	
25	Air transport	
26	Other supporting and auxiliary transport activities; activities of travel agencies	
27	Post and telecommunications	
28	Financial intermediation	
29	Real estate activities	
30	Renting of machinery and equipment and other business activities	
31	Public administration and defense; compulsory social security	Public and personal services
32	Education	
33	Health and social work	
34	Other community, social, and personal services	
35	Private households with employed persons	

Note: Sectoral coverage of the ADB Multi-Regional Input–Output Tables database released in 2019.

Source: ADB. Multi-Regional Input–Output Tables.