2

Impacts of Trade Tensions and COVID-19 on Global Value Chains

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2.1 Introduction

The organization of trade in global value chains (GVCs) has facilitated the circulation of goods and services between sectors and countries, but at the same time has increased their interdependence (Baldwin, 2017; Feenstra, 1998). Recent shocks have led to an increased awareness of mutual interdependence among countries and highlighted the susceptibility of trade flows to trade barriers. Changes in a country's trade policy or exogenous shocks, such as COVID-19, reverberate down the supply chain leading to disruptions. That said, such events also come as opportunities to better understand the interplay between existent policies and the organization of GVCs, to improve resilience to future shocks.

This chapter discusses the propagation of shocks in global value chains and their interaction with trade policies illustrated by the trade tensions between the US and its main trade partners, and the COVID-19 pandemic. In recent years, trade conflicts and COVID-19 have caused GVCs to re-adjust. Trade-restrictive policies often lead to retaliation by affected countries that in turn raise import tariffs or place other restrictions on their trade partners. For instance, in 2018 and the following years, tariffs were raised on bilateral trade between the United States and several of its trade partners, especially the People's Republic of China (PRC), with significant impacts on global trade and investment (Bown & Kolb, 2023). This chapter aims to better understand how economies react to shocks depending on their interlinkages in GVCs, paving the way towards better preparedness strategies for future shocks.

Another important major shock to GVCs was the COVID-19 pandemic. The world's most significant public health crisis since the 1918 influenza pandemic hit both

supply and demand side, resulting in the worst recession since the Great Depression. Disruptions in global supply chains caused by several lockdowns led to a significant contraction in demand (Freeman & Baldwin, 2020). The global economy decelerated, countries' GDP, imports and exports fell, and the prices of goods rose. The disruptions to GVCs prompted stakeholders to modify their strategies, both at the macro and micro level. At the macro level, governments had to undertake several measures to cushion the negative impacts on producers and consumers. At the micro level, firms adapted by reorganizing their supply chains, considering diversification of their suppliers, an increase in inventories or revisiting their supply chains' length.

After all, as mentioned above, disruptions in supply chains might also come as opportunities to better prepare for future shocks. Since COVID-19 has resulted in an unprecedented shock to the global economy, digital technologies have been regarded as a key tool for resilience and recovery during the pandemic era. Digitalization can indeed facilitate access to labor supply for certain industries, especially through the services sector. This paper also discusses its interaction with GVCs in the context of resilience and reducing risks of future shocks.

The rest of the chapter is organized as follows. Section 1 first discusses propagations of shocks and spillover effects in GVCs by illustrating how changes in trade policy along the value chain affect trade partners. Section 2 discusses trade tensions and how they may intensify regionalism. Section 3 focuses on the impact of COVID-19 on GVCs. Section 4 explores digitalization, resilience, and recovery, and section 5 concludes.

2.2 Sources of shocks and their propagation in Global Value Chains

Events such as trade conflicts or a global pandemic create disruptions that propagate through the value chain. For instance, US–PRC trade tensions have significantly increased bilateral tariffs and non-tariff measures for the concerned countries and their main trading partners. In addition, these shocks have sparked new debates regarding the benefits and risks related to GVCs. There is growing consideration about whether shifting towards more localized production would offer better protection against disruptions, which often result in supply shortages and uncertainty for consumers and businesses.

This section discusses the possible sources and risks related to the propagation of shocks in GVCs, providing an overview at the macro and micro levels. It also illustrates how trade policies amplify the propagation of shocks and discusses the role of tariffs and non-tariff measures.

Sources of Shocks and Mechanisms of Propagation

Shocks to GVCs are varied, including extreme weather events, trade tensions, geopolitical tensions, and pandemic (Solingen et al., 2021). Such shocks can be interlinked with each other and interact in specific contexts. For instance, trade tensions between the US and the PRC overlapped with the pandemic reinforcing each other's effects on increased uncertainty in trade policy as revealed by the trade policy uncertainty index (Ahir et al., 2022).

Supply chain connections play a crucial role in how shocks are transmitted between countries. This has far-reaching implications for the interplay between demand, trade, and production. Traditional models typically assume that a country's imports rely on domestic demand. However, in the current world characterized by intricate international supply chains, changes in demand in other countries have also become influential determinants. According to OECD TIVA statistics, more than 20% of global imports are utilized as inputs in domestic production processes and then integrated into goods that are subsequently re-exported. Demand shocks in a particular country can propagate upstream through the global production network to input suppliers. Similarly, supply disruptions can be transmitted downstream, affecting other parts of the supply chain.

The outbreak of COVID-19 has revealed the interdependence of countries in terms of the supply of inputs and final goods. The demand for some manufactured goods and services, such as airlines, tourism, restaurants, sports, and other face-to-face communication-dependent services dropped significantly, leading to a decrease in demand for all parts of the production chain linked to these goods and services.Cigna et al. (2022) show that GVC spillovers could magnify the decline in world trade, adding some 25% to the effects that could occur on the back of bilateral linkages. In contrast, the demand for other goods increased, such as medical equipment, electronics, and vaccines, with GVCs central to the effective supply of these items worldwide (WTO, 2023).

Large firms also play an essential role in the propagation of shocks through GVCs. Fluctuations at the firm level can be connected to overall economic fluctuations (Gabaix, 2011; Herskovic et al., 2020). Trade linkages at the firm level are significantly associated with increased comovement of international business cycles (di Giovanni et al., 2018). The extent of shock transmission also relies on the type of transaction between firms, whether through arm's length trade (i.e., trade between independent parties) or intra-group trade (i.e., trade between vertically linked firms). During the trade collapse in the 2008-09 global financial crisis, intra-group trade in intermediates experienced a more rapid decline followed by a faster recovery than arm's length trade (Altomonte et al., 2012).

Trade policies certainly play an important role in helping to cope with shocks or hinder their adverse effects. For instance, trade flows subject to lower trade costs declined by less than average during the 2020 COVID-19 pandemic, as higher-cost and less established suppliers were squeezed out of international markets (Nicita & Tresa, 2023). However, trade policies in the global value chain are also an instrument of shock propagation as countries are interlinked. This is what the following sub-section focuses on.

Propagation of Shocks through Tariff Measures in GVCs

The rise of GVCs has partly resulted from the liberalization of intermediate goods trade. Access to foreign intermediate inputs can increase the amount and quality of exports by exposing firms to new inputs and technologies (Cal`ı et al., 2022; Goldberg et al., 2010). Though tariffs are relatively low due to several liberalization initiatives, minor tariff variations might significantly affect the global production chain. In fact, economic shocks and their potential propagation effects induce countries to reconsider their policies in the international trading system and reconsider linkages through global value chains(Blanchard et al., 2016).

GVCs can amplify the impact of tariff changes on imported intermediate goods. The multi-stage production model implies that trade costs play a larger role for two reasons. First, products cross borders multiple times, so tariffs are repeatedly imposed on some parts. Second, even if the value added by a country represents only a tiny percentage of the value of an exported good, its trading partners will still levy tariffs on the total value. These two effects are sometimes called accumulation and magnification effects (Dollar et al., 2017; Yi, 2003; Yi, 2010).

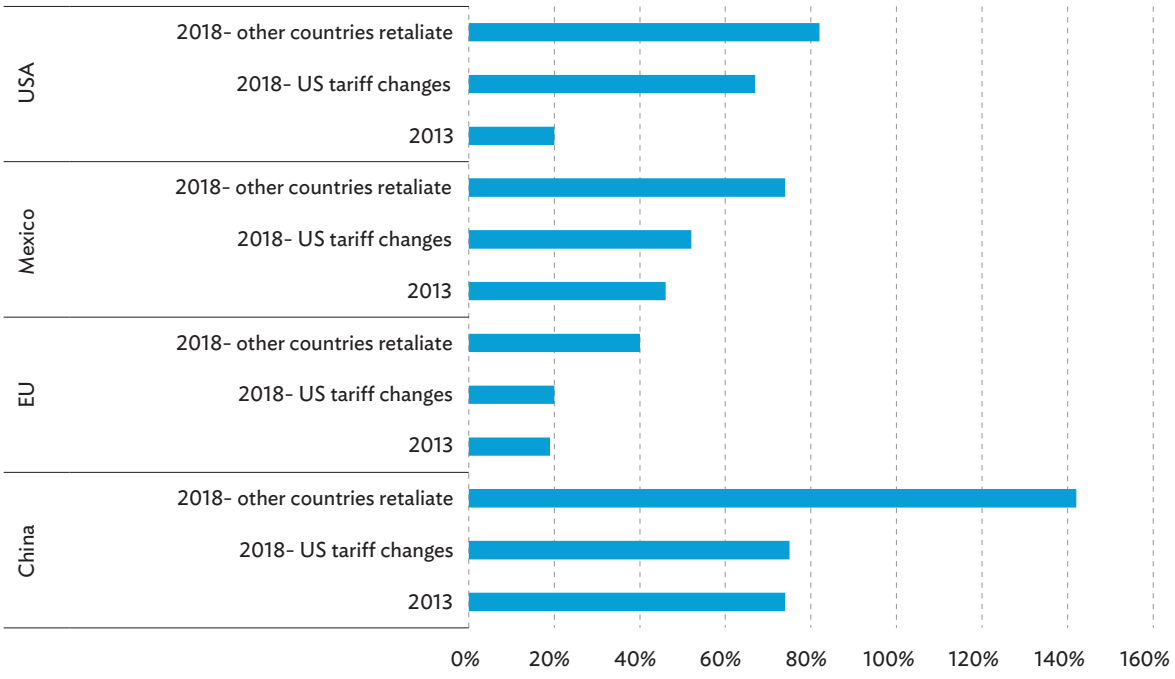
As a result, when production is fragmented, trade policy can have particularly strong impacts on indirect users located further downstream in the chain. Yi (2003) was the first to highlight that relaxing trade barriers in sequential production could result in spillover effects on the performance of indirect users. This idea has been supported by several theoretical contributions demonstrating the significant impact of indirect trade costs on downstream producers (Costinot et al., 2012; Johnson & Noguera, 2012; Noguera, 2012). Recent studies utilize quantification exercises to examine the role of trade protection in GVCs (Bellora & Fontagné, 2019; Erbahar & Zi, 2017). They underline the importance of considering vertical linkages and reveal the adverse consequences of trade protection for trade partners operating within the same production chain.

Rouzet and Miroudot (2013) compute cumulative tariffs and show that tariffs increase significantly when finished goods reach customers. Tresa (2022) does a similar exercise but distinguishes tariffs on inputs and final goods by computing cumulative input tariffs. His analysis shows how the effects of the trade tension between the US and the PRC have also been felt by their main trade partners. The cumulative input tariff is the trade weighted sum of all tariffs directly and indirectly embodied in all stages of GVCs, which can be captured by the Leontief inverse matrix.

Figure 2.1 shows the variations in cumulative input tariffs from 2013 to 2018 along the entire production chain under a fixed GVC structure (Tresa, 2022). The second bar for each country/economic bloc shows the cumulative input tariffs following changes in tariffs imposed by the US in 2018. As expected, cumulative input tariffs increased for the US. Interestingly, other countries' cumulative input tariff exposure also increased, especially for Mexico. This reflects that Mexico sources many inputs from the US, and the cumulative input tariffs increase in the US propagated to Mexican products that use components from the US.

The final bar for each country/economic bloc shows the cumulative input tariffs following not only US tariff changes but also those by countries that retaliated. As can be seen, the increase was significant, with the PRC's cumulative input tariffs almost doubling. This amplification was the result not only of the increase in tariffs by the PRC, but also of the increases by countries that are part of the Chinese value chain, such as the US. Importantly, the cumulative input tariffs of the US also increase in the final bar, even if US tariffs did not change. As in the case of the Mexican example above, this resulted from using foreign components that became more expensive following retaliation. The example illustrates that value chains should be a key consideration when determining trade policy.

Figure 2.1: The Change of the Average Cumulative Input Tariffs



Notes: This figure shows cumulative input tariffs with simple mean on sectors concerned by increases in tariffs: Agriculture, Hunting, Forestry and Fishing; Basic Metals and Fabricated Metal; Chemicals and Chemical Products; Coke, Refined Petroleum and Nuclear Fuel; Electrical and Optical Equipment; Electricity, Gas and Water Supply; Food, Beverages and Tobacco; Leather, Leather and Footwear; Machinery, Nec; Manufacturing, Nec, Recycling; Other Non-Metallic Mineral; Pulp, Paper, Paper, Printing and Publishing; Renting of M&Eq and Other Business Activities; Rubber and Plastics; Textiles and Textile Products; Transport Equipment; Wood and Products of Wood and Cork. The second bar for each economic block shows cumulative input tariffs following the US tariff changes in 2018. The final (upper) bar shows cumulative input tariffs following all other countries' tariff changes in 2018.

In terms of costs, US–PRC trade tensions have resulted in a total extra 23 billion US dollars (the currency throughout the paper)indirect tariff burden (0.11% to the total global imports), of which 67% is attributed to the US's unilateral additional tariffs on Chinese goods. Moreover, the US and the PRC have had to bear additional indirect tariff burdens of approximately 10 and 6.5 billion US dollars (about an extra 0.31% and 0.09% to the total global imports), respectively. The European Union (EU), Canada, and Mexico have also incurred additional indirect tariff costs between 700 million and 1.7 billion US dollars (Mao & Görg, 2020; Wu et al., 2021). Focusing on individual sectors concerning indirect tariffs, all sectors in the PRC except for wood products were subject to indirect tariff increases of less than 50%, while all sectors in the US except for textiles and petroleum incurred additional indirect tariffs of more than 150%.

This illustration clearly shows that due to the pervasive presence of GVCs, trade tensions come at a cost to the overall economy that is much larger than direct impacts might suggest.

Propagation of Shocks through Non-Tariff Measures in GVCs

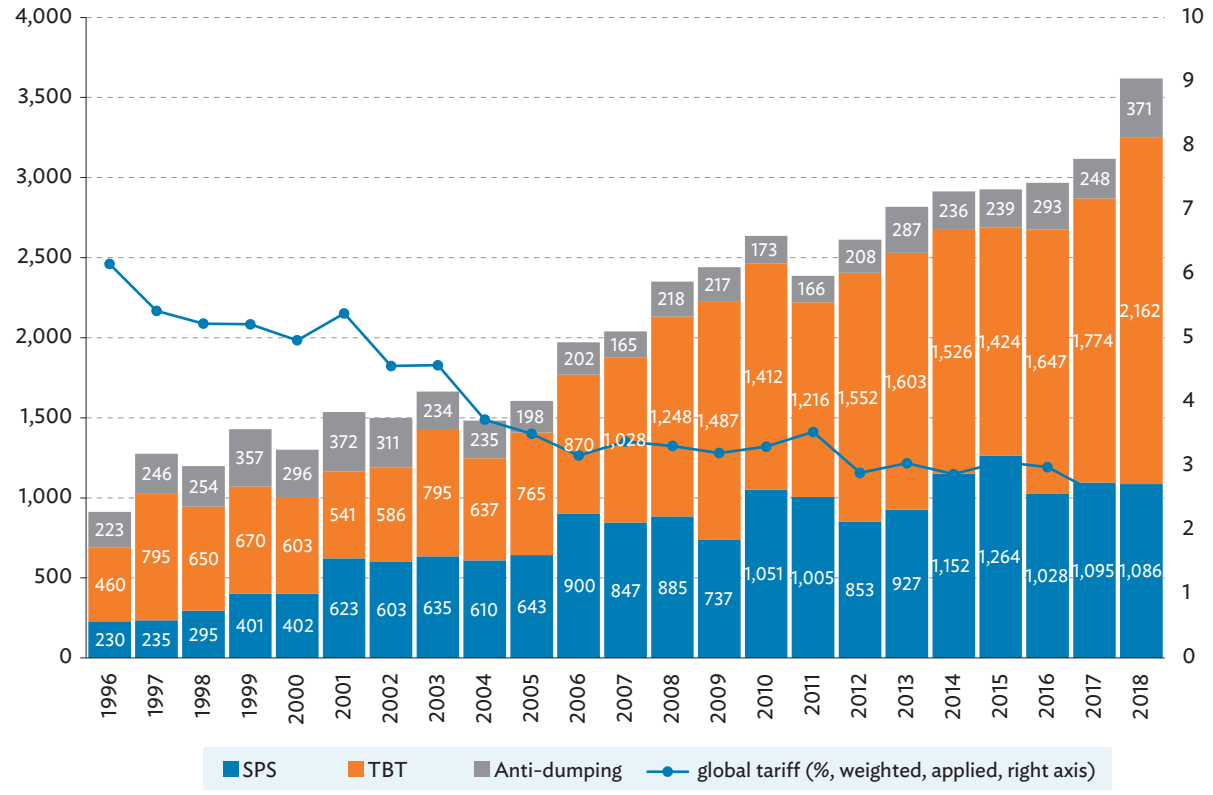
Few studies have quantitatively analyzed the impact of NTMs on GVCs, especially in comparison with tariffs. Ghodsi and Stehrer (2022) examined the effects of two types of NTMs, sanitary and phytosanitary (SPS) measures and technical barriers to trade (TBTs), on GVCs and found that the cumulative effect of tariffs was greater than that of NTMs. However, the cumulative cost of compliance with TBTs over previous stages of production had a significant negative impact on value-added and gross exports. This indicates that the cumulative effect of NTMs is relevant in the context of production fragmentation.

Average global tariffs have declined from more than 12% in the 1990s to less than 9% today, but there has been a rapid increase in NTMs to about four times the level in the 1990s, and they continue to rise (see Figure 2.2). As a result, the impact of behind-the-border NTMs on international trade is growing, especially vis-à-vis tariffs (OECD, 2019).

During the initial period of the COVID-19 pandemic until August 2020, various countries collectively implemented 384 trade-related measures, of which 283 were NTMs (see Figure 2.3). During this period, almost all tariffs aimed to reduce import costs, while 179 NTMs aimed to restrict trade (Lee & Prabhakar, 2021). These NTMs were mainly aimed at securing the domestic supply of goods and preventing the importation of the COVID-19 virus.

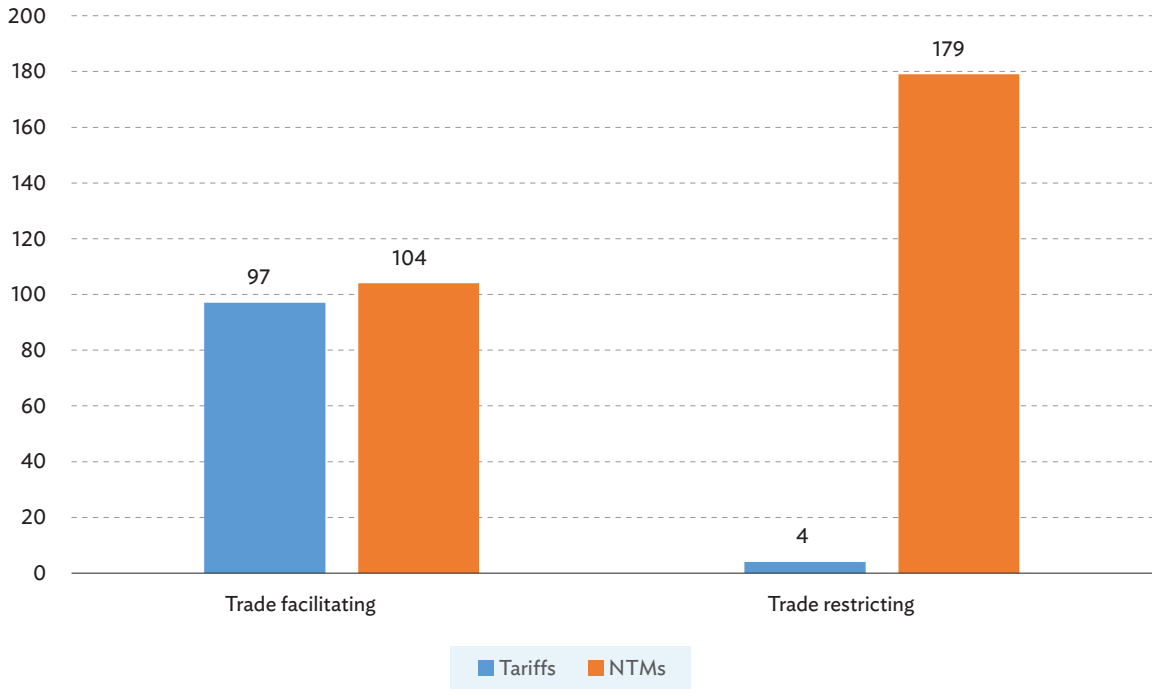
Recent research highlights that NTMs can have substantial adverse effects on GVCs. Ghose and Montfaucon (2022) show that firms that were part of a GVC were more resilient in the long run during the pandemic, but that NTMs, such as port-of-entry restrictions, severely aggravated the harmful effects of COVID-19. Cal`ı et al. (2022) corroborate these findings by showing that negative competitiveness shocks cause exports of firms subject to NTMs on their inputs to decline much stronger than exports of other firms. Notably, the magnitude of the effect depends on the type of NTM, which suggests that policymakers may achieve policy objectives without unduly restricting trade by using the appropriate NTMs.

Figure 2.2: The Trend of Global Tariff and NTMs



Sources: Cho et al. (2020)

Figure 2.3: Trade Facilitating and Restricting NTMs during COVID-19



Sources: Lee and Prabhakar (2021)

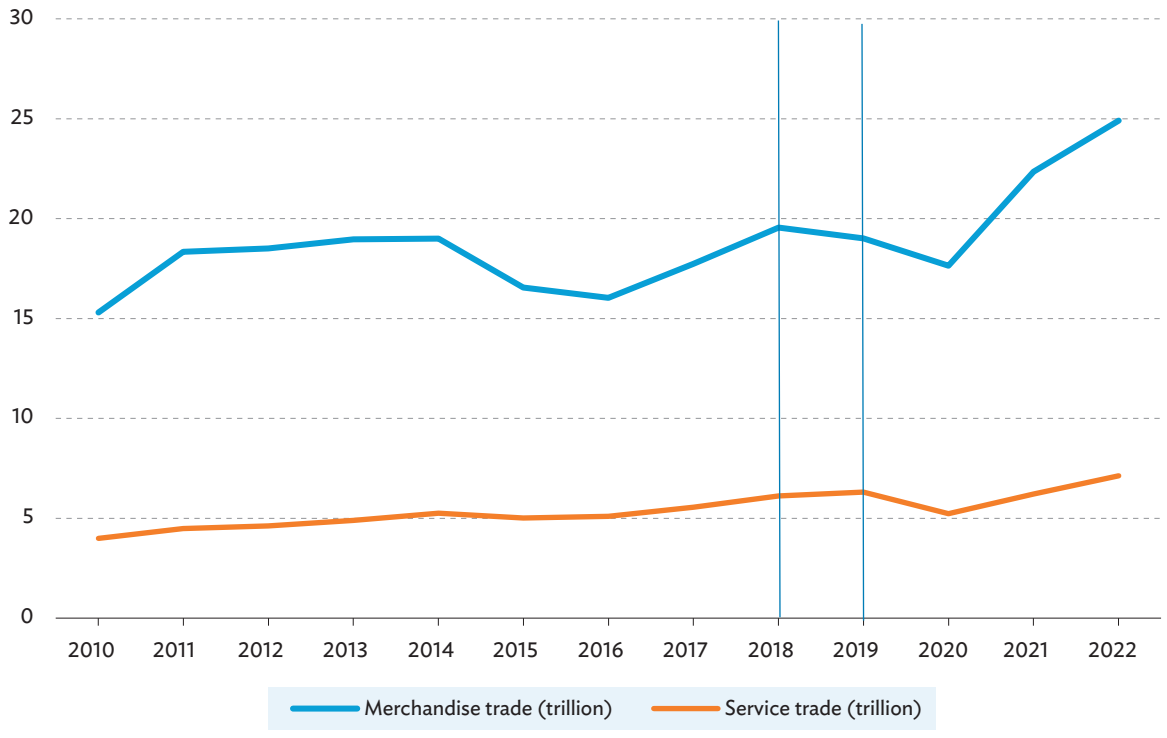
2.3 Patterns of Restructuring and Regionalization of Global Trade

Global Trade Picture

Globally, merchandise trade increased in 2018 and 2019 despite rising trade tensions leading to higher tariffs. Trade in services increased initially but then decreased. The outbreak of the COVID-19 pandemic hurt global trade, which fell sharply, especially trade in services. However, trade is resilient and recovered quickly after the pandemic, reaching new heights in 2021 and 2022 (see Figure 2.4).

The PRC, the US, and the EU continue to be the largest contributors to the global economy and GVCs, playing by far the greatest roles in the global supply of goods and services in 2021 (see Figure 2.5). Taking the intermediate market as an example, these three regions exported 10.2%, 10.3% and 29.9% of global total intermediate goods and services, respectively. The intermediate import shares of these three regions are 14.7%, 9.9% and 28.2%, respectively.

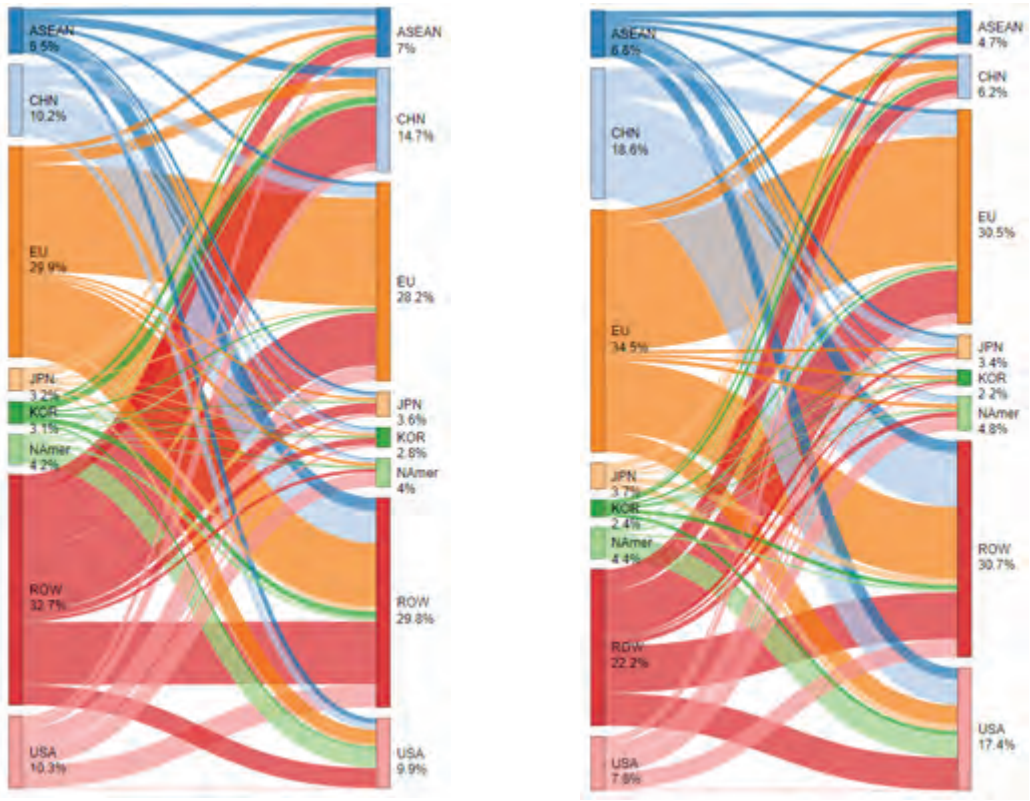
Figure 2.4: Global Export of Merchandise and Service



Source: World Trade Organization (WTO) statistics.

As to the bilateral trade flows, shown as the links between the exporters and importers, the PRC supplied 24% of Europe's imports of final goods and services from outside the continent but only 13%[1] of its imports of intermediate goods. The EU imported more intermediate products from the US (17%), and 20% of the US's imports were from the EU. In contrast, for final consumption, the US and the EU were more reliant on supplies from the PRC. The PRC provided 25% of the rest of the world's imports of final products, while the PRC and the US each supplied 14% of the rest of the world's intermediate product imports.

Figure 2.5: Global Trade of Intermediate and Final Products in 2021



Note: Domestic trade of each country was omitted in the initial input–output table and then aggregated to 8 regions. Regions in the left part of each panel are the exporters, and the corresponding numbers are the export shares of each country. Similarly, regions on the right part of each panel are importers and the numbers are import share. The links between exporters and importers are bilateral exports.
Sources: Asian Development Bank (ADB) Multi-regional Input–Output (MRIO) Database database 2021

Trade Diversion

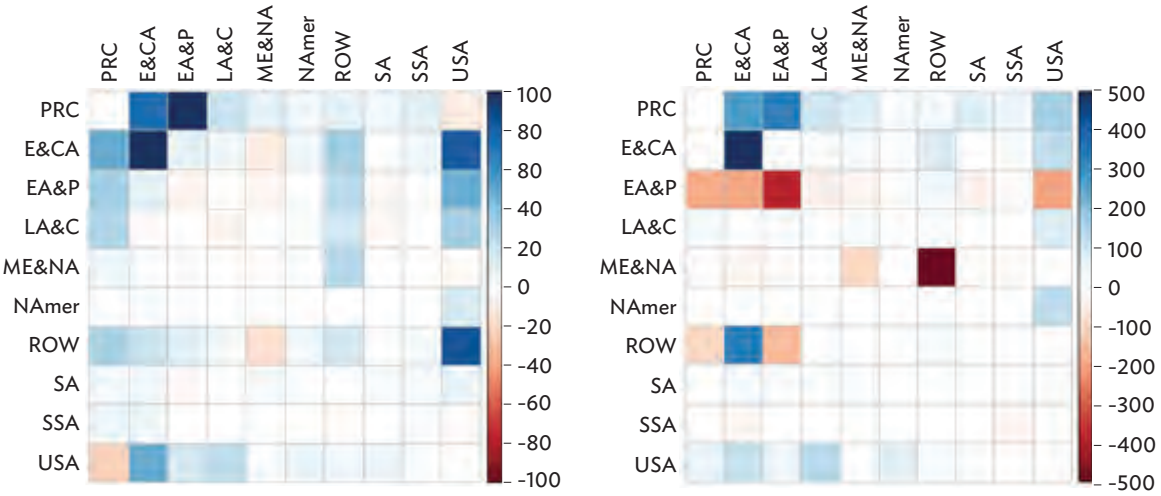
While aggregate trade held up despite trade tensions and was resilient during the pandemic, there have been significant changes in the geography of trade during the period 2017–2022 (see Figure 2.6). In response to the tariff increases by the US, the

[1] According to the ADB MRIO 2021, the EU's total import of intermediate goods and services in 2021 (excluding the intra-regional trade) was 2053.4 billion dollars, the imports from the PRC were 269.1 billion dollars, so the share was about 13%.

PRC shifted its export focus to East Asia and Pacific and Europe and Central Asia, with exports to those regions increasing by 11.7% and 16.1%, respectively, or about 100 billion US dollars and 75 billion US dollars, respectively. Exports of goods from the PRC to Viet Nam, Indonesia, and Malaysia increased by 36.7%, 31.3%, and 25.0%, respectively. The US increased its exports to Europe and Central Asia by 14.9%, of which the exports to the UK increased by 22.8% (12.9 billion US dollars). Meanwhile, exports of goods from the US to Mexico and Canada increased by 5.3% (12.9 billion US dollars) and 3.5% (9.9 billion US dollars), respectively. These are the top three absolute changes in exports to individual countries. As for imports, the PRC and the US shifted their sourcing to the Europe & Central Asia region, the East Asia & Pacific region, and the Latin America & Caribbean region.

Gross trade data suggests that the PRC strengthened its ties with East Asia during the period 2017–2019, while the US forged closer trade ties with Canada and Mexico, while both the PRC and the US reorganized their imports from the Europe & Central Asia region, the East Asia and the Pacific region, and Latin America & Caribbean region.

Figure 2.6: Change in Gross Exports in 2017–2019 and 2019–2022



Notes:
1. The changes in gross export between regions are shown in the picture. Actually, the intra-export from E&CA to E&CA in the left picture increased by 331 billion dollars, and that in the right picture increased by 993 billion. But both were truncated for better visualization.
2. The classification of region is based on World Bank. E&CA=Europe & Central Asia, EA&P = East Asia & Pacific, LA&C = Latin America & Caribbean, ME&NA = Middle East & North Africa, NAmer = North America, SA = South Asia, SSA= Sub-Saharan Africa, ROW = Rest of the world.

Source: World Integrated Trade Solution (WITS) trade data, gross exports.

Global trade has changed dramatically in the post-COVID era (2019–2022), compared with the pre-COVID period (2017–2019). Intra-trade (gross export) in the Europe & Central Asia region has increased by $331 billion US dollars prior to the COVID-19 pandemic, and has increased by $993 billion US dollars in the post-pandemic period. Europe and Central Asia region has also strengthened their ties with the PRC and Africa (included in the rest of

the world), while reducing trade with the Americas. The East Asia and Pacific region and Middle East and North Africa region experienced significant supply shortages during the pandemic and have become more reliant on Chinese imports to meet their consumption and production requirements. Looking at the PRC and the US, although bilateral trade declined during the trade tensions, they strengthened their ties in the face of the COVID-19 pandemic and were responsible for the largest change in each other's imports.

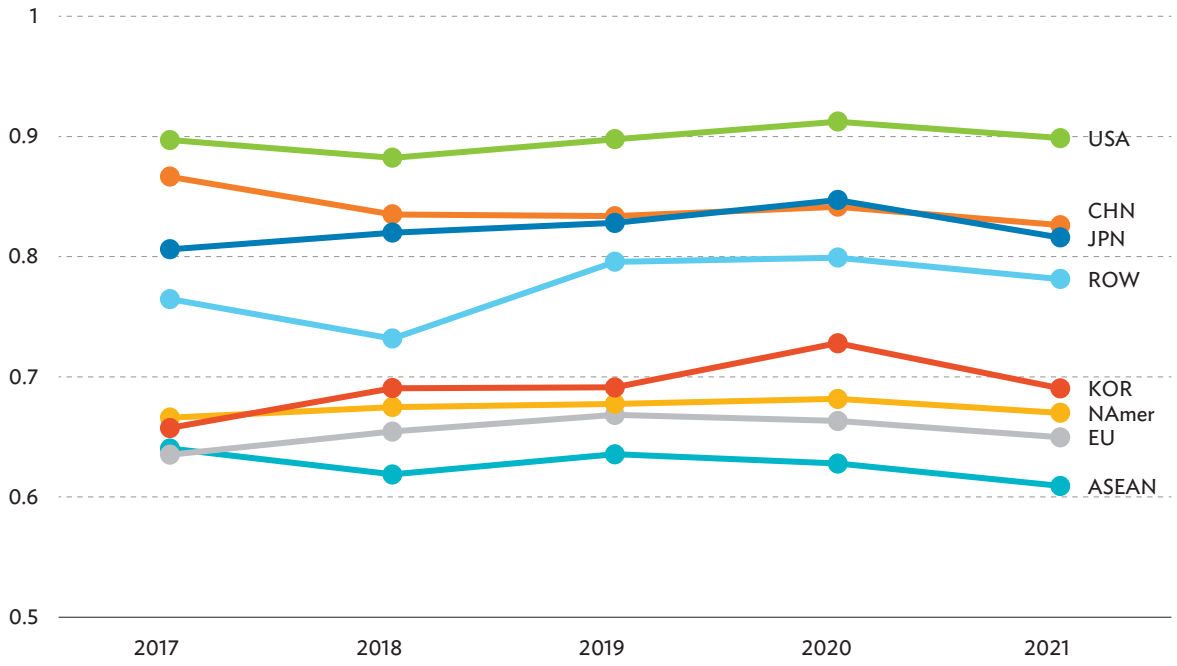
Focusing on Asia, imports of inputs by developing Asian economies from non-Asia regions declined, but there was an increase in intra-regional trade (see Figure 2.8). Thus, the resilience of regional supply chains mitigated the decline in imports from non-regional suppliers. The resilience of the PRC's exports enabled upstream industries in developing Asian economies to remain solvent, and regional sales of intermediate goods to the PRC also increased. The PRC's resilient demand for final goods helped developing Asian economies' exporters of inputs to weather the COVID-19 pandemic.

Reshoring and Regionalization

Through GVCs, developing countries have taken over most of the low-skilled production due to their abundant labor resources to supply the world (Baldwin & Ito, 2021). However, the frequent occurrence of internal or external shocks, such as trade tensions, pandemics and geopolitical conflicts, have raised concerns about the stability and security of GVCs. To minimize the risk of disruptions, some countries have enacted supply chain security strategies to ensure the stability of their supply chains. Such strategies might entail efforts to re-shore or regionalize production. This is less of an option for developing regions, which are relatively technologically backward who are dependent on importing high-tech inputs to increase their competitiveness in the global market. This sub-section briefly analyzes patterns of trade with several indicators that could help identify patterns of reshoring or regionalization, such as the domestic value-added share in exports (DVAR), value-added trade in intermediates, and production length.

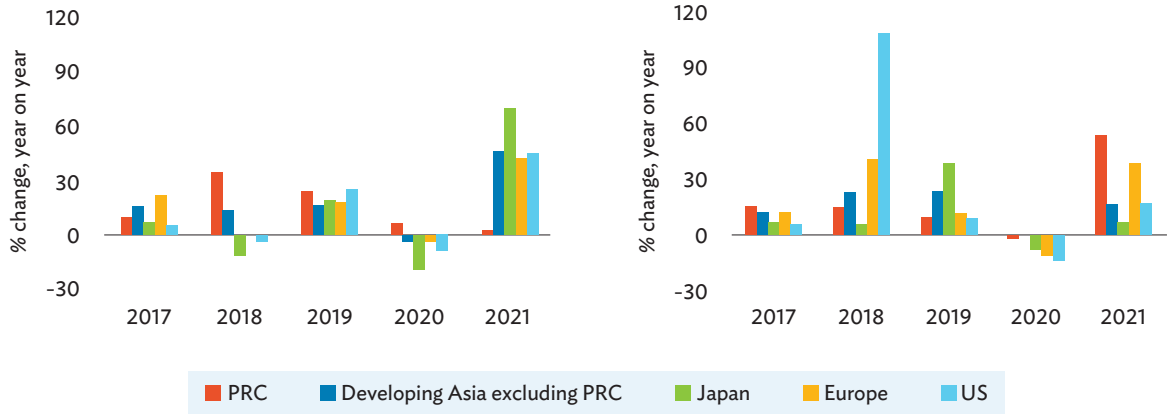
From 2017 to 2021, DVA shares were mostly steady in most regions (see Figure 2.7). While there has been a slight decline in the shares of the PRC and ASEAN, these variations are minor. However, developing Asia's intermediate goods trade data indicates the first signs of regionalization. Developing Asia's value-added trade in intermediate goods remained stable in the pre-tension period 2013–2016 in terms of both intra- and extra-regional trade. In contrast, by 2019, value-added trade in intermediate goods within developing Asian economies had risen by 63% compared with 2016 (see Figure 2.8), which was primarily driven by regional exports of intermediates to the PRC. These patterns reflect the increased level of regionalization as US–PRC tensions mounted (Hugot & Platitas, 2022), with the PRC shifting its imports of intermediate goods away from the US toward developing Asian economies. According to Hugot and Platitas (2022), regional exports of intermediate goods from developing Asia economies to the rest of the world declined significantly in 2019, which made the PRC an even more critical market for producers of intermediate inputs throughout Asia.

Figure 2.7: The Domestic Value-Added Share in the Total Export



Notes: North America (the US, Canada and Mexico), EU refers to the European Union excluding the United Kingdom, ASEAN includes Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Philippines, Singapore, Thailand, Myanmar, and Viet Nam.
Source: University of International Business and Economics (UIBE) global value chain index database, EXin5VA, ADBMRIO2022 version

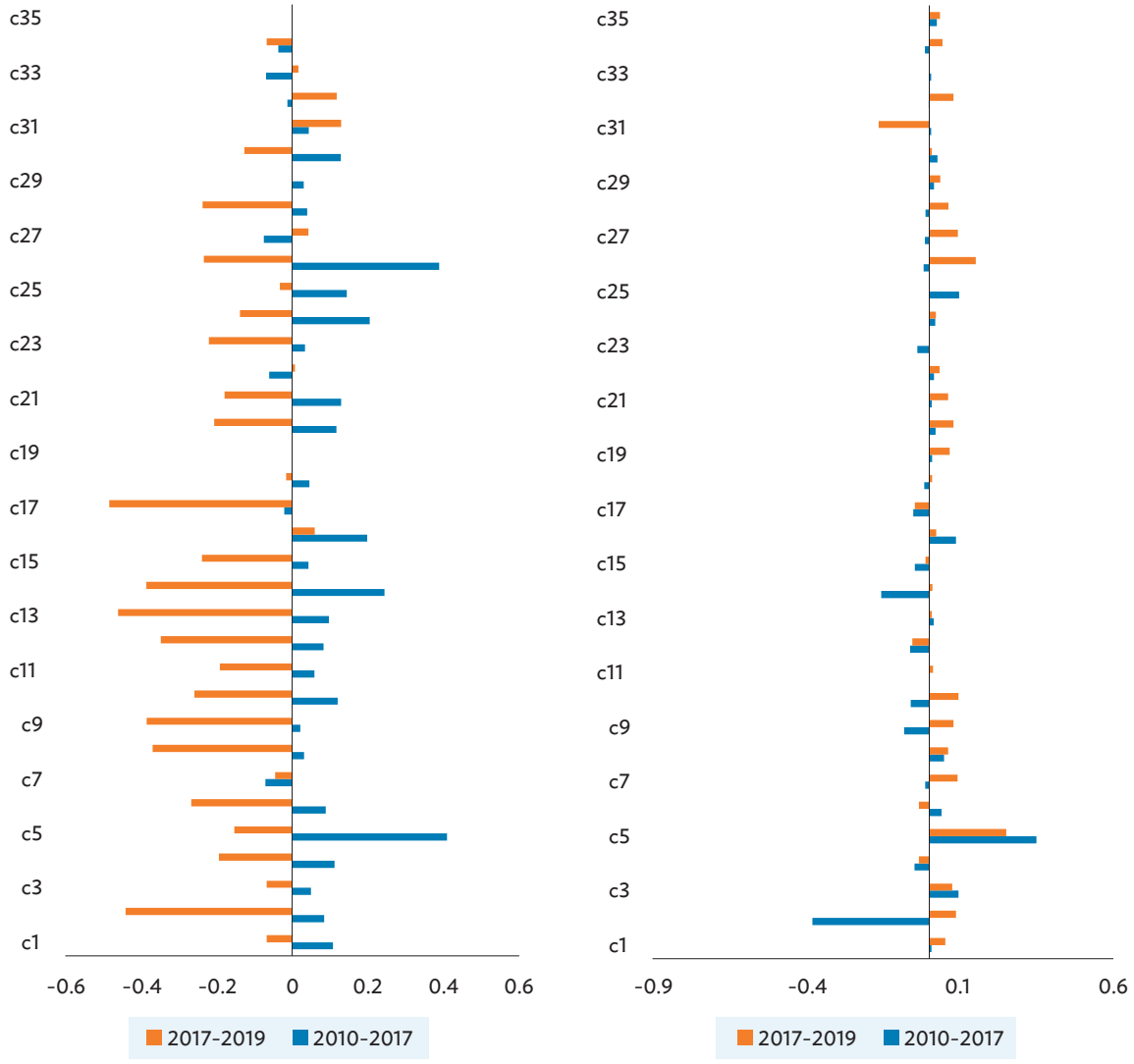
Figure 2.8: Changes in Developing Asian Economies' Value-Added Trade in Intermediate Goods



Notes: Europe = the European Union, Norway, Russia, Switzerland, Türkiye, and the United Kingdom; PRC = People's Republic of China; US = United States, Developing Asia = Bangladesh; Bhutan; Brunei Darussalam; Cambodia; Fiji; Hong Kong, China; India; Indonesia; Kazakhstan; Kyrgyz Republic; Lao People's Democratic Republic; Malaysia; Maldives; Mongolia; Nepal; Pakistan; People's Republic of China; Philippines; Republic of Korea; Singapore; Sri Lanka; Chinese Taipei; Thailand; and Viet Nam.
Trade in intermediate goods was excluded for the following industries: mining, mineral fuels, food and beverages, metals, and other minerals.
Sources: Asian Development Bank Multi-regional Input Output Database 2022. Hugot, J., & Platitas, R. (2022).

In addition, changes in the production length also imply a trend towards more local intermediate goods markets, at least for the PRC. Before 2018, the length of the production chain in most industries in the PRC increased, implying a deeper integration into the global production system, especially in the manufacturing sector, while the length of US manufacturing value chains remained relatively stable. However, from 2017-19 the length of the production chain in the vast majority of Chinese industries (30 out of 35) declined, while that in most US industries (29 out of 35) increased, albeit to a much smaller degree (see Figure 2.9).

Figure 2.9: Changes in Sectoral Production Length of the PRC and the USA



Source: UIBE global value chain index database, Length_ADBMRIO2022

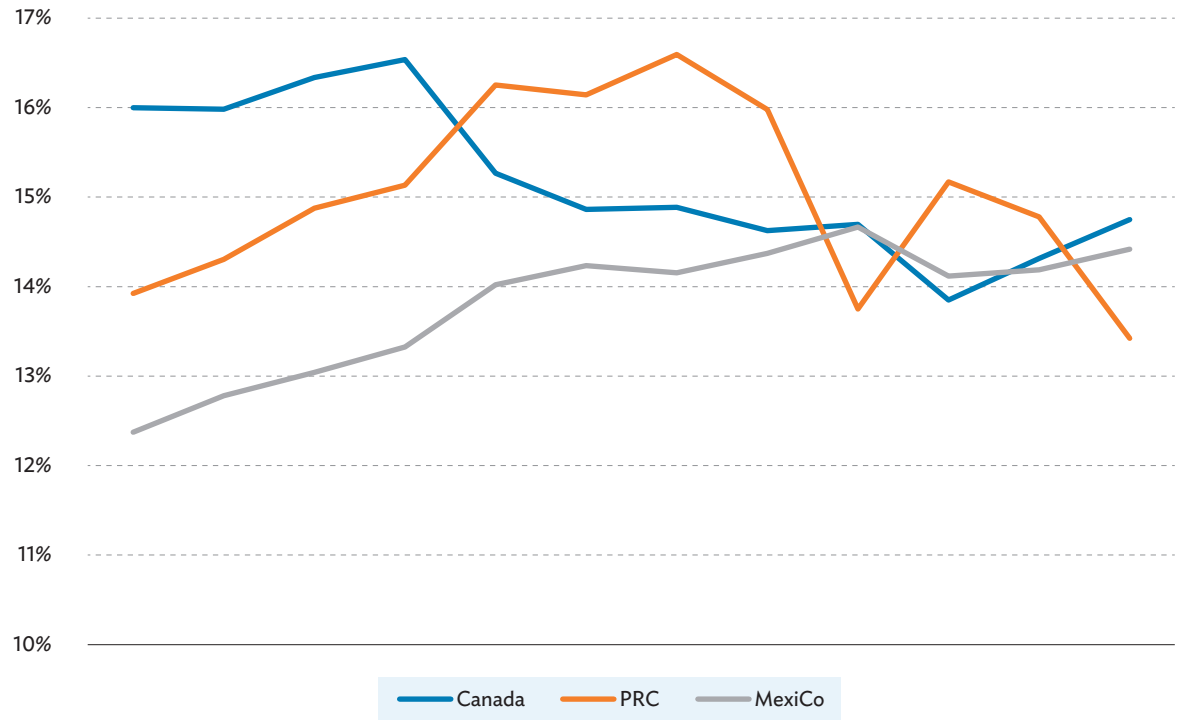
2.4 Trade Tensions and Global Value Chains

Trade Among the Major Economies

Since the onset of the US–PRC trade tensions and the COVID-19 pandemic, the trade patterns of the world's major economies have changed (see Appendix 3). The EU has increased its trade with the PRC and the US driven in particular by changes in German trade. Germany has increased its trade with the PRC, the US, and Poland while reducing its trade with France, which has fallen from first to fourth in terms of Germany's largest trading partners. The US continues to be PRC's largest trading partner, even though trade between the two countries in relative terms has fallen since the commencement of the trade tensions. The PRC's trade with high-tech Asian economies initially declined, but trade with Southeast Asian countries such as Viet Nam has increased. Malaysia has the highest share of trade within the ASEAN region, and the PRC has long been its largest trading partner beyond the region, followed by the US; Hong Kong, China; and Japan.

Before the trade tensions, the PRC was the largest source of imports and the third-largest export destination for the US, while the US was the third-largest source of imports and the largest export destination for the PRC. Since then, the US slipped from being the PRC's largest trading partner to its third-largest partner behind ASEAN and the EU, while the PRC fell from being the US's largest trading partner to its third-largest partner behind Canada and Mexico (see Figure 2.10).

Figure 2.10: Top Three Trade Partners in Merchandise of the US

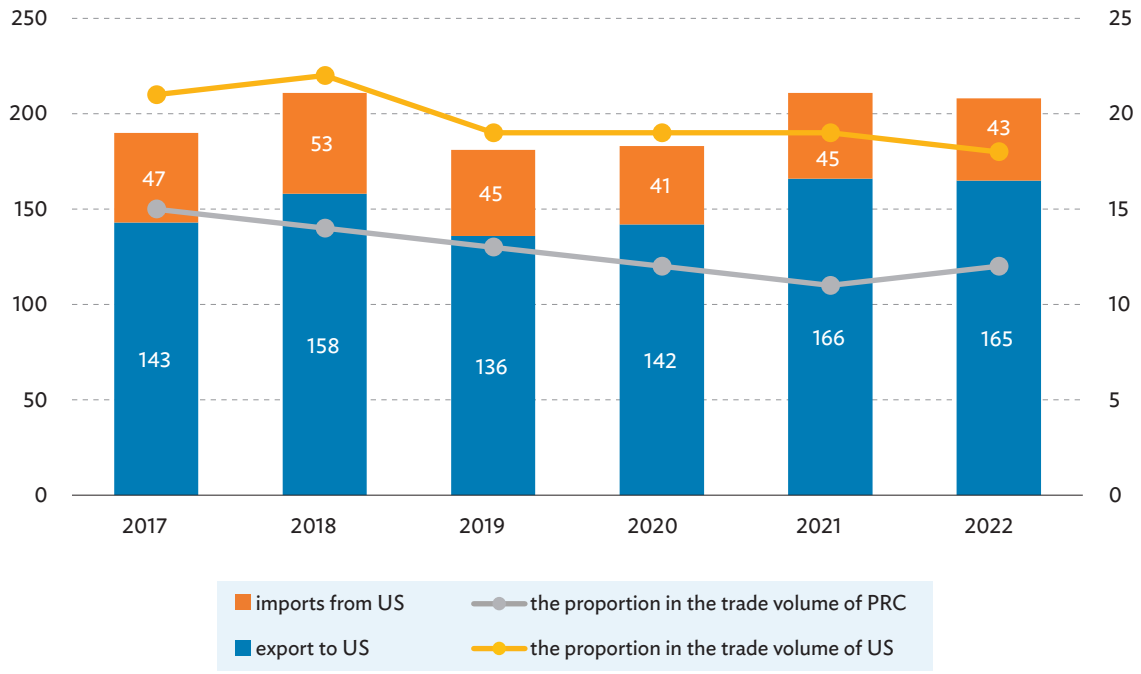


Sources: United Nations (UN) Comtrade database

Between 2017 and 2019, total imports by the US from the PRC decreased by 11.1%, with imports of products subject to increased tariffs decreasing by 18.4%, while imports of other products increased by 3.5%. Specifically, the US reduced its imports of industrial supplies and consumer goods from the PRC and increased its imports of automobiles and food products. As for the PRC, total imports from the US decreased by 19.8%, with imports of products subject to increased tariffs decreasing by 27.0% and imports of other products decreasing by 0.8%. During COVID-19 (2019–2022), bilateral trade between the US and the PRC increased dramatically. Total US imports from the PRC increased by 19.5%, with imports of products subject to tariff increases rising by 5.6% and imports of other products rising by 41.4%. Meanwhile, the PRC's imports from the US increased by 15.9%, with imports of products subject to tariff increases falling by 0.1% and imports of other products rising by 58.4%. Thus, in terms of overall trade volume, PRC–US bilateral trade has demonstrated resilience.

Although the total trade volume between the PRC and the US has maintained an upward trend in recent years, trade in products subject to tariffs, especially high-tech products, has shown a gradual downward trend (Bown, 2023; WTO, 2023). The US has introduced numerous trade acts and policies in an effort to limit the trade of certain security-related high-tech products with the PRC. In line with this and as shown in Figure 2.11, the PRC's trade volume of high-tech products with the US declined. Imports fell from $46.5 billion in 2017 to $43 billion in 2022. The fall has been even more pronounced in relative terms. The proportion of the PRC's total trade in high-tech products that was accounted for by trade with the US fell from 14.5% in 2017 to 11.8% in 2022, while the proportion of the US's total trade in high-tech products that was accounted for by trade with the PRC fell from 21.1% to 18.0% over the same period.

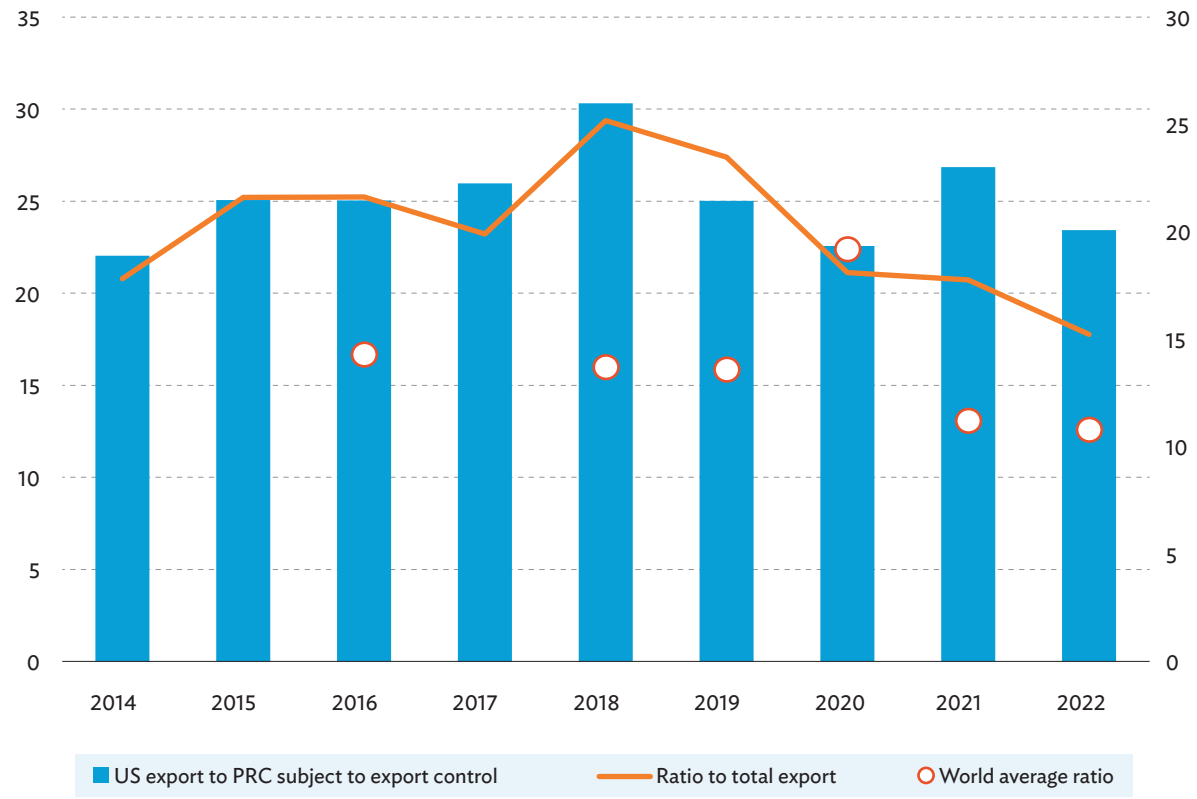
Figure 2.11: PRC-US Trade in High-Tech Products



Source: WITS database.

The decline in US exports of high-tech products to the PRC is likely to have been affected by US export controls. The US has increased exports of some products in specific areas to the PRC over the past few years. However, the Bureau of Industry and Security of the US Department of Commerce has reported that the overall trend of exports to the PRC of products belonging to export-controlled categories is declining (see Figure 2.12). The PRC increased its imports of these goods before the US export controls came into effect, resulting in exports of US export-controlled goods increasing significantly in 2018 before declining. Despite some volatility in subsequent years, the share of total exports to the PRC represented by these goods declined from 25% in 2018 to 15% in 2022.

Figure 2.12: US Export to PRC Subject to US's Government Export Control



Notes: Controlled exports include exported products subject to a BIS license requirement and exports under No License Required (NLR) reporting an Export Control Classification Number
Source: US Bureau of Industry and Security (BIS) report, US Trade with China, 2014–2022

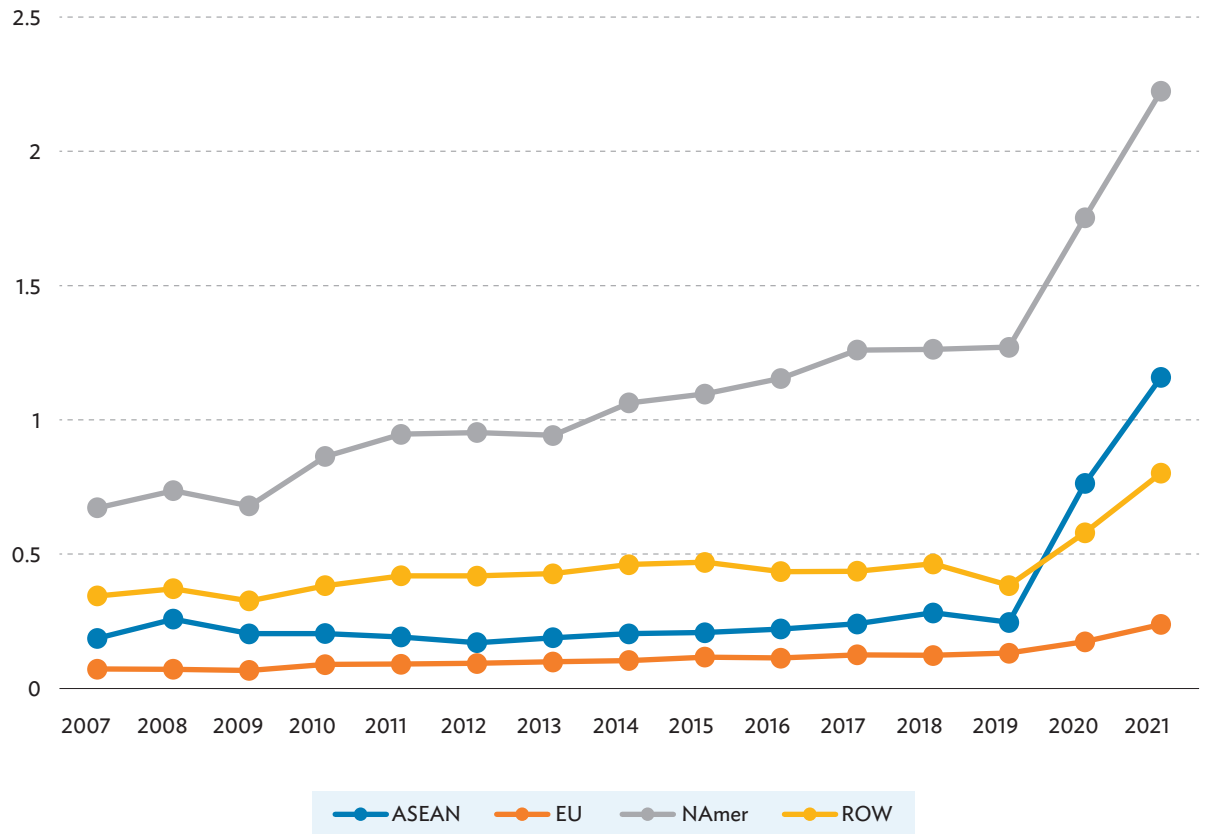
Triangular Trade between the PRC, the US and Third Countries

The rise of GVCs implies that countries are increasingly connected indirectly through trade. As the foreign content of exports increases, importers depend to a larger degree on the suppliers of their suppliers. This means that looking at simple bilateral gross trade statistics when assessing the interdependence between two countries might be

misleading. For instance, in response to an increase in bilateral trade costs, companies look for alternative paths in an effort to avoid tariffs and the associated uncertainty. A prominent example of this is the response of firms from the PRC and the Republic of Korea, which avoided US antidumping duties by relocating production to countries not targeted by those duties (Flaaen et al., 2020). This section presents initial statistics on indirect imports by the US from the PRC through third parties.

Using multi-regional input–output tables published by the Asia Development Bank, we calculate indirect exports from the PRC to the US through third regions by multiplying the ratio of intermediate imports of a given third country from the PRC to the total intermediate input of that country with the ratio of its exports of final products to the US to its total exports at the sectoral level and then aggregating to the regional level using simple averages. Although direct exports from the PRC to the US have gradually decreased since 2018, Figure 2.13 shows that indirect exports have increased in recent years, primarily via ASEAN, Mexico, and Canada since 2020. At the industry level, fabrics and textile products, leather and footwear, equipment manufacturing, electrical and optical equipment, and transportation equipment (see Box 2.1) are the key US industries that indirectly import intermediate goods from the PRC.

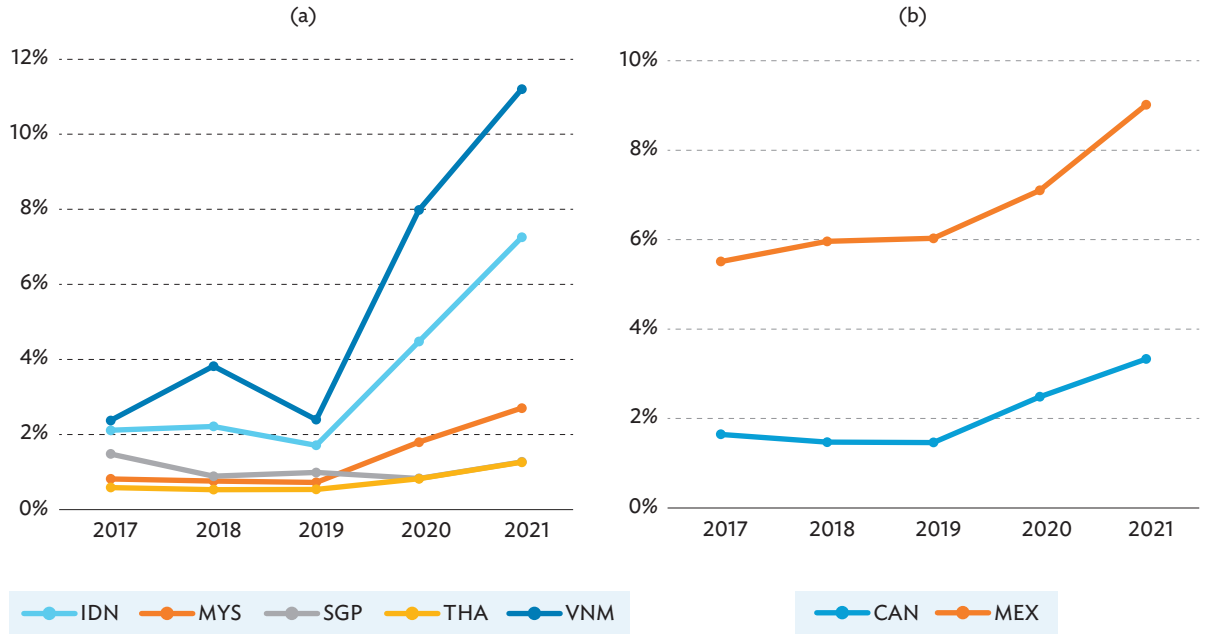
Figure 2.13: Indirect Import of Intermediate Inputs from the PRC to the US through Third Regions



Notes: The indirect import was calculated by multiplying the ratio of intermediate imports of the third country from the PRC to the total intermediate input of the third country with the ratio of export of final products from the third country to the US to the total export of third country at the sectoral level. The lines represent simple averages across sectors.
Sources: Asian Development Bank Multi-regional Input–Output Database 2022

Southeast Asian countries, which are geographically close to the PRC and have relatively low labor costs, have become important intermediaries for trade between the PRC and the US. In particular, Malaysia, Singapore, and Viet Nam have experienced a significant increase in exports to the US as a share of total exports. Meanwhile, imports of intermediate goods from the PRC by ASEAN countries such as Indonesia, Malaysia, Thailand, and Viet Nam have rapidly increased, especially in 2020 and 2021. Figure 2.14a shows that the proportion of US imports from the PRC through Viet Nam and Mexico has risen significantly over the past five years. Goods imported through Viet Nam went from as low as 2% in 2019 to 10.4% in 2021. The indirect intermediate import from the PRC through Mexico to the US rose to 8% at that year, up from 5% in 2017 (see Figure 2.14b).

Figure 2.14: The Ratio of Indirect Intermediate Import of the US from the PRC through ASEAN and USMCA Countries.



Notes: We compute here the share of sector-specific exports of final goods from the PRC to the US as a percentage of the total sectoral exports of final goods, and the share of sector-specific intermediate goods exported to the US from the PRC as a percentage of the total sectoral imports of intermediate goods by the US. These two figures were then multiplied and aggregated using simple averages at the country level to represent the indirect imports by the US of intermediate goods from the PRC through ASEAN countries.
Sources: ADB MRIO database

This evidence on triangular trade is in line with several recent studies. Fajgelbaum et al. (2021) highlight that some third countries, especially Viet Nam, Thailand, the Republic of Korea, and Mexico, benefitted significantly from the tensions as they increased their exports to the US and the rest of the world. Alfaro and Chor (2023) suggest that this combination of increased sourcing of inputs from the PRC and increased exports to the US of these economies is likely inefficient and presents early evidence of associated price increases in US imports from Viet Nam and Mexico.

Box 2.1: Changes in Global Trade Patterns – The Rise of Electric Vehicles and the Auto Industry

The International Organization of Motor Vehicle Manufacturers (OICA) has reported that the PRC has become the world's leading auto manufacturing and consuming country, accounting for approximately 31.8% of global production and 32.9% of global sales in 2022 thanks in part to electric vehicles (O, 2023). In recent years, the Chinese government has provided support to new-energy vehicle (NEV) producers in an effort to promote domestic auto production. During 2012–2017, the DVA share of auto exports rose slightly. Meanwhile, the DVA shares in processing exports and foreign-invested firms' exports declined during this period, indicating that the PRC's domestic auto industry was positioned deeper in GVCs as an intermediate importer (Cai & Wang, 2022).

In the meantime, the tariffs imposed by the US on Chinese-made auto parts significantly impacted US imports from the PRC, resulting in declines of 22.8% and 26.7% in 2019 and 2020, respectively (Gaydarska et al., 2022). Mexico was one of the beneficiaries of the trade tensions because the decline in imports by the US of auto parts from the PRC was accompanied by a corresponding increase in imports from Mexico.

2.5. COVID-19, GVCs and Digitalization

The Impact of COVID-19 on Reshaping Global Value Chains

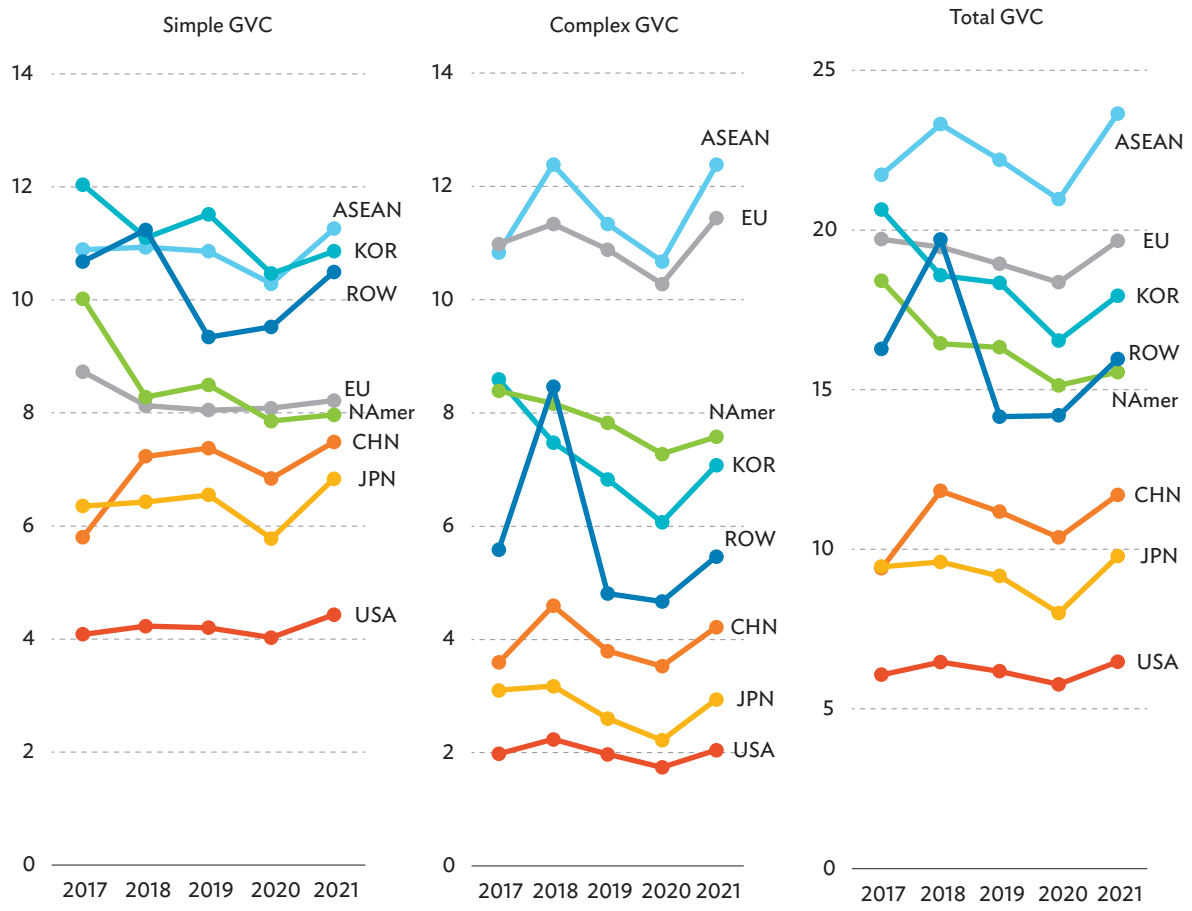
The COVID-19 pandemic and related disruptions to the movement of products and people have exacerbated challenges to globalization. The collapse of supply chains during the pandemic has led to concerns about the ongoing availability of key commodities, and policymakers have considered various responses to increase resilience, including regionalization and reshoring (Barbieri et al., 2020). Moreover, the pandemic came during a period at which GVC expansion was already slowing down. Previous studies have identified several factors behind this trend (Bacchetta et al., 2021; Enderwick & Buckley, 2020). These factors include rising trade costs and trade policy uncertainty. As discussed above, rising trade tensions have led to tariff increases between major trading economies. Another factor is eroding wage differences between developed and developing economies that decrease the returns to offshoring. A third factor is technological progress in areas like automation and artificial intelligence.

Recent trade data provide some clues regarding the reconfiguration of the value chains to see whether the pandemic accelerated the slowdown of GVCs through regionalization. We analyze the reconfiguration of GVCs using aggregate interregional trade data and value chain indicators (see Figure 2.15). The pandemic led to a severe contraction of GVCs in 2020, but GVC activity rebounded rapidly in 2021.

Counterfactual Analysis of the Impact of the COVID-19 Pandemic on GVCs

To assess whether the rebound in GVC activity is likely to continue, we use a counterfactual analytical framework in the form of an extended computable general equilibrium (CGE) model to explore the impact of this external shock on GVCs (see Appendix 4). This analysis considers four sources of shock: labor, consumption preferences, trade costs, and tourism. The key setting is that while various countries are

Figure 2.15: The Share of Total, Simple and Complex GVC Activities



Notes: For simplicity, the GVC indicators are aggregated from UIBE GVC indexes, which originally are country-specific indices. The country-level backward decomposed items are firstly aggregated and then calculated the share of GVCs, which may induce bias.
Sources: UIBE global value chain database, FGin5VA, ADBMRIO 2022 version.

set to recover at different rates depending on their performance during the pandemic, almost all the shocks are expected to return to the baseline by 2025. For example, the labor supply decreased sharply in 2020 due to COVID-19, but would gradually bounce back to the original level prior to the pandemic.

Next, we assess the impact of the COVID-19 shock on different components of exports based on a decomposition that allows to more clearly separate between GVC trade and traditional trade (see Box 2.2 for details). In addition, we distinguish between domestic and foreign firms as the COVID-19 pandemic has significantly impacted global investment patterns.

The effects discussed in this section are counterfactual estimates representing the difference between the business-as-usual and policy scenarios so that the results can be positive or negative. For example, the World Economic Outlook data published by the International

Monetary Fund in October 2019 suggested that the PRC's GDP growth was expected to be 5.8% in 2020 under the business-as-usual scenario. However, due to the COVID-19 pandemic, GDP growth was only 2.2%. Thus, the counterfactual result is negative 3.6%, which can be regarded as the effect of the COVID-19 pandemic on the PRC's GDP.

Box 2.2: GVC activities with FDI heterogeneity

Extended CGE modeling incorporating MNEs was used to quantify the impact of the COVID-19 pandemic on GVCs. A GVC decomposition method that distinguishes between domestic and foreign investment (Wang et al., 2021) was used to map the impacts of the COVID-19 pandemic. This framework distinguished five indexes: VD, VRT, VGT, VGI, and VGTI.

(1) **VD:** Value added created by domestic firms in their final production to satisfy domestic final demand, which is pure domestic activity.
(2) **VRT:** Value added created by domestic firms but embedded in final goods exports to satisfy final demand abroad, representing traditional trade production activities.
(3) **VGT:** Value added embodied in intermediate exports that are produced by domestic firms in the exporting country, but used by domestic firms in the direct importing country to produce final products either for domestic consumption or for export to third-party countries, which is regarded as trade-related GVC activities.
(4) **VGI:** Value added embodied in the activities of foreign firms in a host country. All of the production activities and linkages between foreign firms and domestic/foreign firms are located in the host country and aim to meet the final demand in either domestic or foreign markets, which represents FDI-related GVC activities (VGI).
(5) **VGTI:** Value added embodied in activities involving both cross-border investment by foreign firms and cross-border trade. The value added created by domestic (foreign) firms is embedded in the intermediate exports that are used by foreign (domestic) firms to produce final products that are either consumed domestically (in the direct importing country) or exported to other countries, which represents trade- and FDI-related GVC activities.

The COVID-19 pandemic significantly impacted traditional global trade (VRT), with trade of final products falling by 13.3% in 2020 before rebounding by 20.4% in 2021. Regarding trade-related activities (VGT), this was mainly the result of the contraction of trade in intermediate goods due to lockdowns or export restrictions at the global level.

However, FDI activities (VGI and VGTI) were not significantly affected by the COVID-19 pandemic. First, capital is more mobile than physical goods, and multinational companies were able to adjust their global allocations in response to the pandemic. Second, due to national lockdowns, overall demand tended to favor domestic supply, thereby increasing linkages between domestic producers, among which the strong links between local and foreign firms support the FDI activities. Although all items experienced a negative impact in 2020, the structure shows that the proportion of pure domestic production activities increased while that of all other items decreased. Following the breakdown of international supply chains as a result of increased trade costs, coupled with government restrictions on exports, especially of essential goods, there was an increase in domestic production and supply.

At the economy level, PRC, Mexico, and ASEAN differed from other economies (see Figure 2.16). The PRC experienced a sharp increase in pure domestic activities, which offset the decline in international demand. In addition, the PRC's FDI-related activities increased, which is more likely to have been driven by foreign firms within the PRC

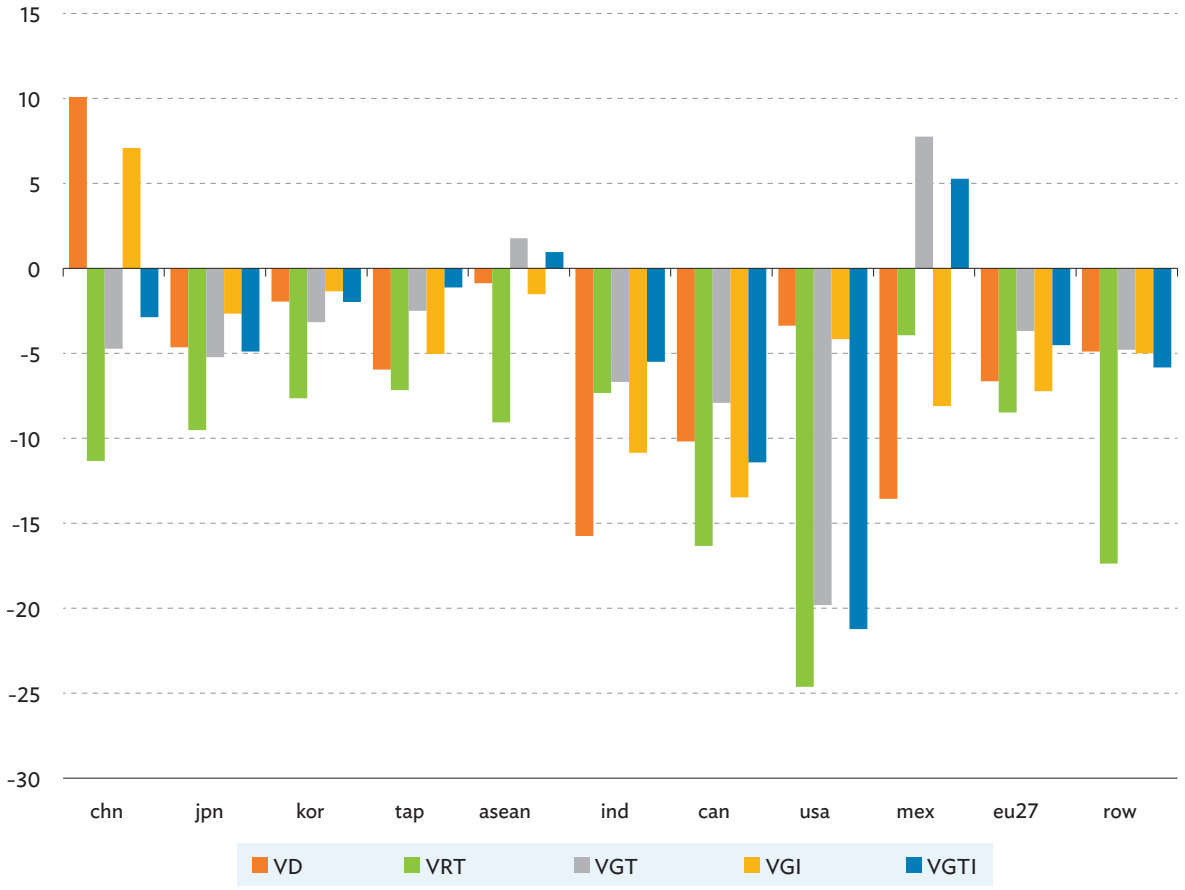
than by cross-border trade activities of foreign firms. First, as mentioned earlier, the resilience of the PRC's production during the pandemic enabled the PRC to continue to supply significant amounts of products to the rest of the world, particularly ASEAN countries. Second, the increase in domestic demand, coupled with border closures, increased demand from the PRC's domestic suppliers, including foreign-owned firms within the PRC. This is also consistent with the internal financing hypothesis whereby local foreign-owned firms tend to retain profits to enable increased investment in regions offering higher returns (Moosa & Merza, 2022). UNCTAD data revealed that the PRC's FDI inflows increased during the pandemic in both 2020 and 2021[2].

In contrast, Mexico and ASEAN received more orders from abroad, so the trade-related activities (VGT) and trade- and FDI-related activities (VGTI) in these countries increased during the pandemic. The former describes cross-border production activities of domestic firms in different regions, while the latter describes cross-border production activities between domestic and foreign firms. The increase in both suggests that Mexico and ASEAN imported intermediate products to enable them to produce final products during the pandemic. As can be seen from the detailed GVC decomposition framework, several channels require further empirical analysis. Firstly, domestic firms strengthened their linkages with local firms in other countries. Secondly, foreign firms in other countries used their global advantages to outsource to domestic or foreign firms in Mexico and ASEAN. Third, foreign-owned firms in Mexico and ASEAN purchased intermediate goods from domestic firms in other countries.

The COVID-19 pandemic not only affected the structure of global trade but also restructured the value chains. We chose four countries, the PRC, the US, Mexico, and India, to discuss the typical changes in GVCs (see Figure 2.17). After the PRC returned to normal following the pandemic, pure domestic production and FDI-related activities were higher than the baseline. Mexico's traditional trade was crowded out by the economic recovery in other regions and has continued to decline since then. In addition, although trade-related activities and trade- and FDI-related activities increased during the 2020 pandemic, they might decline in the future once these activities in other countries start to recover. Mexico's performance was essentially the result of a reorganization of the GVCs. At the beginning of the pandemic, Mexico imported more intermediate goods to produce final goods, attracting a large amount of FDI. During the recovery, the PRC's strong supply capacity for final products and productivity recovery in other countries reduced the demand for Mexican products. Thus, Mexico's traditional trade has gradually declined. Global capital has also tended to gravitate toward the PRC, the US, and Europe, thereby reducing investment into Mexico and shifting the impact of COVID-19 on Mexico's FDI-related activity from positive to negative in the long run.

2 UNCTAD, Global foreign direct investment flows over the last 30 years, https://unctad.org/data-visualization/global-foreign-direct-investment-flows-over-last-30-years, accessed by July, 2023

Figure 2.16: Changes in Value-Added Activities in 2020 (%)

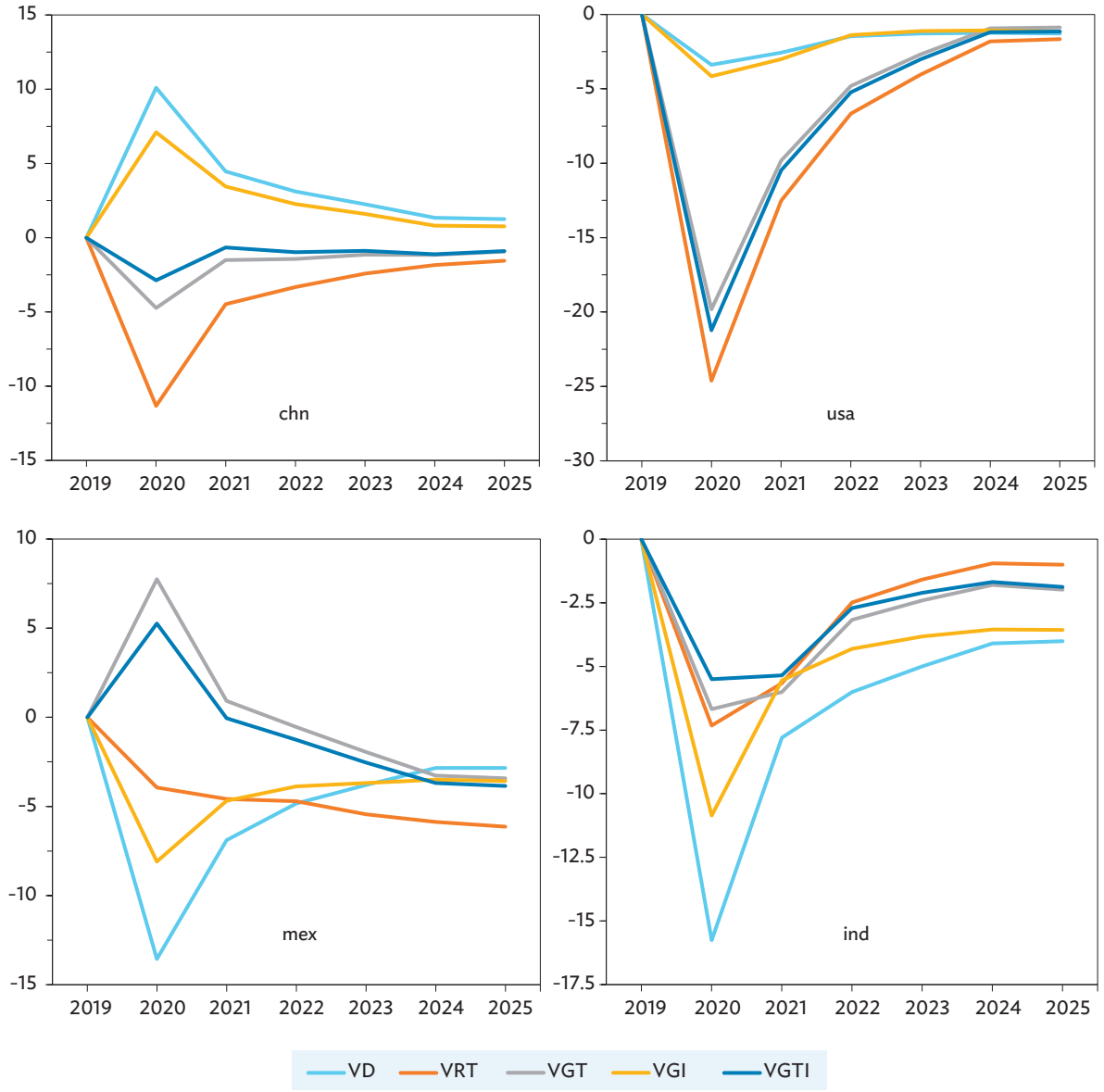


Note: VD = pure domestic production activities, VRT = traditional trade production activities, VGT = trade-related GVC activities, VGI = FDI-related GVC activities, and VGTI = trade- and FDI-related GVC activities, following Wang, Wei, Yu & Zhu (2021).

The long-term trends in the US and India are similar, with the GVC indicators gradually returning to the baseline following the shock. However, the impact of the pandemic was more significant in India, which experienced an outbreak of COVID-19 in the first half of 2021 and thus was slower to recover than the US. In addition, the US, which offers greater returns on investment, received more FDI, enabling a faster recovery.

As shown in Figure 2.17, due to the higher growth rates of pure domestic and FDI-related activities relative to other components, the proportions of these two activities in the PRC would increase. Similarly, as for India, all items except pure domestic activities increased indicating that India would participate more in GVC activities. At the same time, Mexico's trade-related and trade-FDI-related activities are also important to the global value chains. In summary, trade disruptions as a result of the COVID-19 pandemic caused a sharp decline in trade. However, trade rebounded even stronger in 2021, reversing previous trends.

Figure 2.17: Growth rates of GVC items in the PRC, the US, Mexico, and India.



Note: VD = pure domestic production activities, VRT = traditional trade production activities, VGT = trade-related GVC activities, VGI = FDI-related GVC activities, and VGTI = trade- and FDI-related GVC activities, following Wang, Wei, Yu & Zhu (2021).

Digitalization, Resilience and Recovery

In an increasingly interconnected and rapidly changing world, GVCs face numerous challenges that can disrupt operations and impact global economies. Digital infrastructure and technologies offer a promising means of enhancing the resilience of supply chains, promoting rapid adaptability and thereby enabling businesses to thrive in volatile environments.

Firstly, the development of the digital economy itself can enhance economic resilience by increasing the size of the economy (OECD, 2018). The rise of digital industries, such as the platform economy and the Internet economy, has increased the number of industrial forms in numerous countries, expanded employment options (Bai et al., 2021), and spread regional systemic risk, all of which can help countries to combat external shocks (Pisu et al., 2021).

Secondly, digitalization improves transparency and the allocation of resources (OECD, 2018). Digital technologies can help reduce information asymmetries, lowering search costs for producers and dramatically increasing the circulation of resources. Information sharing can strengthen the connection between suppliers and buyers, and facilitate collaboration among stakeholders, thereby reducing friction along the value chain. Digital platforms enable seamless communication, information sharing, and coordination among suppliers, manufacturers, distributors, and customers (Santos et al., 2023). Technologies like the Internet of Things, cloud computing, and big data analytics enable businesses to streamline processes, monitor operations in real-time, and make data-driven decisions.

Thirdly, digitalization can help manage the risks and improve the security of global supply chains (Eling & Lehmann, 2018). Increased visibility enables early detection of potential disruptors and the appropriate adjustments to mitigate risks swiftly and effectively. By creating an interconnected ecosystem, businesses can quickly identify bottlenecks, resolve issues, and make informed decisions, thereby fostering resilience and adaptability (Bürgel et al., 2023; Forliano et al., 2023).

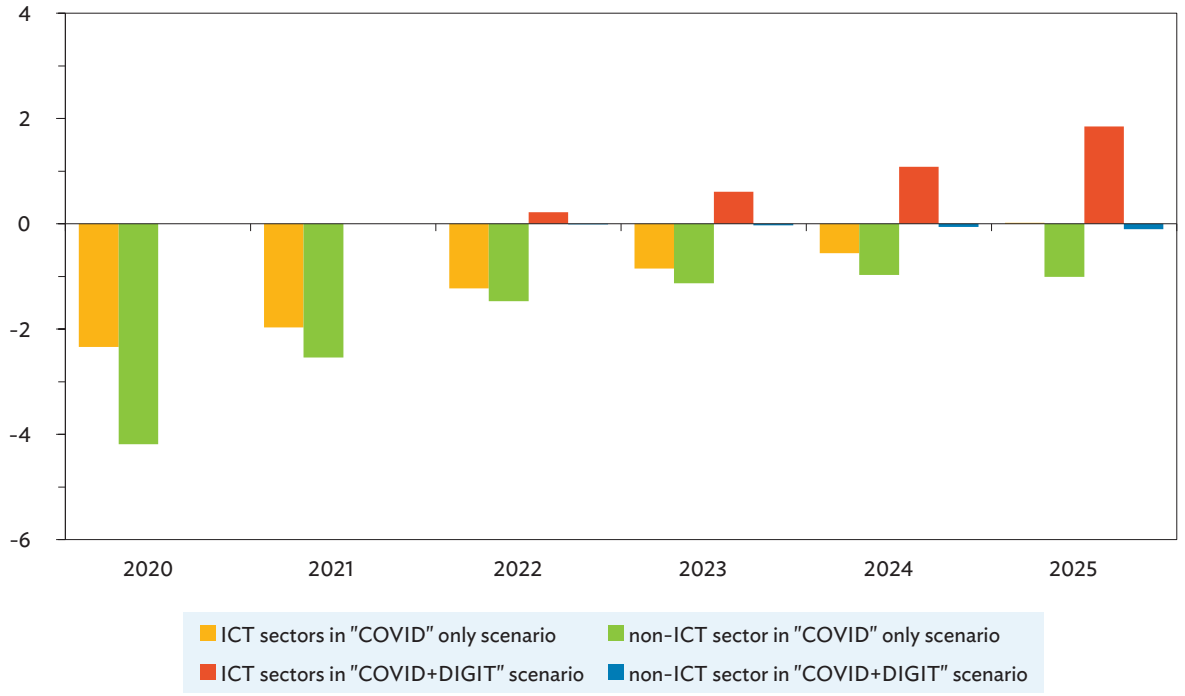
In particular, blockchain technology can provide an immutable and transparent transaction record, thereby enhancing stakeholders' trust and security (Ganne, 2018). Radio Frequency Identification technology enables tracking products, materials, and components, enabling greater control of the production process and reducing the likelihood of disruptions. With improved visibility, businesses can proactively manage supply chain complexities, respond to evolving customer demands, and minimize the impact of unexpected events. Integrating automation and robotics technologies into industrial processes reduces dependence on manual labor and enhances efficiency.

During the COVID-19 pandemic, digital technology enhanced the resilience of the production and supply chain systems in various countries, thereby reducing the impact of the pandemic on their economies (Gaspar et al., 2022; Jaumotte et al., 2023; Kim & Kim, 2023; Kim et al., 2022). The flexibility provided by the ability to work remotely increased the labor supply in some industries, while technologies such as artificial intelligence and robots maintained stable productivity in the manufacturing industry (Abidi et al., 2022; Copestake et al., 2022). Digital technologies enable productivity gains and economic growth by improving users' access to information and reducing trade and transaction costs (Khalil et al., 2022). In particular, establishing a healthy digital economic ecosystem in low- and middle-income countries can help them recover and build resilience in response to shocks similar to the COVID-19 pandemic. However, the digital divide can potentially exacerbate economic inequality, and technological catch-up requires considerable organizational and institutional change (Tinhinan, 2020).

Evidence from quantitative modeling that estimates the effects of digital technology policies on GVCs during COVID-19 reveals several facts (Gao et al., 2022). As shown in Figure 2.18, the decline in output of the information and communications technology (ICT) industry was less than that of non-ICT industries as a result of the increased demand for remote communication by individuals, businesses, and governments.[3] The results showed that the ICT industry experiences significant growth, while non-ICT industries barely change. The reasons for the difference between these two sectors are twofold. First, producers may shift resources to ICT inputs without affecting average costs (cost-neutral preference). Thus, total costs are unchanged but demand for ICT products rises. Second, we also assumed that the efficiency of ICT intermediate input would improve in the future, which can reduce the demand for ICT products, but this effect was insufficient to offset the effect of preference shift on the ICT demand. Thus, the overall effect of these two settings on the output of ICT sector was positive.

A natural question is whether the impact of the COVID-19 pandemic on GDP was relatively small in regions with relatively well-developed ICT infrastructure. Figure 2.19 shows scatter plots of several digital indicators against potential GDP changes.[4] All the scatter

Figure 2.18: Counterfactual Outputs of ICT and non-ICT Industries During the COVID-19



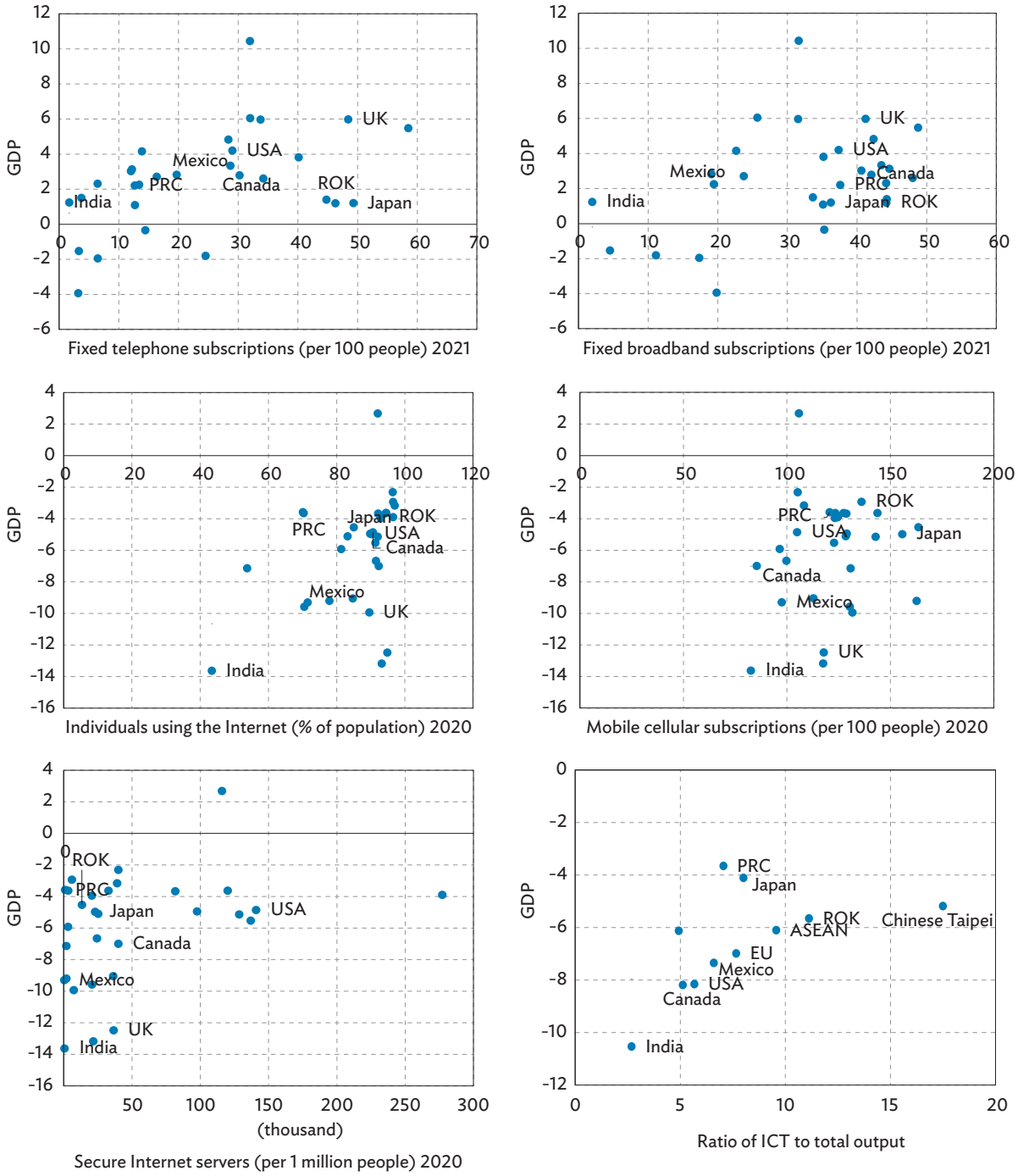
Notes: In the 'COVID' scenario, we only considered shocks to the labor supply, consumption preferences, trade costs, and tourism. In the 'COVID+DIGIT' scenario, we considered the shocks in the COVID scenario, but also included extra shocks, that is the producers would prefer more digital technology input and the efficiency of the technology usage will rise.

3 Here it is assumed that demand for intermediate ICT inputs by industries rose, as well as the efficiency of ICT inputs.

4 These indicators were obtained from the World Bank, and included fixed broadband subscriptions, fixed telephone subscriptions, mobile cell phone subscriptions, numbers of individuals using the Internet, and numbers of secure Internet servers per unit of population.

plots indicate that economies with more developed digital infrastructure experienced smaller declines in GDP (c-e), or recovered more quickly than other regions (a-b). Such findings illustrate the role of digitalization in dealing with shocks such as the COVID-19 pandemic and in shielding productivity and preserving employment.

Figure 2.19: Potential GDP Changes (%) and Digital Infrastructure



Note: The potential GDP changes in the first five scatterplots, panel (a)-(e), are the difference between actual and projected GDP published in the IMF's World Economic Outlook in October 2019. Panel (f) shows the counterfactual GDP result obtained from the CGE model.

Sources: World Development Indicators, International Monetary Fund World Economic Outlook, October 2019,

Conclusion

This chapter illustrated the propagation of shocks in GVCs and the correspondingly changing patterns in trade through events such as the US–PRC trade tensions and the COVID-19 pandemic. It discussed such effects based on the existing literature as well as indicators constructed by the authors. It also provided a general overview of trade patterns after such events and discussed the role of digital technology in the recovery and some trends toward reshoring.

Trade tensions between the PRC and the US reshaped global trade. Even though the aggregate trade flows did not decrease significantly, effects were felt at the sectoral level. Numbers show that during 2017–2022, global trade was reconfigured, and trade diversion effects followed. For instance, in response to the tariff increases by the US, the PRC shifted its export focus to East Asia and Pacific region and Europe and Central Asia region, with exports to those regions increasing by 11.7% and 16.1%, respectively.

The trade tensions increased the costs of global production, especially for downstream producers. Trade costs such as tariffs and non-tariff measures can accumulate along GVCs as goods and services cross borders several times, leading to higher costs of intermediate goods for downstream producers. The PRC's cumulative input tariffs, which consist of the retaliatory tariffs imposed by the PRC on the US and indirect tariffs along GVCs, jumped by an average of 47%. The US and the PRC incurred an additional indirect tariff burden of 10 and 6.5 billion US dollars, respectively, while third-party countries incurred additional costs of 30%–70%. The elasticity of DVA in response to the cumulative input tariffs was about 34%. Additional non-tariff burdens induced by the trade tensions and the COVID-19 pandemic mainly affected firms that were less able to diversify their production inputs or use additional inventories. While the trade tensions also induced increased regionalization and reduced the length of the global production chains, they did not trigger de-globalization.

The disruption of GVCs caused by the COVID-19 pandemic led to significant changes in the global economy. The COVID-19 pandemic first led to a sharp decline in trade, but the process subsequently reversed. Almost all traditional trade and trade-related activities significantly contracted during the COVID-19 pandemic, leading to an increase in consumption of output produced domestically (without intermediate inputs from abroad). Meanwhile, cross-border trade involving MNEs increased slightly as a result of stronger links between MNEs and domestic firms. The PRC played a far greater role in Asian production during the COVID-19 pandemic, with developing Asian economies' imports of inputs from the PRC declining by just 1%, while those from other regions (e.g. Europe, the US) fell by over 10%.

The effects of digitalization on economic recovery were also analyzed, and further evidence was obtained supporting the hypothesis that countries with superior digital infrastructure were less affected than others during the COVID-19 pandemic. Global

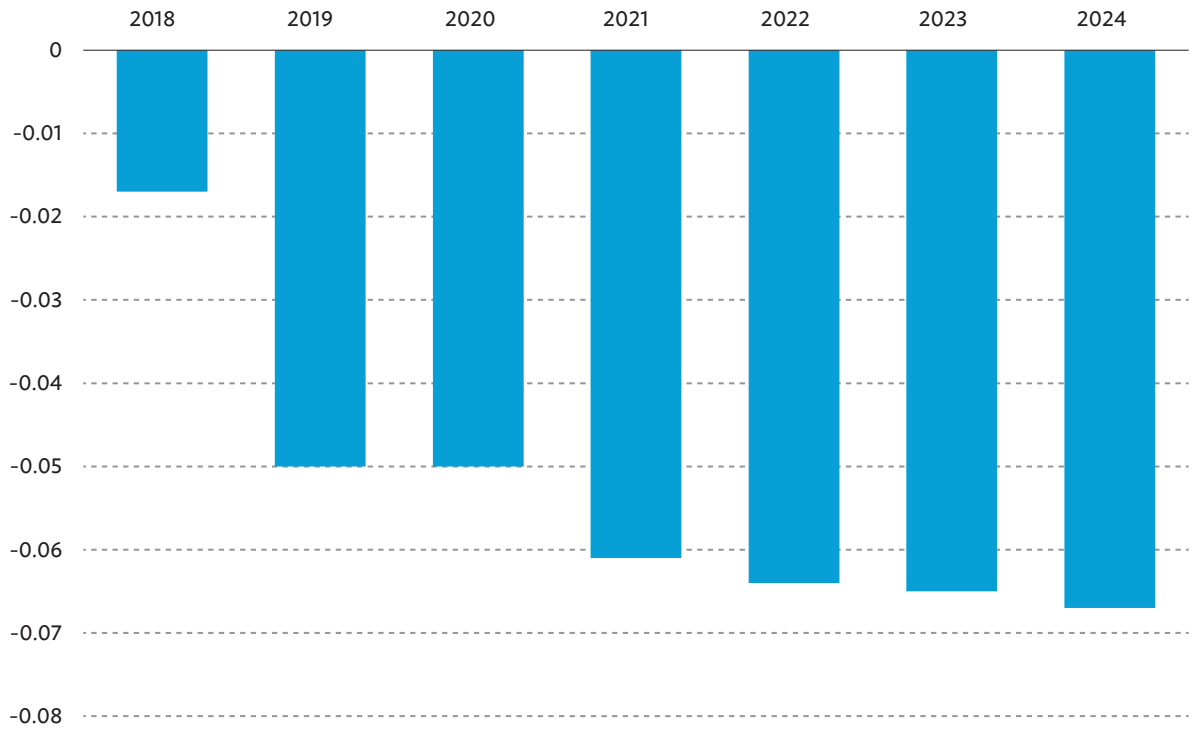
demand for digital technology led to increased investment in high-tech industries, thereby boosting FDI-related activities. The findings should help public policymaking in the post-COVID era about the resilience of GVCs, which could be strengthened by increasing the digitalization of economies, to better cope with uncertainties caused by trade conflicts and other external shocks.

Appendix

Appendix 1: Changes in the Average Global Value Chain Production Length as a Result of the US–PRC Trade Tension

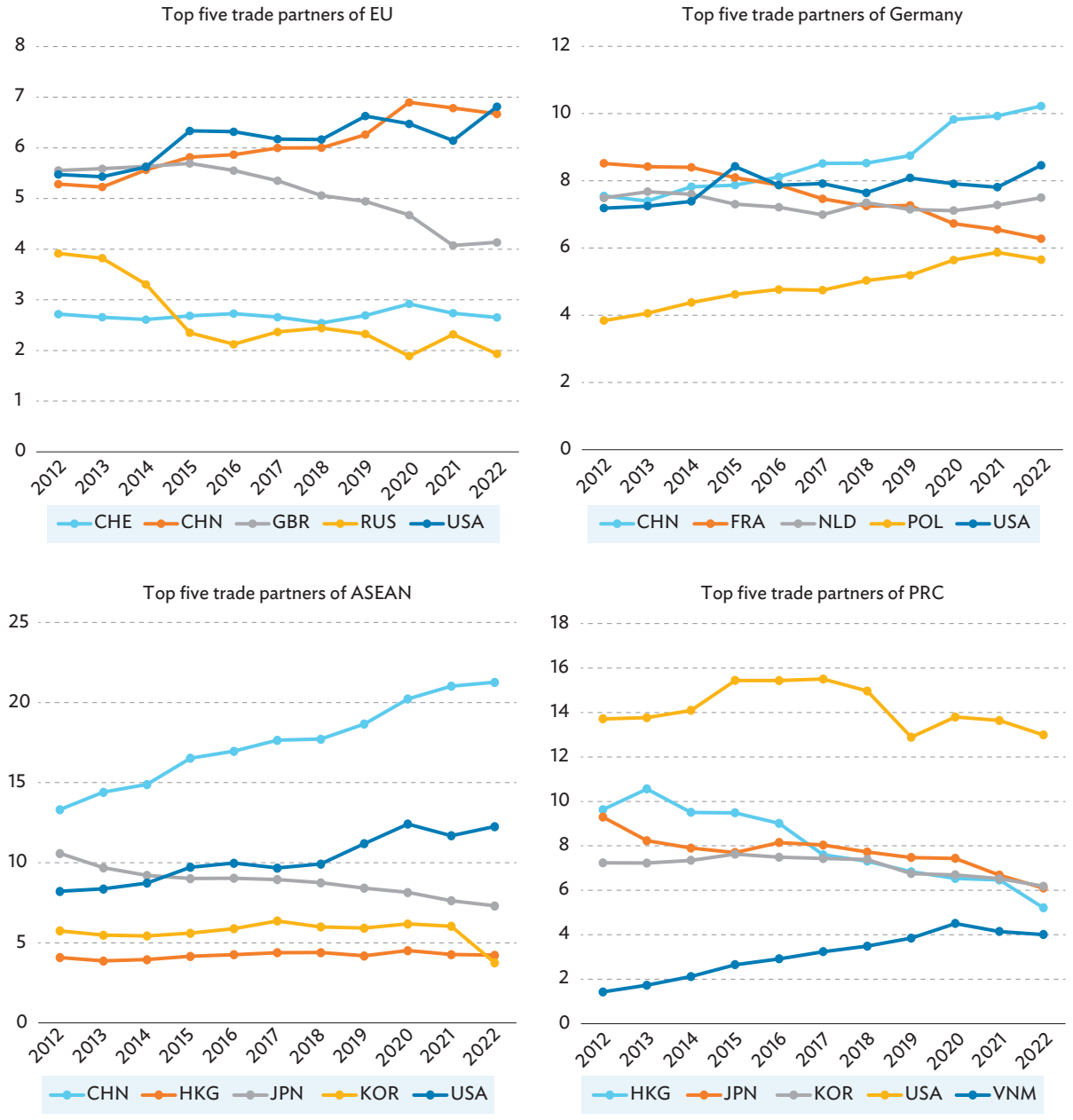
Disruptions arising from the US–PRC trade tension were expected to lead to an increase in reshoring (Meng et al., 2022). Although the average GVC production length is projected to decrease in the near future based on CGE modeling, this does not necessarily mean that the US–PRC trade tension triggered a process of de-globalization, if it is defined as the shortening of global value chain production length. Indeed, only two Asian economies, Hong Kong, China and Malaysia, de-globalized, although many less-developed Asian economies increased their self-reliance through increased domestic consumption while reducing their exports. In contrast, self-reliance declined in most advanced regional economies in terms of consumption, but increased in terms of exports, with machinery exports including more domestic content (Hugot & Platitas, 2022). Moreover, this CGE study has only considered the additional tariffs imposed by the US and the PRC on each other. We have not included other policies to minimize the adverse effects of these two countries or even any policies of other countries.

Figure 2.20: Changes in the Average Global Value Chain Production Length as a Result of the US–PRC Trade Tension (%)



Source: (Meng et al., 2022)

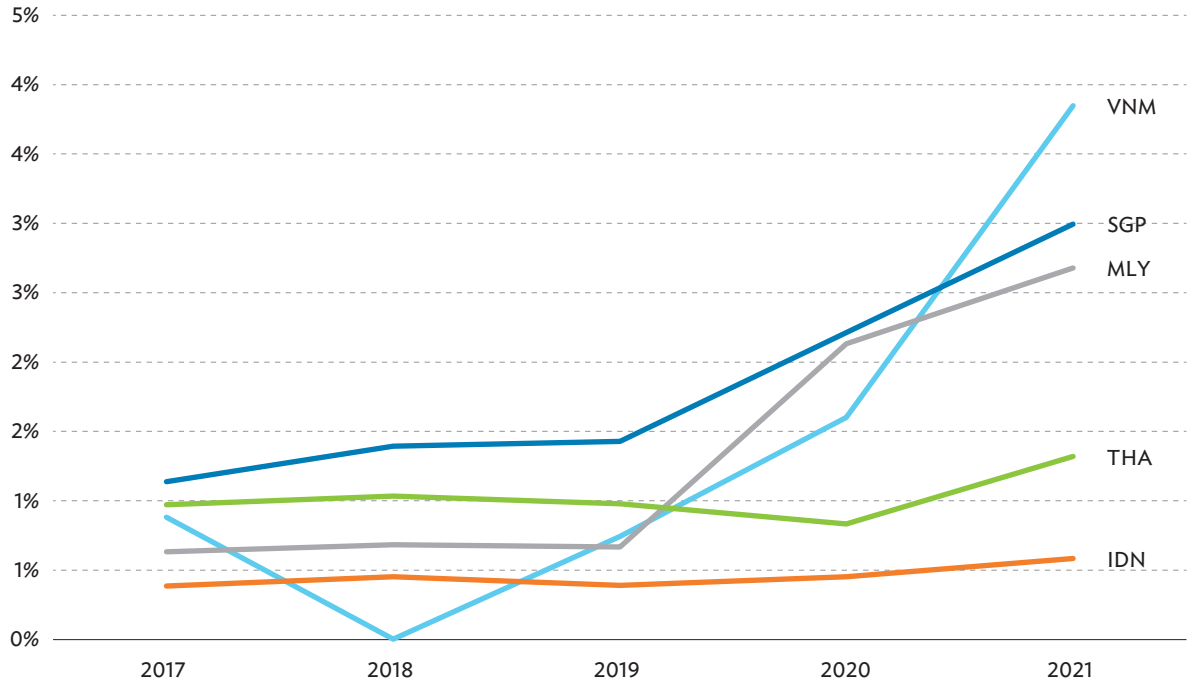
Appendix 2: Top Five Trading Partners of the World's Main Economies



Source: UN COMTRAD

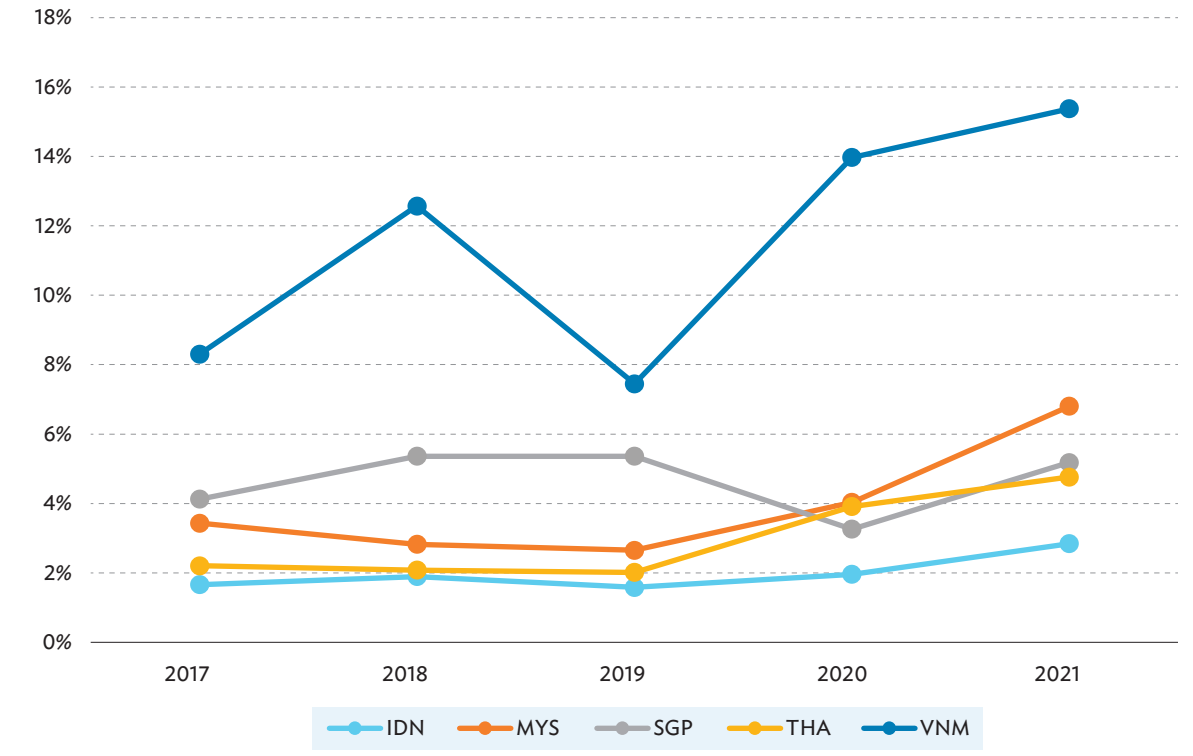
Appendix 3: Gross Trade between the US and ASEAN Countries

Figure 2.21: ASEAN Exports to the US as a Share of Total Exports (2017–2021)



Source: ADB MRIO database

Figure 2.22: Intermediate Imports from the PRC as a Proportion of ASEAN Total Intermediate Imports by Country (2017–2021)



Source: ADB MRIO database

Appendix 4: CGE Model Construction and Scenario Setting

Clear insights into the role and activities of MNEs are critical to understanding GVCs, whose strong growth has significantly challenged existing economic insights and policy implications associated with globalization. This study combines the OECD AMNE database and the GTAP-MRIO tables to develop a CGE model that incorporates MNEs, as well as the GVC decomposition module (Wang et al., 2021). The AMNE database is a global input–output database covering 34 industries and 60 regions that provides detailed data on the activities of foreign affiliates in specific countries (inward and outward activities of MNEs). The GTAP-MRIO database is a global set of input–output tables covering 141 regions and 65 industries that does not consider firm heterogeneity.

The basic premise of the model is to use the AMNE database to calculate the shares of intermediate use, final use, value added, and gross output of domestic and foreign firms, and then to divide the GTAP-MRIO database into domestic and foreign firms before rebalancing the database. For the extension involving the global computable general equilibrium model, comprehensive reference is made to other investment settings (Mai, 2005; Xiao & Ciuriak, 2014) in an effort to improve the production and consumption behavior of firms, but monopolistic behavior is not considered currently. In addition, for the dynamic mechanism setting, we refer to the MONASH investment function (Dixon et al., 2013). Specifically, first, the accumulation of capital uses recursive dynamic rules. Second, it basically presents an inverse logistic function relationship between investment and the return on capital.

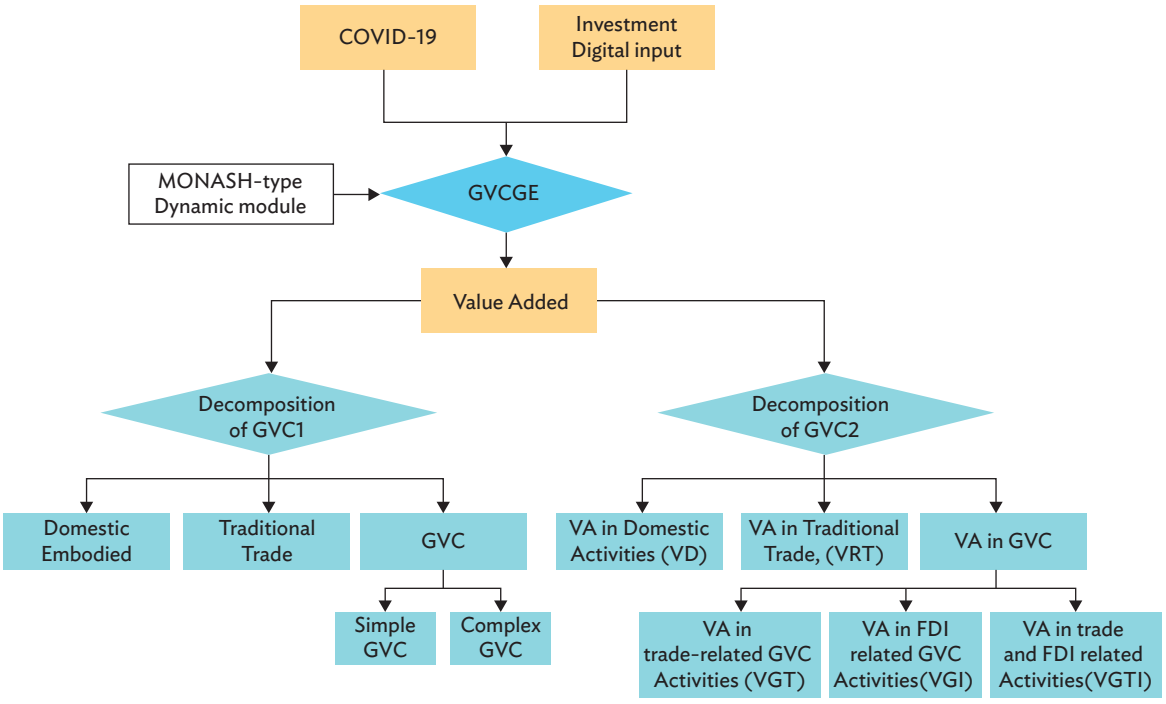
Three policy scenarios are examined in this study: the US–PRC trade tension, the COVID-19 pandemic, and digitalization (see Appendix Table 1).

Appendix Table 1: Scenarios in the CGE Modeling

Scenarios	Contents
BASELINE	growth rate of GDP, skilled labor force, unskilled labor force, and population
TRADE	US-PRC trade conflicts: additional tariffs in 2018 and 2019, Phase One Agreement in 2020. Export control of high-tech products from the US to the PRC
COVID	Decline in labor supply, shift in consumption preference, increase in trade costs, decline in tourism.
DIGITAL	Producers input more ICT intermediate goods or services, more efficient use of ICT intermediate input

- In the trade scenario, the conflict commenced in 2018 and ended in 2020 with a Phase One Agreement. Direct tariffs increased in the first two years and then decreased in 2020. Specifically, shocks on the agricultural import of the PRC from US are included in 2020 and 2021. Controls on the export of high-tech products from the US to PRC were also considered.
- The COVID-19 pandemic affected the global economic system through four major paths: a decline in the labor supply, a shift in consumption preferences towards telecommunication, health, public administration service etc., increased trade costs, and a decline in tourism demand. The economies of each country are recovering at different rates, but all are expected to return to their baseline by 2025.
- An important factor affecting resilience and recovery is digital technology. ICT was used as a proxy in the evaluation of the impact of the digital gap on the recovery of various countries. We assumed that producers preferred increasing their use of ICT intermediate input during the COVID-19 pandemic. Meanwhile, the efficiency of intermediate input of ICT products is also expected to be improved. These two shocks would have opposite effects on the ICT's output.

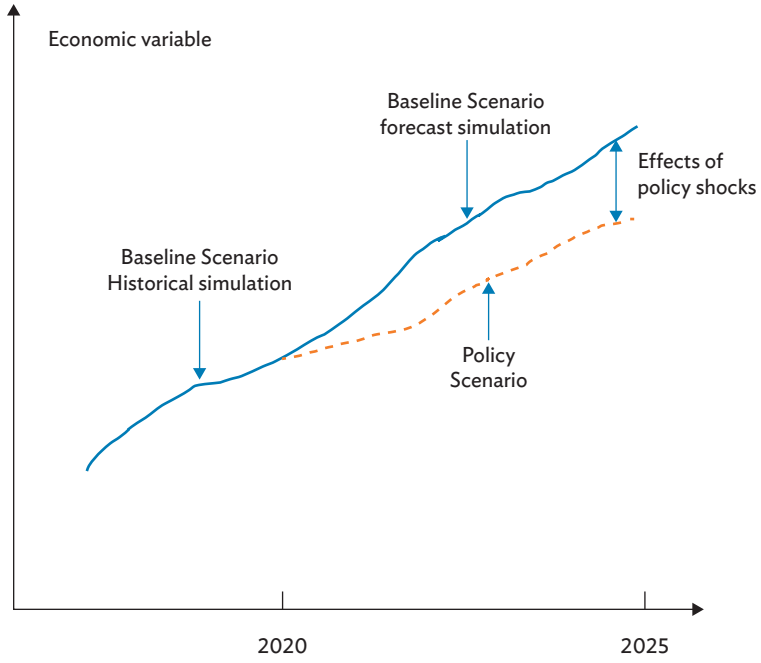
Figure 2.23: The GVCGE Framework



Note: The GVCGE model follows Aguiar et al., (2020), Corong et al., (2017), Hertel, (1997), the MONASH type dynamic module follows Dixon et al., (2013), and the GVC decomposition follows Wang et al., (2017, 2021).

Figure 2.24 can help readers to understand the results of the counterfactual analysis. The effects of policy shocks (e.g., trade tension, COVID-19 and digitalization in Appendix Table 1) on the economic variables (e.g., global value chain indicators) are represented by the differences of variables in the baseline and policy scenarios. For example, the latest reference year of the GTAP v10 database is 2014, but the COVID-19 outbreak in 2020, so that the historical simulation would start in 2014 and end in 2020. Then the forecast simulation moves the figure of the global economy to the future without considering COVID-19. The historical and forecast simulations consist of the baseline scenario. In the policy scenario, the COVID-19 shocks were introduced to the model, which would impose negative (or positive) effects on some economic variables, such as the GDP growth rate. In this chapter, we only focus on the effects of policy shocks mentioned in Appendix Table 1.

Figure 2.24: The Effects of Policy Shocks on Economic Variables



Source: Mai et al. (2010)

Appendix 5: The Impact of Digital Policy on Global Value Chains

The impacts of digital input and technological improvements on GVC trade were also analyzed (see Appendix Table 2). Pure domestic, FDI-related and trade-related activities are all predicted to increase in both the PRC and ASEAN, with a greater increase in pure domestic activities in ASEAN. Trade-related activities will also increase in Chinese Taipei, while the US, Canada, and India will benefit from increased traditional global trade. The PRC will experience a slight increase in all areas except trade-related activities because if the PRC attracts more investment in digital infrastructure, domestic consumption and all FDI-related activities will increase.

Appendix Table 2: Projected Impacts of Digital Input and Technological Improvements on GVC Activities in 2025

	VD	VRT	VGT	VGI	VGTI
PRC	0.20	0.01	-0.32	0.12	0.14
Japan	0.13	-0.14	-0.91	-0.20	-1.27
Republic of Korea	0.57	-0.47	-0.10	0.18	-0.19
Chinese Taipei	0.57	-0.37	0.30	0.19	0.00
ASEAN	0.63	-0.23	-0.71	0.46	0.10
India	-0.16	0.20	-0.54	-0.28	-0.58
Canada	-0.03	0.21	-0.48	-0.09	-0.51
USA	-0.07	0.21	-0.40	-0.18	-0.45
Mexico	0.26	-0.61	-0.95	-0.01	-0.88
EU27	0.26	-0.12	-0.74	0.10	-0.74
ROW	-0.09	0.30	-0.49	-0.17	-0.63

Note: VD = pure domestic production activities, VRT = traditional trade production activities, VGT = trade-related GVC activities, VGI = FDI-related GVC activities, and VGTI = trade- and FDI-related GVC activities, following Wang, Wei, Yu & Zhu (2021).

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