Book

The evolution of Indonesia's participation in global value chains

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THE EVOLUTION OF INDONESIA'S PARTICIPATION IN GLOBAL VALUE CHAINS

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Notes:
In this publication, "$" refers to United States dollars.
ADB recognizes "China" as the People's Republic of China and "Vietnam" as Viet Nam.

On the cover. *Top row, left to right.* Neighbors helping each other pull a fishing net in Gentuma Raya, Gorontalo, Indonesia; Ayu Dwi Rahayu and Wahyu S. Amin at Supreme Energy, Muara Laboh geothermal project site. *Second row, left to right*. Fresh fish always sells for more than dried fish; Sri Wahyuni, a chemical analyst working at the Lahendong Geothermal Power Plant. *Third row*. Locals traverse the old market area of Tanjung Pinang in Bintan. *Bottom row, left to right*. A vendor displays her merchandise at Tanjung Pinang market; Threshing rice panicles (photos by ADB).
Cover design by Maria Denise Peña.

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Foreword by the Vice-President for Knowledge Management, Asian Development Bank

The last two decades were a time of global value chain (GVC) revolution. Since the 1990s, the rise of GVCs—that is, complex network structures of production processes across countries—has changed our economic landscape in fundamental ways. At the same time, events such as the financial crisis of 2008 and the escalating trade tensions have shaken global production and affected trade governance in many economies. While many developing economies have taken advantage of global production reallocation, others are still figuring out their role in GVCs.

The vast global interconnection of economies in production and trade helps developing economies to produce goods, not just assemble them. Asia's tiger economies are slowly learning and catching up by linking into GVCs. Instead of having to build an entire value chain, developing economies can participate in GVC production relatively easily by specializing in those activities where they have comparative advantage, thereby augmenting their income and allowing them to further learn and upgrade their production. Therefore, GVCs allow economies to build their comparative advantage, and thus, to accelerate industrialization.

However, quantitative analysis on GVCs shows that developing economies accrue varying levels of benefits from participating in production sharing arrangements. This is in part due to the diverse characteristics of supply chains, depending on the products involved, production structures adopted, and markets served. Production activities involved in such supply chains can be of high value addition, or on the contrary very low value addition. Therefore, for governments to strategize their economies' participation in GVCs, they must analyze the value they bring to domestic sectors by discerning production and trade in value-added terms.

There is a growing body of literature on reconfiguring trade data to reveal the complex value-added structure in GVCs and the impact of participation in GVCs on economies. Today, two-thirds of global trade involves intermediate goods, complicating the task of measuring value-added without double counting. Trade statistics shift substantially when measured in value-added terms rather than in terms of gross flow of exports and imports. Breaking

down the composition of value-added in final products, imports, and exports provides a clearer picture of a country's production structure. *The Evolution of Indonesia's Participation in Global Value Chains* does a commendable job in decomposing Indonesia's production to reveal its economy's specialization and role in global trade.

Through the case study of Indonesia, this report provides an in-depth review of the many concepts and indicators of GVCs that have been discussed in economic literature since the current phase of economic globalization took hold in early 1990s. The critical concepts used in these GVC indicators are complex, and this report gives an accessible introduction to these measures and how they can be used to interpret the evolution of Indonesia's participation in GVCs. It provides insights into structural shifts within the country's domestic sectors that warrant further consideration to develop governance and policy.

The Indonesian economy saw a steady slowdown of growth since peaking in 2010, characterized by declining exports and falling global commodity prices, and steadily weakening competitiveness. Following a discernible shift toward the domestic market, production in the country appears to have reverted from a strategy of export orientation back to import substitution. Thus, Indonesia's participation in GVCs remains low as its domestic sectors continue to grow, but its main role in GVCs is still as a supplier of primary goods. This report comes at an opportune time.

Statistical analysis shows that Indonesia's declining participation in GVCs appears related to the growth of its domestic sectors. The GVC indicators presented in this report show that developing the manufacturing sector needs to be a policy priority. One clear message is the need to promote domestic value addition through manufacturing. The indicators also demonstrate the need to allow for a certain extent of export promotion or increased GVC participation in manufacturing to boost industrial competitiveness. An economy's strategy cannot be separated from GVCs. Participation in GVCs improves productivity and thus, competitiveness, leading to sustainable development fueled by a continuous process of increased specialization and further foreign investments.

Much of recent economic literature is coming to the conclusion that economies participating in GVCs are experiencing faster growth, but a greater understanding of the inner working of an economy and the domestic and foreign linkages of its sectors is required to inform policy. This report is valuable, then, as it captures the complexity of Indonesia's economy at the crossroads of globalization. The report also brings into focus the major trends on the domestic sectors' role in GVCs.

Overall, this report is an excellent resource, which will open more discussions on policy recommendations to promote Indonesia's economic development through its greater participation in GVCs. *The Evolution of Indonesia's Participation in Global Value Chains* is intended as a key reference for policymakers, development practitioners, government officials, researchers, students, and for the general public. It is a necessary contribution to support trade policy decisions for economic development that are founded on evidence.

Bambang Susantono
Vice-President for Knowledge Management
Asian Development Bank

Foreword by the Vice-President, Country Programs, Islamic Development Bank

Prodigious advances have recently been made in information, communication, manufacturing, and transportation technologies. These advances, together with concerted initiatives taken to attenuate policy barriers to trade and mobility over the last three decades, have been enabling enterprises to fragment, segment, and modularize goods production processes and globally distribute them to benefit from location specific comparative advantages. The rapid emergence of a number of East and Southeast Asian countries as hubs for global manufacturing and the stark decline of traditional industries in advanced economies demonstrate the reach and impact of this phenomenon of economic globalization. When economic sectors of various countries are systematically integrated into a cross-border network to supply a product to the final consumers, they form a global value chain (GVC). Interestingly, the paradigm shift in product development and delivery effected by more recent innovations in web and other technologies has facilitated the development of specific service GVCs while transforming those related to goods.

The proliferation of cross-border production arrangements enables especially the developing countries to grow their economies by participating in specific GVCs without having the resources, infrastructure, and ecosystem required to produce the relevant goods or services end-to-end domestically. On the other hand, value chain participation catalyzes diversification in primary sector-oriented economies. By attracting and localizing segments of GVCs, countries make value contributions to the relevant supply networks as well as generate income for their residents. Further, by fostering a conducive environment for transferring technology and technical know-how, the globalized production systems contribute to economic upgrading of the participant countries.

There is also strong evidence that globalization of production results in better labor welfare. Increased demand for labor has resulted not only in greater participation of women in the workforce but also in greater gender wage parity in many countries. Improvement in average working conditions, growth in wages, and other benefits due to implementation of labor welfare standards throughout GVCs is also observed. Furthermore, it is noteworthy

that globalization has increased the awareness on environmental issues and climate change. Now, there is more impetus on businesses, especially those engaged in cross-border production sharing, to produce more eco-friendly goods and services in eco-friendly conditions. Studies also show that foreign direct investment tend to concentrate more along value chain segments thereby catalyzing infrastructure development along value chain nodes and hubs. Thus, economic globalization contributes to the achievement of certain key sustainable development goals (SDGs).

The ongoing collaboration among the Asian Development Bank (ADB), Islamic Development Bank (IsDB), and other international development organizations has previously produced evidence based reports on Indonesia. In 2010, ADB and IsDB, along with the International Labour Organization, released the report on *Indonesia Critical Development Constraints*. This was followed by the publication titled *Diagnosing the Indonesian Economy: Towards Inclusive and Green Growth* in 2012.

This report, *The Evolution of Indonesia's Participation in Global Value Chains*, adds to the ADB-IsDB efforts in providing knowledge solutions by analyzing the evolution of Indonesia's participation in GVCs since 2000. It employs well-structured economic data, especially the inter-country input–output tables, and cutting-edge quantitative methods to develop a framework for succinctly depicting value chain participation of the country's sectors and studying the consequent economic effects. The report also looks at the challenges and opportunities posed by current and emerging phenomena such as trade conflict and automation. Given that it identifies key trends in Indonesia's GVC participation, it is envisaged that this study would serve as a useful reference for policymakers and analysts. I would like to congratulate the ADB and IsDB officials along with the consultants working on this collaboration for producing this important statistical analysis which will certainly facilitate evidence-based policymaking.

Mansur Muhtar
Vice-President, Country Programs
Islamic Development Bank

Acknowledgments

This report is a product of an ongoing collaboration between the Asian Development Bank (ADB) and the Islamic Development Bank (IsDB) in providing knowledge solutions to key socioeconomic issues. Specifically, the report analyzes the state and evolution of Indonesia's participation in global value chains (GVCs) since 2000. It employs well-structured economic data, especially the inter-country input–output tables for 2000–2017, together with cutting-edge quantitative methods, to develop a framework for depicting global value chain participation of the country's sectors and its economic consequences. The report also looks at the challenges and opportunities posed by current and emerging global phenomena such as the trade conflict and rapid automation of economies. Given that it identifies key trends in Indonesia's GVC participation, this study would certainly serve as a useful reference for policymakers and analysts.

We gratefully acknowledge Vice-President for Knowledge Management and Sustainable Development of ADB, Bambang Susantono and Vice-President for Country Programs of IsDB, Mansur Muhtar who provided strong leadership and indispensable guidance from the very beginning of this study. We also thank Joseph Ernest Zveglich Jr., Edimon Ginting, Rana Hasan, and Kaushal Joshi of ADB and Areef Suleman, Abu Camara, Amadou Diallo, Ibrahim Shoukry, and Mustafa Yagci of IsDB for their valuable support in undertaking this overarching initiative. I would like to especially acknowledge the initiatives taken by Vicky Tan of ADB and Hayat Sindi of IsDB in promoting and disseminating GVC related knowledge products including this report.

Mahinthan Joseph Mariasingham of ADB led the team of consultants comprising Kristina Baris, Donald Jay Bertulfo, Janine Elora Lazatin, and Angelo Jose Lumba to accomplish this study. The ADB Multi-Regional Input–Output Tables (MRIOT) forming the quantitative framework for GVC analysis were prepared by Kristina Baris, John Arvin Bernabe, Donald Jay Bertulfo, Marc Alvin Ermino, Krizia Anne Garay, Janine Elora Lazatin, Angelo Jose Lumba, Julieta Magallanes, Sarah Mae Manuel, Dianne Lara Monis, Maria Denise Peña, Reizle Jade Platitas, Ana Francesca Rosales, Clara Delos Santos, Janine De Vera, and Jonarie Vergara. We also acknowledge the Joint Research Centre of the European Commission for sharing the industry and country data from World Input–Output Database (WIOD).

Maricris Jan Tobias edited the publication. The cover was designed by Maria Denise Peña and Joe Mark Ganaban led the typesetting process. Eric B. Suan organized and coordinated the preparation of this report. The publishing team in ADB's Department of Communications and Office of Administrative Services Logistics Management Unit (Printing) provided general guidance on production issues. I appreciate the concerted efforts of people very much who have been involved in making this report.

Yasuyuki Sawada
Chief Economist and Director General
Asian Development Bank

Abbreviations

ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
EU	European Union
FDC	foreign value-added double counted in exports
FDI	foreign direct investment
FVA	foreign value-added
GDP	gross domestic product
GFC	global financial crisis
GVC	global value chain
IMF	International Monetary Fund
IsDB	Islamic Development Bank
M&As	mergers and acquisitions
MRIOT	multi-regional input–output table
NEC	not elsewhere classified
NRCA	new revealed comparative advantage
PDC	pure double counted terms
PRC	People's Republic of China
RCA	revealed comparative advantage
R&D	research and development
R&D&D	research, development, and design
SDGs	sustainable development goals
SMEs	small market enterprises
TiVA	trade in value-added
TRCA	traditional revealed comparative advantage
TSNR	technically specified natural rubber
US	United States
WIOD	World Input–Output Database

HIGHLIGHTS

This report analyzes Indonesia's participation in, and contribution to, global value chains (GVCs) during the period 2000–2017. It applies cutting-edge methods on well-structured economic data to discern the nature, position, and intensity of such participation by various sectors of the country's economy and estimate the income accruing to its residents as a result of such participation.

Indonesia's Production and Value-Added Exports

- Indonesia's production and use of intermediates generally increased between 2000 and 2017. However, data indicate a period of decline from 2009 to 2014 in domestic intermediate production and use. On average, more than 80% of the intermediates used in the country's production was sourced domestically, while over 75% of the locally produced intermediate goods and services stayed within the economy.

- The use of foreign intermediates declined across the economic sectors, except for medium- and high-technology manufacturing. More than 60% of the intermediate imports was used by manufacturing industries which, in turn, accounted for nearly three-fifths of the country's intermediate exports, signifying the relative intensity in the participation of these sectors in GVCs.

- Domestic value-added in the final products of all sectors increased notably. At the economy level, the domestic share in production increased from 83.2% in 2000 to 89.9% in 2017. It is worth noting that although Indonesia's value-added contribution to the production processes of other economies was small, it grew markedly between 2000 and 2017.

- Domestic value-added constituted over 90% of Indonesia's gross exports from 2000 to 2017. A large portion of this was either embedded in final exports used by direct importing economies or embodied in intermediate exports used directly by importing economies in their production of final goods for domestic consumption. The share of

foreign value-added in Indonesia's gross exports was generally low. Foreign value-added made up 13.2% of gross exports by Indonesia's industrial sectors in 2017, while this share was 6% and 4.1% for the services and primary sectors, respectively.

- Domestic value-added embedded in the primary sector's intermediate exports that were re-exported by partner economies increased from 27.7% of the sector's gross exports in 2000 to 35.1% in 2017. Except in the primary sector, the share of domestic value-added embedded in intermediate exports that underwent multiple border crossings declined from 2000 to 2017.

- In 2000, only the United States imported a significant amount of Indonesia's value-added. However, by 2010, the list of key importers grew with the inclusion of Germany; Hong Kong, China; the People's Republic of China; Singapore; and the United Kingdom. In 2017, many emerging and developing economies in Asia and the Pacific were also importing Indonesia's value-added for their intermediate and final consumption.

Indonesia's Participation, Position, and Specialization in Global Value Chains

- Trade-related value-added generated in Indonesia as a share of its total value-added declined from 31.8% in 2000 to 17.6% in 2017. On the other hand, trade-related value-added as a share of the economy's final production also declined from 27.8% in 2000 to 15.0% in 2017.

- Indonesia's participation in GVCs through both forward and backward linkages declined from 2000 to 2017. Forward GVC participation declined from 21.5% in 2000 to 12.9% in 2017, while backward participation declined from 16.9% to 10.1% during the same period. The country's forward GVC participation, however, stayed consistently above backward participation, indicating the economy's greater involvement in upstream activities.

- Indonesia's international trade was more bilateral than global. From the forward perspective, a larger portion of Indonesia's domestic value-added was used by its direct importers to produce their final products for domestic consumption. Meanwhile, from the backward perspective, most of the value-added embedded in Indonesia's intermediate imports were used in final production for domestic consumption rather than for export.

- From 2000 to 2017, the primary sector increased its forward GVC participation. Moreover, data show increased border crossing by the sector's value added, indicating its growing involvement in more complex GVCs. The low-technology manufacturing sector was more engaged in downstream and simple GVC activities, while participation was moderately higher for industries in the medium- and high-technology sector. The service sector's GVC participation was generally low in Indonesia.

- Country-sector specific upstreamness indices from 2000 to 2017 show that Indonesia's production moved closer to final use, contrary to the world trend. This is operationalized by the country's upstreamness decreasing from 2.06 to 1.96 during the period. Further, final products in gross output rose by 3.6 percentage points. These numbers imply that Indonesia's intermediate supply links with other countries weakened and became simpler between 2000 and 2017.

- Indonesia's comparative advantage was concentrated in the industries constituting the primary and low-technology manufacturing sector. Many of these industries, including "food, beverage, and tobacco" manufacturing, "rubber and plastics" manufacturing and "small equipment" manufacturing increased their comparative advantages between 2000 and 2017. Notably, "mining and quarrying" industry's comparative advantage fell from 3.4 in 2000 to 2.5 in 2017 and that of "coke, refined fuel, and petroleum" manufacturing dipped to 2.7 from 8.2. The economy, however, gained comparative advantage in "chemicals and chemical products" manufacturing in 2017.

Other Aspects of Global Value Chains

- Indonesia's production processes tended to rely more on domestic, own-sector sources for intermediate inputs during periods of economic crisis (e.g., global financial crisis of 2008).

- For Indonesia, the strength of the local supply chains estimated by backward linkage-based agglomeration indices was highest for low-technology manufacturing and business services. Moreover, the local supply chain for business services was relatively strong based on the forward linkage measure. The country's medium- and high-technology, and primary industries displayed weak forward and backward ties. Nonetheless, analysis shows no evidence of association between the strength of domestic links and revealed comparative advantage as far as Indonesia's industries are concerned.

- Technological development and transfer associated with GVCs contributed to the decline in labor demand across all economic sectors (–29%) in Indonesia from 2005 to 2015 with agriculture suffering the largest impact (–49%) and services the least (–9%). For the same period, task relocation was associated with an 8% and 5% increase in demand for labor in manufacturing and services, respectively. Results also indicate that the change in own-country income from 2005 to 2015 was associated with a 79% increase in employment in services and 45% in manufacturing.

- Decomposing changes in employment by type of occupation for the manufacturing sector shows that employment in nonroutine cognitive occupations grew by 110%, while routine cognitive occupations contracted by 36%. Meanwhile, for services, employment in routine manual occupations increased by 176%, while employment in nonroutine cognitive and routine cognitive occupations increased by 77% and 21%, respectively.

- Country-level efficiency was associated with a decline in employment for all types of occupation in the manufacturing sector. In the services sector, it was associated with a 30% decrease in employment in routine manual occupations and 22% decrease in employment in nonroutine cognitive occupations.

- Indonesia is one of the countries that would benefit the least from trade redirection brought about by the current trade conflict between the United States and the People's Republic of China. Analysis indicates that, in 2–3 years, it could gain only 0.06% to 0.14% of its gross domestic product as a result of trade redirection, under various assumptions of tariff imposition. However, Indonesia can still potentially benefit in a protracted trade conflict as it could become a strong alternative source of palm kernel, babassu oil, natural rubber, and sports footwear for the United States. It also has the capacity to be an alternative source of lignite, palm vegetable oil, and wood pulp for the People's Republic of China.

- In Asia and the Pacific, Indonesia was the 6th largest recipient of foreign direct investment (FDI) in 2018, with investment inflows amounting to almost $22 billion. Singapore, Japan, and the People's Republic of China were the largest investors in Indonesia. Moreover, more than 90% of FDI inflows to Indonesia was from Asian economies. Only 41% of foreign-owned firms in Indonesia, however, engaged in international trade, indicating low GVC participation from an FDI perspective.

- Greenfield investment in Indonesia amounted to $39 billion in 2018, while investment through mergers and acquisitions totaled $3.5 billion. Greenfield investments have traditionally been natural resource based, but alternative/renewable energy displaced coal, oil, and natural gas as the top recipient of greenfield investment come 2018. Manufacturing also attracted an increasing amount of greenfield investment, with 2018 recording the highest greenfield committed investments to date. The top recipients of investments linked to mergers and acquisitions in 2018 were software and IT services; food and tobacco; and financial services.

Reaping the Benefits of Global Value Chain Involvement

- To effectively and beneficially participate in GVCs, Indonesia needs to institute a coordination mechanism to ensure consistency and coherence in industrial policies, address governance bottlenecks, and further develop its manufacturing sector. Domestic linkages among firms should be strengthened by bridging infrastructure investment gaps to facilitate efficient transportation and fast transmission of information. Production processes should also be facilitated through highly reliable utility services.

- Labor policies that would incentivize the movement of workers from agriculture and other primary sectors towards manufacturing and services should be instituted. Proper human resource development strategies should be implemented to ensure a steady supply of skilled workers sensitive to industry needs. The capacity for innovation should be developed by encouraging local and foreign investments in non-extractive and research and development-oriented industries that have the potential to strengthen their production links with other sectors in the economy, as well as with the rest of the world.

Chapter 1
Introduction

An exemplar of a country that has escaped the so-called "resource curse" (Rosser 2007), Indonesia maintains a steady growth path. Its growth in the first quarter of 2019 fared at 5.1%, following a stable growth pattern ranging from 4.9% to 5.3% in the last 14 quarters (World Bank 2019). A complex myriad of factors, including a large domestic demand base, suitable demographic structures and rapid urbanization, constitutes relevant "pull forces" of economic growth that enabled Indonesia to grow despite weak reliance on exports (Das 2018; World Bank 2014). To illustrate, the share of working-age population in Indonesia is projected to reach a peak of 70% in 2031 from 67% in 2016 (IMF 2018), providing opportunities for Indonesia to reap gains from demographic dividends. Indonesia is also currently the fourth most populous nation in the world with a population of over 270 million as of 2019, providing the country with a strong domestic market base for its production.

Studies have shown that Indonesia's economic policies enabled it to weather global shocks (Basri and Rahardja 2010; Blanchard, Das, and Faruqee 2010). In fact, an analytic decomposition of domestic versus external contributors to Indonesia's real output growth performed in Das (2018) revealed that domestic factors dominated external factors in explaining real output growth in Indonesia, especially before the global financial crisis. However, since late 2013, decomposition results show that despite Indonesia's insularity from external forces, global factors became a stronger countervailing force against domestic forces. This may be due to the stronger linkages in the global economy which allow for the indirect transmission of output shocks along value chains. The increasing fragmentation of global production activities makes countries that are predominantly domestic oriented, such as Indonesia, unanticipatedly vulnerable to global developments and shocks.

While Indonesia displays stable and robust macroeconomic performance, literature contends that the country may be suffering from an unsustainable lack of global competitiveness. Aswicahyono and Rafitrandi (2018) maintained that Indonesia's suboptimal performance in terms of global competitiveness has resulted in weak ties with global production networks. While current policies target revitalizing the country's manufacturing

sector, Indonesia's economic progress remains impeded by lack of clarity and coherence in industrial policy, a predominant focus on downstreaming industries and a gravitation towards increasing domestic value-added share in production (Aswicahyono and Rafitrandi 2018). Drawing from a sectoral perspective, Soejachmoen (2016) showed that factors such as restrictive foreign investment policies, high trade costs, protectionism in the auto sector, and quality of labor explain why Indonesia was lagging peers in terms of export performance in auto and auto parts.

Against this policy and contextual backdrop, this report describes Indonesia's participation in global production networks by examining patterns of involvement in global value chain (GVC) related activities by its economic sectors. In the next few paragraphs, the concept of GVC is discussed together with the data frameworks used in measuring GVC-related indicators.

Economic globalization catalyzed by dramatic improvements in information and communication, transportation, and production technologies has drastically reduced the costs of moving goods, services, people, and even technologies. This phenomenon underpinned the rise of GVCs, which involve extensive cross-border production sharing arrangements resulting in the dispersion of segments of production processes worldwide. In a GVC world, the status of gross exports as a reliable indicator of economic growth is contested. To properly account for the income generated across GVCs, recent theoretical and empirical advances in gross trade accounting have emerged as the principal frameworks for analysis (Johnson and Noguera 2012; Koopman, Wang, and Wei 2014; Wang, Wei, and Zhu 2018).

To elaborate, consider an iPod designed and finalized in the United States. Parts assembled to produce this iPod originated from different countries in the world. Materials used to produce the parts also require inputs. Likewise, inputs employed to produce the materials utilized to create these parts may constitute a separate network of production processes, which can occur in multiple parts of the globe. However, when an iPod is exported from the United States, traditional gross trade accounting indicates that its total value shall be counted as exports by the United States. This is not necessarily correct because the value of this finished product is an agglomeration of value-added originating from different country-sectors. In other words, in the creation of final products, value-added is generated across and between production processes that are dispersed throughout the world.

In this report, Indonesia's involvement and participation in GVCs during the time period 2000–2017 are measured and analyzed. To address measurement issues that pervade accounting for intermediates mentioned above, cutting-edge empirical frameworks are adopted. The GVC indicators presented in this

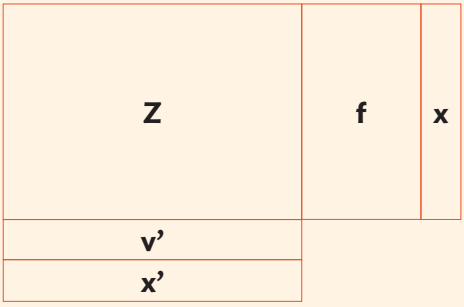
report were generated using multi-regional input–output tables (MRIOTs) (Box 1) compiled by the Asian Development Bank (ADB), augmented with those made available through the World Input–Output Database (WIOD) (Timmer et. al 2015).

Box 1: The Structure of a Multi-Regional Input–Output Table

In a multi-regional input–output framework, outputs are produced using domestic primary factors of production, i.e., labor and capital, combined with intermediate inputs that are sourced either domestically or from foreign suppliers. These can either be used for final consumption or be utilized to produce more goods or services at home or abroad, i.e., be used as intermediates (Timmer et al. 2015).

Multi-regional input–output tables (MRIOTs) present the global production recipe, viewed from a country-sector perspective. The tables can be read using two interrelated perspectives. Reading the MRIOTs along the row, output by country-sectors can either be used for final consumption at home or abroad (final demand) or for further production by other country-sectors (intermediate demand). Reading the MRIOTs column-wise shows, for each country-sector, purchases of goods and services from country-sectors plus the value-added by primary factors of production. A stylized representation of an MRIOT is shown in Box 1 Figure below.

Box 1 Figure: A Stylized Representation of a Multi-Regional Input–Output



where **Z** is the matrix of intermediate demand, **f** is the matrix of final demand, **x** is the vector of gross output and **v** is the vector of value-added. Market clearing conditions imply that, at the country-sector level, total gross output is equal to total inputs. Many of the indicators in this report were generated from the multi-regional input–output tables compiled on an annual basis by the Asian Development Bank. As of this writing, the Asian Development Bank MRIOTs cover 35 sectors, 5 final demand categories, and 63 economies (including 24 economies in developing Asia and 132 countries aggregated as rest-of-the-world).

Source: M. P. Timmer, E. Dietzenbacher, B. Los, R. Stehrer, R. and G. J. de Vries. 2015. An Illustrated User Guide to The World Input–Output Database: The Case of Global Automotive Production. *Review of International Economics*. 23(3) pp. 575–605.

The use of a multi-regional input–output approach in analyzing GVCs offers at least two advantages. First, it makes tracing the flow of value-added from source to destination possible at a remarkable level of granularity. Second, it adheres to the basic principles of national income accounting.

The report mainly intends to elucidate trends that demonstrate Indonesia's role in GVCs. In section 2, the analysis begins with an examination of the structure of the country's use and production of intermediates and proceeds to discuss the value-added content of its final production. Gross exports are then decomposed into value-added terms to uncover structural changes in the factor content of Indonesia's gross exports across time.

To what extent is Indonesia's production dependent on domestic sources of intermediates? Data and analysis indicate that a large portion of the country's domestic production of intermediates stayed within the economy. Moreover, a significant share of intermediates used by Indonesia was sourced domestically. Sectoral analysis shows that manufacturing industries that used significant shares of imported manufactured intermediates also accounted for the highest shares in the country's total intermediate exports of manufactured goods. Thus, the data indicate high export activity in industries that utilized foreign inputs in production.

How much of total value of final production in Indonesia is accounted for by production activities occurring in other parts of the world? Results indicate that final production in Indonesia was generally dependent on domestic value-added. Final products of the primary sector embedded the highest domestic value-added content; the share was the lowest in the final products of the medium- and high-technology manufacturing.

How important are production activities occurring in Indonesia to the production of goods and services consumed abroad? Analysis shows that Indonesia contributed a small but growing share of its value-added to the final production of other economies, such as (i) France and Germany in Factory Europe; (ii) India; Malaysia; the Philippines; Singapore; Taipei,China; and Thailand in Factory Asia; and (iii) Canada, Mexico, and the United States in Factory America. Moreover, Indonesia's contributions to final production in neighboring Asian economies were greater than its contributions to economies in other parts of the globe.

What types of value-added are embedded in Indonesia's gross exports? Export decomposition analysis reveals that the character of Indonesia's involvement in GVCs was more bilateral than global. Much of value-added generated in the production of the country's exports crossed international borders only once.

To elaborate, a significant portion of the domestic value-added generated in the production of Indonesia's exports was either embedded in final products consumed by direct importers or contained in intermediate imports used by a direct partner country to produce final products that were consumed domestically.

An analysis of broad sectors reveals diverse patterns in the value-added composition of products. First, the composition of the primary sector's gross exports changed over time. An increasing proportion of value-added became more involved in production activities that crossed borders more than once. Second, gross exports of Indonesia's manufacturing sectors embodied higher foreign value-added than those of the services and primary sectors. Lastly, services exports predominantly contained domestic value-added that crossed administrative borders only once.

Closing the section is a visualization of Indonesia's forward GVC links. Network analysis reveals that, over the years, Indonesia had established stronger forward ties with central GVC hubs, namely Germany, the People's Republic of China, and the United States. Moreover, its forward GVC links with services-oriented economies such as Hong Kong, China and Singapore were also on the rise.

Section 3 discusses Indonesia's participation, position, and revealed comparative advantage in global production networks. *Is Indonesia's role more on the supply-side of GVCs, or is it more involved in the purchase of goods and services produced elsewhere?* A decomposition of Indonesia's value-added and final production indicates that Indonesia was relatively more involved in upstream, or supply-side, activities. At the country-level, forward GVC participation dominated backward participation. However, the data exhibit a declining trend in both forward and backward GVC participation rates. This coincides with a relative increase in the proportion of domestic value-added generated in the production of domestically consumed goods and services. Findings echo their current policy stance which promotes domestic production capacity and encourages utilization of domestically sourced products. A further decomposition of GVC participation rates suggests that Indonesia was participating more in simple GVCs than in complex GVCs, supporting the observation that Indonesia's involvement in GVCs was more bilateral than global.

A sector analysis of participation in GVCs indicates that the primary sector was more involved in complex GVCs. Manufacturing sectors displayed the highest involvement in GVCs, both from the forward- and backward-linkage perspectives. Participation of services sectors in GVCs, meanwhile,

was generally lower compared to the primary and manufacturing sectors. A high proportion of value-added generated in services was involved in the production of final goods and services that served both domestic and foreign markets, rather than in the production of exported intermediates. Results also indicate that Indonesia's services sectors relied heavily on value-added generated within the domestic economy.

Is Indonesia moving closer to domestic markets, or is it becoming more involved in longer production chains? Upstreamness indices are calculated to gauge how far the outputs of Indonesia's industries were from final consumers. The country's upstreamness index displayed a downward trend, suggesting that the goods and services produced in Indonesia were moving closer to the final consumer. This contrasts with the world average and many other economies that exhibited increasing trends in upstreamness. While Indonesia was more involved in upstream than downstream GVC activities, declining trends in the upstreamness index point to the economy moving downstream relative to the global average. This implies weakening intermediate supply links with other economies and a rising share of final goods and services in total gross output.

Indonesia's declining gross output weighted average upstreamness can also be attributed to the increasing proportion of total gross output from sectors that were, on average, one step or less away from final consumers. Such sectors produced goods and services largely for domestic final consumption and for the use by direct importers in final production. This coincides with Indonesia's declining participation in GVCs and its bilateral export orientation.

In which sectors does Indonesia display a comparative advantage? Using a forward-linkage based value-added indicator to measure revealed comparative advantage, the analysis reveals a gradual shift in comparative advantage towards low-technology manufacturing sector. Although resource-rich Indonesia retained its comparative advantage in the primary sector, the indicator for the sector has declined over time.

Following the presentation of trends and patterns concerning Indonesia's participation in GVCs, section 4 discusses specific input–output applications and GVC analyses in the Indonesian context. Analyses show that the country was highly reliant on domestic production. But *how strong are domestic linkages within Indonesia?* An examination of agglomeration indices reveals that Indonesia tended to rely more on domestic, own-sector sources of intermediate inputs during the crisis, and less so during non-crisis periods. Domestic backward linkages suggest that low-technology and business services sector received relatively more domestic inputs than others. On the flipside, Indonesia's business services sector exhibited strong domestic

forward links, implying that their outputs were crucial to domestic sectors' production activities.

To what extent have improvements in global production processes (e.g., relocation of tasks along value chains or technology-induced efficiency increases along GVCs) influenced labor demand in Indonesia? A structural decomposition is employed to break down the labor demand change in Indonesia into several determinants. The data indicates that from 2005 to 2015, employment in services grew faster than in manufacturing. Structural decomposition analyses reveal that technology within GVCs was associated with a decline in labor demand across all broad sectors considered, with the largest negative impact occurring in manufacturing jobs. Task relocation, meanwhile, was associated with growth in employment in manufacturing and services. Lastly, changes in income and preferences were associated with an increase in labor demand, with positive partial impacts on employment in services and manufacturing.

Labor demand change can also be decomposed by type of occupation and by sector. A breakdown of employment into four broad occupation groups shows that nonroutine cognitive occupations experienced the highest increase while routine cognitive occupations contracted. In the manufacturing sector, country-level efficiency was associated with a decline in all types of occupations. However, holding other factors constant, uptakes in the overall level of total factor productivity in Indonesia affected nonroutine cognitive occupations the most. Technology within GVCs was associated with a reduction in demand for nonroutine cognitive, routine cognitive, and nonroutine manual occupations in manufacturing. Task relocation effects were mixed, while the income effects generally had positive effects on labor demand across all types of occupations in manufacturing.

In services, routine manual occupations exhibited the largest increase in employment, followed by nonroutine cognitive, and then routine cognitive occupations. Country-level efficiency was associated with reduced demand for all types of service occupations, while technology within GVCs was associated with an increase in demand for routine manual occupations. Task relocation and income effects were also positive for routine manual occupations, suggesting that the largest activity in services employment in Indonesia occurred in routine manual jobs.

How vulnerable is Indonesia to shocks arising from a global trade conflict? The trade conflict between the United States and the People's Republic of China offers an interesting case study when viewed from a GVC vantage point. Analysis reveals that Indonesia was among those that would benefit the least from potential trade redirection partly due to Indonesia's weak trade ties with the two countries, as well as with the economies that serve the GVCs oriented

towards the two countries. Because tariffs imposed on each other's products by the two countries do not directly affect Indonesia, its economy could serve as a viable alternative source of products such as palm kernel, babassu vegetable oils, natural rubber, and sports footwear for the United States. Similarly, Indonesia could also serve as an alternative source of lignite, palm vegetable oil and wood pulp for the People's Republic of China.

What does the GVC-FDI nexus look like in Indonesia? Economies in Asia and the Pacific accounted for significant shares in global inward and outward foreign direct investment (FDI), which is reflective of the increasing trade and investment openness in the region. This trend was observed over time, whether it be through mergers and acquisitions (M&As) or greenfield investments. FDI is historically linked to GVCs, driven mostly by cost minimization objectives of multinationals. Indonesia consistently ranked among the top destinations for inward FDI with most sources based in the Asia and the Pacific. Greenfield investments generally dominated M&As however, unlike in the rest of the region, the country's top FDI recipients tended to be natural resource dependent industries.

Section 5 concludes and, based on the analysis presented in the report, provides policy recommendations on the steps Indonesia could consider taking to participate more in globalized production processes and, consequently, generate greater income for its residents. That Indonesia lagged other economies in the Association of Southeast Asian Nations (ASEAN) in GVC participation could be attributed to many factors including economic policy, the quality of governance, infrastructure, and the state of business environment. The right changes, and improvements, on these fronts are expected to deepen the participation of its manufacturing and services industries in GVCs and move away from natural resource dependence.

Chapter 2

Indonesia's Production and Value-Added Exports

Improved transportation, faster transmission of information, and wage differences gave rise to the fragmentation of production processes and their distribution across international borders (Baldwin 2016). The offshoring of segments of the production process allowed economies to enter the production of goods and services at various stages, depending on their factor endowment advantages. Thus, the focus of production became less about producing for final consumption and more about producing intermediate goods and services.

As global value chains (GVCs) began to dominate production and trade, traditional trade statistics became inadequate in discerning the issue of double counted exports. The problem stems from the back and forth trading of goods, and increasingly services, across international borders. As double counting became more pervasive, gross trade and production data became less reliable in capturing various economy-sectors' value-added contribution to the globalized production processes, rendering tracing value-added across global production networks through innovative methods a necessary feat.

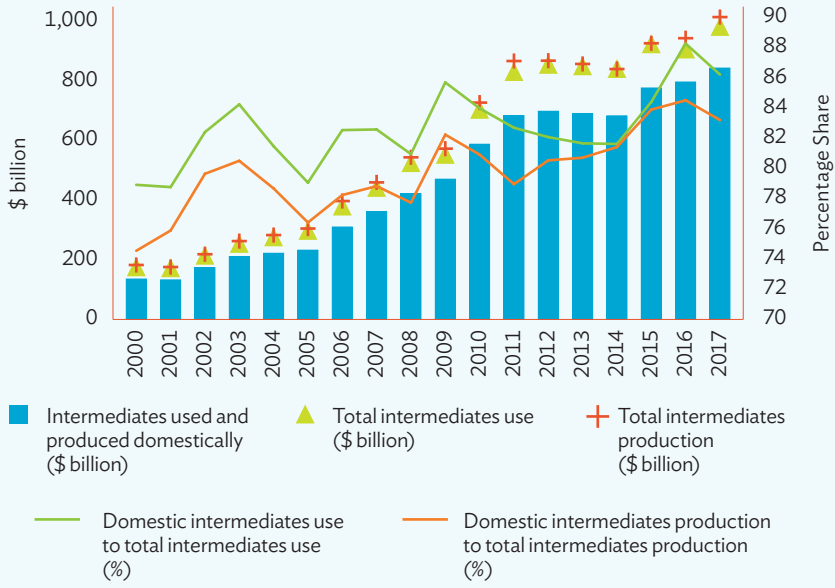
Given this background, this section focuses on analyzing Indonesia's production and use of intermediate goods and services, as well as on tracing value-added in both final production and exports. It makes use of multi-regional input–output tables (MRIOTs) to analyze domestic production and consumption of intermediates in the first subsection. The second subsection follows Timmer et al.'s (2013) backward perspective approach in tracing the sources of value-added in Indonesia's final products. It also analyzes how much value-added in other economies' final products were sourced from Indonesia. In the third subsection, gross exports are decomposed into value-added terms using the methodology espoused by Wang, Wei, and Zhu (2018). This decomposition provides a backward perspective on the sources of value-added embodied in an economy-sector's outputs and exports. Finally, the last subsection shifts to the forward perspective and uses network analysis to trace where Indonesia's domestic value-added goes.

2.1 Domestic Production and Consumption of Intermediate Goods and Services

An analysis of GVCs requires a careful examination of patterns concerning the use and production of intermediates for two main reasons. First, embedded in imported intermediates are knowledge and technology-related intangibles from foreign sources. Second, back-and-forth trade in intermediate goods and services signify high GVC activity (Wang, Wei, and Zhu 2018). Therefore, understanding Indonesia's role as a purchaser and supplier of intermediates globally helps illuminate its influence as a player in global production networks.

Data from the ADB MRIOTs indicate that the nominal value of Indonesia's total production and use of intermediates generally increased from 2000 to 2017 (Figure 2.1). During this time period, Indonesia obtained 80% to 88% of its total use of intermediates from domestic sources while 75% to 84% of its total production of intermediates remained within domestic bounds. The remaining 16% to 25% were exported as intermediates to other nations. Trend analysis revealed that during the post global financial crisis (from 2009 to 2014), both

Figure 2.1: Structure of Production and Use of Intermediates, Indonesia, 2000–2017

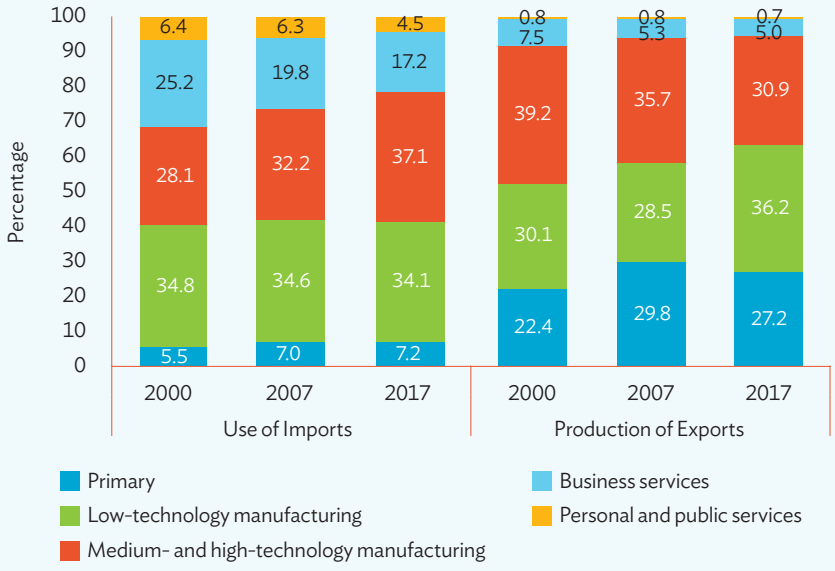


Sources: Multi-Regional Input–Output Tables, 2000, 2007–2017, Asian Development Bank; World Input–Output Database, 2001–2006; Asian Development Bank estimates.

the share of domestic sources in total use and production of intermediates fell. The trend reversed in 2014 before slumping again in 2016. On the other hand, the share of domestic intermediate supply in total supply of intermediates declined sharply from 2009 to 2011 before increasing and then sinking back again in 2016. These findings suggest an erratic trend in the relative structure of production and use of intermediates post global financial crisis.

Disaggregating the use and production of intermediates by broad sector category, the data reveal that more than 60% of total intermediate imports were used by manufacturing sectors. Likewise, manufacturing sectors accounted for more than three-fifths of Indonesia's total exports of intermediates (Figure 2.2). The share of medium- and high-technology manufacturing in total use of intermediate imports grew by 9 percentage points from 28.1% in 2000 to 37.1% in 2017. This was accompanied by a large decline in the share of business services in total use of imported intermediates, which shrank from 25.2% in 2000 to 17.2% in 2017. Moreover, the imports of low-technology manufacturing sectors for further production remained steady at around 34%, while the share of primary products and personal and public services displayed marginal changes.

Figure 2.2: Structure of Intermediate Imports and Exports, Indonesia, 2000, 2007, and 2017



Sources: Multi-Regional Input–Output Tables, 2000, 2007–2017, Asian Development Bank; World Input–Output Database, 2001–2006; Asian Development Bank estimates.

While intermediate imports of medium- and high-technology manufacturing increased as a share of total intermediate imports, its share to total exports of intermediates fell from 39.2% in 2000 to 30.9% in 2017. Exports of low-technology manufacturing shrank from 30.1% in 2000 to 28.5 in 2007, but then picked up thereafter, reaching 36.2% in 2017. The opposite was observed in personal and public services, whose share of intermediate exports in the total increased from 22.4% in 2000 to 29.8% in 2007 but then fell afterwards. By 2017, its share to total intermediate exports stood at 27.2%.

Table 2.1 below lists the 14 aggregate manufacturing industries covered in the MRIOTs, along with their contribution to Indonesia's total exports production and share to total use of imported intermediates. In general, industries

Table 2.1: Use of Intermediate Imports and Production of Intermediate Exports, Indonesia, 2000, 2007, and 2017 (% Share of Total)

Sector	Use of Imports			Production of Exports		
	2000	2007	2017	2000	2007	2017
Low-technology Manufacturing						
Food, beverages, and tobacco	6.7	6.8	6.3	4.8	11.1	17.3
Rubber and plastics	3.9	4.2	5.0	4.8	6.3	8.5
Pulp, paper, paper products, printing, and publishing	3.3	2.2	1.8	5.9	4.2	3.7
Wood and products of wood and cork	1.0	0.6	0.6	8.2	3.3	2.6
Textiles and textile products	6.2	3.2	3.5	5.1	3.0	2.4
Manufacturing, NEC; recycling	0.9	0.9	0.9	0.5	0.5	0.8
Leather, leather products, and footwear	1.2	0.6	0.8	0.8	0.2	0.7
Medium- and high-technology Manufacturing						
Chemicals and chemical products	5.6	5.8	5.0	6.3	6.7	8.0
Coke, refined petroleum, and nuclear fuel	3.8	5.6	15.5	15.3	10.3	7.5
Basic metals and fabricated metal	6.1	7.4	6.0	5.1	9.6	7.1
Electrical and optical equipment	4.8	5.3	4.2	7.2	4.5	4.4
Transport equipment	3.6	3.6	2.2	1.1	2.2	2.4
Machinery, NEC	3.1	3.1	1.9	2.6	1.3	0.8
Other nonmetallic minerals	1.1	1.6	2.3	1.5	1.0	0.6
Total Manufacturing	**51.3**	**50.8**	**55.9**	**69.2**	**64.2**	**66.9**
Total (all sectors)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

NEC = not elsewhere classified.
Note: Industries are arranged by their percentage contribution to total intermediate exports in 2017.
Sources: Multi-Regional Input–Output Tables, 2000, 2007 and 2017, Asian Development Bank; Asian Development Bank estimates.

that accounted for a large share in total use of imported intermediates also contributed significantly to the production of intermediate exports. Examples of such industries in low-technology manufacturing are "food, beverages, and tobacco" and "rubber and plastics." In medium- and high-technology manufacturing, exemplar industries include "coke, refined petroleum, and nuclear fuel," "chemicals and chemical products," and "basic and fabricated metals."

Interestingly, manufacturing industries experienced a decline in their share in total use of imported intermediates from 2007 to 2017. This goes in contrast with what was observed in the period 2000 to 2007, when many medium- and high-technology industries showed increases in intermediate use shares. Notable exceptions include "coke, refined petroleum, and nuclear fuel" (which experienced a steep increase in use share from 5.6% in 2007 to 15.5% in 2017) as well as "garments and textiles" and "rubber and plastics." Meanwhile, the shares of "food, beverages, and tobacco," "rubber and plastics," as well as "chemical and chemical products" to total production of intermediate exports rose from 2007 to 2017.

From 2007 to 2017, Indonesia's trade in intermediate products displayed rather erratic but generally declining use of foreign intermediates, increasing utilization of imported intermediates by medium- and high-technology manufacturing sectors relative to others, and a cursory link between high use of foreign intermediates and high relative export orientation particularly in non-primary sectors.

2.2 Value-Added Sources in Final Products

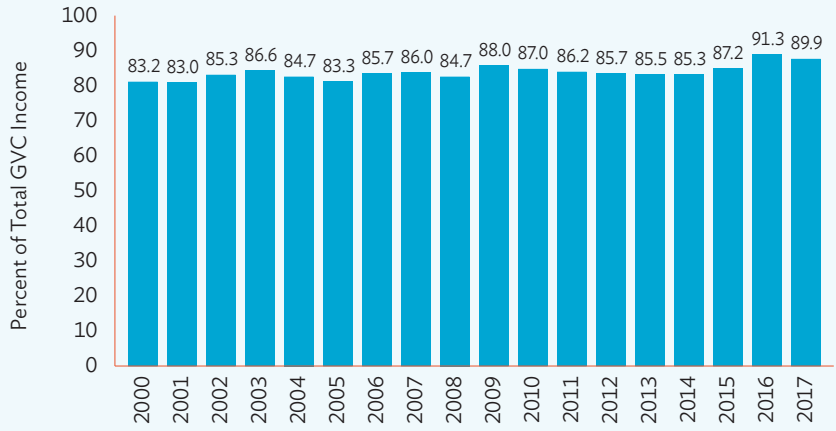
The rise in cross-border production sharing has led to a new area of research which focuses on analyzing how production processes are fragmented and distributed across countries and industries within countries. One strand of inquiry attempts to systematically quantify the amount of value-added originating from economy-sectors worldwide that is embodied in final goods and services as well as exports. Such a decomposition relates to work done by Johnson and Noguera (2012; Timmer et al. (2013); Koopman, Wang, and Wei (2014); and Wang, Wei, and Zhu (2018).

Timmer et al. (2014) defines a GVC as a country-industry pair that delivers a good or service to its final use. Final products refer to goods and services that are consumed by the final demand sector without being subjected to further processing. Intermediate inputs, together with value-added—that is, the contributions of labor, capital, government, and entrepreneurial effort—are used to produce final products. However, the production of some intermediates also requires further intermediate inputs (plus the primary

inputs). Hence, value-added is generated directly and indirectly in the process of producing final products. This implies that in order to properly trace sources of value-added generated from the production of final products, both direct and indirect channels should be accounted for. This underpins the concept of "GVC income." Timmer et al. (2013) provide a neat framework that allows one to trace the sources of value-added that is ultimately embodied in a given final product. Using this as a guide, economies' value-added contributions to the total value of Indonesia's final products were estimated. Results show that the domestic value-added content of Indonesia's final products rose in the past decade (Figure 2.3). The share of Indonesia's domestic value-added to its total GVC income was 89.9% in 2017, about 6.7 percentage points higher than its ratio in 2000. Not surprisingly, the 2008 global financial crisis seemed to have reverted Indonesia's production back to domestic, as indicated by the abrupt spike in the domestic value-added content of Indonesia's final products in 2009.

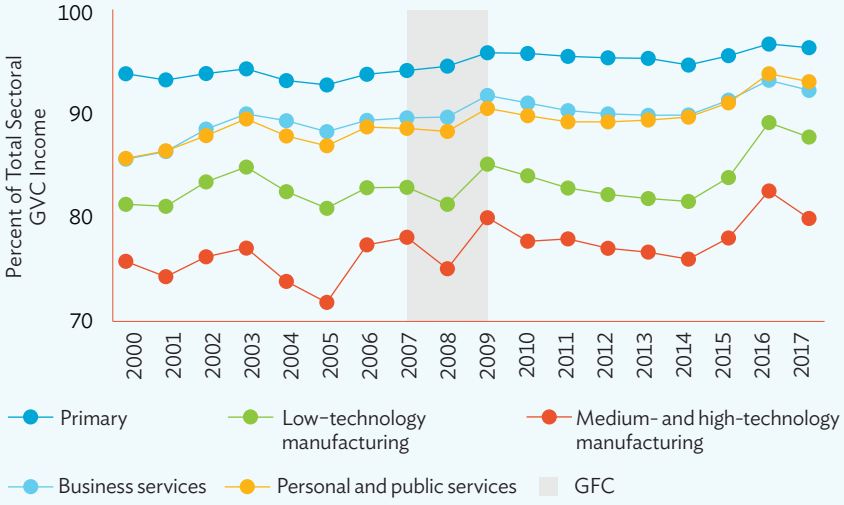
Examining trends by broad sectoral categories, results show the rising contribution of domestic value-added to sectoral GVC incomes (Figure 2.4). Despite this commonality, differences across broad sectors are worth noting. In Indonesia, primary sectors had the highest share of domestic value-added to the total sectoral value of final production. This trend was consistent across all years from 2000 to 2017. Meanwhile, Indonesia's final industries generally had the lowest domestic value-added content, although it rose during the more recent years covered in the analysis. To illustrate,

Figure 2.3: Share of Domestic Value-Added in Total Global Value Chain Income, 2000–2017



GVC = global value chain.
Note: Asian Development Bank estimates are based on the methodology of Timmer et al. (2013).
Sources: Multi-Regional Input–Output Tables, 2000, 2007–2017, Asian Development Bank; World Input–Output Database, 2001–2006; Asian Development Bank estimates.

Figure 2.4: Share of Domestic Value-Added in Total Sectoral Global Value Chain Income, 2000–2017

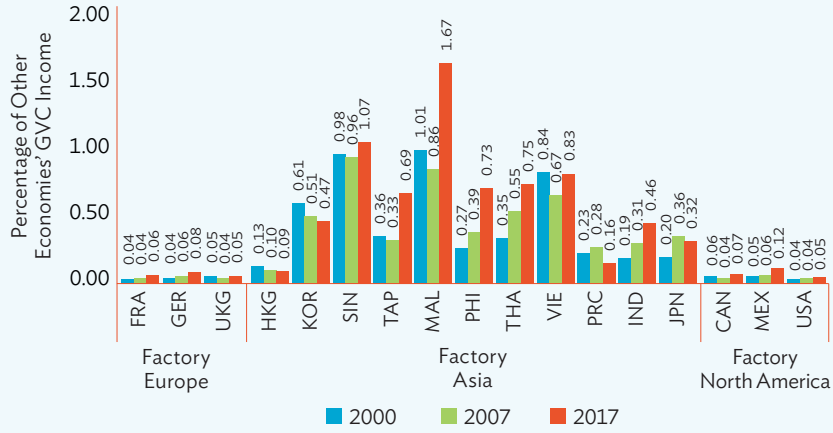


GFC = global financial crisis, GVC = global value chain.
Note: Asian Development Bank estimates are based on the methodology of Timmer et al. (2013).
Sources: Multi-Regional Input–Output Tables, 2000, 2007–2017, Asian Development Bank; World Input–Output Database, 2001–2006; Asian Development Bank estimates.

the domestic value-added content of low-technology final industries in Indonesia climbed 6.9 percentage points from 81.0% in 2000 to 87.9% in 2017. In 2000, 75.1% of the total value of final products by the medium- and high-technology manufacturing sectors was attributable to value-added from domestic sources. This share rose to 79.5% in 2017.

To measure Indonesia's involvement in the production of final products by selected economies, Indonesia's contribution in the total GVC income of other economies are also examined (Figure 2.5). Results show that Indonesia's value-added accounted for a small but growing proportion of final production of other economies. Value-added generated in Indonesia accounted for an increasing proportion of GVC incomes in "factories" such as (i) France and Germany in Factory Europe; (ii) India; Malaysia; the Philippines; Singapore; Taipei,China; and Thailand in Factory Asia; and (iii) Canada, Mexico, and the United States in Factory America. Indonesia's contributions were, not surprisingly, largest in Factory Asia due to proximity. For instance, in 2017, the value-added generated by Indonesia accounted for 1.1% and 1.7% of Singapore's and Malaysia's GVC incomes respectively. Final products produced by other Asian economies such as the Philippines; Republic of Korea; Taipei,China; Thailand; and Viet Nam also contained relatively significant value-added content coming from Indonesia.

Figure 2.5: Indonesia's Share in Other Economies' Global Value Chain Income, 2000, 2007, and 2017



CAN = Canada; FRA = France; GER = Germany; GVC = global value chain; HKG = Hong Kong, China; IND = India; KOR = Republic of Korea; SIN = Singapore; TAP=Taipei,China; JPN = Japan; MAL = Malaysia; MEX = Mexico; PHI = Philippines; PRC = People's Republic of China; THA = Thailand; VIE = Viet Nam; UKG = United Kingdom; USA = United States.
Note: Asian Development Bank estimates are based on the methodology of Timmer et al. (2013).
Sources: Multi-Regional Input–Output Tables, 2000, 2007, and 2017, Asian Development Bank; Asian Development Bank estimates.

2.3 What Comprises Indonesia's Exports? Decomposing Indonesia's Exports into Value-Added Terms

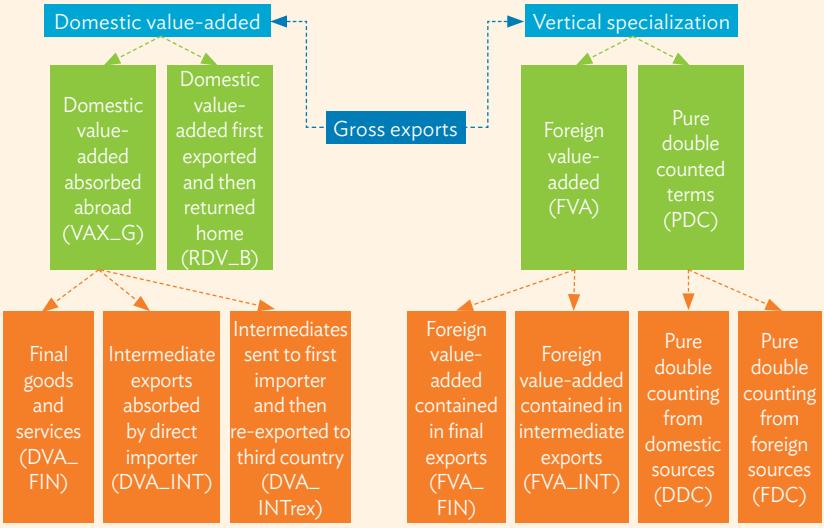
Decomposing gross exports into value-added terms allows for a more detailed look at the country-sector contribution to a country's export basket. Box 2 shows how such a decomposition is carried out using MRIOTs. Figure 2.7 shows a time-series breakdown of Indonesia's gross exports in value-added terms, where four trends relating to Indonesia's trade in value-added can be observed.

First, Indonesia's gross exports had a generally stable and sizeable domestic value-added content. In fact, more than 80% of the total value of Indonesia's gross exports was generated by domestic production factors. A huge fraction (63.2% in 2000 and 62.7% in 2017) of this domestic value-added was embedded in final exports that were consumed by a partner country (DVA_FIN), or embodied in intermediate exports that were used by a direct importing country to produce final goods and services ultimately absorbed by the partner country (DVA_INT). This suggests that the character of Indonesia's export activity was more bilateral than global, a fact that will be revisited in the subsequent sections.

Box 2: Decomposing Exports into Value-Added Terms

In a world where global value chains (GVCs) define new patterns of production and specialization, accounting for value creation along GVCs necessitates a careful and systematic analysis. Because back-and-forth trade characterizes GVC activity, it makes sense to analyze trade flows. One empirical question concerns how exports should be counted if multiple countries contribute to their production. To answer this question, one can take the full value of exports and identify, using information from multi-regional input–output analysis, how much value-added embedded in exports are accounted for by domestic or foreign production factors. Such a decomposition is accomplished in Wang, Wei, and Zhu (2018), which proposed a systematic way of quantifying international production sharing by decomposing gross exports in value-added terms (Box 2 Figure).

Box 2 Figure: Decomposition of Gross Exports in Value-Added Terms



Source: Wang, Wei, and Zhu (2018).

Gross exports can be decomposed into two major categories: domestic value-added and vertical specialization. Domestic value-added may be embedded in exports that are ultimately consumed as final goods abroad (VAX_G) while some may be embedded in exports that ultimately return home (RDV_B). VAX_G may be further broken down into a part that is embedded in final exports (DVA_FIN), that which is first embedded in intermediate exports that are used by the direct importer to produce final products (DVA_INT) and lastly, that which is embedded in intermediates sent to the first importer and then re-exported to a third country (DVA_INTrex).

Vertical specialization, meanwhile, consists of foreign value-added (FVA) and pure double counting terms (PDC). Foreign value-added can be further decomposed into two: FVA embedded in final exports (FVA_FIN) and FVA embedded in intermediate exports (FVA_INT). Pure double counting occurs due to the back-and-forth trade in intermediates. The greater the value of PDC, the greater the intensity of cross-border production sharing activities.

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

Second, Indonesia's domestic value-added embedded in the exports of primary goods displayed a notable structural shift. To elaborate, the share of Indonesia's value-added embedded in the intermediate exports of the primary sector that was re-exported to other economies (DVA_INTrex) increased from 27.7% in 2000 to 35.1% in 2017. This reflects strengthening forward ties with the GVCs to which Indonesia's primary sector contributed during the period.

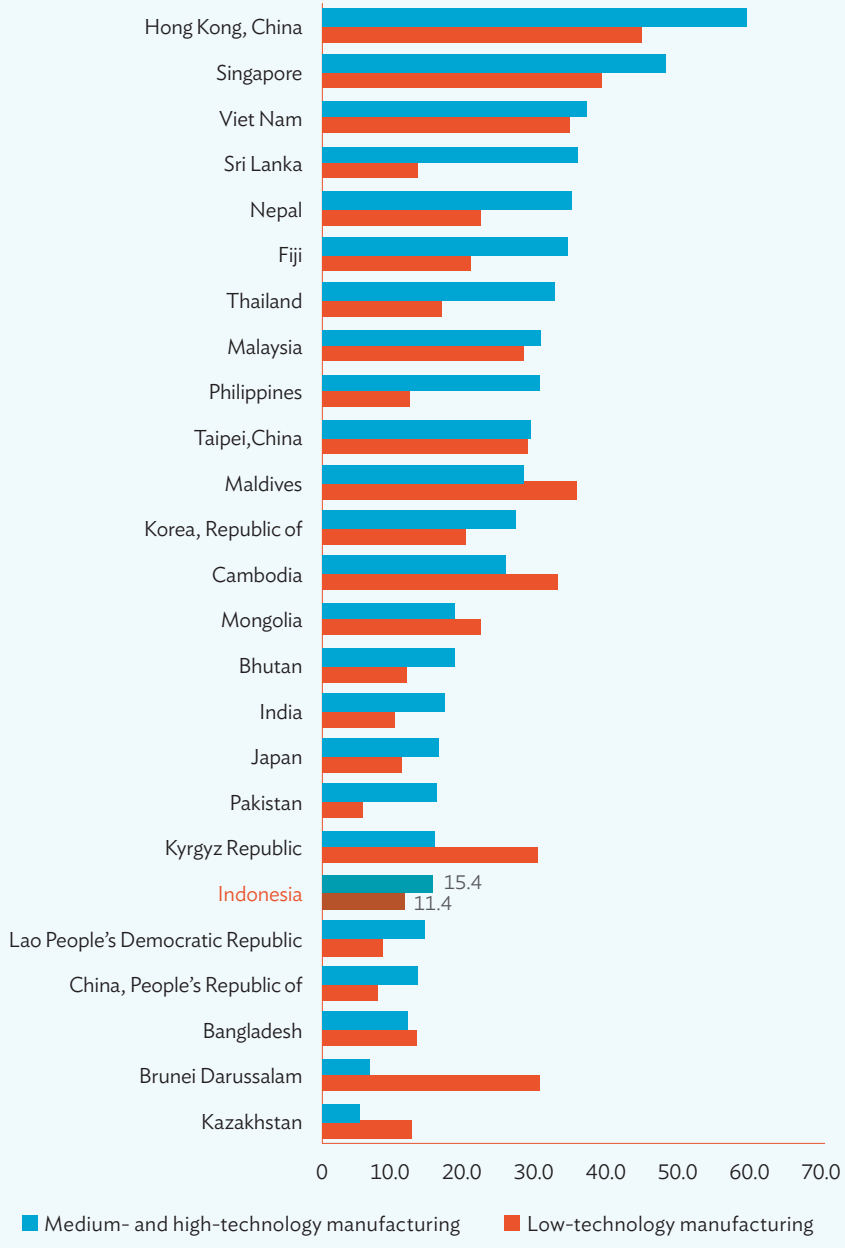
Third, Indonesia's manufacturing sectors benefited from foreign sourced value-added more than services and primary sectors. In 2017, foreign value-added used by manufacturing comprised 13.2% of sectoral gross exports, while foreign value-added in exports of services and primary sectors comprised about 6% and 4.1% of sectoral gross exports, respectively. However, compared to other economies in developing Asia, Indonesia's foreign value-added share to total industry exports remained quite low (Figure 2.6). It is noteworthy that, from 2000 to 2017, foreign value-added shares in the exports of manufacturing industries in services-oriented economies such as Hong Kong, China and Singapore ranged between 40% and 50%. Indonesia, meanwhile, joined resource-rich economies Brunei Darussalam and Kazakhstan and an increasingly domestically oriented People's Republic of China in the list of countries for which foreign value-added share to total exports was the lowest.

Lastly, Indonesia's exports of services were mostly driven by domestic production activities that were not involved in GVCs (DVA_FIN) and domestic production factors that were not part of complex GVCs (DVA_INT). In the business services sector, the combined shares of DVA_FIN and DVA_INT made up between 64.2% and 73.4% of gross exports during 2000–2017. In the same period, DVA_FIN and DVA_INT comprised between 75.6% and 82.9% of gross exports of the personal and public services sector.

In Figure 2.8, changes in nominal values of each decomposition term are depicted. Two time periods, 2000 to 2007 and 2007 to 2017, were selected for purposes of comparison. The former corresponds to the period before the global financial crisis, while the latter pertains to the post crisis period. Value-added components changed marginally in both time periods, with greater transformation occurring during 2000–2017.

In the period 2000–2007, domestic value-added embedded in intermediate exports from Indonesia that were re-exported to other economies (DVA_INTrex) increased across all major economic sectors except business services. It should be noted that this type of value-added in exports is related to multiple cross-border production sharing arrangements and is therefore highly GVC-related. DVA_INTrex grew by 6.8 percentage points in primary goods, 1.0 percentage point for personal and public services, and by 3.5 percentage

Figure 2.6: Foreign Value-Added Shares of Industrial Sectors, Developing Asia, 2017 (% of Sector Exports)



Note: Asian Development Bank estimates are based on the methodology of Wang, Wei, and Zhu (2018).
Source: Multi-Regional Input–Output Tables, 2017, Asian Development Bank; Asian Development Bank estimates.

Figure 2.7: Decomposition of Gross Exports, by Economy and by Broad Sector Category, 2000–2017

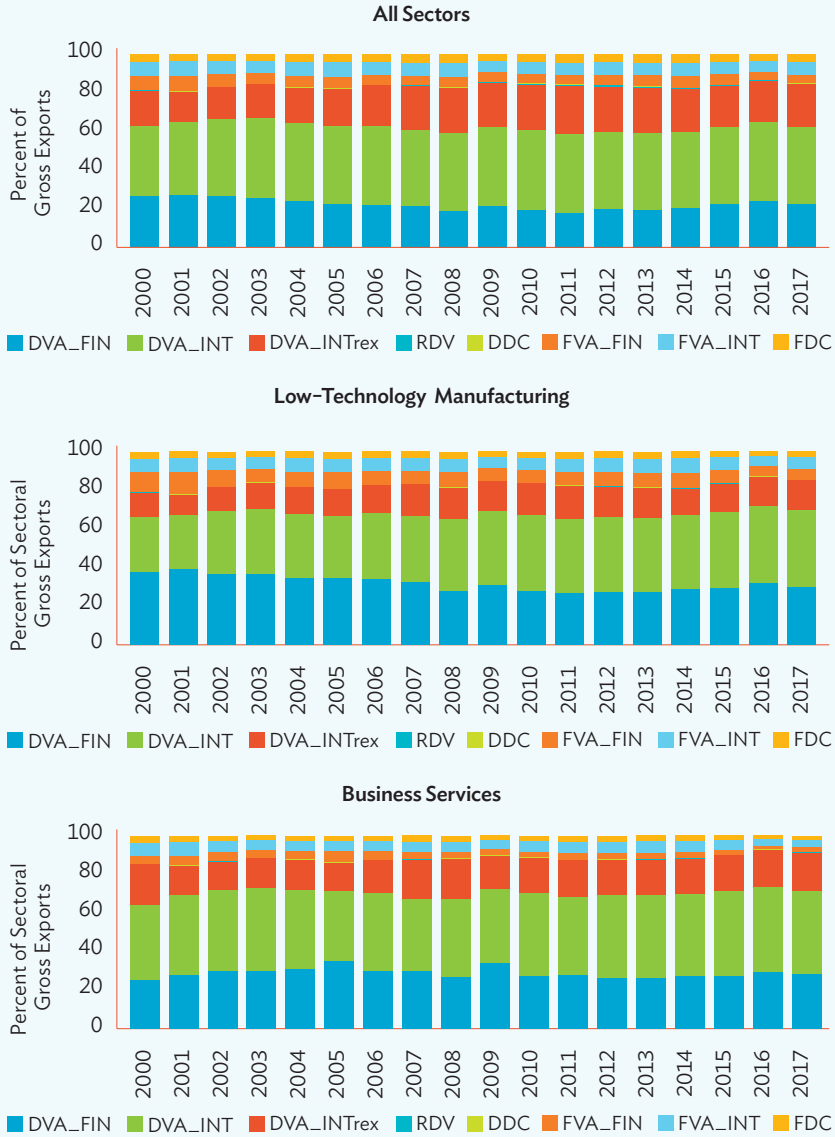


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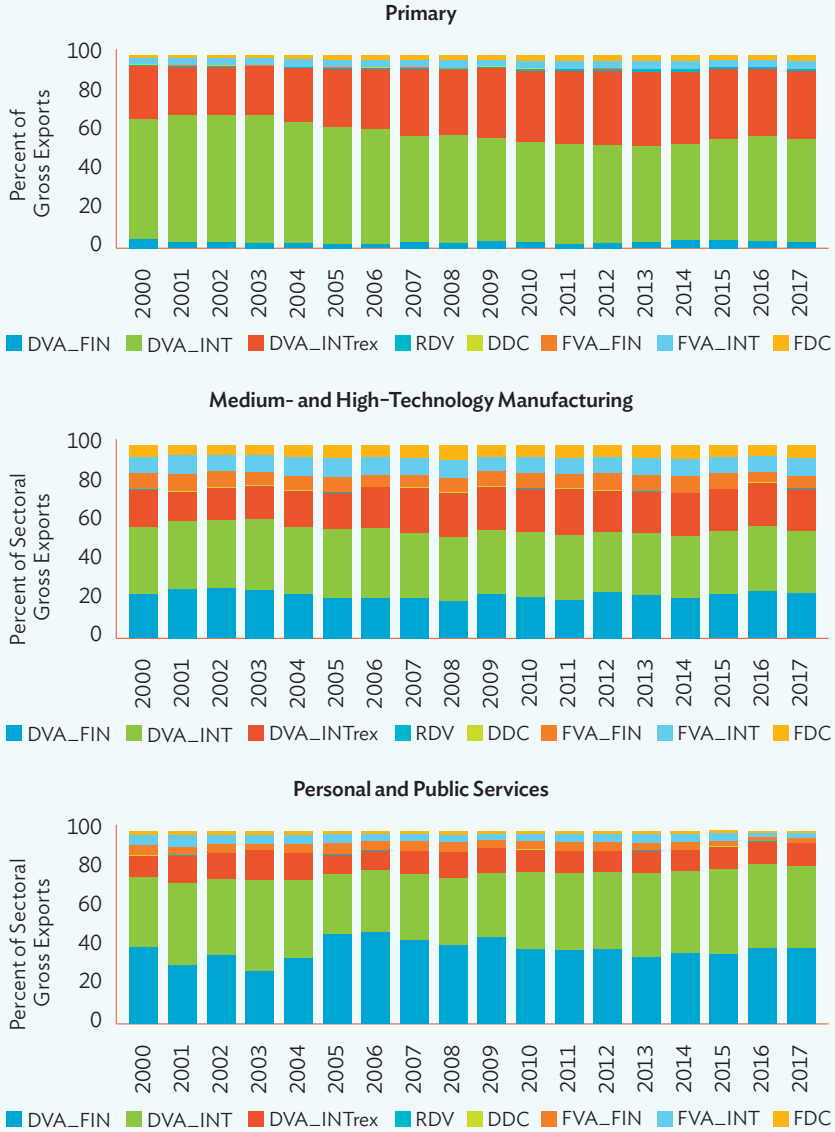
Figure 2.7 continued

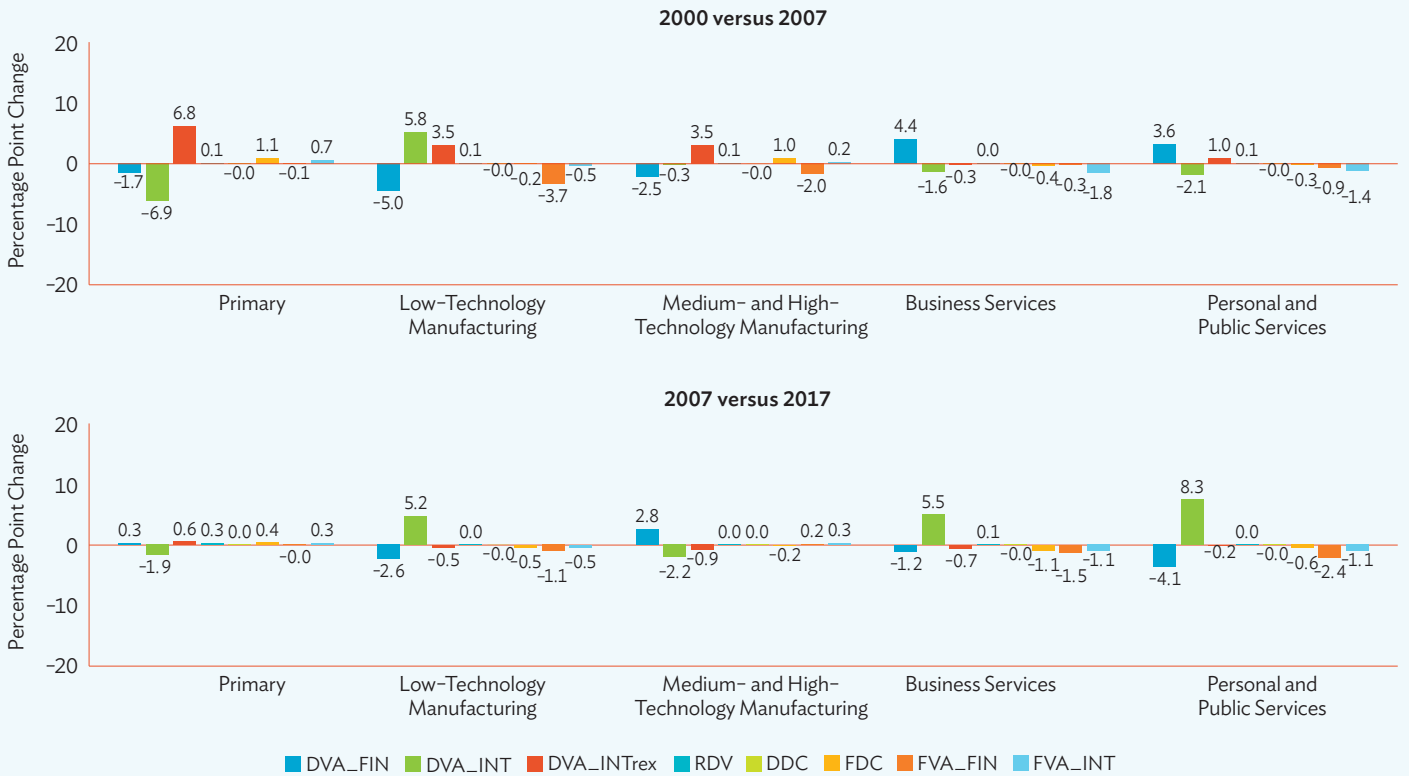


DDC = domestic double-counted, DVA_FIN = domestic value-added in final product exports, DVA_INT = domestic value-added in intermediate product exports, DVA_INTrex = domestic value-added in intermediate product exports that are re-exported, FDC = foreign double-counted, FVA_FIN = foreign value-added in final product exports, FVA_INT = foreign value-added in intermediate product exports, RDV = returned domestic value-added.

Note: Asian Development Bank estimates are based on the methodology of Wang, Wei, and Zhu (2018).

Sources: Multi-Regional Input–Output Tables, 2000, 2007–2017, Asian Development Bank; World Input–Output Database, 2001–2006; Asian Development Bank estimates.

Figure 2.8: Changes in Value-Added Components of Exports, 2000 versus 2007 and 2007 versus 2017



DDC = domestic double-counted, DVA_FIN = domestic value-added in final product exports, DVA_INT = domestic value-added in intermediate product exports , DVA_INTrex = domestic value-added in intermediate product exports that are re-exported, FDC = foreign double-counted , FVA_FIN = foreign value-added in final product exports, FVA_INT = foreign value-added in intermediate product exports, RDV = returned domestic value-added.

Note: Asian Development Bank estimates are based on the methodology of Wang, Wei, and Zhu (2018).

Sources: Multi-Regional Input–Output Tables, 2000, 2007, and 2017, Asian Development Bank; Asian Development Bank estimates.

points both in medium- and high-technology manufacturing goods as well as low-technology manufacturing goods. This increase in DVA_INTrex was accompanied by a decline in DVA embedded in final goods (DVA_FIN) produced by manufacturing sectors. DVA_FIN contracted by 5.0 percentage points in low-technology manufacturing goods and 2.5 percentage points in medium- and high-technology manufacturing goods.

Meanwhile, during 2007–2017, Indonesia's domestic value-added embedded in intermediate exports used by partner economies to produce final products consumed within their boundaries (DVA_INT) increased in low-technology manufacturing and services sectors. Coincidentally, DVA_INTrex declined (albeit marginally) in all broad sectors considered, except for the primary sector. The rather significant changes in these two value-added terms imply that, in general, Indonesia participated less in complex GVCs, which characteristically cross at least two administrative borders.

2.4 Tracing Indonesia's Value-Added Links through Network Analysis

Network analysis using the time series ADB MRIOTs is undertaken to visualize where Indonesia fares in the entire landscape of global production networks, and how its involvement in GVCs has evolved over time. Box 3 presents a brief exposition on how graph networks may aid in understanding the evolution of GVC. In the analysis presented in this section, the GVC networks for the years 2000, 2010, and 2017 are visualized using domestic value-added statistics derived from the ADB MRIOTs (Figure 2.9).

As different representations of GVC networks may be generated based on varying indicators, it is helpful to first define the elements of the network charts presented below. The set of nodes comprises economies in ADB MRIOTs, excluding "rest-of-the-world," which serves as a catch bin of all countries that are not yet individually modeled in the ADB MRIOTs. The size of the nodes pertains to the amount of domestic value-added that is ultimately involved in GVC-related activities (i.e., the monetary value of forward GVC participation). Whereas, the thickness of the edges, or the lines connecting any two nodes, represents the monetary value of domestic value-added that is embedded in bilateral exports of one node (country) to another.[1] The size of the nodes signifies the importance of countries as a supplier of value-added in GVCs while edges depict the extent of cross-border production sharing (in value-added terms) occurring across countries.

[1] A minimum threshold value of $5 million was set for the edges. Transaction values that show levels lower than this threshold do not appear in the network charts. Countries that do not have links with other countries were omitted from the charts.

Box 3: Examining Networks of Value-Added Trade

In a global value chain (GVC) world, countries and industries are highly interdependent. Network analysis presents a way to visualize this interdependence (Jackson 2014). Presenting GVCs as a network of interconnected players enables one to analyze both the intensive and extensive margins of trade in value-added (TiVA). In a directed network, the intensive margin reflects the volume of trade activity (*thickness of edges*) while the extensive margin displays the frequency of links in the network (*number of indegrees and outdegrees*).

Research on international trade has started utilizing networks in examining the evolving nature and dynamics of international trade. For example, Amador and Cabral (2016) use data on bilateral foreign value-added (FVA) embedded in exports covering the years 1995 to 2011. The authors find that directed FVA networks have become denser, more complex and intensively connected over time, which affirms the expansion and deepening of GVCs as recognized in trade literature. Moreover, networks of value-added trade are characterized as centralized and asymmetric, exhibiting a hierarchical structure dominated by central countries that act as hubs. These structural properties are important as they have material consequences on the propagation of shocks (Acemoglu et. al 2012). Other notable recent applications of complex network analysis in the context of GVCs include Amighini and Gorgoni (2014), Cerina et al. (2015), and Ferrarini (2013).[a]

[a] Amighini and Gorgoni (2014) utilized trade data at the detailed product level in analyzing how emerging players in the global value chain have caused a structural change in the international organization of auto production. Cerina et al. (2015) use data from harmonized multi-regional input–output tables in the World Input–Output database in mapping the network of monetary goods flows across economy-sectors. Ferrarini (2013) generated networks reflecting vertical trade using product-level trade data.

Sources: D. Acemoglu, V. Carvalho, A. Ozdaglar, and A. Tahbaz-Salehi. 2012. The Network Origins of Aggregate Fluctuations. *Econometrica*. 80(5) pp. 1977–2016.
J. Amador and S. Cabral. 2016. Global Value Chains: A Survey of Drivers and Measures. *Journal of Economic Surveys*. 30(2) pp. 278–301.
A. Amighini and S. Gorgoni. 2014. The International Reorganisation of Auto Production. *The World Economy*. 37(2) pp. 923–952.
F. Cerina, Z. Zhu, A. Chessa, and M. Riccaboni. 2015. World Input–Output Network. *PLoS ONE*. 10(7) pp. 1–21.
M. Jackson. 2014. Networks in the Understanding of Economic Behaviors. *Journal of Economic Perspectives*. 28(4) pp. 3–22.

In defining the layout of the network charts, a Force-Atlas algorithm (Bastian, Heymann, and Jacomy 2009) was utilized. There are two main features in this algorithm. First, it pushes hubs (i.e., those with the highest number of output links) towards the periphery while it puts authorities (i.e., those with the highest number of input links) toward the center of the network chart. The push-and-pull forces defined by linkages influence the relative position of the nodes in the charts. Likewise, forces created by linkages balance out such that the topological structure of the charts depends on the strength of input and output links.

As the charts show (Figure 2.9), in 2000, the major players in global production networks were Germany, Japan, the United Kingdom, and the United States. Indonesia, seen in the periphery, exhibited strong forward ties with only one country—that is, the United States. Also, the United States exported its value-added into Indonesia which ultimately became embedded in Indonesia's exports. The network graph for 2000 also shows that Indonesia had no significant forward link with its neighboring Asian economies.

In 2010, the shape and structure of GVCs became more complex. Asia's former hub was replaced by the People's Republic of China and more forward links were established among economies. The social network graph in 2010 shows that Indonesia managed to establish forward ties with Germany; Hong Kong, China; the People's Republic of China; Singapore; the United Kingdom; and the United States. It also became a significant destination for value-added from Australia, Germany, France, and a number of Asian economies.

By 2017, Indonesia further strengthened its forward ties with France; Germany; Hong Kong, China; the People's Republic of China; Singapore; the United Kingdom; and the United States. The charts, however, show that Indonesia did not interact intensively with ASEAN neighbors. It supplied value-added that ultimately became embedded in exports of central countries in Factory Asia, Factory North America, and Factory European Union, as well as of resource-scarce economies such as Singapore and Hong Kong, China. This trend is similar to the trade patterns seen for the People's Republic of China where developed economies become increasingly important as export destinations.

An examination of the list of products exported from Indonesia to Hong Kong, China and Singapore reveals that among the major imports of these two economies from Indonesia were resource-based and low-technology manufacturing products such as pearls and semi-precious stones; mineral fuels and oils; electrical machinery, equipment and parts; dairy products; tobacco; fish; crustaceans; tin; and chemical products.

Figure 2.9: Networks of Value-Added Trade, 2000, 2010, and 2017

A. 2000

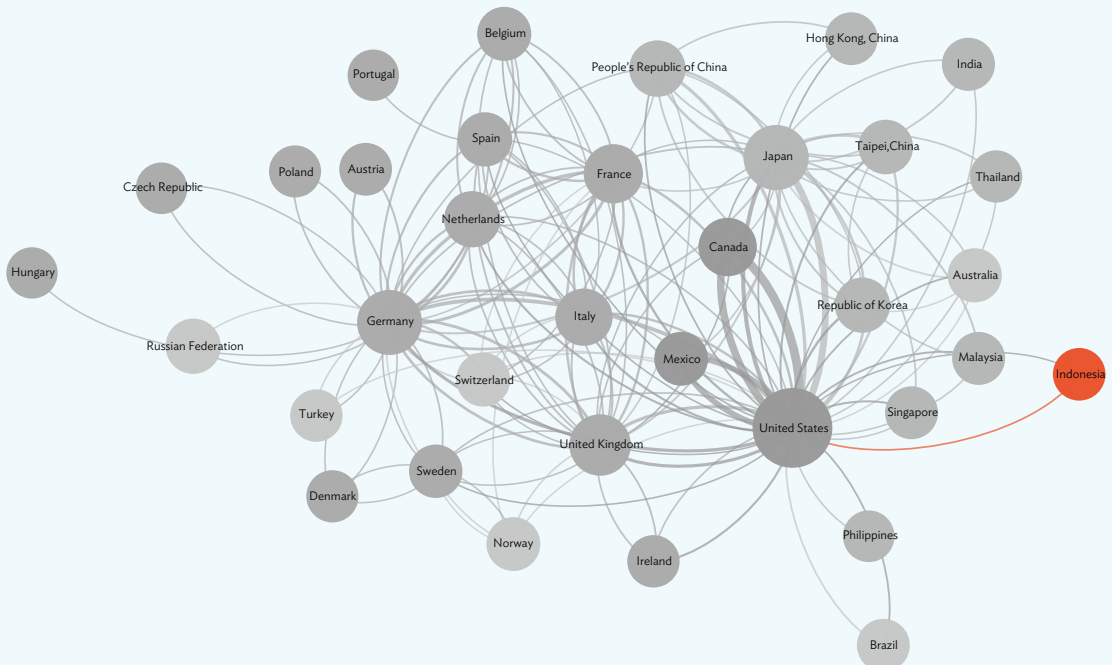


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Figure 2.9 continued

B. 2010

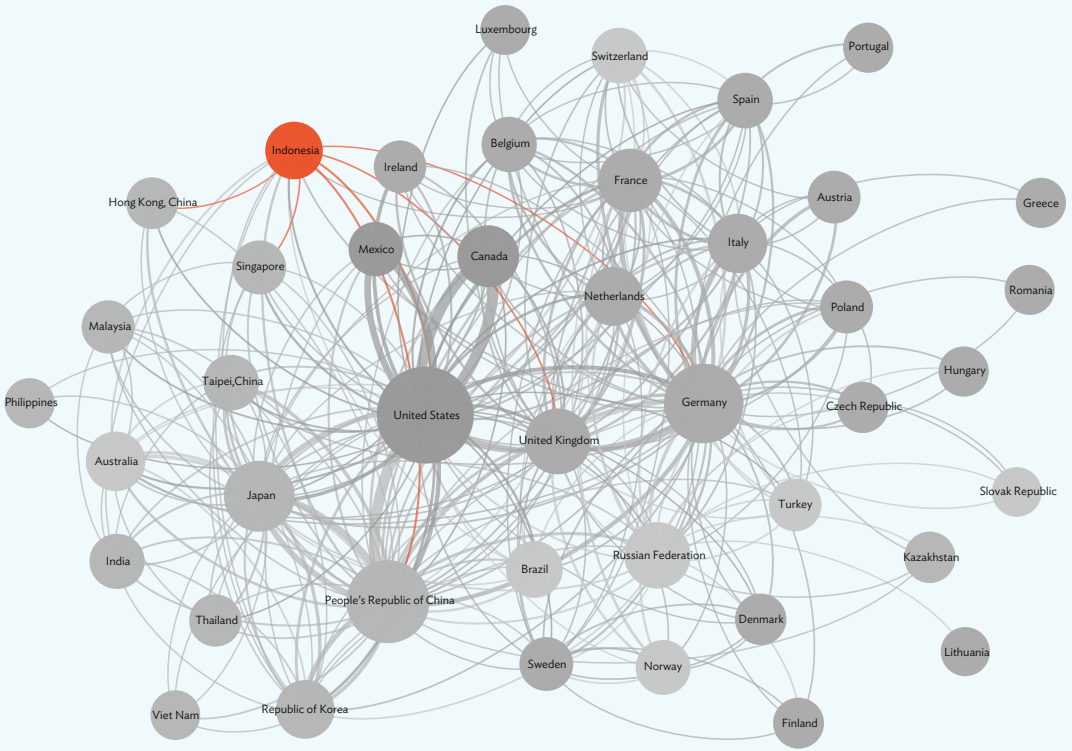

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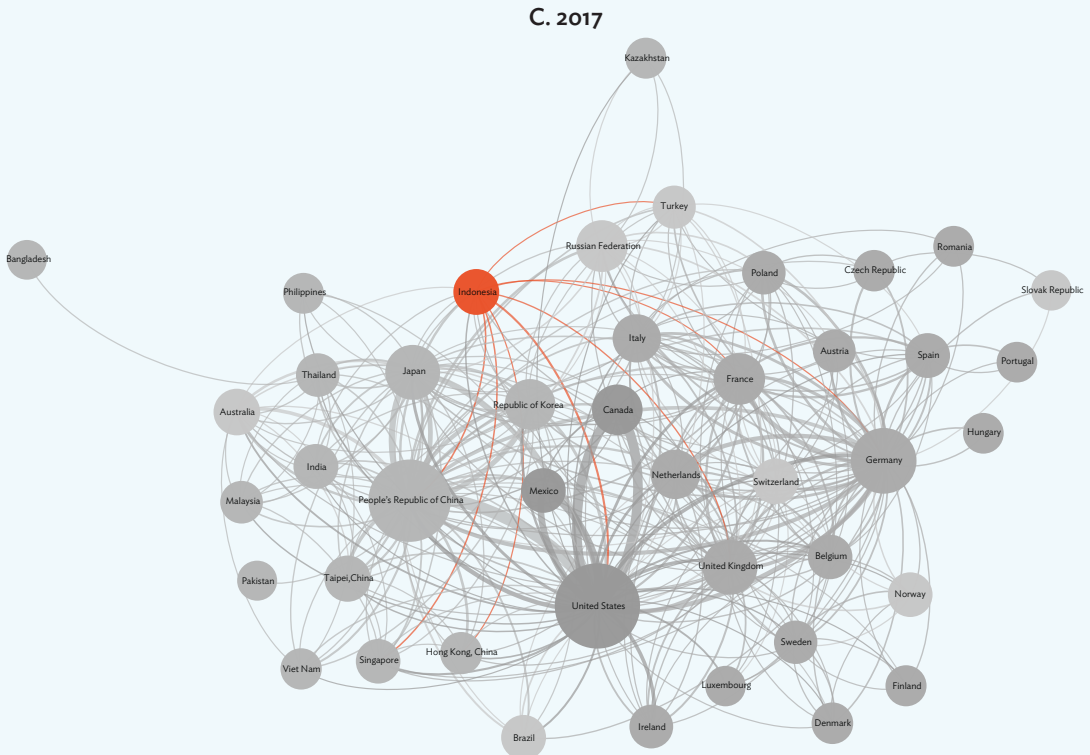
Figure 2.9 continued



DVA = domestic value-added.

Note: Chart shows economies with the highest levels of domestic value-added involved in GVC-related activities. Node size corresponds to the monetary value (in $) of DVA that is ultimately involved in GVC-related activities (forward GVC participation). DVA embedded in exports of source economy to a destination economy defines the edges of the network charts. Line thickness indicates the size of domestic value-added produced by the economy that is absorbed abroad. Asian Development Bank estimates are based on the methdology of Wang, Wei, and Zhu (2018).

Sources: Multi-Regional Input–Output Tables, 2000, 2010, and 2017, Asian Development Bank; Asian Development Bank estimates.

Chapter 3
Indonesia's Participation, Position, and Specialization in Global Value Chains

For countries, participating in global value chains (GVCs), directly or indirectly, is inevitable in a highly globalized world where production processes are largely fragmented across borders. When, where, and how economies enter any given GVC depends on their endowments. However, it should not be assumed that the intensity and position of an economy's participation in value chains and its product or process specialization are static. Instead, depending on multiple factors—such as economic conditions and the goals of policy makers—economies can shape their involvement in cross-border production arrangements.

This section analyzes how Indonesia's involvement in GVCs evolved since the start of the millennium. Using indicators derived by applying Wang, Wei, Yu, and Zhu (2017), this section presents stylized facts on the country's participation in GVCs. It also assesses Indonesia's position in GVCs using the upstreamness index discussed in Antràs and Chor (2013, 2018), Fally (2012), and Miller and Temurshoev (2017). Finally, Indonesia's evolving comparative advantage is also analyzed through a new measure of revealed comparative advantage (RCA). Following Wang, Wei, and Zhu (2018), this new measure uses domestic value-added through forward linkage instead of gross exports in computing country-sectors' comparative advantages.

3.1 Indonesia's Participation in Global Value Chains

An economy's production activities can be divided into three categories: first, those related to domestic trade; second, those linked to bilateral trade of final products; and third, those attributed to intermediates trade. The third category is considered GVC-related activity and determines the extent to which an economy participates in global production networks.

Economies can participate in GVCs in two ways. In the forward perspective, an economy can supply domestic value-added by exporting intermediate products to other economies. On the other hand, in the backward perspective, it can use intermediate inputs from other economies in its production of final goods and services. Box 4 discusses in detail how production can be decomposed and how participation in the forward and backward linkages can be measured.

Box 4: Measuring Countries' Participation in Global Value Chains

Wang et al. (2017), hereafter WWYZ (2017), proposed a value-added based decomposition of final production at the economy-sector level from two interrelated perspectives: forward and backward linkage. On the one hand, value-added generated by one country-sector contributes to its own or another country-sector's final production. Tracing where a focal country-sector's value-added "goes to" corresponds to the forward linkage perspective. On the other hand, an economy-sector's final production may be decomposed into value-added contributions made by economy-sectors worldwide. Tracing the origin of value-added given a fixed focal destination economy-sector corresponds to the backward linkage perspective.

When tracing the origin or destination of value-added in the context of GVCs, it is not only the perspective (i.e., backward or forward) that matters. Quantifying the GVC-related value-added requires that source and destination geographical markers be made clear. Explicitly accounting for geographical flows, WWYZ (2017) characterized value-added into three major categories: (a) value-added that is domestically produced and consumed; (b) value-added that is embedded in final product exports or imports; and (c) value-added that is embodied in intermediate exports or imports. Only value-added associated with trade in intermediate goods (i.e., item c) is considered GVC-related.

A simplified framework for decomposing gross domestic product (GDP) and final goods production is shown in Box 4 Figure. In WWYZ (2017), the forward-linkage decomposition relates to separating a country-sector's total value-added into several components. If the goal is to understand which types of production and trade are GVC-related activities, one can decompose GDP into three component parts: (1.a) value-added associated with the production of final products sold in the domestic market (pure domestic), (1.b) value-added associated with the production of final products exported to a direct importing country (traditional trade) and (1.c) value-added associated with the production of intermediate exports (GVC-related value-added).

Meanwhile, the backward-linkage decomposition concerns breaking down the total final goods and services production of a country-sector into several components. If the goal is to estimate the part of final goods and services production that were involved in GVC-related activities, one can break final production into three component elements: (2.a) domestic value-added embedded in domestically-used final products (pure domestic); (2.b) domestic value-added embedded in final exports (traditional trade); and (2.c) domestic and foreign value-added embedded in intermediate imports used to produce final goods and services (GVC-related value-added).

To reiterate, the broad definition entails that value-added associated with intermediate exports (1.c) or imports (2.c) are classified as generated from or involved in GVC-related activities. From the forward GVC perspective, value-added generated in the production of intermediate exports that is ultimately absorbed by the direct importer constitutes simple GVC-related activities. On the other hand, value-added generated through the production of intermediate exports that are re-exported or re-imported to the source country is classified as belonging to complex GVC-related activities. From the backward perspective, creation of value-added embedded in intermediate imports that are used in the production of goods and services consumed domestically constitutes simple GVC-related activities while the creation of value-added embedded in the production of exported goods and services are classified as belonging to complex GVC-related activities.

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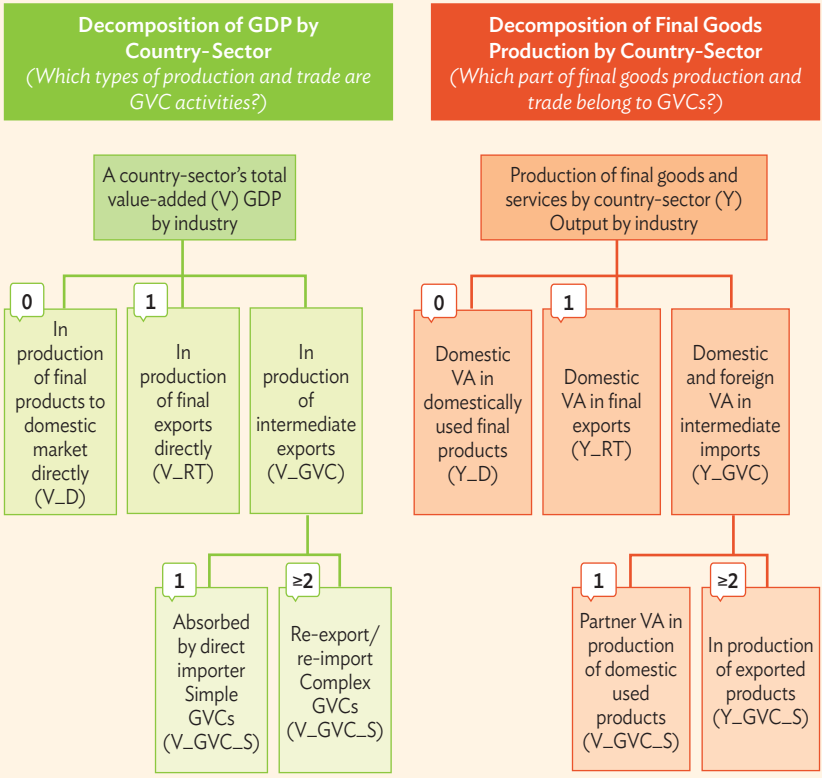
Box 4 continued

Box 4 Figure: Decomposition of GDP and Final Goods Production by Country-Sector



Source: Wang, Wei, Yu, and Zhu (2017).

The decomposition framework presented above is used to estimate measures of GVC participation. In particular, the fraction of value-added associated with trade in intermediates from the forward linkage perspective denotes the level of *forward GVC participation* in WWYZ (2017). It is operationally defined, for each country-industry, as the domestic value-added generated through GVC-related activities as a share of total value-added. The strength of backward *GVC participation* is indicated by the fraction of value-added associated with trade in intermediate products from the backward linkage perspective. It measures the percentage of an economy-sector's total production of final goods and services that represent value-added involved in GVC activities.

Source: Z. Wang, S. Wei, X. Yu, and K. Zhu. 2017. Measures of Participation in Global Value Chains and Global Business Cycles. *NBER Working Paper* No. 23222. Cambridge, MA: National Bureau of Economic Research.

From 2000 to 2017, trade-related activity as a percentage of value-added and final goods and services production declined in Indonesia (Figure 3.1.A). The combined domestic value-added generated in the production of final exports and in GVCs made up 31.8% of total value-added, but this share declined by over 14 percentage points to 17.6% by 2017. As in the forward linkage, decomposition of final products also showed a declining share of trade-related activities (Figure 3.1.B). In 2000, 27.8% of final production could be traced to trade-related activities. This share declined by almost 13 percentage points to 15 percentage points in 2017.

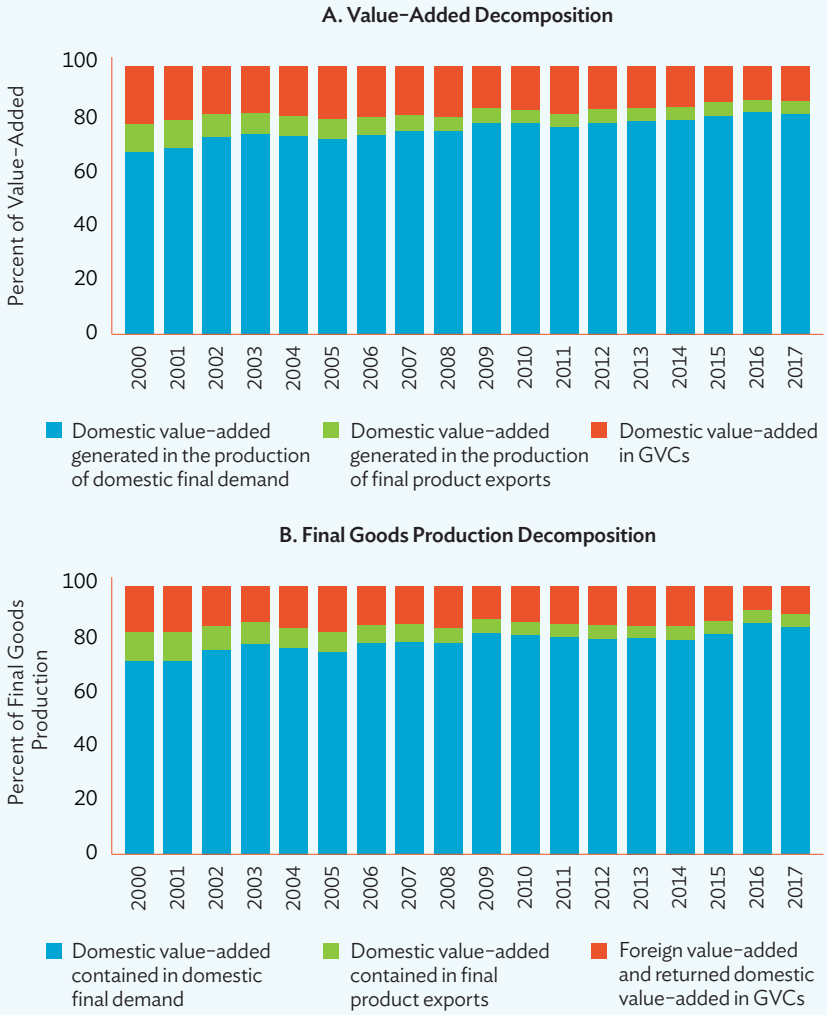
Figures 3.1.A. and 3.1.B. show that much of the decline in trade-related activities in both the forward and backward linkages could be attributed to declines in traditional trade, or trade in final exports. Meanwhile, trade in intermediates experienced slower declines as percentages of total value-added and final production in the forward and backward linkages, respectively.

As discerned earlier through other indicators, Indonesia's participation in GVCs declined between 2000 and 2017. In 2000, Indonesia's forward GVC participation was 21.5% of total value-added, above all hubs' forward GVC participation (Figure 3.2.A). By 2017, the ratio declined to 12.9%, below Germany's 19.8% and the world average of 13.3%. Likewise, Indonesia's backward GVC participation also declined during the period. The country's backward GVC participation was 16.9% of total final production in 2000, but the share declined to 10.1% in 2017. However, data also show a slightly increasing trend in backward participation from 2009 to 2014, before a downward trend from 2014 to 2016 and a slight rebound in 2017 (Figure 3.2.B). This decline in GVC participation, beginning in 2014, coincided with the enactment of the New Trade Bill, which emphasizes the importance of domestic trade.

A comparison of the forward and backward GVC participation indices can be used to discern an economy's or economy-sector's relative position in various GVCs. A higher forward GVC participation compared to backward GVC participation indicates that an economy, or a sector therein, is more engaged in relatively upstream activities. On the other hand, a higher backward participation index versus forward participation index implies that an economy or economy-sector is engaged in relatively more downstream activities.

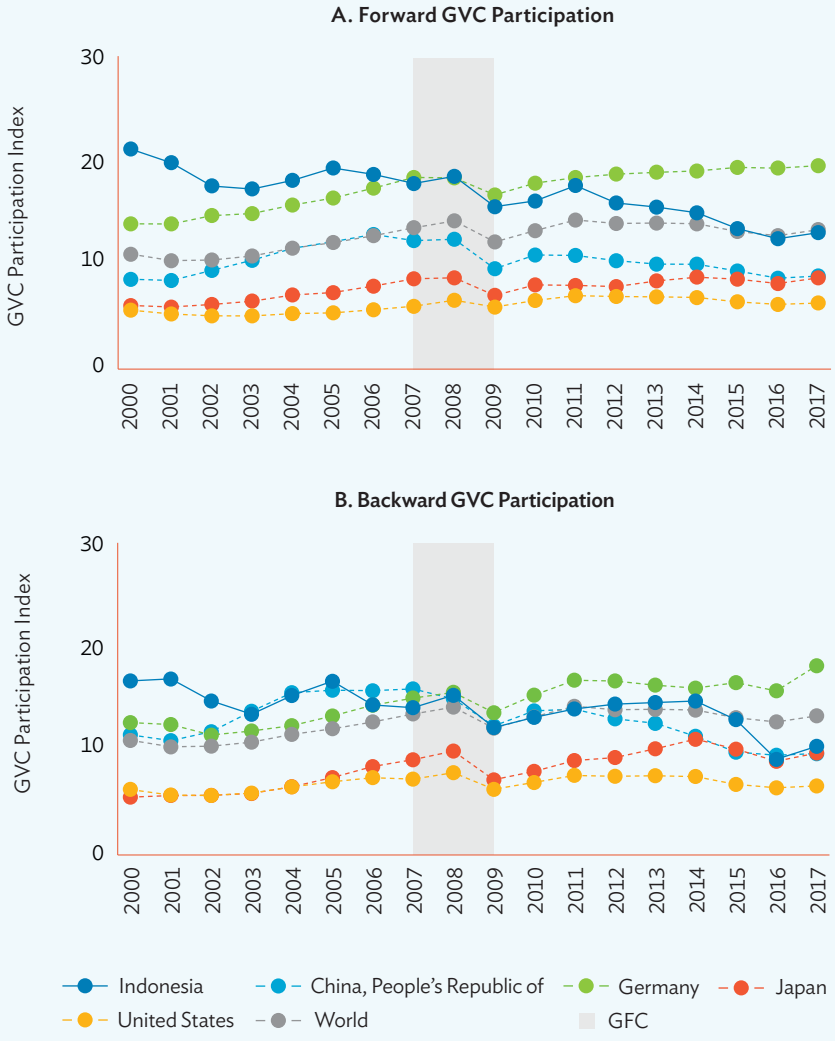
Data show that Indonesia was more actively engaged in upstream production. The country's forward GVC participation was higher than its backward participation across all years (Figure 3.3). This implies that, in the aggregate, the economy's intermediate exports contained a higher proportion of domestic value-added than foreign value-added and returned domestic value-added put together. In other words, over the period considered, Indonesia supplied more domestic value-added than its use of foreign value-added and returned domestic value-added in production-sharing activities.

Figure 3.1: Decompositions of Value-Added and Final Production, Indonesia, 2000–2017



GVC = global value chain.
Note: Asian Development Bank estimates are based on the methodology of Wang, Wei, Yu, and Zhu (2017).
Sources: Multi-Regional Input–Output Tables, 2000, 2007–2017, Asian Development Bank; World Input–Output Database, 2001–2006; Asian Development Bank estimates.

Figure 3.2: Global Value Chain Participation Across Manufacturing Hubs, 2000–2017



GFC = global financial crisis, GVC = global value chain.
Note: Asian Development Bank estimates are based on the methodology of Wang, Wei, Yu, and Zhu (2017).
Sources: Multi-Regional Input–Output Tables, 2000, 2007–2017, Asian Development Bank; World Input–Output Database, 2001–2006; Asian Development Bank estimates.

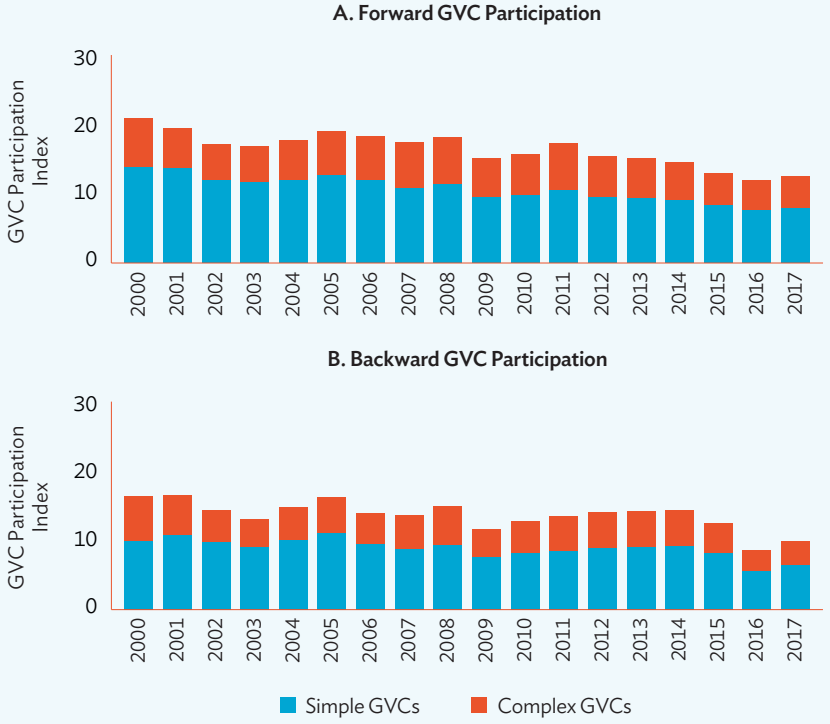
Indonesia's trade in intermediates was also dominated by value-added that crossed border only once from both the backward and forward perspectives. Figure 3.3 shows that simple GVCs dominated complex GVCs regardless of the perspective. In the forward perspective, this implies that most of the domestic value-added generated in the country's production of intermediate exports was used by direct importers in their final production. The data on the backward perspective imply that most of Indonesia's intermediate imports came from bilateral trading partners and were used in the making of domestically consumed products. In contrast, in complex GVCs, foreign value-added and returned domestic value-added are used in significant measures in export production.

A sector-wise dissection shows Indonesia's orientation towards primary exports in intermediate trade. Its primary sector consistently showed the highest forward participation ratios since 2007 (Figure 3.4). This reflects the country's position as the second largest exporter of coal briquettes and as a major exporter of agricultural products during 2000–2017. Participation ratios in the medium- and high-technology manufacturing sector were also relatively high compared to other sectors.

Trends in participation indices also varied by sector in Indonesia. Except in the medium- and high-technology sector, both forward and backward participation indices showed markedly higher proportions of simple GVCs compared to complex GVCs (Figure 3.4). Complex GVCs generally dominated simple GVCs in the backward linkages in the medium- and high-technology sector. Forward participation was also higher than backward participation for the primary sector, whereas the reverse was the case in the low-technology manufacturing, and personal and public services sectors. Interestingly, for the medium- and high-technology manufacturing and business service sectors, backward participation exceeded forward participation in some years while lagging during others.

Indonesia's primary sector was more involved in upstream activities that largely exported intermediates used by direct importers in their production of final products. Forward participation indices for the primary sector in Indonesia ranged between 23.8% to 35.9%, whereas backward participation indices for the primary sector fell below 6% for all years considered (Figure 3.4). Thus, the primary sector was strongly oriented towards supplying domestic value-added in intermediate exports rather than using foreign value-added and returned domestic value-added in production. Moreover, a higher proportion of simple GVCs in the forward linkage implies that the domestic value-added embodied in Indonesia's primary sector intermediate exports was used by direct importers largely in the production for their domestic consumption.

Figure 3.3: Simple and Complex Global Value Chain Participation in Indonesia, 2000–2017



GVCs = global value chains.
Note: Asian Development Bank estimates are based on the methodology of Wang, Wei, Yu, and Zhu (2017).
Sources: Multi-Regional Input–Output Tables, 2000, 2007–2017, Asian Development Bank; World Input–Output Database, 2001–2006; Asian Development Bank estimates.

Through the years, an increasing portion of Indonesia's primary sector's intermediate exports crossed border more than once. In 2000, value-added generated in the production of intermediate exports that were used in domestic final production of direct importers made up 68.7% of total intermediate exports production. However, by 2017, this share declined to 62.1%. Thus, Indonesia's primary sector was engaged in relatively more complex GVCs as already seen in Section 2.3.

Indonesia's low-technology manufacturing sector was generally more involved in downstream activities relative to upstream activities, and most of the GVC activities within the sector involved single border crossings. The data on the country's low-technology manufacturing sector show that the sector's forward GVC participation fell below its backward participation for all years considered (Figure 3.4). Additionally, simple GVCs constituted more than

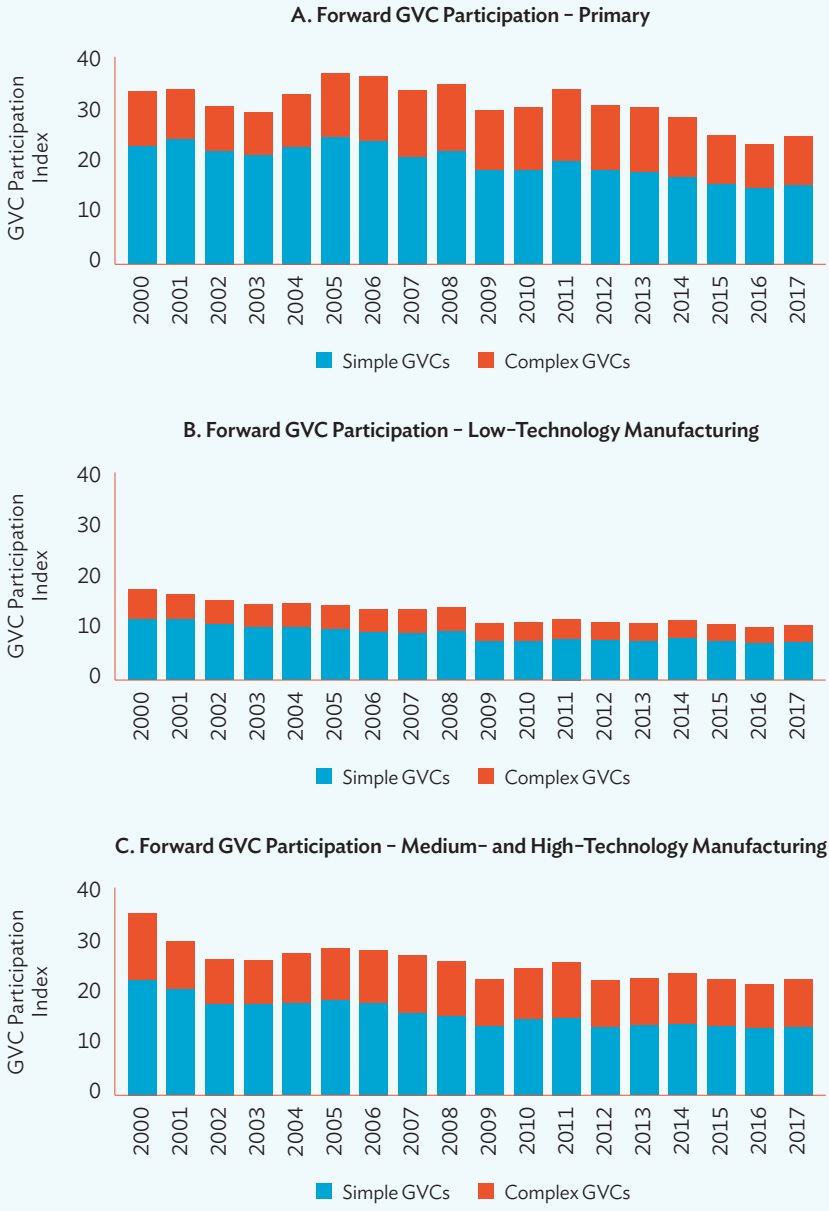
two-thirds of total GVC-related activities in the forward linkage, whereas at least 58% of total GVC-related activities in backward linkage could be categorized as simple GVCs (Figure 3.4). In the forward linkage perspective, this means that at least two-thirds of domestic value-added generated in Indonesia's production of low-technology manufacturing intermediates exports were used by direct importers to produce final goods and services that were consumed locally. Meanwhile, in the backward perspective, over 58% of value-added embodied in the sector's intermediates imports was foreign value-added from partner economies that Indonesia used in the production of goods and services consumed domestically.

Forward and backward GVC participations by the medium- and high-technology sector in Indonesia were relatively high compared to other sectors. On the one hand, 22.1% to 36.2% of gross value-added generated by the medium- and high-technology sector was through the production of intermediate exports (Figure 3.4). The two largest contributors to domestic value-added in intermediate exports were "coke, refined petroleum, and nuclear fuel" manufacturing and "chemicals and chemical products" manufacturing. On the other hand, foreign value-added and returned domestic value-added contained in intermediate imports in the sector ranged between 17.8% and 25.8% (Figure 3.4). Intermediates used in "electrical and optical equipment" manufacturing and "transport equipment" manufacturing contained the most foreign value-added and returned domestic value-added in the sector.

Engagement in simple and complex GVCs was also more proportional in the backward linkages of Indonesia's medium- and high-technology sector. In some years, participation in simple backward GVCs exceeded that in complex backward GVCs (Figure 3.4). This was true in 2007, 2008, 2016, and 2017. In other years, foreign value-added and returned domestic value-added in intermediate imports used in the production of the sector's exports exceeded foreign value-added in intermediate imports used in the production of domestically consumed products. In other words, participation in complex GVCs was higher in those years.

Indonesia's service sectors showed low to moderate participation in GVCs. Participation in both the backward and forward linkages in the business services sector consistently fell below 15%, and the values of both the indices were similar year after year (Figure 3.4). In the personal and public services sector, the difference between forward GVC participation and backward GVC participation was larger. Forward GVC participation shows that, at most, only 2.9% of the sector's gross value-added was generated in the production of its intermediate exports (Figure 3.4). This is not surprising given that services were mostly rendered within the domestic economy. On the other hand, backward GVC participation for the sector ranged between 5.6% and 14.4% of

Figure 3.4: Simple and Complex Global Value Chain Participation in Indonesia, by Sector, 2000–2017



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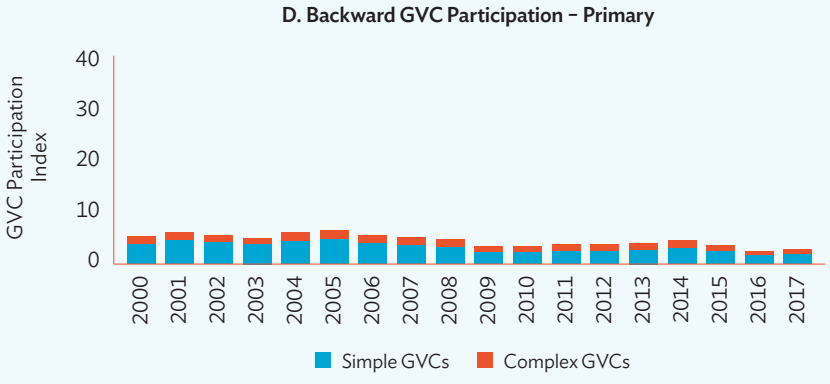

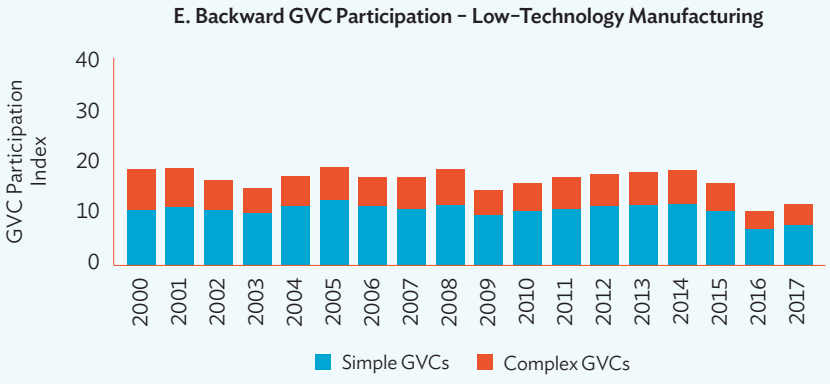

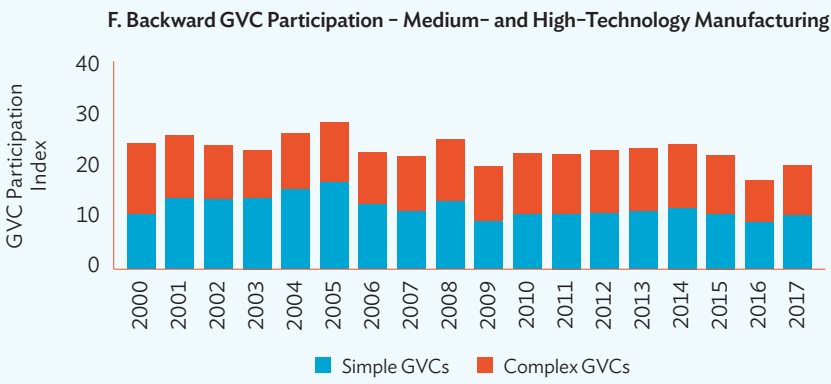

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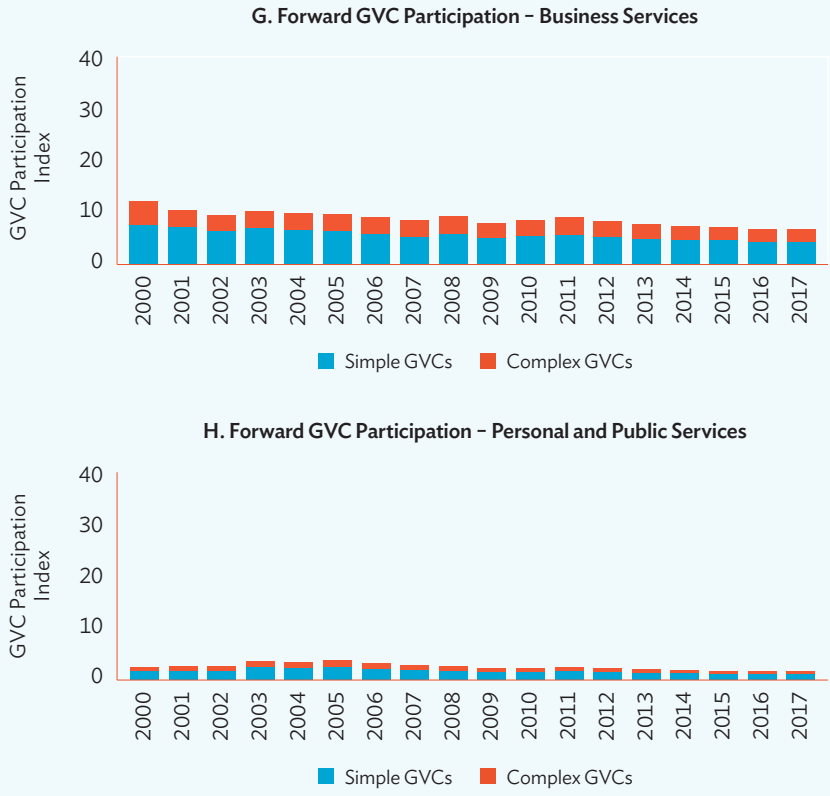
Figure 3.4 continued



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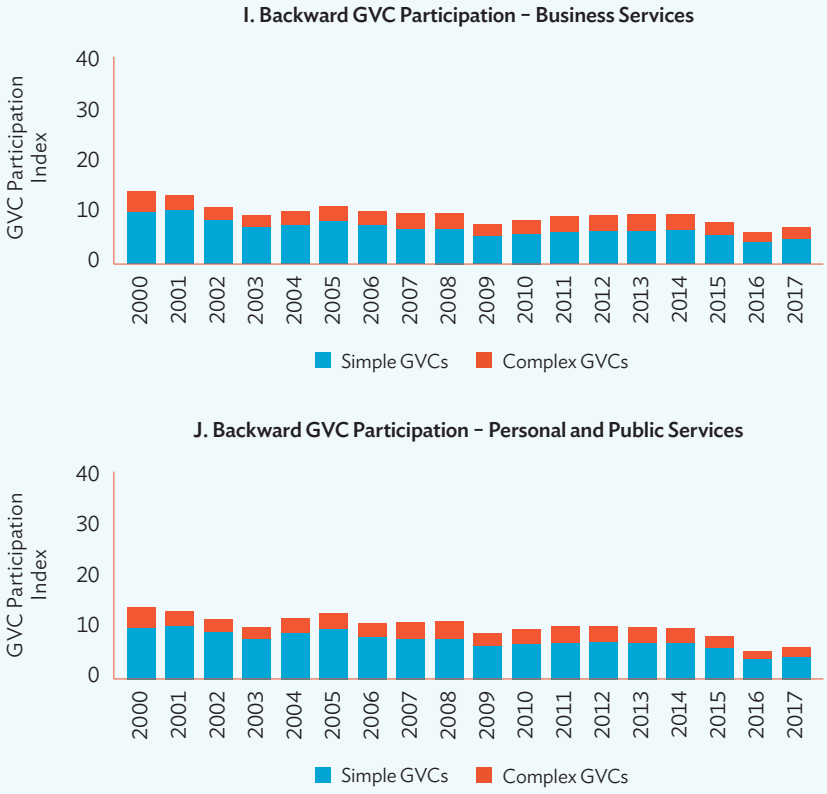
total final production (Figure 3.4). Thus, a portion of value-added contained in the final services of the sector could be attributed to foreign value-added and returned domestic value-added embodied in intermediate imports.

Overall, from 2000 to 2017, Indonesia's participation in GVCs declined in the aggregate and across sectors. Its participation, through both the forward and backward linkages, was on a downward trend when comparing 2000, 2007 and 2017 levels (Figure 3.3). The negative trends in the economy-wide GVC participation indices were also observed at the five-sector level (Figure 3.4). Moreover, the decline was evident even before the global financial crisis of 2008, with participation indices declining from 2000 to 2007. Notable increases in participation could be seen after the crisis for some industries, but generally participation declined from 2007 to 2017.

Figure 3.4 continued



GVCs = global value chains.
Note: Asian Development Bank estimates are based on the methodology of Wang, Wei, Yu, and Zhu (2017).
Sources: Multi-Regional Input–Output Tables, 2000, 2007–2017, Asian Development Bank; World Input–Output Database, 2001–2006; Asian Development Bank estimates.

Declining trends in participation indices in Figure 3.3 and Figure 3.4 imply that Indonesia became less integrated in intermediate supply chains and more involved in final goods trade and production for domestic consumption. The value-added and final production decompositions in Figure 3.1 show that Indonesia became less involved in GVC activities as larger portions of domestic value-added became attributable to final products. In other words, the country's links to the intermediates supply network weakened. Thus, despite Indonesia engaging more in upstream activities (as shown by the higher forward participation compared to backward participation), its position in GVCs trended downstream.

3.2 Indonesia's Position in Global Value Chains

An economy-sector's position in GVCs can be quantified through the upstreamness index as proposed by Fally (2012) and Antràs and Chor (2013). The upstreamness of an economy-sector is simply its average distance from final use (Box 5). An economy-sector is said to be relatively upstream if its output goes through several stages before reaching final use (Miller and Temurshoev 2017). A simpler measure of upstreamness also relates the share of gross output of an economy-sector that is sold to final consumers.

Box 5: Upstreamness

Fally (2012) and Antràs and Chor (2013) develop a measure of distance of a production sector from final demand called *upstreamness*. Succinctly, the *upstreamness* of sector r in economy i, or U_i^r, is the average distance from final use and is given by:

$$U_i^r = 1\times\frac{F_i^r}{X_i^r} + 2\times\frac{\sum_{s=1}^{S}\sum_{j=1}^{J} a_{ij}^{rs}F_j^s}{X_i^r} + 3\times\frac{\sum_{s=1}^{S}\sum_{j=1}^{J}\sum_{t=1}^{S}\sum_{k=1}^{J} a_{ij}^{rs}a_{jk}^{st}F_k^t}{X_i^r} + \cdots$$

where F is final demand, X is gross output, superscripts refer to sector, and subscripts refer to in economy. Moreover, a_{is}^{rj} is the dollar amount of sector r's output from economy i needed to produce one dollar worth of sector s's output in economy j.

Antràs and Chor (2018) show that given $\sum_{s=1}^{S}\sum_{j=1}^{J} a_{ij}^{rs} < 1$ for all j–s pairs, then the numerator of U_i^r is just the $([i-1]\times S+r)$–th element of the $J\times S$ by 1 column matrix $(I-\mathbf{A})^{-2}\mathbf{F}$, where $\mathbf{A}$ is a $J\times S$ by $J\times S$ matrix whose $([i-1]\times S+r,[j-1]\times S+s)$–th element is a_{ij}^{rs}, while $\mathbf{F}$ is a column matrix whose $([i-1]\times S+r)$–th row is F_i^r. Furthermore, given that the gross output column matrix satisfies, $\mathbf{X}=(I-\mathbf{A})^{-1}\mathbf{F}$, the numerator of U_i^r is also equal to the $([i-1]\times S+r)$–th element of the $J\times S$ by 1 matrix $(I-\mathbf{A})^{-1}\mathbf{X}$, where $\mathbf{X}$ **is a** $J\times S$ by 1 column matrix whose $([i-1]\times S+r)$–th row is X_i^r.

Note that $U_i^r \geq 1$, and that the higher U_i^r is, the higher is the *upstreamness* of the output from sector r in economy i. A sector that sells a higher proportion of output to final consumers would appear to be relatively downstream (i.e., relative low U_i^r), while a sector that sells a smaller proportion to final consumers would be relatively more upstream (i.e., relatively high U_i^r).

Antràs and Chor (2018) also present *upstreamness* as the share of gross output in sector r in economy i that is sold to final consumers. Mathematically, this is given by the ratio F_i^r/X_i^r, where F_i^r is the total final use of output from sector r in economy i and X_i^r is the gross output of sector r in economy i. In this case, the higher F_i^r/X_i^r is, the more downstream sector r in economy i is.

Sources: P. Antràs and D. Chor. 2013. Organizing the Global Value Chain. *Econometrica*. 81(6) pp. 2127–2204.
P. Antràs and D. Chor. 2018. On the Measurement Of Upstreamness and Downstreamness in Global Value Chains. *NBER Working Paper* No. 24185. Cambridge, MA: National Bureau of Economic Research.
T. Fally. 2012. *Production Staging: Measurement and Facts*. University of Chicago Boulder (mimeo).

In this case, an economy-sector that sells a large amount of its output for intermediate use, i.e., it has a lower ratio between final use and total output, is said to be relatively upstream.

3.2.1 Indonesia's Average Position in Global Value Chains

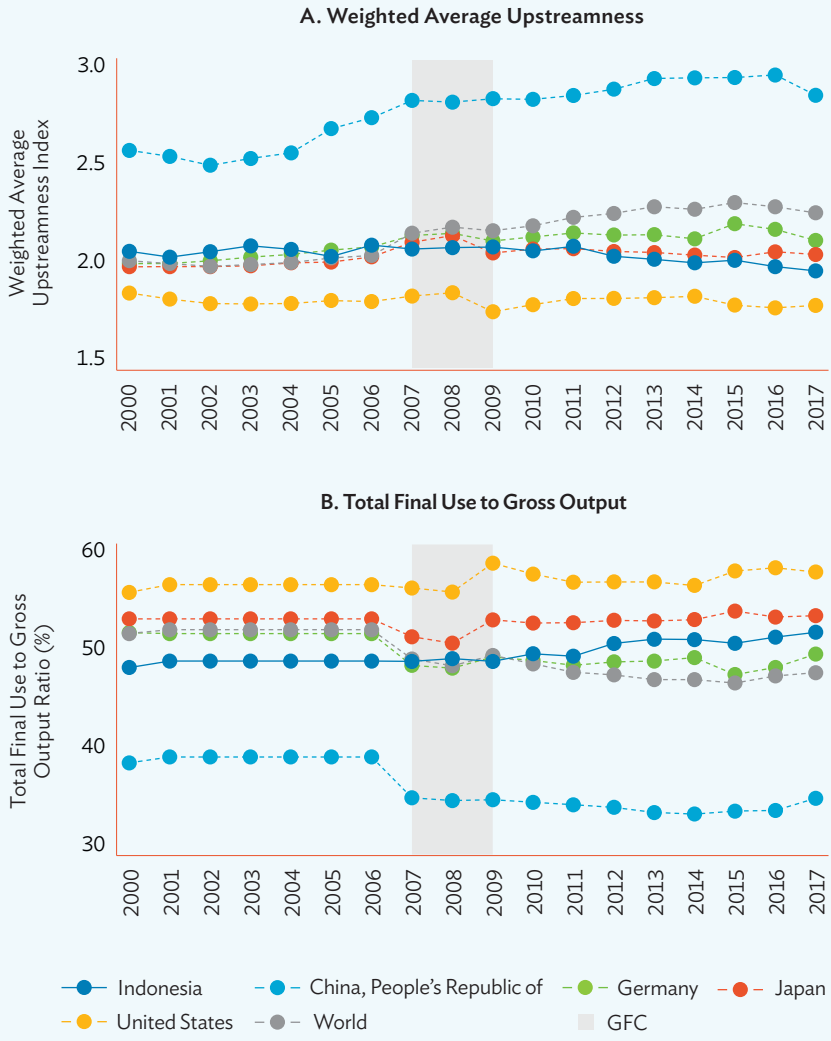
Weighted average upstreamness indices can be used to trace the evolution of economies' average positions in GVCs. Antràs and Chor (2018) and Miller and Temurshoev (2017) make use of gross output shares as weights in aggregating upstreamness indices. Figure 3.5.A presents the weighted average upstreamness indices for several economies. While Figure 3.5.B presents the average total final use to gross output ratio of the same economies, which is computed by aggregating total final use of all sectors within each economy and then dividing them by each of their corresponding total economy gross output.

Indonesia's upstreamness indices point to it moving relatively downstream or closer to final use, a trend contrary to those of the world and of many manufacturing hubs (Figure 3.5.A). The country's gross output weighted-average upstreamness was in decline from 2000 to 2017. In 2000, its weighted-average upstreamness was 2.06, above the world average (2.01), Germany (2.00), Japan (1.98), and the United States (1.85). Since then, however, the world, Germany, and Japan showed generally increasing upstreamness, whereas the indices for Indonesia and the United States declined. By 2017, upstreamness in Indonesia (1.96) had diverged from, and fallen below, the world average (2.26) and that of Germany (2.12) and Japan (2.04).

Indonesia's intermediate supply links with other countries weakened over 2000–2017 although the change in Indonesia's upstreamness was marginal (0.10 units), meaning that a larger share of its gross output was used to satisfy final demand. Thus, it was supplying less intermediates to other economies. Furthermore, declining upstreamness also implies that the country's intermediate supply links with other economies were becoming simpler and weaker as production shifted towards final goods and services. Meanwhile, Germany, Japan, and the world showed increased shares of intermediates in their gross output and strengthened intermediate supply links with other countries.

Higher final use to gross output ratios also imply that Indonesia was moving relatively downstream (Figure 3.5.B). An increasing final use to gross output ratio implies that the share of intermediates in gross output was decreasing.

Figure 3.5: Trends in Upstreamness Across Economies, 2000–2017



GFC = global financial crisis.
Note: Asian Development Bank estimates are based on the methodologies of Antràs and Chor (2018) and Miller and Temurshoev (2017).
Sources: Multi-Regional Input–Output Tables, 2000, 2007–2017, Asian Development Bank; World Input–Output Database, 2001–2006; Asian Development Bank estimates.

Thus, the country was supplying less intermediates to other economies for further processing. On the other hand, the final use to gross output ratios for the world, Germany, and the People's Republic of China declined from 2000 to 2017.

Indonesia was among the economies that moved downstream, as measured by changes in the upstreamness index and the total final use to gross output ratio. Figure 3.6.A shows the percentage changes in the weighted average upstreamness indices of economies from 2000 to 2017. Meanwhile Figure 3.6.B shows the percentage point changes in total final use to gross output ratio of economies for the same period. Indonesia was among the 15 (out of 62) economies that registered a decrease in weighted average upstreamness index from 2000 to 2017 and among the 23 (out of 62) economies that showed increases in their total final use to gross output ratio from 2000 to 2017. Other economies where weighted average upstreamness decreased include India, Malaysia, and the United States. For the period studied, Indonesia registered a 4.9 percentage point decrease in its upstreamness index and a 3.6 percentage point increase in its total final use to gross output ratio. Meanwhile, most economies experienced rising upstreamness indices and declining total final use to gross output ratios. These economies include the People's Republic of China and Viet Nam. Therefore, as GVCs were becoming more complex, with many economies strengthening their links to the intermediate supply chains, Indonesia was participating less in intermediate products trade and delving more in final goods and services trade.

Given that Indonesia's weighted-average upstreamness index is constructed using gross output weighted sectoral upstreamness indices, trends in the aggregate economy's upstreamness can be traced back to sectoral changes. The next subsection tackles trends and patterns in the positions of the country's sectors in GVCs.

Figure 3.6: Changes in Upstreamness Across Economies, 2000 versus 2017

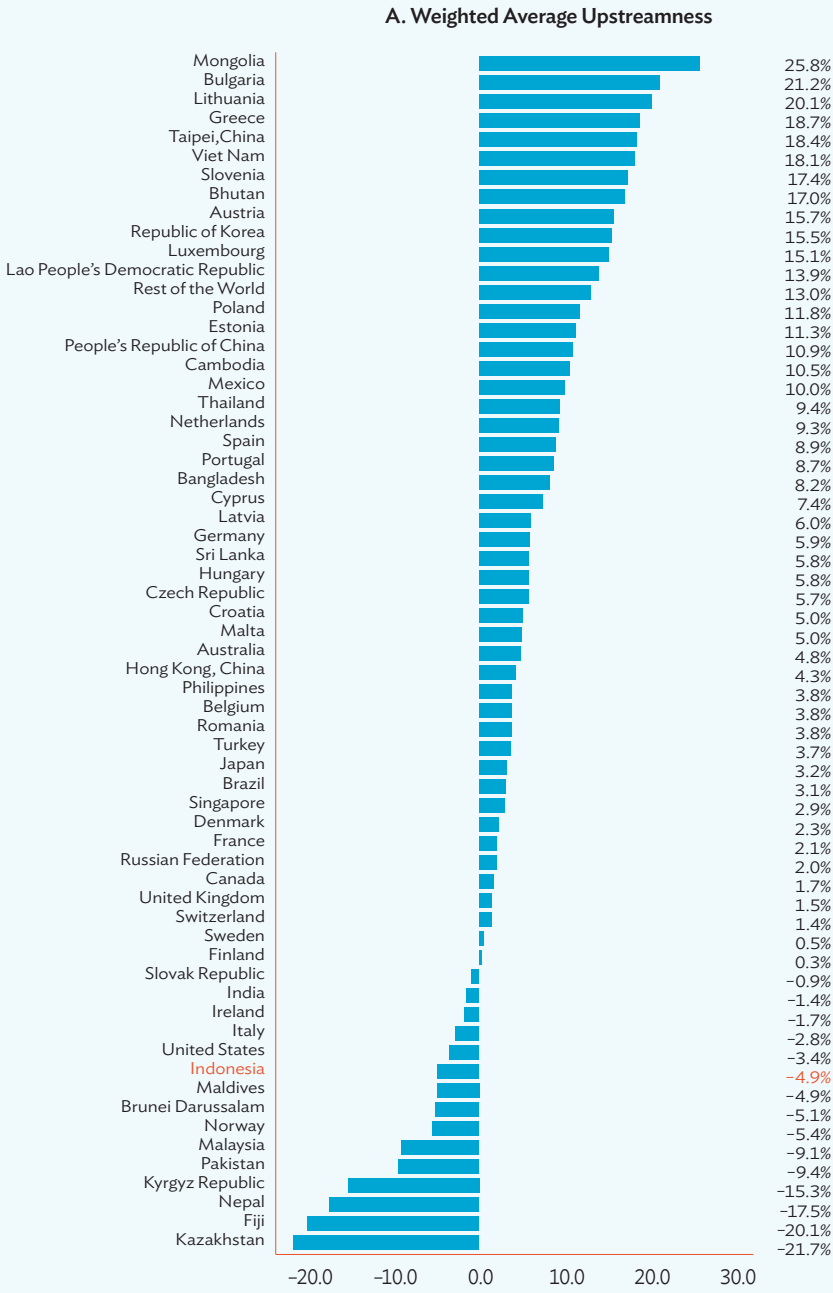


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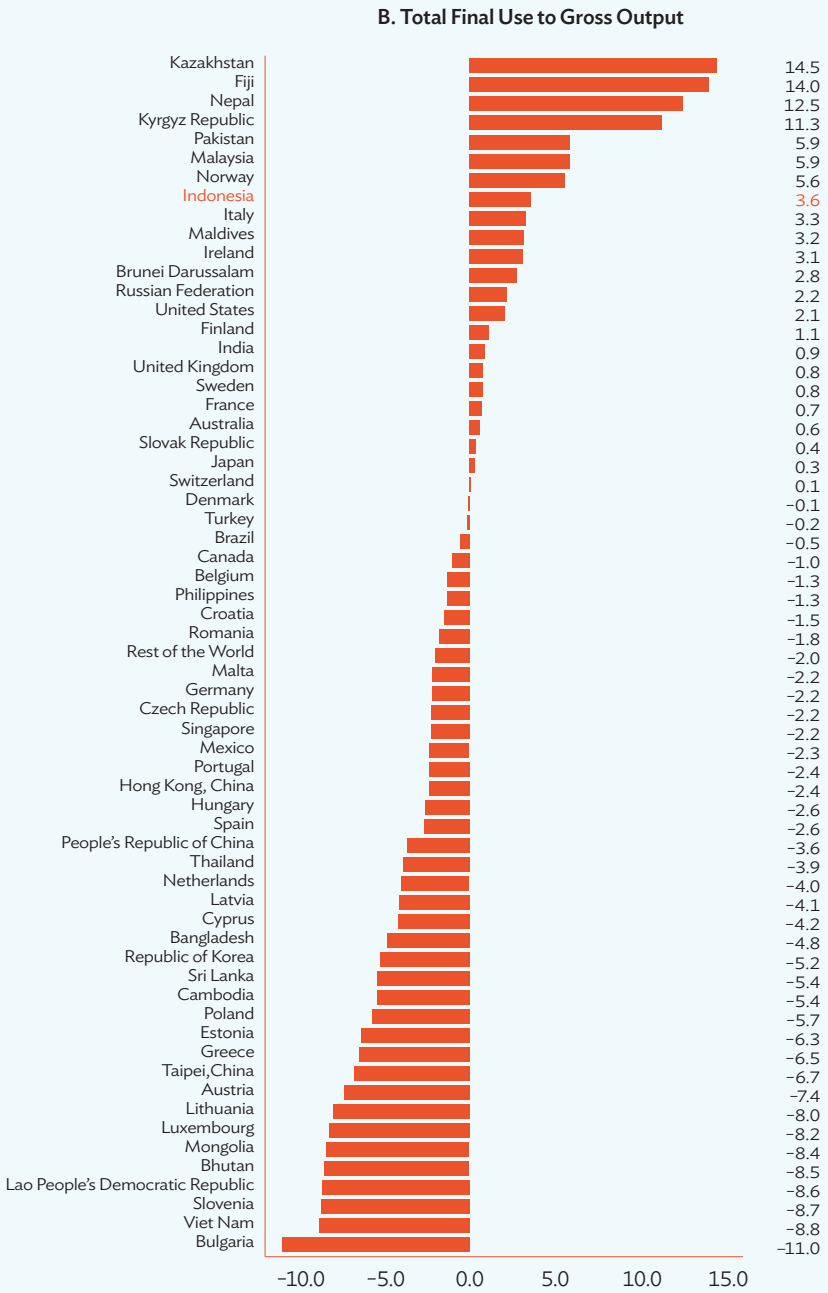
Figure 3.6 continued



Note: Asian Development Bank estimates are based on the methodologies of P. Antràs and D. Chor (2018) and Miller and Temurshoev (2017).

Sources: Multi-Regional Input–Output Tables, 2000, 2007–2017, Asian Development Bank; World Input–Output Database, 2001–2006; Asian Development Bank estimates.

3.2.2 Positions of Indonesia's Sectors in Global Value Chains

The heatmap in Figure 3.7 orders Indonesia's industries according to their average upstreamness from 2000 to 2017. It shows, industry-wise, the relative upstreamness across time. "Mining and quarrying" had an upstreamness index of 3.87 in 2011, the economy's highest value for the index from 2000 to 2017 (Figure 3.7). This means that this industry was approximately three to four stages away from final use in the relevant GVCs. On the other hand, "education" and "construction," among others, had upstreamness indices close to 1, implying that they provided their outputs directly to final consumers.

Except for "mining and quarrying," Indonesia's top industries in terms of gross output displayed upstreamness indices near 2, driving the country average close to that number. The leading industries in terms of gross output were "construction"; "food, beverages, and tobacco" manufacturing; "agriculture, hunting, forestry, and fishing"; "mining and quarrying"; and "wholesale trade" (Figure 3.8). Except for "mining and quarrying," the average upstreamness index of which across 2000 to 2017 was at 3.71, the average upstreamness indices from 2000 to 2017 of the other four industries ranged only from 1.14 to 2.15. In 2017, these industries contributed to over 39% of Indonesia's total gross output.[2]

Moreover, industries with upstreamness indices less than 2.5 for each year from 2000 to 2017 accounted for 74% to 80% of the total gross output. In 2017, for example, the combined contribution of all industries with upstreamness indices less than 2.5 was 77.7% of the total gross output.

Six industries in Indonesia with upstreamness indices averaging less than 1.5 contributed between 17.5% to 26.7% to total gross output from 2000 to 2017. These industries, which provided almost all their outputs directly to final consumers, were "other manufacturing and recycling"; "public administration, defense and compulsory social security"; "health and social work"; "education"; "construction"; and "hotels and restaurants." In 2000, these industries contributed 17.5% of the total gross output; by 2017 the share increased to 25.9%.

Twenty industries with average upstreamness indices from 1.5 to less than 2.5 made up between 50.9% to 57.9% of the total gross output from 2000 to 2017. These industries, which were positioned roughly one stage away from final use, included "real estate activities"; "retail trade"; "wholesale trade";

[2] For the same year, the contribution of "mining and quarrying" to the economy's total gross output was 5.65%.

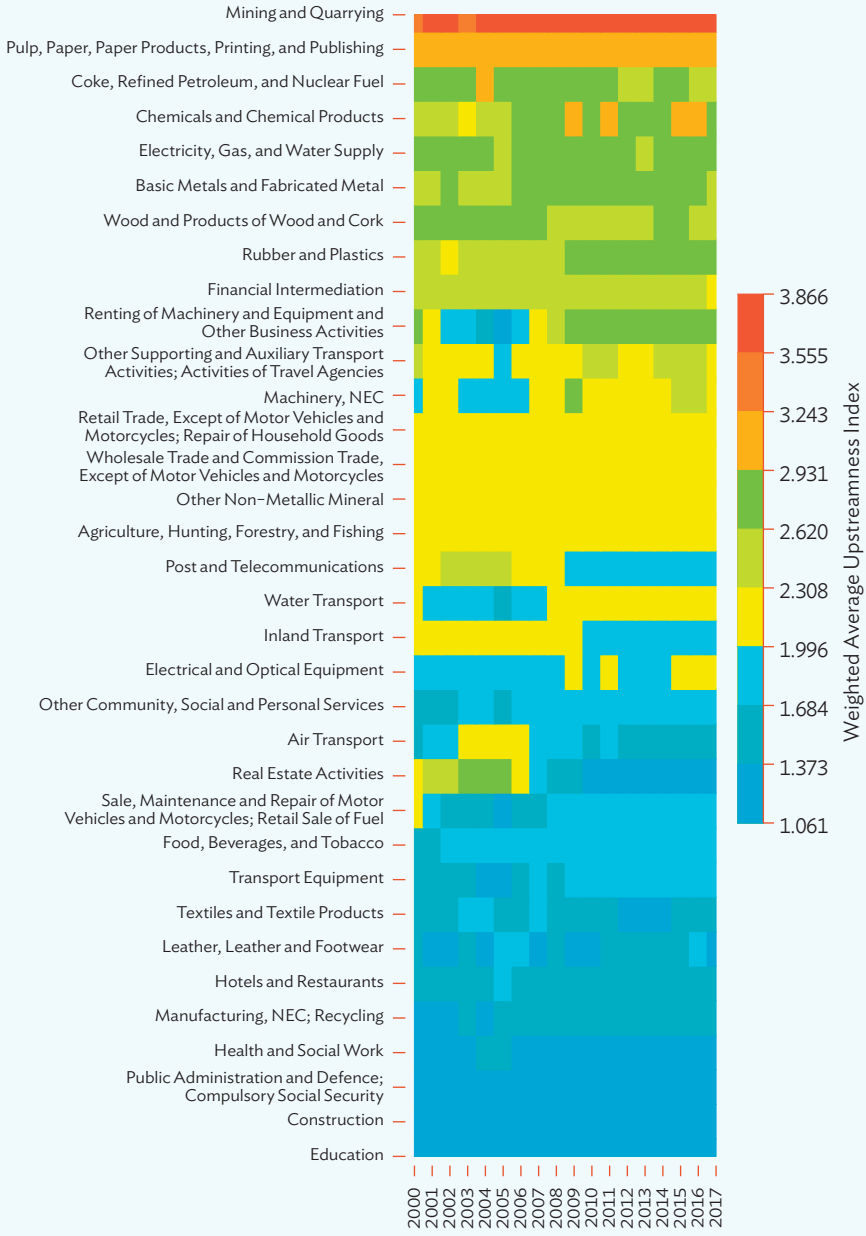
"textiles and textile products" manufacturing; "water transport"; "transport equipment" manufacturing; "post and telecommunications"; "other community, social and personal services"; "other machinery" manufacturing; "electrical and optical equipment" manufacturing; "sale, maintenance and repair of motor vehicles and retail sale of fuel"; "renting of machinery and equipment and other business activities"; "other supporting and auxiliary transport activities"; "activities of travel agencies"; "other non-metallic mineral" manufacturing; "food, beverages, and tobacco" manufacturing; "financial intermediation"; "air transport"; "agriculture, hunting, forestry, and fishing"; "leather and footwear" manufacturing; and "inland transport." Their contribution to gross output declined from 57.6% in 2000 to 50.9% in 2012 but increased to 53.5% by 2017.

Industries with average upstreamness indices in the range 2.5 to 3.5 provided 14.7% to 19.0% of Indonesia's total gross output. Such industries were roughly two to three stages away from final use. Their contribution to total gross output was at 18.2% in 2000 and peaked at 19.0% during the global financial crisis (2008). Thereafter, their combined shares declined and reached 14.9% in 2017. Seven industries were in this category: "wood and products of wood and cork" manufacturing; "rubber and plastics" manufacturing; "coke, refined petroleum, and nuclear fuel" manufacturing; "basic metals and fabricated metal" manufacturing; "pulp and paper production, and printing and publishing"; "electricity, gas, and water supply"; and "chemicals and chemical products" manufacturing.

As noted earlier, only "mining and quarrying" had an average upstreamness index above 3.5; and it contributed between 5.3% to 8.4% of total gross output from 2000 to 2017. While "mining and quarrying" accounted for a large share of Indonesia's exports, the industry's contribution to gross output was only at 6.6% on average for all years considered. From 2000 to 2009, the contribution of "mining and quarrying" to gross output fared between 6.1% to 6.9%. This share climbed after the global financial crisis to reach 7.5% in 2010 and 8.4% in 2011 before declining to 5.6% in 2017.

In summary, Indonesia's upstreamness index was driven close to 2 largely due to its key industries moving more downstream—with industry-specific upstreamness indices ranging between 1.5 and 2.5. Moreover, the downward movement of average upstreamness in Indonesia can be attributed to the growing share of gross output that is generated by industries that were closer to final use and the decline in the share of those that were further upstream.

Figure 3.7: Upstreamness of Indonesia's Industries Across Time, 2000–2017



NEC = not elsewhere classified.

Note: Sectors are ranked according to average upstreamness across time. Asian Development Bank estimates are based on the methodologies of Antràs and Chor (2018) and Miller and Temurshoev (2017).

Sources: Multi-Regional Input–Output Tables, 2000, 2007–2017, Asian Development Bank; World Input–Output Database, 2001–2006; Asian Development Bank estimates.

Figure 3.8: Industrial Gross Output in Total Gross Output Across Time, 2000–2017

NEC = not elsewhere classified.

Note: Sectors are ranked according to average upstreamness across time. Asian Development Bank estimates are based on the methodologies of Antràs and Chor (2018) and Miller and Temurshoev (2017).

Sources: Multi-Regional Input–Output Tables, 2000, 2007–2017, Asian Development Bank; World Input–Output Database, 2001–2006; Asian Development Bank estimates.

3.3 Indonesia's Specialization in Global Value Chains

Understanding patterns of specialization across countries has been a long-standing policy concern in international trade research. Knowing "what a country does more efficiently" than other countries guides industrial policy and aids in crafting an evidence-based approach to determining key sectors. Revealed comparative advantage offers a way to quantify and rank product-specific specialization in trade across economies. Box 6 discusses how traditional and new measures of revealed comparative advantage can be derived using exports and domestic value-added data.

A country is said to have a comparative advantage in a certain sector if the share of that sector in total country exports exceeds its share in total world exports (Balassa 1965). Otherwise, it is said to have a comparative disadvantage in that sector. Policymakers use traditional revealed comparative advantage (TRCA) measures to identify key sectors in the economy; in fact, it is taken to be a measure of export competitiveness (Serin and Civan 2008; Tripa et al. 2018).

In view of recent empirical advances in GVC analysis, the concept of "revealed comparative advantage" can be revised to incorporate information on exports of domestic value-added. Wang, Wei, and Zhu (2018) proposed a new measure of revealed comparative advantage based on forward-linkage based domestic value-added exports. This measure, called new revealed comparative advantage (NRCA), is analogous to Balassa's measure except that it is based on domestic value-added.

From 2000 to 2017, Indonesia's comparative advantage shifted towards low-technology manufacturing. NRCA values of the broad sectoral categories in Figure 3.9 show that the country's comparative advantages were in the primary and low-technology sectors. During 2011–2018, its comparative advantage (as measured in value-added terms) in low-technology sectors exhibited a gradual rise. NRCA values increased from 1.4 in 2000 to 1.5 in 2007 and 1.8 in 2017.

Primary sectors, on the other hand, showed a decline in competitiveness with NRCA values of 3.1 in 2000 and 2.8 in 2007. Post global financial crisis, NRCA indices of primary sectors declined to 2.6 in 2017. Despite the decline, data indicate that Indonesia's comparative advantage in the low-technology sectors continued to have the highest NRCA values across all years covered. While, during 2000–2017, Indonesia consistently lagged with a comparative disadvantage in services, and medium- and high-technology sectors.

Box 6: Calculating Measures of Revealed Comparative Advantage

The traditional measure of revealed comparative advantage follows Balassa (1965). The measure is obtained by dividing the share of a country-sector's gross exports with the sector's gross exports from all countries as a share of world total gross exports. More formally, TRCA can be expressed as

$$TRCA_i^r = \left(\frac{e_i^r}{\sum_{i=1}^{N} e_i^r}\right) \Big/ \left(\frac{\sum_{k=1}^{G} e_i^k}{\sum_i^N \sum_{k=1}^{G} e_i^k}\right)$$

where $e_i^{r^*}$ is country r's exports of products from sector i, N is the number of products (or industries in the input–output setting), and G is the number of countries in the world economy. A country r is said to have a comparative advantage (with respect to the world) in the production of product i if $TRCA_i^r > 1$. Otherwise, it is said to have a comparative disadvantage in product i.

Balassa's index more accurately reflects cross-country differences in comparative advantage in a world that exclusively trades finished products. As argued in theoretical literature, TRCA may not be the most appropriate measure of comparative advantage in a GVC world characterized by intensive and extensive networks of trade in intermediates. There are at least two reasons for this. First, TRCA ignores the fact that a country-sector's value-added may be exported indirectly via the country's exports in other sectors. Hence, a more conceptually correct measure should be able to account for value-added exported indirectly across country-sectors. Second, TRCA neglects the fact that a country-sector's gross exports may partly carry foreign value-added content. Therefore, a conceptually correct measure should exclude foreign value-added content embedded in exports.

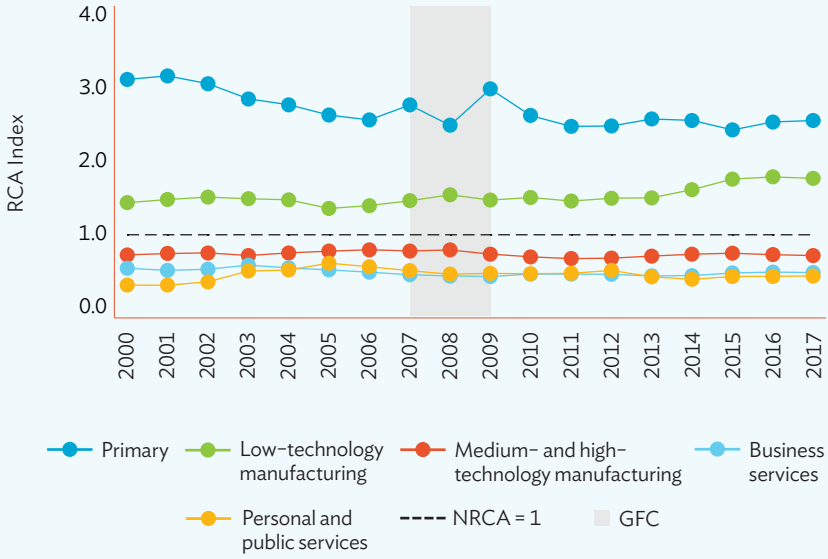
The abovementioned empirical complications may be evaded by using forward-linkage based domestic value-added in exports (DVA_F) in lieu of gross exports. A particular country-sector's DVA_F refers to the domestic value-added that is originated from that country-sector and ultimately embodied in exports regardless of where these exports are finally consumed. Intuitively, DVA_F may be interpreted as a measure of a country-sector's significance as a supplier of value-added in exports. Rewriting Balassa's index by replacing gross exports with DVA_F yields a new RCA measure that more accurately depicts patterns of specialization in a GVC world. Here, new revealed comparative advantage of country r in product i is obtained using the following formula:

$$NRCA_i^r = \left(\frac{DVA\_F_i^r}{\sum_{i=1}^{N} DVA\_F_i^r}\right) \Big/ \left(\frac{\sum_{k=1}^{G} DVA\_F_i^k}{\sum_i^N \sum_{k=1}^{G} DVA\_F_i^k}\right)$$

As in TRCA, country r is said to have a comparative advantage (with respect to the world) in the production of good i if $TRCA_i^r > 1$. Otherwise, it is said to have a comparative disadvantage in product i.

Sources: B. Balassa. 1965. Trade Liberalisation and "Revealed" Comparative Advantage. *The Manchester School*. 33(2) pp. 99–123.
Z. Wang, S. Wei, and K. Zhu. 2018. Quantifying International Production Sharing at the Bilateral and Sector Levels. *NBER Working Paper* No. 19677. Cambridge, MA: National Bureau of Economic Research.

Figure 3.9: Revealed Comparative Advantage of Broad Sectors in Indonesia, 2000–2017



GFC = global financial crisis, NRCA = revealed comparative advantage based on value-added terms, RCA = revealed comparative advantage.

Note: Asian Development Bank estimates are based on the methodology of Wang, Wei, and Zhu (2018).

Sources: Multi-Regional Input–Output Tables, 2000, 2007–2017, Asian Development Bank; World Input–Output Database, 2001–2006; Asian Development Bank estimates.

From a sectoral perspective, data reveal that the activities in which Indonesia had comparative advantage tended to be concentrated in a small number of primary and low-technology industries. Figure 3.10 compares NRCA rankings for the years 2000, 2007, and 2017 across the 35 industries presented in the ADB MRIOTs.

Indonesia remained very competitive in low-technology manufacturing industries such as "textiles"; "food, beverages, and tobacco"; and "rubber and plastics." Moreover, for some of these industries, the country's competitiveness indices had increased. In 2000, "food, beverages, and tobacco" manufacturing had an NRCA index of 2.0, whereas in 2017 its value was 3.8. For "rubber and plastics" manufacturing, the NRCA indices in 2000 and 2017 were 1.1 and 1.5, respectively. Indonesia continued to show a comparative disadvantage in construction. However, the index steadily inched up from 0.2 in 2000 to 0.8 in 2017.

Indonesia's "other manufacturing" industry gained comparative advantage. Starting with a comparative disadvantage in 2000 with NRCA value of 0.8, this industry achieved an NRCA value of 1.0 by 2017. This means that Indonesia had managed, albeit slowly, to gain a comparative advantage in the production of certain types of low-technology manufacturing goods.

However, competitiveness indices of most of Indonesia's medium- and high-technology industries declined post global financial crisis. For "coke, refined fuel, and petroleum" manufacturing, for example, the NRCA value decreased sharply from 8.2 in 2000 to 2.7 in 2017, reflecting the country's declining oil and gas products exports. Data show that nearly all the products supplied by the oil and gas industry experienced declining prices as well as weakening global demand. Much of the slowdown in exports of these industries could be attributed to the weakening Chinese economy, a major export market for Indonesia, as well as the slowdown in global trade due to the trade conflict.

Other medium- and high-technology industries such as "other non-metallic" and "other machinery" manufacturing also declined in competitiveness. While the former saw a drop in NRCA value from 0.8 in 2000 to 0.3 in 2017, the latter's index declined from 0.4 to 0.2 during the same period. However, "chemicals and chemical products" manufacturing notably gained comparative advantage, with the industry's index increasing from 0.6 to 1.1 from 2000 to 2017.

Given the primary sector's contribution to Indonesia's exports, it is important to highlight the country's decreasing competitiveness in this sector. The decline was mostly driven by the "mining and quarrying" industry, the NRCA value of which decreased from 3.4 in 2000 to 2.5 in 2017.

Figure 3.10: Ranking of Sectoral Revealed Comparative Advantage in Indonesia, 2000, 2007, and 2017

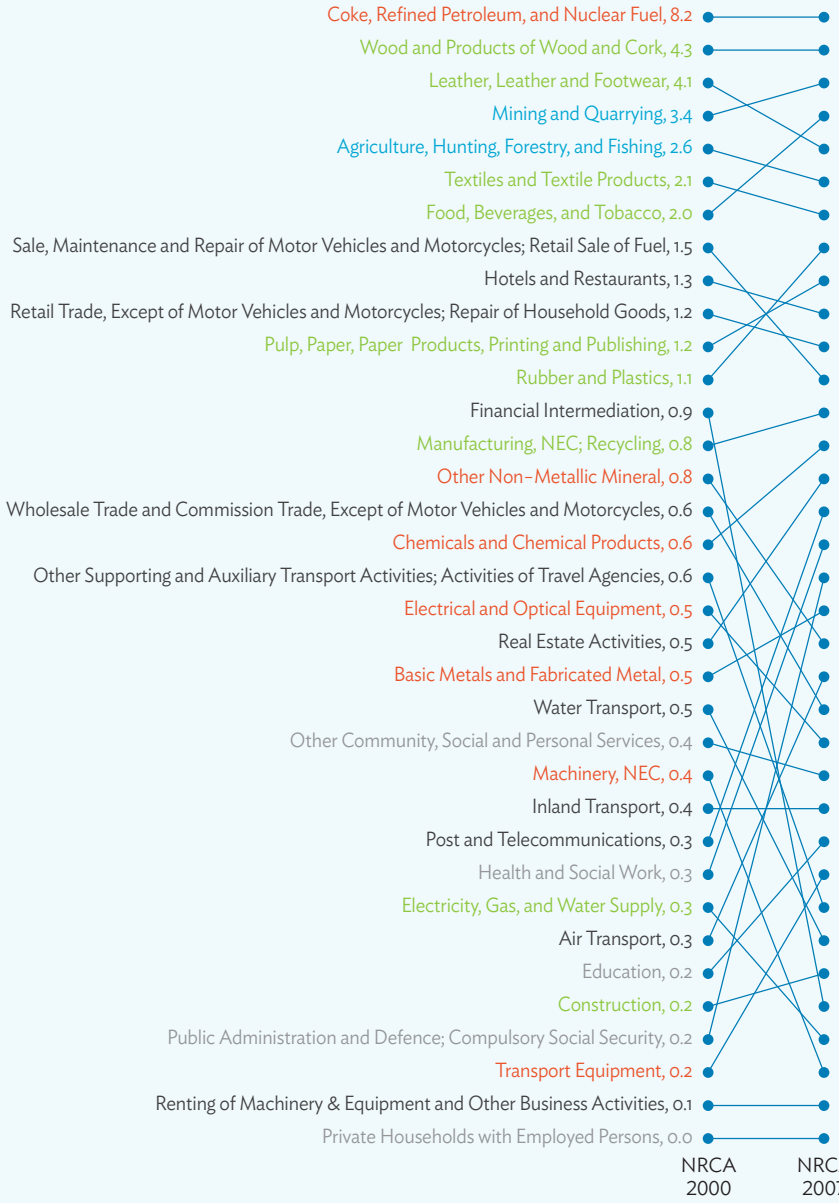


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Figure 3.10 continued

NEC = not elsewhere classified, NRCA = revealed comparative advantage based on value-added terms.

Note: Sectors colored in blue represent primary sectors. Sectors in green represent low-technology manufacturing sectors. Sectors colored in orange represent medium- and high-technology manufacturing sectors. Sectors colored in black represent business services. Sectors colored in grey represent personal and public services. Asian Development Bank estimates are based on the methodology of Wang, Wei, and Zhu (2018).

Sources: Multi-Regional Input–Output Tables, 2000, 2007 and 2017, Asian Development Bank; Asian Development Bank estimates.

Research shows evidence of divergence between TRCA and NRCA measures (Brakman and van Marrewijk 2016; Wang, Wei, and Zhu 2018), lending support to the assertion that measures of revealed comparative advantage need to be more oriented towards the forward linked valued-added export concept given the ever increasing trade in intermediates.

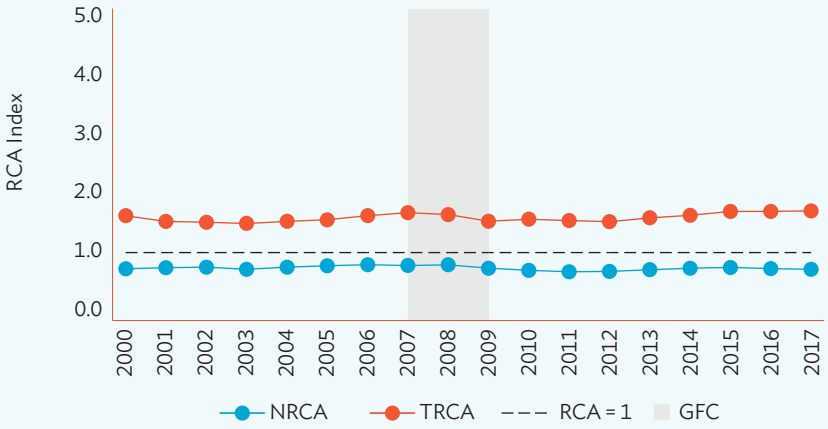
Figure 3.11 uses Indonesia's comparative advantage indices in the medium- and high-technology sector to illustrate that NRCA and TRCA for a given sector can differ. By failing to net out foreign value-added and pure double counted valued-added that is originated abroad, the TRCA makes the medium- and high-technology sector appear to have a comparative advantage. This higher TRCA compared with NRCA is due in part to the large share of foreign value-added that is embodied in the exports of the sector. Thus, NRCA index shows that Indonesia in fact did not have a comparative advantage in the medium- and high-technology sector.

Moreover, a comparison of the two measures in Figure 3.12 suggests that Indonesia's comparative advantage in the low-technology manufacturing sector was lower than indicated by the traditional approach. Although both measures show increase in the competitiveness of this sector, it was more gradual than indicated by the TRCA measure. However, regardless of the measure used, Indonesia still displayed comparative advantage in the low-technology manufacturing.

3.4 Evolution of Participation, Position, and Specialization in Indonesia

To tie the concepts of GVC participation, value chain position, and revealed comparative advantage together, Figure 3.13A maps the relevant indices in a scatter plot for 2000, while Figure 3.13.B shows the picture in 2017. The x-axis and y-axis correspond to the forward and backward participation, respectively, of Indonesia's industries. The nodes refer to industries and the size of each node corresponds to an industry's NRCA, or revealed comparative advantage based on forward-linked value-added exports. Those industries which Indonesia specializes in, or those with NRCA>1, are labeled with their industry codes and colored according to their respective upstreamness values. Comparative advantage industries with upstreamness values less than 1.5 are colored dark blue. Those with upstreamness values greater than or equal to 1.5 but less than 2.5 are colored light blue. Those with upstreamness values greater than or equal to 2.5 but less than 3.5 are colored green. Finally, those with upstreamness values greater than or equal to 3.5 are colored orange.

Figure 3.11: Revealed Comparative Advantage in Indonesia's Medium- and High-technology Manufacturing Sector, 2000–2017

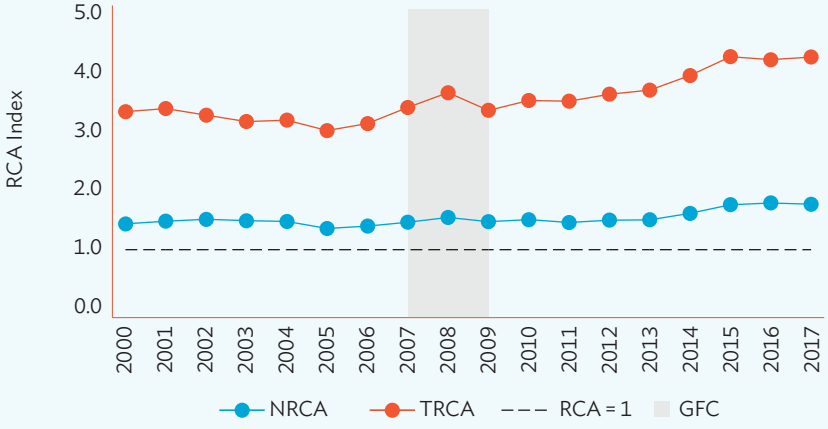


GFC = global financial crisis, NRCA = revealed comparative advantage based on value-added terms, RCA = revealed comparative advantage, TRCA = revealed comparative advantage based on gross exports.

Note: Asian Development Bank estimates are based on the methodology of Wang, Wei, and Zhu (2018).

Sources: Multi-Regional Input–Output Tables, 2000, 2007–2017, Asian Development Bank; World Input–Output Database, 2001–2006; Asian Development Bank estimates.

Figure 3.12: Revealed Comparative Advantage in Indonesia's Low-technology Manufacturing Sector, 2000–2017

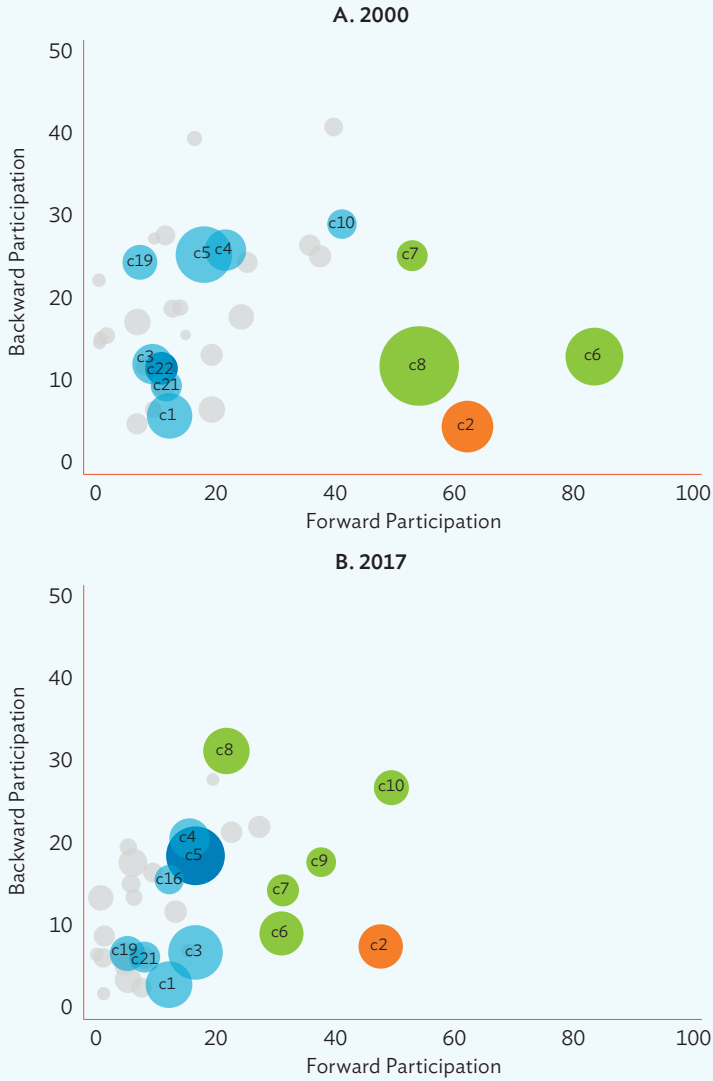


GFC = global financial crisis, NRCA = revealed comparative advantage based on value-added terms, RCA = revealed comparative advantage, TRCA = revealed comparative advantage based on gross exports.

Note: Asian Development Bank estimates are based on the methodology of Wang, Wei, and Zhu (2018).

Sources: Multi-Regional Input–Output Tables, 2000, 2007–2017, Asian Development Bank; World Input–Output Database, 2001–2006; Asian Development Bank estimates.

Figure 3.13: Participation, Position, and Revealed Comparative Advantage, 2000 versus 2017



Note: The nodes refer to sectors and the size of each node corresponds to the sector's revealed comparative advantage based on value-added terms. Only sectors with comparative advantage are labeled with their sector codes (Appendix 2) and colored according to their respective upstreamness values. Comparative advantage sectors with upstreamness values less than 1.5 are colored dark blue. Those with upstreamness values greater than or equal to 1.5 but less than 2.5 are colored light blue. Those with upstreamness values greater than or equal to 2.5 but less than 3.5 are colored green. Finally, those with upstreamness values greater than or equal to 3.5 are colored orange. Asian Development Bank estimates are based on the methodologies of Antràs and Chor (2018); Wang, Wei, Yu, and Zhu (2017); and Wang, Wei, and Zhu (2018).

Sources: Multi-Regional Input–Output Tables, 2000 and 2017, Asian Development Bank; Asian Development Bank estimates.

In both 2000 and 2017, Indonesia specialized in both upstream and downstream industries as represented by the colored nodes. However, Indonesia had comparative advantage in more industries in 2017 than it did in 2000. In 2000, Indonesia had comparative advantage in 12 industries. By 2017, it had lost its comparative advantage in "hotels and restaurants" services but gained advantage in "chemicals and chemical products" manufacturing and "other manufacturing."

It is noteworthy that three of the top five industries in 2000 in terms of NRCA were also those that had upstreamness values greater than 2.5. These industries were "coke, refined petroleum, and nuclear fuel" manufacturing; "wood and products of wood and cork" manufacturing; and "mining and quarrying." They also showed higher forward participation indices compared to most other industries, but their backward participation indices were below 15%. By 2017, both their forward participation and comparative advantage had decreased. Also noticeable was the increased backward participation of "coke, refined petroleum, and nuclear fuel" manufacturing in 2017.

In 2017, Indonesia's "rubber and plastics" manufacturing also had a higher upstreamness index as it increased its forward participation and revealed comparative advantage. Meanwhile, "wood and products of wood and cork" manufacturing experienced decreases in its comparative advantage, upstreamness, backward participation, and forward participation from 2000 to 2017. The "pulp, paper, printing and publishing" industry, on the other hand, saw decreases in upstreamness and forward and backward participation in 2017, but its revealed comparative advantage increased.

Another noticeable change from 2000 to 2017 was Indonesia's growing comparative advantage in the other industries with upstreamness indices that were less than 2.5. Of the eight that had indices less than 2.5 in 2000, five gained comparative advantage by 2017. Four industries saw decreases in their upstreamness and participation indices while increasing their comparative advantages. These industries include "agriculture, hunting, forestry, and fishing"; "leather and footwear" manufacturing; "sale, maintenance and repair of motor vehicles and motorcycles"; and "retail sale of fuel." Meanwhile, for "food, beverages, and tobacco" manufacturing and the "rubber and plastics" manufacturing, increases in comparative advantages were accompanied by increases in upstreamness and forward participation and decreases in backward participation.

This was also true for the "other manufacturing and recycling" industry which had comparative advantage in 2017, but not in 2000. Meanwhile, "textiles and textile products" manufacturing, along with "hotels and restaurants" services, experienced decreases in NRCA and participation indices but had an increase in upstreamness. All four indicators declined for "retail trade" from 2000 to 2017.

Overall, a number of trends can be discerned from the various indicators discussed. Firstly, Indonesia specialized in industries with different positions and levels of participation in GVCs. This can be seen by the presence of the different node colors in both years. Moreover, for its industries, there were no strong correlations between NRCA and upstreamness (0.24), between NRCA and forward participation (0.47), and between NRCA and backward participation (0.12).

Secondly, throughout 2000–2017, backward participation was generally on the low side for all Indonesian industries which had participation indices less than 45%. This means intermediate imports (which were made up of foreign value-added and returned domestic value-added) had a relatively lower level of contribution to the country's final production.

Lastly, in general, increases in upstreamness were accompanied by increases in forward participation. For Indonesia, the correlation between upstreamness and forward participation was 0.70, considering all values of these two indicators for 2000 and 2017.[3] Intuitively, as the forward participation of an industry increases, the domestic value-added generated by its production of intermediates as a share of its total domestic value-added also increases. This also implies that the share of intermediates in gross output will increase. Consequently, the upstreamness of an industry increases as larger shares of its output go through more stages of processing before reaching final use, or in other words, as larger shares of its output become intermediate inputs of other industries.

[3] When considering all country-sectors across 2000 to 2017 and taking out outliers, the correlation between upstreamness and forward GVC participation goes up marginally to 0.72.

Chapter 4
Examining Other Aspects of Global Value Chains: The Case of Indonesia

This section adopts analysis on different GVC-related domains and applies them to the Indonesian case. First, Indonesia's domestic supply chains are analyzed using the agglomeration indices developed by Mercer-Blackman, Foronda, and Mariasingham (2017). Second, the impacts of GVC-related factors on jobs in Indonesia are studied following Bertulfo, Gentile, and de Vries (2019). Third, following Abiad et al. (2018), input–output analysis is used to quantify the potential impacts of the trade conflict between the United States and the People's Republic of China on Indonesia. Lastly, GVC-linked foreign direct investment (FDI) flows in Indonesia are examined using balance of payments (BOP) and firm-level data.

4.1 Agglomeration in Indonesia

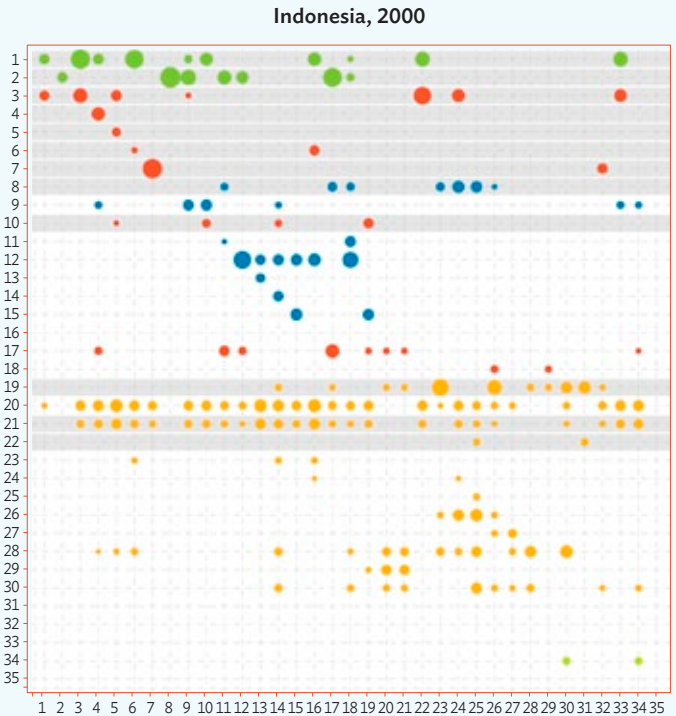
Dot plot matrices were created to visualize the evolution of Indonesia's domestic supply chains over time (Figure 4.1). These matrices were computed using the domestic technical coefficients derived from Indonesia's input–output tables, specifically for the years 2000, 2007, 2010, and 2017. The size of the dot corresponds to the magnitude of the technical coefficient, which is larger if the column sector uses a substantial amount of intermediate inputs from the row sector.[4] In this regard, these dot plot matrices may also be interpreted as input dependency matrices. Table 4.1 below shows the economic blocks considered and their corresponding color codes in the dot plot charts.

Table 4.1: Sector and Economic Block Descriptions and Color Legend for Dot-Plot Matrices

Economic Block	Color Code in Dot Plot Matrix
Primary	
Low-technology manufacturing	
Medium- and high-technology manufacturing	
Business services	
Personal and public services	

[4] For visualization purposes, technical coefficients less than 0.02 are ignored.

Figure 4.1: Dot Plots, Indonesia's Technical Coefficient Matrices, 2000, 2007, 2010, and 2017



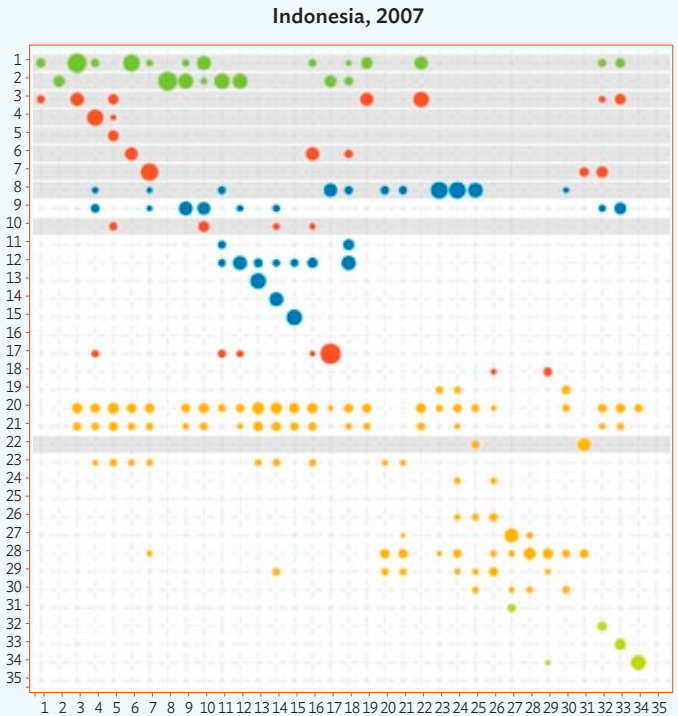


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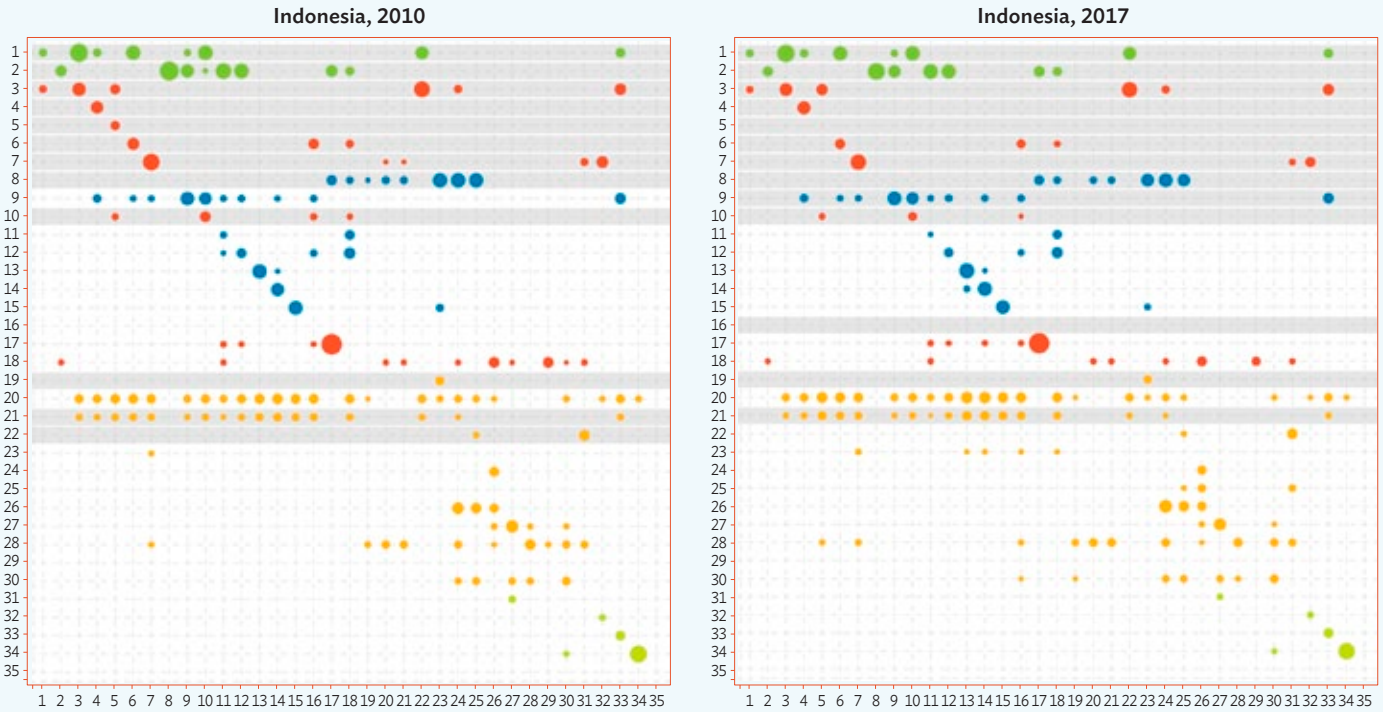
Figure 4.1 continued



Note: Asian Development Bank estimates of revealed comparative advantage are based on Wang, Wei, and Zhu (2018).
Source: Multi-Regional Input–Output Tables, 2000, 2007, 2010, and 2017, Asian Development Bank; Asian Development Bank estimates.

Sectors depend highly on inputs from domestic own-sector if the diagonal entries in the dot plot matrices are large. From Figure 4.1, domestic own-sector dependency had consistently been pronounced in low-technology manufacturing sectors (green), and medium- and high-technology manufacturing sectors (red orange), but the size of the dots along the diagonal of the dot plot matrices were larger during 2007 and 2010, years that characterize the onset of the 2007 global financial crisis and its aftermath, respectively. This suggests that Indonesia tended to rely more on domestic own-sector sources for intermediate inputs during the crisis years, and less during non-crisis periods.

The dot plot matrices in Figure 4.1 also show the sectors that comprised the set of Indonesia's comparative advantage industries, and how its composition changed over time. In particular, the highlighted rows correspond to the country's comparative advantage industries, based on the new revealed comparative advantage index developed by Wang, Wei, and Zhu (2018). In 2000, the country had a revealed comparative advantage in "agriculture, fishery and forestry," "mining and quarrying," and low-technology manufacturing industries such as "food and beverages," "rubber and plastics," "textiles and textile products," among others. In services, data indicate a revealed comparative advantage in "sale and repair of motorcycles and vehicles," "retail sale of fuel," "retail trade," and "hotels and restaurants." Comparative advantage in "sale and repair of motorcycles and vehicles," as well as in "retail trade," was lost in 2007 and reappeared in 2010. By 2017, Indonesia lost its comparative advantage in "hotels and restaurants." This coincided with a gain in revealed comparative advantage in "chemicals and chemical products" and "other manufacturing including recycling." Overall, domestic production structures did not show evidence of any gradual or abrupt structural change or transformation. Competitiveness in many industries stayed stagnant from 2000 to 2017.

Table 4.2 shows the agglomeration indices for the years 2000 and 2007 to 2017. Agglomeration based on backward linkages was the strongest in low-technology manufacturing sectors, as well as business services, indicating that domestic supply chains in these broad sector categories received relatively more (domestic or foreign) intermediate inputs than others. Personal and public services, meanwhile, did not have strong backward linkages. In fact, their agglomeration indices via backward linkages fell below zero across all years considered.

The broad sector category that exhibited the strongest agglomeration index via forward linkages in Indonesia was business services, hinting that production activities in other sectors had strong services-related value-added embeddings. However, this does not say anything about the quality of services that became ultimately embedded in production activities.

Table 4.2: Agglomeration Indices of Broad Sectors in Indonesia, 2000, 2007–2017

	Agglomeration index												
	2000	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Overall													
Primary	−0.79	−0.82	−0.92	−0.74	−0.77	−0.78	−0.91	−0.78	−0.69	−0.64	−0.85	−0.87	−1.05
Low-technology manufacturing	0.55	0.66	0.62	0.74	0.71	0.72	0.64	0.60	0.59	0.70	0.72	0.63	0.44
Medium- and high-technology manufacturing	0.28	0.47	0.57	0.53	0.36	0.32	0.27	0.28	0.22	0.42	0.44	0.39	0.06
Business services	1.32	1.19	1.03	1.06	1.01	1.01	0.95	1.00	1.07	1.10	1.07	1.02	0.88
Personal and public services	−1.55	−1.01	−1.22	−1.05	−1.09	−1.10	−1.10	−1.07	−1.06	−1.03	−1.07	−1.08	−1.10
Based on backward linkages													
Primary	−1.97	−2.23	−2.22	−1.91	−1.91	−1.92	−2.21	−1.93	−1.70	−1.51	−1.93	−1.94	−2.26
Low-technology manufacturing	1.00	1.13	1.06	1.00	0.97	0.98	0.99	0.94	0.92	0.99	1.07	1.00	0.88
Medium- and high-technology manufacturing	0.52	0.54	0.55	0.55	0.42	0.41	0.33	0.32	0.29	0.54	0.57	0.54	0.07
Business services	1.00	0.94	0.83	0.93	0.87	0.86	0.75	0.81	0.88	0.87	0.80	0.73	0.64
Personal and public services	−0.32	−0.25	−0.44	−0.35	−0.43	−0.43	−0.44	−0.37	−0.37	−0.30	−0.39	−0.40	−0.43
Based on forward linkages													
Primary	0.39	0.59	0.38	0.43	0.37	0.37	0.38	0.36	0.33	0.23	0.23	0.21	0.16
Low-technology manufacturing	0.10	0.18	0.17	0.48	0.45	0.47	0.29	0.27	0.27	0.41	0.38	0.25	0.00
Medium- and high-technology manufacturing	0.03	0.39	0.60	0.51	0.29	0.24	0.20	0.23	0.15	0.29	0.30	0.24	0.04
Business services	1.64	1.43	1.24	1.19	1.16	1.17	1.15	1.19	1.26	1.34	1.33	1.31	1.13
Personal and public services	−2.79	−1.77	−2.00	−1.76	−1.76	−1.76	−1.76	−1.76	−1.75	−1.75	−1.76	−1.76	−1.78

Note: Asian Development Bank estimates are based on Mercer-Blackman, Foronda and Mariasingham (2017).
Source: Multi-Regional Input–Output Tables, 2000, 2007, 2010, and 2017, Asian Development Bank; Asian Development Bank estimates.

Box 7: Calculating the Agglomeration Index

Mercer-Blackman, Foronda and Mariasingham (2017) constructed a numerical measure that reflects the information presented in the dot plot matrices. This indicator is named the *agglomeration index*, which quantifies the degree of clustering within a domestic economic block. The agglomeration index has two components—the first is based on backward linkages while the second is based on forward linkages. The agglomeration index, ultimately, is derived by simply taking the arithmetic average of its two components.

The agglomeration index based on backward linkages for any economic block k of country c is defined as

$$AGG(b)_c^k = \ln\left[\sum_{i=1}^{l} m(b)_i * \frac{\sum_{i=1}^{l}\sum_{g=1}^{n} P_{g,i}}{l * n}\right]$$

where $m(b)_i$ is the sum of the Leontief inverse coefficient values along the column corresponding to sector i, l is the total number of sectors in the economic block, n is the total number of sectors in the economy, and $P_{g,i}$ is a binary variable set to one if the corresponding technical coefficient $a_{g,i}$ of row sector g and column sector i is greater than the threshold 0.02[a] and 0 otherwise.

The construction of the agglomeration index based on forward linkages follows the same logic, but sums the Leontief inverse coefficient $m(f)_i$ and binary variable $p_{j,h}$ along sector rows of an economic block,

$$AGG(f)_c^k = \ln\left[\sum_{i=1}^{l} m(f)_i * \frac{\sum_{i=1}^{l}\sum_{h=1}^{n} P_{g,i}}{l * n}\right]$$

where $m(f)_j$ is the sum of the Leontief inverse coefficients along the row corresponding to sector j, l is the total number of sectors in the economic block, n is the total number of sectors in the economy, and $p_{j,h}$ is a binary variable set to one if the corresponding technical coefficient $a_{j,h}$ of row sector j and column sector h is greater than the threshold 0.02[a] and 0 otherwise.

The indices are higher for economic blocks with stronger linkages among sectors (as embodied by the first factor, e.g., $\sum_{i=1}^{l} m(f)_j$ for forward-based agglomeration index) and higher degree of participation within the economic block (as represented by the second factor, e.g., $\frac{\sum_{i=1}^{l}\sum_{h=1}^{n} P_{g,i}}{l * n}$ for forward-based agglomeration index). This means that if sectors belonging to the economic block demand intermediate inputs from more domestic sectors and in larger quantities, the agglomeration index based on backward linkages is higher. The same goes for the agglomeration index based on forward linkages. If sectors within an economic block contribute to the production processes of more domestic sectors and in larger degrees, this index becomes larger.

continued on next page

Box 7 continued

Finally, these two components are summarized into one indicator defined as the total agglomeration index,

$$AGG_c^k = \frac{AGG(b)_c^k + AGG(f)_c^k}{2}$$

The total agglomeration index simply takes the average between the indices based on backward linkages and forward linkages.

[a] Threshold set by the authors of the index.

Source: V. Mercer-Blackman, A. Foronda and M. Mariasingham. 2017. Using Input–Output Analysis Framework to Explain Economic Diversification and Structural Transformation in Bangladesh. *ADB Economics Working Paper Series* No. 513. Manila: Asian Development Bank.

Analyzing the two agglomeration indices together shows that Indonesia had strong forward and backward linkages in business services and low-technology manufacturing. On the other hand, medium- and high-technology manufacturing appeared to have weak forward and backward ties, indicating that the potential of this sector to link domestic and foreign firms together in value chains was at its nascent stage. Primary sectors, meanwhile, had weak forward and backward ties. Linking the primary sector to manufacturing and services activities may enable production of primary goods that carry more value-added. Since Indonesia has had a comparative advantage in resource-based products, enhancing the domestic links of primary sectors to other sectors should be an industrial policy priority in order to reap the economic benefits of greater multiplier effects.

It is often argued that developing domestic sectoral linkages and increasing the strength of local value chains could facilitate entry into GVCs and help sectors gain comparative advantage (World Bank 2016). Regression analysis was used to test whether stronger domestic links are associated with stronger comparative advantage (see Appendix 3). Results were, however, inconclusive and no statistically significant association was found between agglomeration and NRCA.

4.2 Jobs and Technology in Indonesia

A structural decomposition analysis of labor demand in Indonesia reveals interesting patterns (Table 4.3). First, demand for labor in services accelerated the fastest during the period 2005 to 2015. Employment in the sector grew by 62%, compared to 25% in manufacturing. Second, technology within GVCs was associated with a decline in labor demand across all broad sector categories. However, the associated ceteris paribus change was most pronounced in agriculture and was least apparent in services. Third, task relocation was associated with a positive change in demand for labor in both services and manufacturing, suggesting that the GVC phenomenon may have spurred a reallocation of labor demand from other countries into Indonesia. In fact, holding other factors constant, task relocation accounted for 8% of growth in manufacturing employment and 5% growth in services employment in the period 2005 to 2015. Fourth, the effect associated with changes in consumption levels driven by increases in own-country income and from rest-of-the-world appeared to have had a positive impact on employment in Indonesia in the period studied. Results of structural decomposition analyses indicate that the change in own-country income was associated with a 79% uptake in services employment and 45% in manufacturing.

Decomposing changes in manufacturing and services employment by type of occupation gives a more nuanced view of the interplay between jobs and technology in Indonesia (Table 4.4). For manufacturing, estimates show that employment in nonroutine cognitive occupations experienced the highest increase, while routine cognitive occupations contracted the most. In fact, nonroutine cognitive occupations grew by 110% while routine cognitive occupations shrank by 36%.

Structural decomposition results suggest that country-level efficiency was associated with a decline in employment for all types of occupation in Indonesia's manufacturing sector, although its impact was most felt in nonroutine cognitive occupations. While technology within GVCs was associated with a marginal negative impact on employment in nonroutine cognitive occupations, it appeared to have had a sizeable impact on both routine cognitive and nonroutine manual occupations. To illustrate, the increase in efficiency within GVCs cut labor demand in routine cognitive and nonroutine manual occupations by 67 and 52%, respectively, ceteris paribus. Task relocation effects were mixed, with a substantial positive impact on nonroutine cognitive occupations (51%) and a rather significant negative ceteris paribus effect on routine cognitive occupations (–11%). Income effects explain 86% of the change in nonroutine cognitive occupations while it was only associated with a 53% increase in routine cognitive occupations, holding other things constant.

Table 4.3: Change in Labor Demand in Indonesia, by Broad Economic Sector, 2005 versus 2015

	Employment		Change	Country-level efficiency	Technology within GVCs	Task relocation	Consumption composition	Income	
	2015	2005						Own-country	Rest-of-the-World
	('000 persons)		(% change from 2005 value)						
Agriculture	39,394	41,933	−6	−15	−49	4	−17	62	9
Manufacturing	14,922	11,946	25	−18	−32	8	2	45	19
Services	58,525	36,030	62	−21	−9	5	1	79	7
All Sectors	122,698	95,464	29	−18	−29	5	−7	68	9

GVC = global value chain.
Source: Bertulfo, Gentile, and de Vries (2019).

Table 4.4: Change in Manufacturing and Services Labor Demand in Indonesia, by Occupation Type, 2005 versus 2015

A. MANUFACTURING									
	Employment		Change	Country-level efficiency	Technology within GVCs	Task relocation	Consumption composition	Income	
	2015	2005						Own-country	Rest-of-the- World
	('000 persons)		(% change from 2005 value)						
Nonroutine cognitive	1,227	583	110	−25	−3	51	2	60	26
Nonroutine manual	675	691	−2	−15	−52	3	0	43	18
Routine cognitive	334	526	−36	−13	−67	−11	1	35	18
Routine manual	12,686	10,146	25	−18	−32	8	2	45	19
B. SERVICES									
	Employment		Change	Country-level efficiency	Technology within GVCs	Task relocation	Consumption composition	Income	
	2015	2005						Own-country	Rest-of-the- World
	('000 persons)		(% change from 2005 value)						
Nonroutine cognitive	32,917	18,635	77	−22	1	6	1	84	7
Nonroutine manual	9,396	9,557	−2	−15	−55	−2	1	62	7
Routine cognitive	4,210	3,490	21	−17	−54		16	73	4
Routine manual	12,002	4,348	176	−30	82	21	−9	102	11

GVC = global value chain.
Source: Bertulfo, Gentile, and de Vries 2019.

Box 8: Decomposing Changes in Employment in the Context of Global Value Chains

A structural decomposition analysis using the multi-regional input–output tables augmented with task-specific employment information helps dissect the economic factors that drive changes in employment over time. One such decomposition is implemented in Bertulfo, Gentile and de Vries (2019), which decomposed changes in occupational labor demand in developing Asia into six determinants: (a) changes in efficiency or total factor productivity, (b) changes in GVC technology, (c) relocation of intermediate production stages, (d) relocation of final production stages, (e) changes in consumption composition and (f) changes in consumption levels. Each of the effects are evaluated ceteris paribus—that is, assuming all factors other than the one that is being evaluated are held constant. The same decomposition framework is applied in de Vries et al. (2019) with jobs classified by business function (i.e., research and development, fabrication, logistics, and sales and marketing).

In Bertulfo, Gentile, and de Vries (2019), employment is classified into four major groups of occupations: routine manual, routine cognitive, nonroutine manual, and nonroutine cognitive, following the taxonomy of occupations developed by Autor, Levy, and Murnane (2003) (Box 8 Table). Routine occupations are loosely defined as jobs that can be accomplished by following an explicit set of rules. Nonroutine occupations, on the other hand, require problem-solving and complex communication skills that cannot be codified in terms of overt guidelines. Manual occupations are those that demand more dexterity, eye-hand coordination, or physical labor while cognitive occupations require more analytical faculties.

Box 8 Table: Classification of Occupations

	Routine	Nonroutine
Manual	Craft and related trade workers [71–75]	Services and sales workers [51–54]
	Plant and machine operators and assemblers [81–83]	
	Elementary occupations [91–96]*	
Cognitive	Clerical support workers [41–44]	Managers [11–14]
		Professionals [21–26]
		Technicians and associate professionals [31–35]

* Elementary occupations involve the performance of simple and routine tasks which may require the use of hand-held tools and considerable physical effort. The numbers in brackets refer to ISCO–08 codes, excluding Agriculture [61–63] and Armed forces [01–03].

Sources: D. Autor, F. Levy, and R. Murnane. 2003. The Skill Content of Recent Technological Change: An Empirical Exploration. *The Quarterly Journal of Economics*. 118 (4) pp. 1279–1333.
D. Bertulfo, E. Gentile, and G. de Vries. 2019. The Employment Effects of Technological Innovation, Consumption and Participation in Global Value Chains: Evidence from Developing Asia. *ADB Economics Working Paper Series* No. 572. Manila: Asian Development Bank.
G. de Vries, Q. Chen, R. Hasan, and Z. Li. 2019. Do Asian Countries Upgrade in Global Value Chains?: A Novel Approach and Empirical Evidence. *Asian Economic Journal*. 33 (1) pp. 13–37.

For services, it is routine manual occupations which saw the greatest positive increase in employment (176%), followed by nonroutine cognitive (77%) and routine cognitive (21%). Country-level efficiency had the largest negative ceteris paribus impact on routine manual (30%) and nonroutine cognitive occupations (22%). Also, routine manual occupations experienced the largest positive impact working through technology within GVCs (82%), task relocation (21%), and income effects (113%). These findings suggest that the largest activity in services occurred through routine manual jobs, at least for Indonesia. Routine cognitive and nonroutine manual occupations were adversely affected by technology. They also benefited the least from demand-driven income effects underpinned by domestic and foreign economic activities.

The implications of a changing workforce structure is important in light of the administration's current policy to ride the tide of Industry 4.0 (Box 9). Through reviving the country's manufacturing sector, Making Indonesia 4.0 aims to improve the country's net exports contribution to gross domestic product (GDP), increase productivity-to-cost ratios, and establish local innovation hubs.

A major segment of the national priorities under Making Indonesia 4.0 is workforce reskilling through training and bridging programs to enhance talent competitiveness and mobility. Workforce automation is expected to double in Indonesia by 2021 (*Willis Towers Watson 2018*) amid a slower workforce growth rate, fueling concerns over the possible substitution of automation for labor. In fact, the Labor Institute Indonesia estimates that about 100,000 jobs in Indonesia were lost due to automation in 2018 (*Asia News Insider 2019*), making skills enhancement a key policy concern in Indonesia.

4.3 Indonesia Amidst Trade Conflict

Trade conflicts pose potentially nontrivial impacts on international trade and macroeconomic landscape in an era where production processes are typically carried out in multiple locations across the globe. In the early 2018, a trade conflict broke out between the United States (US) and the People's Republic of China (PRC), two of the world's major economic superpowers that are also central to global production networks. In this section, the impact of the trade conflict on the global economy and individual countries are assessed. Specific implications for Indonesia are also discussed. Box 10 provides a brief exposition of how the effects of the trade conflict in developing Asia are estimated using multi-regional input–output tables.

Box 9: Making Indonesia 4.0

Launched on the second quarter of 2018, "Making Indonesia 4.0" aims to groom the country into becoming one of the top ten economies globally by 2030 through reviving Indonesia's manufacturing sector. This initiative is underpinned by three main goals: (a) achieve 10% contribution of net exports to GDP, (b) double current productivity-to-cost ratio and (c) build local innovation capabilities by aiming an R&D spending-to-GDP ratio of 2%.

Indonesia has set 10 national priorities under "Making Indonesia 4.0":

a. **Improve the flow of goods.** Enhance domestic upstream material production.
b. **Redesign industrial zones.** Build a single nationwide industry zoning roadmap (e.g., industry belts); resolve zoning inconsistency challenges.
c. **Embrace sustainability.** Grab opportunities under global sustainability trends (e.g., electric vehicles, biofuels and renewables).
d. **Empower small and medium enterprises (SMEs)**. Empower 3.7 million SMEs with technologies (e.g., build SME e-commerce, technology banks).
e. **Build nationwide digital infrastructure.** Advance network and digital platforms (e.g., transition from 4G to 5G, adopt Fiber speed 1Gbps, data centers and cloud).
f. **Attract foreign investments.** Engage top global manufacturers with attractive offers and accelerate technology transfer.
g. **Upgrade human capital.** Redesign curriculum under the Fourth Industrial Revolution era; create professional talent mobility programs.
h. **Establish innovation ecosystems.** Enhance R&D&D (research, development and design) centers by promoting synergistic ties between the government, private sector and universities.
i. **Incentivize technology investment.** Introduce tax exemptions/subsidies for technology adoption and provide support funding.
j. **Reoptimize regulations and policies.** Build more coherent policies/regulations through cross-ministry collaborations.

Five priority industries were selected under the initiative, namely food and beverage, textile and apparel, automotive, electronics, and chemicals. Aspirations were set for each of the abovementioned focus sectors.

Ultimately, "Making Indonesia 4.0" endeavors to massively uplift overall gross domestic product, improve manufacturing contribution to GDP, and create more jobs. Key macroeconomic success indicators include

(a) cascading real GDP growth from approximately 5% to an average of 6% to 7% during 2018 to 2030,
(b) generating 30 million new jobs by 2030 and
(c) pulling manufacturing's contribution to GDP from 16% to 20% by 2030.

Source: Kementerian Perindustrian Republik Indonesia. 2018. *Making Indonesia 4.0*. Jakarta, Indonesia.

Box 10: Estimating the Effects of the Trade Conflict on Developing Asia

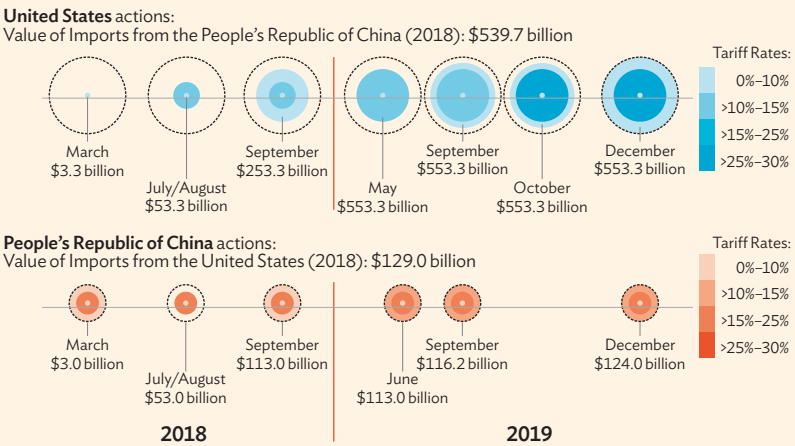
Abiad et al. (2018) utilized the ADB Multi-Regional Input–Output Table (version 2017) to tease out potential effects of the trade conflict occurring via trade channels. Modeled effects include:

(i) *direct effects* which impact tariff-affected country-sectors;
(ii) *indirect effects* which work through both local and international supply chain linkages; and
(iii) potential *trade redirection* which accounts for potential reallocation of trade (in the medium- to long-run) toward countries not directly affected by tariffs.

The results reported in this section show the implications of three separate trade conflict scenarios examined in the study, updated as of September 2019. The first scenario ("current scenario") reflects all tariff measures imposed by countries involved in the trade conflict as of Sept. 1, 2019. Included in the "current scenario" are the series of tariffs slapped by the United States (US) and the People's Republic of China (PRC) on each other's exports (Box 10 Figure). At the end of 2018, the US hit with tariffs a total of $253.3 billion of Chinese exports while PRC responded by imposing tariffs on $113 billion worth of US goods. In the second quarter of 2019, both the US and the PRC implemented tariff hikes on $200 billion and $60 billion worth of previously affected goods. The latest batch considered in "current scenario" is the $125 billion worth of Chinese goods which the US hit with additional 15% tariffs and PRC's response of additional 5%–10% of tariffs slapped on around $33.3 billion US products, most of which are already covered in the previous product lists. The "bilateral escalation" scenario adds, on top of the current scenario, 30% blanket tariffs on all PRC exports to the US. It is assumed that the PRC retaliates by imposing the same rate (30%) on all US exports to the PRC. Lastly, the "worse-case" scenario adds, on top of the "bilateral escalation" scenario, US blanket tariffs of 25% on all imports of automobiles. It is assumed that all other countries will retaliate to this action by slapping 25% tariff on all autos and auto parts imported from the US.

The direct impact of the trade conflict on the level of exports is first evaluated at the product level. Published lists of tariff-affected commodities were gathered and matched with detailed trade data from the BACI database and the United States Census Bureau. Then, the implied

Box 10 Figure: Measures Included in the Current Scenario



Source: Asian Development Outlook 2019 Update, 2019, Asian Development Bank.

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Box 10 continued

reduction in nominal import values from tariff-affected trading partners are computed using several assumptions about import demand elasticities. Results presented in this section assume that country-level import demand elasticities are equivalent to those published in Tokarick (2010). In Abdul et al. (2018), this assumption yielded the maximal impact across all elasticity assumptions explored. Changes in the nominal value of imports at the product level are then aggregated by industry and type of use categories that are both consistent with what is employed in building the ADB MRIOTs and at par with international statistical classifications. Changes are then applied to the benchmark 2017 ADB MRIOT in order to yield modeled scenario tables. These tables are used as inputs to the multi-regional analysis conducted in the next stage of the modeling process, done in order to compute for the impact on output, employment, and value-added associated with shocks occurring via the trade channels explored in the study.

Sources: A. Abiad, K. Baris, J. Bernabe, D. Bertulfo, S. Camingue-Romance, P. Feliciano, M.J. Mariasingham, and V. Mercer-Blackman. 2018. The Impact of the Trade Conflict on Developing Asia. *ADB Economics Working Paper Series* No. 566. Manila: Asian Development Bank.
ADB. 2018. Asian Development Outlook Update 2018: *Maintaining Stability Amid Heightened Uncertainty*. Manila: Asian Development Bank.
ADB. 2019. *Asian Development Outlook Update 2019: Fostering Growth and Inclusion in Asia's Cities*. Manila: Asian Development Bank.
Tokarick, S. 2010. A Method for Calculating Export Supply and Import Demand Elasticities. *IMF Working Paper* No. 10/180. Washington D.C.: International Monetary Fund.

Figure 4.2 presents estimates of the impact of the US–PRC trade conflict on the main protagonists, the US and the PRC, as well as the European Union, Japan, and developing Asian economies. Under the current scenario (Figure 4.2.A), the direct and indirect impacts of the trade war may potentially cut world GDP by 0.19%. Redirection effects are poised to ease this negative impact to 0.09% of global GDP. As it currently stands, the trade conflict could potentially hurt the PRC economy, shaving 0.65% off its GDP in 2–3 years, assuming trade redirection takes place. The relevant negative effect to the US is substantially lower at 0.13%. Meanwhile, both the European Union and Japan could benefit marginally from trade redirection. Estimates suggest that all trade channels considered could potentially account for a 0.06% increase in GDP in both economies.

Economies in developing Asia, especially Malaysia; Taipei,China; and Viet Nam are poised to be the biggest winners in the current scenario. In fact, Viet Nam could grow by as much as 0.58%, owing to trade redirection effects offsetting the upfront direct and indirect negative shock of the conflict. Anecdotal evidence corroborates this result. News reports state that firms are now moving their production activities to either Malaysia or Viet Nam, which is consistent with what is shown in the charts. For instance, Viet Nam has already started attracting Chinese companies into its borders, driving land and labor costs up. Touted as "the New Guangdong," Viet Nam managed to draw in Chinese manufacturers, as evidenced by the 86.2% rise in FDI into Viet Nam with almost half of it accounted for by Chinese firms (Zhou and Bermingham 2019).

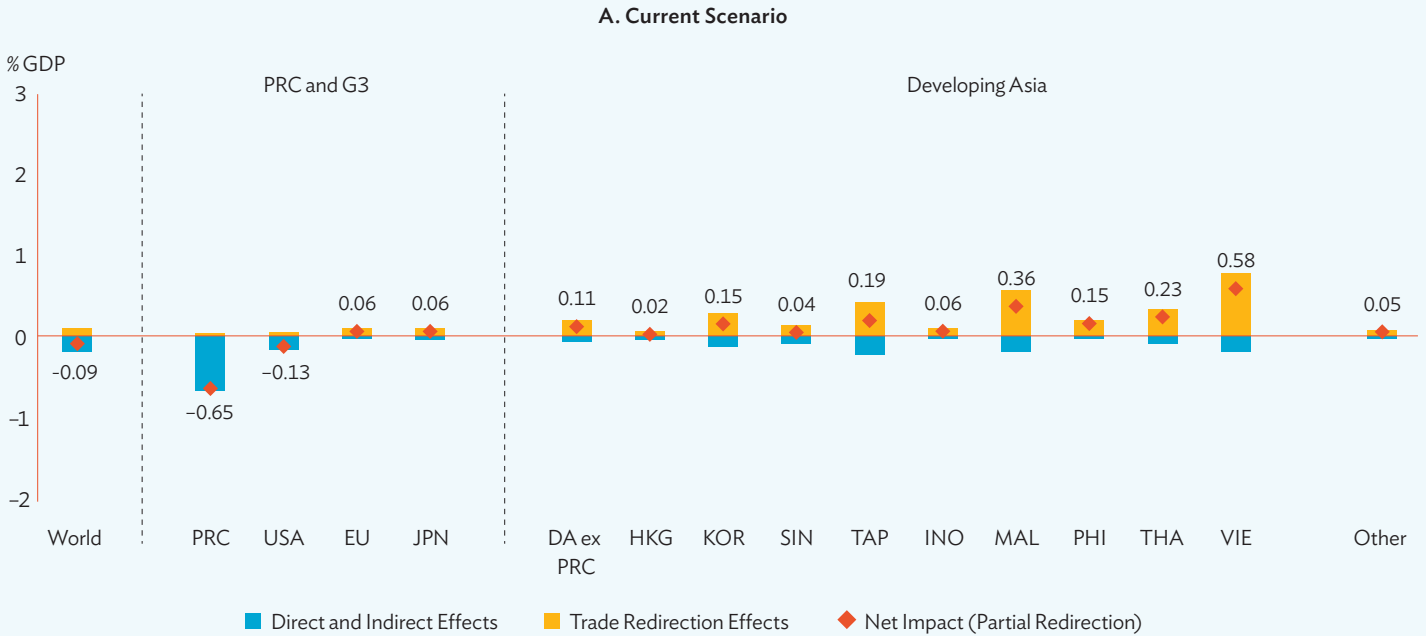
While Viet Nam's comparative advantage has, for long, been on the manufacture of garments and footwear, the trade conflict has induced a massive relocation of medium- and high-tech manufacturing operations into the country. Among the giants reported to have invested in Viet Nam are Samsung, Nintendo, Fox Conn, and Apple (Zhong 2019). However, not all indications are positive for the new favorite of manufacturing production in Asia. In fact, news reports indicate that the sudden influx of Chinese firms into Viet Nam is having tangible negative externalities on labor supply (e.g., talent shortages) and urbanization outcomes, such as more severe traffic jams and more crowded roads (Zhou and Bermingham 2019; Huifeng 2019).

A more protracted bilateral tension (Figure 4.2.B) could double the potential negative impact to both the US and the PRC, trimming down these countries' GDP by 0.24% and 1.22%, respectively, subject to the assumption that half of trade lost due to tariffs are redirected to other potential suppliers in the global market. Under the bilateral escalation scenario, world GDP is estimated to shrink by as much as 0.34% with no trade redirection, and 0.17% with trade redirection. Net impacts to both the European Union and Japan are slightly higher at 0.12% and 0.11% of their respective GDPs. Viet Nam; Malaysia; and Taipei,China remain the top gainers in the bilateral escalation scenario, but the impact for Viet Nam is now more than 4 times higher than the estimates reported in the current scenario. Taipei,China and Malaysia stand to gain 0.76% and 0.65%, respectively in terms of GDP, assuming 50% redirection.

Net impacts on developing Asia as a whole shrink in the worse-case scenario compared to those in the bilateral escalation scenario (Figure 4.2.C). This coincides with negative impacts for developed economies and the PRC. In fact, under the worse-case scenario, the PRC's GDP stands to shrink by 1.25% while the decline is substantially lower at 0.27% for the US. Japan, meanwhile, is projected to experience a net decrease in GDP by 0.19%. Redirection effects to the rest-of-the-world are also marginally lower, yielding slightly lesser positive impacts to all economies in developing Asia as compared to estimates in the bilateral escalation scenario.

Notably, across all scenarios examined, Indonesia appears to be among those economies that would see the least gains from trade redirection effects. Estimates suggest that in a span of 2–3 years, allowing for partial redirection of trade, Indonesia would gain only 0.06% under the current scenario, 0.14% in the bilateral escalation scenario, and 0.11% under the worse-case scenario. While the trade conflict presents an opportunity for developing Asian economies to expand production and trade, especially for those countries that complement goods in the bilateral trade basket of the US and the PRC, analysis suggests that, due to its weak direct and indirect linkages with the US- and the PRC-oriented GVCs, Indonesia is unlikely to capitalize on the opportunity in the short- to medium-term.

Figure 4.2: Gross Domestic Product Impact of the United States and the People's Republic of China Trade Conflict



DA = developing Asia; G3 = European Union, Japan, and United States; GDP = gross domestic product; EU = European Union; HKG = Hong Kong, China; INO = Indonesia; JPN = Japan; KOR = Republic of Korea; MAL = Malaysia; PRC= People's Republic of China; PHI= Philippines; SIN= Singapore; TAP = Taipei,China; THA = Thailand; USA = United States of America; VIE = Viet Nam. Other here refers to Bangladesh, Brunei Darussalam, Bhutan, Cambodia, Fiji, Kazakhstan, the Kyrgyz Republic, Lao People's Democratic Republic, Maldives, Mongolia, Nepal, Pakistan, and Sri Lanka.

Note: Asian Development Bank estimates are based on the methodology of Abiad et al. (2018).

Source: Multi-Regional Input–Output Tables, 2017, Asian Development Bank; Asian Development Bank estimates.

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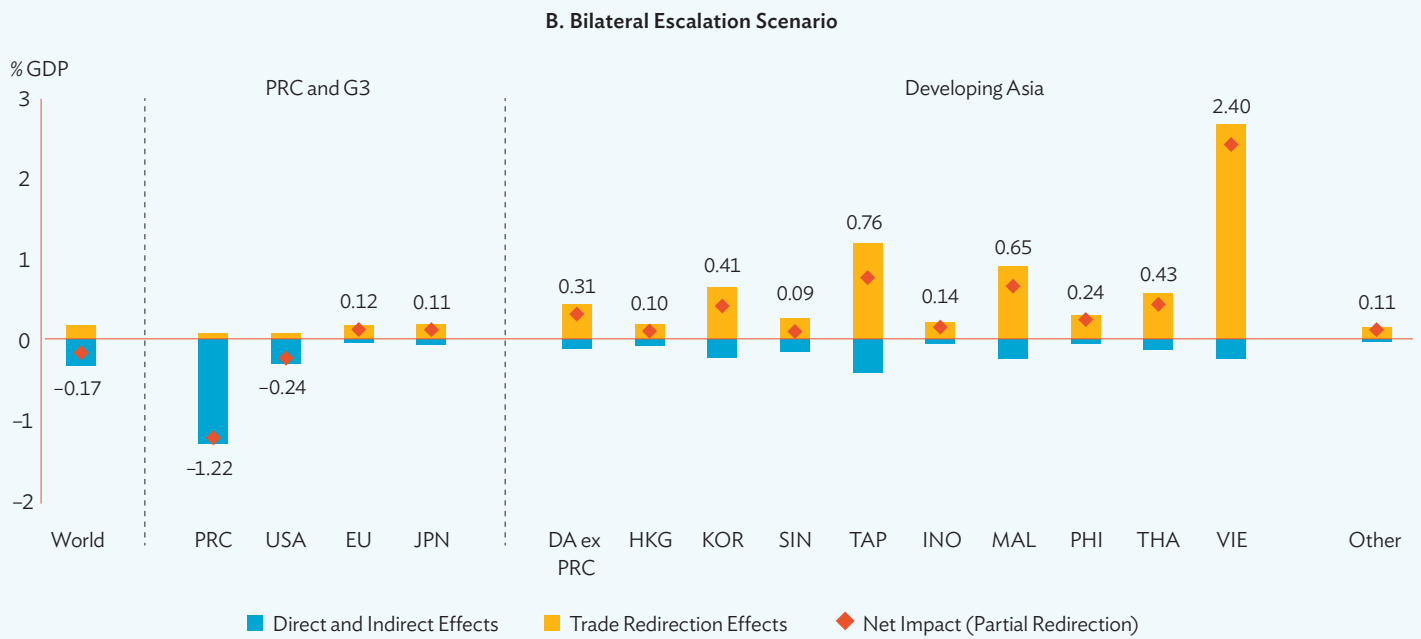
Figure 4.2 continued



DA = developing Asia; G3 = European Union, Japan, and United States; GDP = gross domestic product; EU = European Union; HKG = Hong Kong, China; INO = Indonesia; JPN = Japan; KOR = Republic of Korea; MAL = Malaysia; PRC= People's Republic of China; PHI= Philippines; SIN= Singapore; TAP = Taipei,China; THA = Thailand; USA = United States of America; VIE = Viet Nam. Other here refers to Bangladesh, Brunei Darussalam, Bhutan, Cambodia, Fiji, Kazakhstan, the Kyrgyz Republic, Lao People's Democratic Republic, Maldives, Mongolia, Nepal, Pakistan, and Sri Lanka.

Note: Asian Development Bank estimates are based on the methodology of Abiad et al. (2018).

Source: Multi-Regional Input–Output Tables, 2017, Asian Development Bank; Asian Development Bank estimates.

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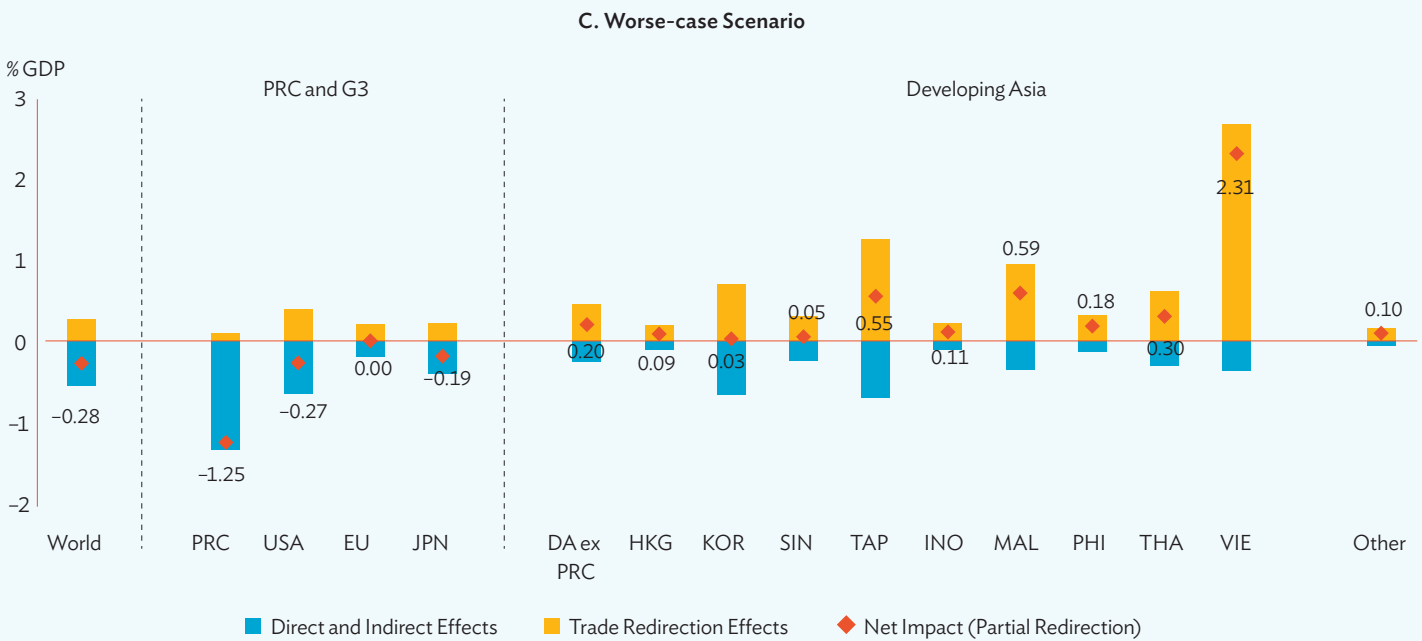
Figure 4.2 continued



DA = developing Asia; G3 = European Union, Japan, and United States; GDP = gross domestic product; EU = European Union; HKG = Hong Kong, China; INO = Indonesia; JPN = Japan; KOR = Republic of Korea; MAL = Malaysia; PRC= People's Republic of China; PHI= Philippines; SIN= Singapore; TAP = Taipei,China; THA = Thailand; USA = United States of America; VIE = Viet Nam. Other here refers to Bangladesh, Brunei Darussalam, Bhutan, Cambodia, Fiji, Kazakhstan, the Kyrgyz Republic, Lao People's Democratic Republic, Maldives, Mongolia, Nepal, Pakistan, and Sri Lanka.

Note: Asian Development Bank estimates are based on the methodology of Abiad et al. (2018).

Source: Multi-Regional Input–Output Tables, 2017, Asian Development Bank; Asian Development Bank estimates.

The next few paragraphs examine in greater detail where Indonesia could potentially benefit or lose in the trade conflict. Though the country is not directly involved in the current conflict, analyses show that its indirect linkages with the US, the PRC, and other economies along the GVCs encompassing the US and the PRC cause the transmission of the trade conflict shocks into Indonesia.

Panels A and B of Table 4.5 show which commodities, among those affected by the tariffs imposed by the US and the PRC, are heavily exported by Indonesia to the US and the PRC, respectively. Products such as palm kernel and babassu vegetable oils, natural rubber and sports footwear are in the US's tariff-affected commodities basket which Indonesia exports heavily to the US (Table 4.5 Panel A). Furthermore, bilateral trade between the US and Indonesia on these commodities constitutes a substantial share of global product trade. To illustrate, 14.05% of global exports of palm kernel and babassu vegetable oils is accounted for by Indonesia's exports to the US. For natural rubber and sports footwear, bilateral Indonesia–US product shares stand at 11.67% and 11.52%, respectively. Since Indonesia is not affected by tariffs imposed on these products, it could emerge as a strong alternative source of exports to the US if sourcing decisions change in a protracted trade conflict.

Turning to the PRC's basket of tariff-affected commodities, Table 4.5 Panel B shows that among the products traded heavily by Indonesia with the PRC (based on 2017 export values) are: lignite ($2.4 million), palm vegetable oil ($2.1 million) and wood pulp ($1.6 million). Indonesia–PRC trade on some of these commodities account for more than 20% of product trade. Examples include Indonesia's exports to the PRC of lignite (73.37%), ferro-alloys (33.21%), and palm vegetable oil (23.15%). Thus, Indonesia can potentially benefit from trade redirection, particularly by becoming an alternative source of supply for specific items affected by the conflict.

News reports offer a more grounded perspective on the current situation in Indonesia against the backdrop of the trade conflict. Even in the early stages of the trade conflict, effects on the footwear industry already started to manifest. In 2018, exports of footwear from Indonesia rose by 6.5%, way above the 3.5% growth in 2017. Gain in footwear exports to the US stood at 4.7%, compared to 3.5% in 2017. This is taken to be a sign of trade redirection, especially since exports of footwear from the PRC to the US are reported to have contracted by 1% in 2018 (Yeung 2019). Garments and footwear are regarded as Indonesia's strong suit, and the economy is well-equipped to adequately bridge the supply gap in the US footwear and apparel markets resulting from the trade conflict.

Table 4.5: Tariff-Affected Commodities Bilaterally Traded by Indonesia with the United States and the People's Republic of China

PANEL A. US TARIFF-AFFECTED COMMODITIES			
HS-12	Commodity description	Exports to US ($ millions)	Share in World Exports (%)
400122	Rubber; technically specified natural rubber (TSNR), in primary forms or in plates, sheets or strip (excluding latex and smoked sheets)	980.6	11.67
401110	Rubber; new pneumatic tyres, of a kind used on motor cars (including station wagons and racing cars)	628.2	1.65
270900	Oils; petroleum oils and oils obtained from bituminous minerals, crude	622.3	0.11
151190	Vegetable oils; palm oil and its fractions, other than crude, whether or not refined, but not chemically modified	585.0	2.38
844331	Printing, copying, and facsimile machines; machines which perform two or more of the functions of printing, copying or facsimile transmission, capable of connecting to an automatic data processing machine or to a network	420.8	2.41
640319	Sports footwear; (other than ski-boots, snowboard boots or cross-country ski footwear), with outer soles of rubber, plastics, leather or composition leather and uppers of leather	381.8	11.52
611020	Jerseys, pullovers, cardigans, waistcoats and similar articles; of cotton, knitted or crocheted	356.1	2.11
151329	Vegetable oils; palm kernel or babassu oil and their fractions, other than crude, whether or not refined, but not chemically modified	353.8	14.05
940360	Furniture; wooden, other than for office, kitchen or bedroom use	328.6	1.35
640399	Footwear; NEC in heading no. 6403, (not covering the ankle), outer soles of rubber, plastics or composition leather, uppers of leather	289	1.15
PANEL B. PRC TARIFF-AFFECTED COMMODITIES			
HS-12	Commodity description	Exports to PRC ($ millions)	Share in World Exports (%)
270210	Lignite; whether or not pulverised, but not agglomerated, excluding jet	2,397.40	73.37
151190	Vegetable oils; palm oil and its fractions, other than crude, whether or not refined, but not chemically modified	2,068.90	8.41
470329	Wood pulp; chemical wood pulp, soda or sulphate, (other than dissolving grades), semi-bleached or bleached, of non-coniferous wood	1,628.40	11.9

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Table 4.5 continued

HS-12	Commodity description	Exports to US ($ millions)	Share in World Exports (%)
270119	Coal; (other than anthracite and bituminous), whether or not pulverised but not agglomerated	1,555.10	12.41
270112	Coal; bituminous, whether or not pulverised, but not agglomerated	1,156.10	1.22
720260	Ferro-alloys; ferro-nickel	1,132.40	33.21
271111	Petroleum gases and other gaseous hydrocarbons; liquefied, natural gas	998.8	1.46
151329	Vegetable oils; palm kernel or babassu oil and their fractions, other than crude, whether or not refined, but not chemically modified	582.8	23.15
270900	Oils; petroleum oils and oils obtained from bituminous minerals, crude	543.7	0.1
260300	Copper ores and concentrates	451.4	0.82

NEC = not elsewhere classified, PRC = People's Republic of China, US = United States.
Source: UN Comtrade Database, 2019, United Nations.

Recently, Indonesian officials called for a strategic approach to managing risks arising from the trade conflict, effectively prioritizing the issue in the national policy agenda. Effective strategizing will help anticipate potential ramifications and plan appropriate actions. The need for a cautious approach supported by regulations that aid (not impede) industry players cannot be overemphasized. Furthermore, expanding beyond the traditional markets to explore opportunities in regions such as the Middle East, Africa, and South America should be part of any strategy. Policymakers maintain that an aggressive business-oriented approach would help cushion against the negative impacts of the trade conflict (Razi Rahman/Suharto 2019).

4.4 Attracting Foreign Direct Investment for Global Value Chains

4.4.1 The Global Value Chain-Foreign Direct Investment Nexus

In the developing world, there exists a complementarity between foreign direct investments (FDI) and GVC participation—a fact that has been supported both by theory and empirics. Participating in GVCs requires local firms to be at par with the requirements of international markets and be able to meet increasingly complex demand (Amendolagine et al. 2019), which intensifies the need for developing and adapting innovative approaches and measures in product supply. It has been observed that, to facilitate such improvements, transfers of knowledge and technology from worldwide leaders to local firms have been occurring within relevant supply chains or GVCs over the years.

This local push for innovation, combined with external sources of productivity-driven progress, creates better business environments which could ultimately attract more foreign investments.

Attracting FDI, however, is not enough to achieve and sustain gains in economic development—or what modern literature recognize as "spillovers".[5] Foreign firms must be willing to impart their technical and managerial knowhow to local suppliers, thus improving human capital as well as the productivity of inputs to production.[6] Since these are viewed as costly by profit-driven firms, there must be enough incentives for them to pursue such measures. In this regard, existing literature (Amendolagine et al. 2019) points out that the type (apart from the degree) of GVC involvement serves as a key determinant for capitalizing on the potential benefits from FDI.

Specializing in more upstream stages of production in GVCs signals to foreign investors that a local economy is more concentrated in the production of key intermediates than merely focusing on the assembly of imported inputs. Thus, more upstream economies are expected to have higher shares of inputs sourced locally by foreign investors. In addition, it has been observed that, the willingness of foreign investors to provide support to local suppliers increases with upstream specialization, thereby making the transmission of positive spillovers to the local economy more likely (Amendolagine et al. 2019).

Given the potential positive impact of FDI on productivity, local suppliers linked to GVCs can become even more competitive, leading to substantial gains in the long run that are driven mostly by a continuous process of increased specialization and further investments by firms from across the globe. In this regard a holistic analysis of GVCs cannot overlook the importance of FDI, which is the focus of this subsection.

4.4.2 Foreign Direct Investment as a Driver of Factory Asia

Asia and the Pacific remained the largest destination for FDI worldwide, receiving almost 43.1% of the $1.3 trillion global total in 2018, up from 11% ($132 billion) in 2000—reflecting the ever-increasing trade and investment openness in the region. The People's Republic of China continued to be the most attractive destination for inward FDI despite the recent geopolitical tensions and trade conflicts (Table 4.6).

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5 Includes improvements in development finance, domestic employment, capital formation, among others (Amendolagine et al. 2019)

6 Aside from outright increases in the savings rate of economies, neoclassical models of economic growth point to technological progress as a key pathway to sustained / improving long run per capita consumption.

Asia also emerged as a major investor, contributing to 49.4% of global FDI in 2018. A significant share of the region's outward FDI was now directed within the region, with the growth particularly pronounced since the global financial crisis. The share of intra-Asian FDI in total Asia-bound FDI increased from 32% in 2007 to almost 50% in 2018. The slow pace of recovery in the global economy and increasing protectionism in advanced economies, along with the ensuing trade conflicts, may have prompted Asian investors to turn towards investment opportunities within the region.

Historically, the surge in FDI to the region was linked to GVCs, mainly in the manufacturing sector. It was driven by multinationals, notably from Japan and the Republic of Korea, that relocated downstream parts of their production process in search of lower labor costs mainly through greenfield investments

Table 4.6: Top Recipients of Foreign Direct Investment (Balance of Payment) in Asia, 2001–2018 ($ million)

2001–2007		2008–2016	
China, People's Republic of	68,555	China, People's Republic of	120,538
Hong Kong, China	36,251	Hong Kong, China	92,247
Singapore	27,303	Singapore	50,146
Australia	17,090	Australia	47,019
India	12,680	India	35,763
Korea, Republic of	10,387	Indonesia	14,171
Thailand	7,286	Kazakhstan	10,867
Japan	6,592	Korea, Republic of	9,692
Malaysia	5,164	Viet Nam	9,285
Kazakhstan	5,124	Malaysia	9,281
2017		**2018**	
China, People's Republic of	134,063	China, People's Republic of	139,043
Hong Kong, China	110,685	Hong Kong, China	115,662
Singapore	75,723	Singapore	77,646
Australia	42,294	Australia	60,438
India	39,904	India	42,286
Indonesia	20,579	Indonesia	21,980
Korea, Republic of	17,913	Viet Nam	15,500
Viet Nam	14,100	Korea, Republic of	14,479
Japan	10,430	Thailand	10,493
Malaysia	9,399	Japan	9,858

Source: United Nations Conference on Trade and Development, 2019, World Investment Report 2019 Statistical Annex Tables.

that entail building assets from the ground up. It is worth noting that empirical evidence suggests that greenfield investments are more linked to GVCs and trade promotion compared to mergers and acquisitions (M&As).[7]

The link between FDI and GVCs was quite evident in Asia. About 60% of all foreign-owned firms in the continent (and around 70% in the manufacturing sector) were engaged in GVC-related activities. Asian-owned firms were even more likely to be engaged in GVC-related activities compared to those owned by non-Asian multinationals (67% versus 45%). Japan was the largest source of GVC-linked FDI in Asia followed by Republic of Korea, while, at least since 2001, the People's Republic of China remained the most popular host despite recent trends in investment redirections towards ASEAN economies amid escalating trade conflict between the United States and the People's Republic of China.

However, in recent years, FDI through M&As also grew rapidly, as multinationals were increasingly drawn to the expanding domestic markets in the region, especially in the services sector. Data on firm level investment activity indicate that, in 2018, the share of M&As in total FDI to the region tripled from only 13% in 2003 (the earliest year for which data are available). These patterns suggest that in the future, Asian economies may also be able to leverage their expanding middle classes in addition to the historical reliance on abundant labor in order to continue FDI driven industrial policies and development strategies.

4.4.3 Foreign Direct Investment in Indonesia: A Closer Look

Indonesia has historically been one of the most popular destinations of inward FDI in Asia as it remained the 6th largest recipient in 2018. Based on balance of payments, FDI inflows in 2018 amounted to almost $22 billion (from $20.5 billion in 2017), recovering from the sharp contraction in 2016 when it had declined precipitously to $4 billion (compared to $22 billion in 2015). Singapore, Japan, and the People's Republic of China were the largest investors in Indonesia, with Singapore accounting for half of all FDI in Indonesia (Table 4.7). More than 90% of FDI inflows to Indonesia were from within the region reflecting its strong intraregional trade and investment linkages (Figure 4.3). The People's Republic of China had gradually cemented its position as a top investor over the years with more than $2 billion worth of inward FDI in 2018, 10 times higher than the annual average in 2001–2007.

[7] Asian Economic Integration Report 2016. *What Drives Foreign Direct Investment in Asia and the Pacific*. ADB. Manila.

Table 4.7: Top Sources of Foreign Direct Investment (Balance of Payment) to Indonesia, 2001–2018 ($ million)

2001–2007		2008–2016	
Netherlands	1,251	Singapore	7,098
Japan	924	Japan	4,196
United States	866	United Kingdom	967
Singapore	684	Seychelles	908
Germany	321	Korea, Republic of	487
Korea, Republic of	259	Luxembourg	467
France	235	China, People's Republic of	459
China, People's Republic of	209	Hong Kong, China	440
Australia	207	Australia	278
Malaysia	193	United States	266
2017		**2018**	
Singapore	9,413	Singapore	10,505
Netherlands	4,059	Japan	4,937
Japan	3,913	China, People's Republic of	2,142
China, People's Republic of	1,994	Hong Kong, China	1,160
Malaysia	976	United States	1,067
Switzerland	575	Malaysia	753
Germany	561	Germany	585
Hong Kong, China	548	Switzerland	564
United Kingdom	469	Thailand	541
Macau, China	197	Netherlands	470

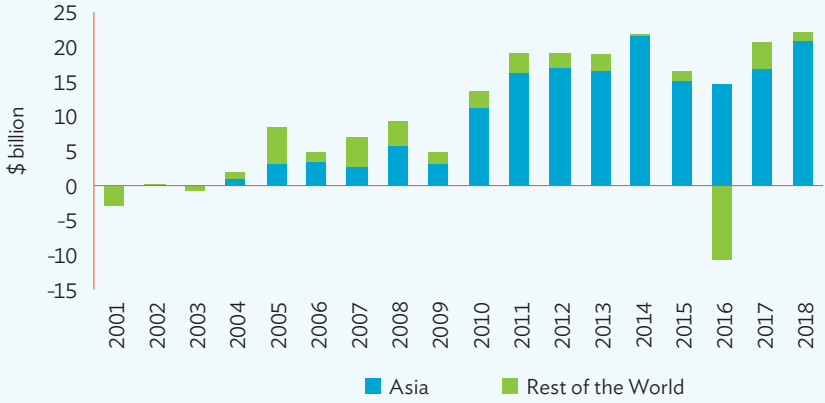
Sources: United Nations Conference on Trade and Development. 2019. Bilateral FDI Statistics; United Nations Conference on Trade and Development. 2019. World Investment Report 2019 Statistical Annex Tables.

The lion's share of inward FDI to Indonesia took the form of greenfield investment with nominal committed investments totaling $39 billion in 2018, compared to $3.5 billion of M&As (Figure 4.4).[8] Greenfield investments generally dominated M&As except in 2008, when there was a surge in investment deals in the service sub-sectors in a trend which could not be sustained.

[8] Greenfield investments recovered dramatically from the sharp decline in 2017 when nominal committed investments were only $9.6 billion.

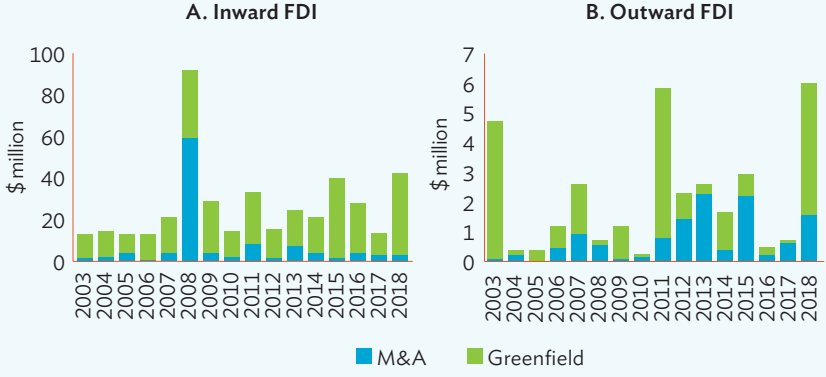
While greenfield investments in the rest of Asia targeted GVC-linked manufacturing sectors, the top recipient industries in Indonesia were traditionally natural resource based, with "coal, oil, and natural gas" and "metals" attracting the most (Table 4.8). However, in 2018, "alternative/ renewable energy" displaced "coal, oil, and natural gas" as the top recipient due to large investments in the industry from the People's Republic of China.

Figure 4.3: Intra-Asia versus Rest of the World Foreign Direct Investment (Balance of Payment) to Indonesia, 2001–2018



Sources: United Nations Conference on Trade and Development. 2019. Bilateral FDI Statistics; United Nations Conference on Trade and Development. 2019. World Investment Report 2019 Statistical Annex Tables.

Figure 4.4: Firm Level Foreign Investment Activity in Indonesia, by Mode of Entry, 2003–2018 ($ million)



FDI = foreign direct investment, M&A = mergers and acquisitions.

Sources: Zephyr M&A Database. 2003–2018. Bureau van Dijk; fDi Markets. 2003–2018. Financial Times; Asian Development Bank estimates.

Table 4.8: Top Recipient Industries, 2003–2018 ($ million)

Total			
2003–2007		**2008–2016**	
Coal, oil, and natural gas	6,012	Coal, oil, and natural gas	7,303
Metals	2,638	Financial services	7,285
Food and tobacco	992	Metals	5,500
Alternative/renewable energy	984	Real estate	1,823
Financial services	608	Chemicals	1,815
Automotive OEM	504	Food and tobacco	1,121
Consumer products	385	Alternative/renewable energy	841
Chemicals	382	Communications	813
Hotels and tourism	359	Automotive OEM	730
Communications	359	Rubber	650
2017		**2018**	
Metals	3,232	Alternative/renewable energy	19,977
Coal, oil, and natural gas	2,040	Coal, oil, and natural gas	4,194
Food and tobacco	1,995	Chemicals	4,065
Alternative/renewable energy	747	Real estate	3,773
Business services	684	Metals	2,599
Hotels and tourism	578	Hotels and tourism	1,647
Chemicals	560	Software and IT services	1,596
Consumer products	350	Food and tobacco	1,118
Building and construction materials	350	Financial services	585
Automotive OEM	331	Automotive OEM	567
Greenfield FDI			
2003–2007		**2008–2016**	
Coal, oil, and natural gas	5,476	Coal, oil, and natural gas	6,304
Metals	2,626	Metals	5,465
Alternative/renewable energy	1,229	Real estate	1,758
Automotive OEM	457	Chemicals	1,693
Rubber	394	Alternative/renewable energy	840
Chemicals	354	Automotive OEM	723
Hotels and tourism	330	Rubber	702
Building and construction materials	311	Food and tobacco	699
Food and tobacco	275	Paper, printing and packaging	617
Semiconductors	233	Transportation	489
2017		**2018**	
Metals	3,075	Alternative/renewable energy	19,974
Coal, oil, and natural gas	1,946	Coal, oil, and natural gas	4,191
Alternative/renewable energy	743	Chemicals	4,054
Chemicals	551	Real estate	3,723

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Table 4.8 continued

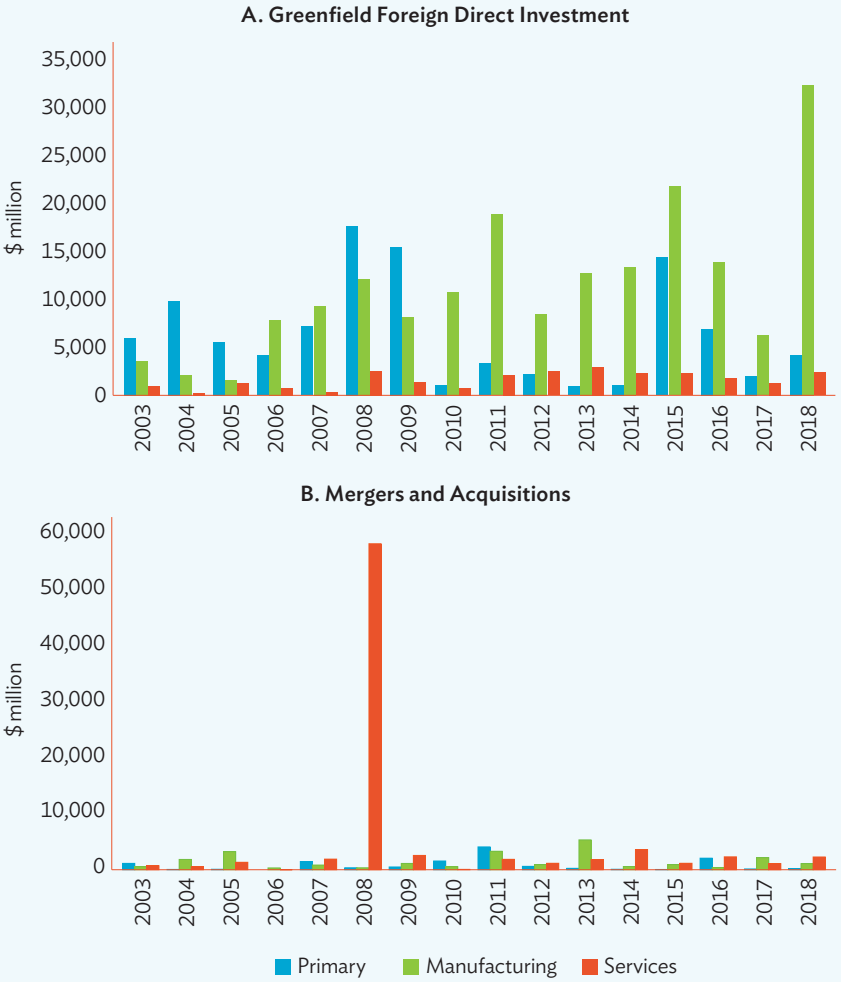
Hotels and tourism	542	Metals	2,372
Building and construction materials	350	Hotels and tourism	1,629
Automotive OEM	331	Automotive OEM	567
Consumer products	288	Rubber	453
Food and tobacco	189	Food and tobacco	427
Pharmaceuticals	176	Warehousing and storage	258
M&As			
2003–2007		**2008–2016**	
Food and tobacco	717	Financial services	6,797
Coal, oil, and natural gas	536	Coal, oil, and natural gas	999
Financial services	487	Communications	676
Consumer products	415	Food and tobacco	422
Communications	412	Beverages	331
Building and construction materials	96	Business services	252
Wood products	68	Consumer products	237
Rubber	52	Automotive components	221
Automotive OEM	47	Chemicals	122
Paper, printing and packaging	38	Consumer electronics	91
2017		**2018**	
Food and tobacco	1,806	Software and IT services	1,500
Business services	578	Food and tobacco	691
Metals	157	Financial services	430
Software and IT services	150	Metals	227
Real estate	110	Business services	158
Coal, oil, and natural gas	94	Communications	137
Communications	81	Rubber	111
Financial services	73	Pharmaceuticals	97
Transportation	69	Consumer products	57
Consumer products	62	Real estate	50

FDI = foreign direct investment, IT = information technology, M&A = mergers and acquisitions, OEM = original equipment manufacturer.
Source: Zephyr M&A Database. 2003–2018. Bureau van Dijk; fDi Markets. 2003–2018. Financial Times; Asian Development Bank estimates.

Concurrently, despite the dominance of the natural resource sector, Indonesia had been attracting an increasing amount of greenfield investment in the manufacturing sector (albeit resource linked manufacturing), recording the highest greenfield committed investments to date in 2018 (Figure 4.5). Also, in an encouraging sign of diversification, the "software and IT services" industry was the top recipient of M&As in 2018 followed by "food and tobacco" and "financial services," with the size of these deals nevertheless being only a fraction of greenfield investments.

Indonesia's GVC participation, from an FDI perspective, remained low compared to other economies in the ASEAN as, in 2016, only 41% of foreign-owned firms engaged in both imports and exports—a proxy for GVC-linked FDI. This pales in comparison to the relevant numbers for Malaysia and Viet Nam, which were 65% and 78%, respectively (ADB 2016).

Figure 4.5: Firm-Level Foreign Investment Activity in Indonesia, by Broad Industrial Sector, 2003–2018 ($ million)



Source: Zephyr M&A Database. 2003–2018. Bureau van Dijk; fDi Markets. 2003-2018. Financial Times; Asian Development Bank estimates.

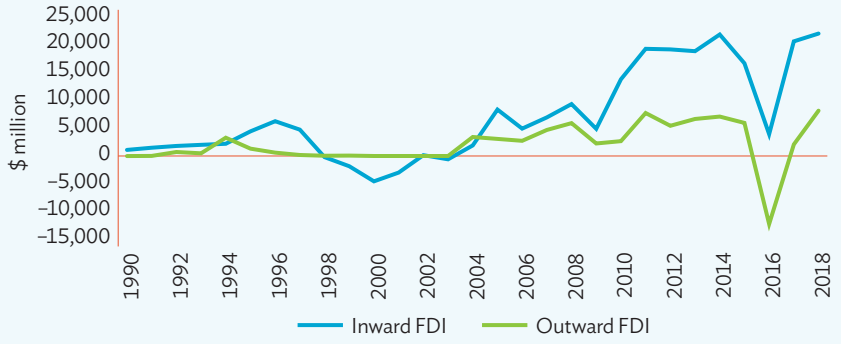
From a policy perspective, while Indonesia generally remained an attractive destination for FDI over 2001–2018, more concerted efforts towards improving governance and the business environment would help deepen and broaden GVC participation, especially in labor intensive manufacturing and services, and help the economy diversify away from its dependence on natural resources. The next sub-section briefly discusses factors that Indonesia could improve upon to increase inward FDI, especially GVC-linked FDI.

4.4.4 The Inextricable Link Between Foreign Direct Investment, Uncertainty, and Policy

Investment has historically been one of the most volatile components of any given country's GDP (Mendoza 1991; Aguiar and Gopinath 2006; Fernandez and Gulan 2015) and FDI, being a subset of aggregate investment, is no exception. Figure 4.6 shows the time trend of Indonesian FDI, which exhibits large swings at certain periods of time.

Building upon the limitations of neoclassical models of investment, economists began to integrate the effects of expectations and uncertainty in forming theoretical foundations that explain the unpredictable nature of investment. One of the key ideas that emerged from such research is that the value of investment projects follows a stochastic process (e.g., geometric Brownian motion) and are therefore subject to uncertainty. Profit-maximizing firms therefore take this into account, apart from the usual considerations of adjustment and replacement costs and marginal values of additional capital, among others, when optimizing their actions.

Figure 4.6: Levels of Inward and Outward Foreign Direct Investment, 1990–2018 ($ million)



FDI = foreign direct investment.

Sources: United Nations Conference on Trade and Development. 2019. World Investment Report 2019 Statistical Annex Tables; Zephyr M&A Database. 2003–2018. Bureau van Dijk; fDi Markets. 2003–2018. Financial Times; Asian Development Bank estimates.

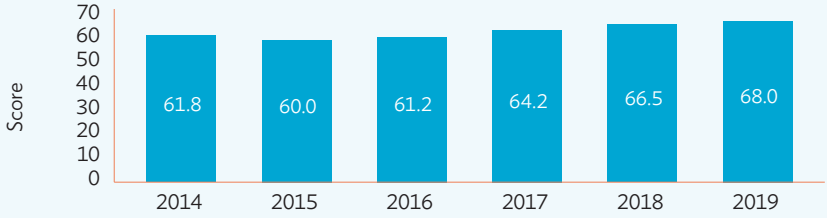
Uncertainty, on the other hand, is recognized as a function of economic and political shocks. In a model conceptualized by Bloom (2009), it was shown that time-varying second-moment shocks (i.e., uncertainty shocks) lead to an increase in the real option value to waiting, which in turn compels firms to scale back on hiring and investment—a result that was empirically validated with the use of vector autoregressions. The results, which pinpointed the relationship between the continued occurrence of such shocks and business decisions across time, shed some light on the volatile nature of investment and, more importantly, strengthened the understanding of economists and policymakers alike on the importance of governance and stability to economic growth.

Cross-country econometric evidence suggests that the quality of governance, as measured by perceptions-based governance indicators, is the most important driver of FDI in the region (ADB 2016). The effect is most pronounced for M&As, particularly in the services sector, but is also significant and positive for greenfield FDI in the manufacturing sector. Empirical evidence also suggests that M&As are more drawn towards economies with good governance and business environment given the domestic market seeking nature of these investments (ADB 2016).

In the absence of good governance, which often takes a concerted effort over a long period of time to achieve, a better business environment may complement and compensate for poor institutions—the positive impact of ease of doing business indicators is strongest when the quality of governance is low. Among the indicators, the ease of "registering property" is most important for greenfield investments and ease of "getting credit" most important for M&As.

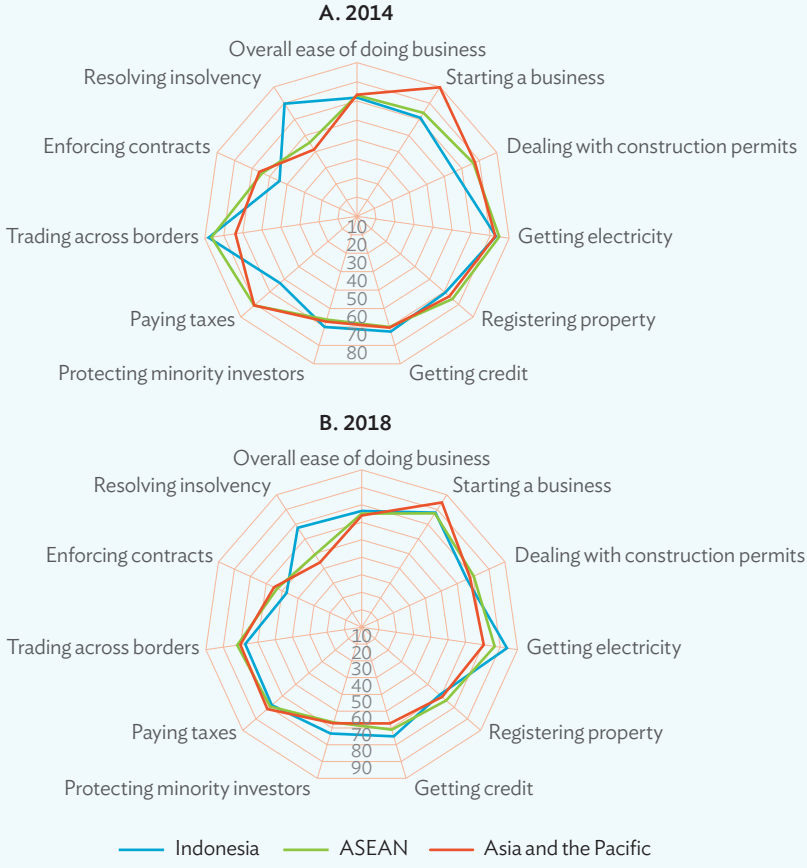
The importance of governance and the business environment is underlined by Indonesia's experience with attracting FDI. The vast proportion of inward FDI to Indonesia was in natural resources, where the quality of governance and ease of doing business do not have as significant an impact. While Indonesia fared relatively poorly in governance and ease of doing business rankings across most dimensions—particularly on dealing with construction permits, registering property and ease of trading across borders—its rankings had been improving over time, especially since 2015 (Figure 4.7 and Figure 4.8). In terms of governance, from 2014 to 2018 Indonesia saw the most improvement in control of corruption and political stability.

Figure 4.7: Overall Ease of Doing Business in Indonesia, 2014–2019



Source: Overall Ease of Doing Business. 2014–2019. World Bank.

Figure 4.8: Ease of Doing Business—Indonesia in a Comparative Context, 2014 versus 2018



ASEAN = Association of Southeast Asian Nations.
Source: World Governance Indicators. 2014 and 2018. World Bank.

Chapter 5
Reaping the Benefits of Global Value Chain Participation: Conclusion and Policy Recommendations

The report assesses Indonesia's participation in GVCs from 2000 to 2017. Since 2000, domestic value-added embedded in the country's exports and final production exhibited a rising trend, specifically in the primary sector. This also reflects the effects of recent policies that support domestic industries in the country. The turn towards the domestic market is captured by the analyses presented in the report. It is, however, necessary to note that a sizeable share of domestic value-added generated in Indonesia accrued from extractive, rather than technology-intensive, industries. Further, Indonesia is seen as one of the countries least likely to reap substantial gains from the trade conflict between the United States and the People's Republic of China.

Indonesia contributed to other countries' output. The value-added it generated accounted for a small but rising share in the production of final goods and services in neighboring ASEAN economies. Forward GVC links from a network perspective, meanwhile, show that a significant share of domestic value-added embedded in the country's goods and services contributed to the production of exports of services-oriented economies such as Hong Kong, China and Singapore as well as central GVC hubs such as the Germany, the People's Republic of China, and the United States.

The decomposition of Indonesia's gross exports into value-added components indicates that its involvement in GVCs was more bilateral than global. Upstreamness indices show that, on average, production in the country was about two steps away from final consumers. A huge portion of the domestic value-added embodied in exported commodities underwent only one border crossing. Traded commodities from the country were either consumed as final products or exported as intermediates used to produce final goods and services in a partner economy.

Trends in Indonesia's GVC participation indicators align with gross exports decomposition results. Overall, forward GVC participation dominated backward GVC participation, with greater shares accounted for by simple GVC than complex GVC-related activities. Findings show that forward GVC participation dominated backward GVC participation in primary and manufacturing sectors. In other words, the country was relatively more involved in supplying value-added that ultimately became embodied in final

products consumed abroad. Hence, these sectors were more engaged in upstream activities. On the other hand, backward participation was higher than forward participation in services, suggesting that services embodied more GVC-related value-added in comparison with primary and manufacturing sectors. This coincided with the country's lack of comparative advantage in services over the period considered. The country imported value-added created in other economies to produce services for domestic consumption.

Comparative advantage remained in the primary and low-technology manufacturing sectors, but these had weak ties with other domestic sectors. To elaborate, the relationship between industrial specialization and strength of domestic production links was nonsignificant in Indonesia. This implies that specialization did not create spillovers that could generate significant multiplier effects in other industries within the local economy. Thus, there remains huge potential for strengthening linkages among sectors for the benefits of specialization to trickle down to other industries.

The analysis of jobs in Indonesia from 2005 to 2015 reveals that upgrades in technology within GVCs had a negative impact on jobs across all sectors, but this displacement effect was counteracted by the job creation associated with increases in income. Holding other factors constant, the negative effect of technology on labor demand was largest in the agricultural sector. Furthermore, changes in final consumer preferences could be displacing workers in agriculture, while the trends were also associated with an increase in demand for jobs in manufacturing and services. Examining results by occupation type, estimates suggest that routine cognitive workers (such as clerical support workers) and nonroutine manual workers (such as sales and services workers) in the country were most vulnerable to changes in technology within GVCs.

Indonesia continued to be a popular destination of foreign direct investment (FDI) in Asia. Greenfield investment in the country has traditionally been in the natural resource sector, but investment in manufacturing sectors have also been increasing in recent years. Mergers and acquisitions linked FDI, though a small share of total FDI inflows in the economy, also began to diversify into services. However, GVC-linked FDI remained low in in the country.

Analysis shows that Indonesia has considerable ground to cover to deepen and broaden its participation in GVCs and realize the associated benefits. Based on the data gathered, statistics compiled, and information analyzed, this report offers the following recommendations:

1. To maximize gains from insertion into GVCs, a concerted effort in bringing multiple stakeholders together to establish stronger links among domestic industries is needed. This can be done through

putting in place coordination mechanisms to ensure consistency and coherence of industrial policies (Tijaja and Faisal 2014); addressing key governance bottlenecks and constraints to foster a business-friendly environment where firms can not only thrive but also innovate; and developing, especially, technology intensive manufacturing to cascade structural transformation.

2. Infrastructure investment is necessary in a GVC-world. Efficient transportation of goods, fast transmission of information, and reliable utilities services are crucial not only in attracting investment in GVC-related firms but also in strengthening linkages of domestic firms. Especially for an archipelago like Indonesia, connectivity among firms from different parts of the country is a key concern. Transportation networks must be designed to make the movement of goods and people easier. Information and telecommunications infrastructure are also important in lowering transactions costs between firms facing geographic barriers. Moreover, reliable utilities services are especially important in the manufacturing sectors, where production is capital-intensive. Disruptions in power and water supplies for example can lead to backlogs in production, which can affect the bottom line of firms. Thus, policy driven efforts must be made in bridging infrastructure gaps in the economy.

3. To the extent that jobs in agriculture are vulnerable to technology diffused by GVCs, the need for labor policies oriented to create incentives for or usher the movement of workers from the agricultural sector towards other sectors cannot be overstated. Moreover, policies that cater to fine-tuning skills, reskilling the workforce, and establishing formal education systems that are both globally competitive and sensitive to industry needs would help establish a steady supply of skilled workers that are not easily at risk of automation. Creating curriculums that are broad-based, and that sharpen competencies in nonroutine tasks that activate multiple intelligences would help cushion against the job-displacement effects of technological change.

4. Studies have recognized that economic policies should not only be sensitive to domestic needs but adaptive to the changing times, the demands of the external environment, and the existence of competing and complementary market players (Naude 2013). In order to reap greater benefits from GVC participation, Indonesia should consider further developing its innovation capacity by aiming to attract FDI investments in non-extractive and research and development-oriented industries, especially in those that are heavily linked to other sectors within the domestic economy. To foster an ecosystem for, and a culture

of innovation, Indonesia should look to gradually reducing its reliance on extractive industries and facilitating greater inflow of technologies, especially through GVCs. Since technology can be disruptive at the onset, policy measures need to be put in place to support vulnerable workers and enterprises.

To conclude, deepening and widening participation in GVCs is a gradual process that involves reorienting capacities, taking risks, and transcending traditional development paradigms. Indonesia has had a long history of intermittent import substitution industrialization, coupled with episodes of export-orientation. In an era of technology-driven GVCs, the country needs to revisit its economic policies and industrial strategies to tactfully use them to define, or redefine its position, in the landscape of global production networks and reap the benefits of supplying its goods and services to a fast evolving global market.

Appendix 1

List of Economies in the ADB Multi-Regional Input–Output Tables

Code	Economy Name
AUS	Australia
AUT	Austria
BAN	Bangladesh
BEL	Belgium
BGR	Bulgaria
BHU	Bhutan
BRA	Brazil
BRU	Brunei Darussalam
CAM	Cambodia
CAN	Canada
CYP	Cyprus
CZE	Czech Republic
DEN	Denmark
EST	Estonia
FIJ	Fiji
FIN	Finland
FRA	France
GER	Germany
GRC	Greece
HKG	Hong Kong, China
HRV	Croatia
HUN	Hungary
IND	India
INO	Indonesia
IRE	Ireland
ITA	Italy
JPN	Japan
KAZ	Kazakhstan

Code	Economy Name
KOR	Republic of Korea
KGZ	Kyrgyz Republic
LAO	Lao People's Democratic Republic
LTU	Lithuania
LUX	Luxembourg
LVA	Latvia
MAL	Malaysia
MEX	Mexico
MLD	Maldives
MLT	Malta
MON	Mongolia
NEP	Nepal
NET	Netherlands
NOR	Norway
PAK	Pakistan
PHI	Philippines
POL	Poland
POR	Portugal
PRC	People's Republic of China
ROM	Romania
RUS	Russian Federation
SIN	Singapore
SPA	Spain
SRI	Sri Lanka
SWE	Sweden
SWI	Switzerland
SVK	Slovak Republic
SVN	Slovenia
TAP	Taipei,China
THA	Thailand
TUR	Turkey
UKG	United Kingdom
USA	United States
VIE	Viet Nam
RoW	Rest of the World

Appendix 2

List of Sectors in the ADB Multi-Regional Input–Output Tables

Code	Sector	Broad Sector
c1	Agriculture, hunting, forestry, and fishing	Primary
c2	Mining and quarrying	Primary
c3	Food, beverages, and tobacco	Low-technology manufacturing
c4	Textiles and textile products	Low-technology manufacturing
c5	Leather, leather products, and footwear	Low-technology manufacturing
c6	Wood and products of wood and cork	Low-technology manufacturing
c7	Pulp, paper, paper products, printing, and publishing	Low-technology manufacturing
c8	Coke, refined petroleum, and nuclear fuel	Medium- and high-technology manufacturing
c9	Chemicals and chemical products	Medium- and high-technology manufacturing
c10	Rubber and plastics	Low-technology manufacturing
c11	Other nonmetallic minerals	Medium- and high-technology manufacturing
c12	Basic metals and fabricated metal	Medium- and high-technology manufacturing
c13	Machinery, NEC	Medium- and high-technology manufacturing
c14	Electrical and optical equipment	Medium- and high-technology manufacturing
c15	Transport equipment	Medium- and high-technology manufacturing
c16	Manufacturing, NEC; recycling	Low-technology manufacturing
c17	Electricity, gas, and water supply	Low-technology manufacturing
c18	Construction	Low-technology manufacturing
c19	Sale, maintenance, and repair of motor vehicles and motorcycles; retail sale of fuel	Business services
c20	Wholesale trade and commission trade, except of motor vehicles and motorcycles	Business services
c21	Retail trade, except of motor vehicles and motorcycles; repair of household goods	Business services
c22	Hotels and restaurants	Business services

Code	Sector	Broad Sector
c23	Inland transport	Business services
c24	Water transport	Business services
c25	Air transport	Business services
c26	Other supporting and auxiliary transport activities; activities of travel agencies	Business services
c27	Post and telecommunications	Business services
c28	Financial intermediation	Business services
c29	Real estate activities	Business services
c30	Renting of machinery and equipment and other business activities	Business services
c31	Public administration and defense; compulsory social security	Personal and public services
c32	Education	Personal and public services
c33	Health and social work	Personal and public services
c34	Other community, social, and personal services	Personal and public services
c35	Private households with employed persons	Personal and public services

NEC = not elsewhere classified.

Appendix 3

New Revealed Comparative Advantage and Agglomeration Index Regression Results

Dependent variable: Total agglomeration (agg_t), forward agglomeration (agg_f), backward agglomeration (agg_b)
Inpendent variable: NRCA
Control: Economic block

Linear regression — Number of obs = 65; F(5, 59) = 1017.96; Prob > F = 0; R-squared = 0.9868; Root MSE = 0.13206

agg_b	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
nrca	−0.04	0.0706389	−0.61	0.546	0.1842351	0.0984611
econ_block						
2	3.06	0.1479724	20.65	0	2.759459	3.351643
3	2.43	0.0753179	32.23	0	2.277055	2.578477
4	2.82	0.0664696	42.47	0	2.689768	2.955778
5	1.68	0.1408308	11.93	0	1.398751	1.962355
_cons	−1.96	0.0662883	−29.6	0	2.094489	−1.829204

Linear regression — Number of obs = 65; F(5, 59) = 648.6; Prob > F = 0; R-squared = 0.9732; Root MSE = 0.1799

agg_f	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
nrca	0.25	0.2722382	0.91	0.367	0.2970064	0.7924883
econ_block						
2	−0.57	0.5719408	−1	0.32	1.717583	0.5713186
3	−0.18	0.1328004	−1.38	0.171	0.4495687	0.0818971
4	0.86	0.0893944	9.66	0	0.6842511	1.042007
5	−2.69	0.6081508	−4.43	0	3.909559	−1.475745
_cons	0.28	0.0723186	3.89	0	0.1364425	0.425861

Linear regression — Number of obs = 65; F(5, 59) = 1140.97; Prob > F = 0; R-squared = 0.9826; Root MSE = 0.1177

agg_t	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
nrca	0.10	0.1404218	0.73	0.469	0.1785564	0.3834103
econ_block						
2	1.24	0.2905363	4.27	0	0.6598478	1.822571
3	1.12	0.0786208	14.27	0	0.9646452	1.279285
4	1.84	0.0557506	33.06	0	1.731394	1.954508
5	−0.51	0.3086996	−1.64	0.106	1.123756	0.1116569
_cons	−0.84	0.0467109	−17.99	0	0.9338157	−0.7468791

Source: Asian Development Bank estimates.

Dependent variable: NRCA
Inpendent variable: Total agglomeration (agg_t), forward agglomeration (agg_f), backward agglomeration (agg_b)
Control: Economic block

Linear regression — Number of obs = 65; F(5, 59) = 598.86; Prob > F = 0; R-squared = 0.98; Root MSE = 0.13422

agg_b	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
agg_b	−0.04	0.0738236	−0.6	0.551	0.1920253	0.1034161
econ_block						
2	2.23	0.2250718	9.9	0	1.778714	2.679449
3	0.56	0.1780395	3.14	0.003	0.203521	0.9160335
4	0.40	0.2132407	1.88	0.065	0.0252348	0.8281523
5	2.07	0.1181059	17.49	0	1.828952	2.301611
_cons	0.15	0.1457095	1.05	0.299	0.1389389	0.4441891

Linear regression — Number of obs = 65; F(5, 59) = 635.54; Prob > F = 0; R-squared = 0.9806; Root MSE = 0.13211

agg_f	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
agg_f	0.13	0.1072237	1.25	0.218	0.0809665	0.3481419
econ_block						
2	2.10	0.0593806	35.45	0	1.986012	2.223653
3	0.46	0.0174857	26.46	0	0.4276517	0.4976292
4	0.15	0.105825	1.44	0.155	0.0593005	0.3642102
5	2.29	0.2441763	9.37	0	1.799713	2.776904
_cons	0.19	0.0380842	5.11	0	0.1182924	0.2707051

Linear regression — Number of obs = 65; F(5, 59) = 571.77; Prob > F = 0; R-squared = 0.9803; Root MSE = 0.13344

agg_t	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
agg_t	0.13	0.1643028	0.8	0.426	0.1971283	0.4604098
econ_block						
2	1.90	0.2505419	7.61	0	1.404681	2.407347
3	0.30	0.1937477	1.54	0.128	0.0884167	0.6869596
4	0.03	0.3111604	0.1	0.922	0.5920488	0.6532121
5	2.03	0.068989	29.49	0	1.896291	2.172384
_cons	0.35	0.1353363	2.57	0.013	0.0765805	0.6181953

Source: Asian Development Bank estimates.

Dependent variable: Total agglomeration (agg_t), forward agglomeration (agg_f), backward agglomeration (agg_b)
Inpendent variable: NRCA
Control: Economic block, year

Linear regression				Number of obs	=	65
				F(17, 47)	=	243.87
				Prob > F	=	0
				R-squared	=	0.9813
				Root MSE	=	0.14531

nrca	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
agg_t	0.17	0.1435411	1.19	0.238	0.1172554	0.4602794
year						
2007	0.07	0.0934333	0.76	0.453	0.1172897	0.2586373
2008	0.05	0.0758779	0.69	0.493	0.1002526	0.2050408
2009	0.05	0.1128617	0.81	0.424	0.1360005	0.3180962
2010	0.05	0.0970483	0.99	0.329	0.0996076	0.2908642
2011	0.05	0.0953138	0.87	0.388	0.1087526	0.2747408
2012	0.05	0.0870582	1.2	0.235	0.0704427	0.2798344
2013	0.05	0.0749705	0.86	0.396	0.0866232	0.2150193
2014	0.05	0.0927654	0.48	0.634	0.1422101	0.2310299
2015	0.05	0.1194717	0.27	0.788	0.2080448	0.2726473
2016	0.05	0.0978341	0.56	0.579	0.1421859	0.2514478
2017	0.05	0.0970681	0.76	0.449	0.1211165	0.2694351
2018	0.05	0.1032709	1.1	0.276	0.0940248	0.3214838
econ_block						
2	1.85	0.224026	8.25	0	1.397277	2.298641
3	0.25	0.1728619	1.46	0.15	0.0950662	0.6004403
4	−0.04	0.2758112	−0.16	0.874	0.5988905	0.5108306
5	2.05	0.059952	34.13	0	1.925761	2.166977
_cons	0.31	0.1319519	2.37	0.022	0.0467019	0.5776077

Linear regression				Number of obs	=	65
				F(17, 47)	=	260.39
				Prob > F	=	0
				R-squared	=	0.9814
				Root MSE	=	0.14504

nrca	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
agg_f	0.11	0.0963846	1.16	0.253	0.0824256	0.3053758
year						
2007	0.06	0.0970728	0.63	0.53	0.1338527	0.2567178
2008	0.04	0.0747924	0.52	0.604	0.1113832	0.1895424
2009	0.08	0.1124289	0.74	0.464	−0.143082	0.3092737
2010	0.08	0.095259	0.88	0.382	0.1075466	0.2757263
2011	0.07	0.0941894	0.76	0.454	0.1183588	0.2606103
2012	0.09	0.08567	1	0.32	0.0862995	0.2583922
2013	0.05	0.0738443	0.7	0.489	0.0970987	0.2000126
2014	0.04	0.0899274	0.4	0.691	−0.144953	0.2168682
2015	0.03	0.1131881	0.28	0.778	0.1956846	0.2597254
2016	0.05	0.0987625	0.47	0.637	0.1517825	0.2455865
2017	0.06	0.0972355	0.66	0.511	−0.131181	0.2600442
2018	0.09	0.0988438	0.91	0.368	0.1089885	0.2887075
econ_block						
2	2.10	0.0680512	30.91	0	1.966749	2.240552
3	0.46	0.0244213	18.88	0	0.4119281	0.5101868
4	0.17	0.1003959	1.72	0.091	0.0289125	0.3750283
5	2.24	0.2165781	10.34	0	1.803995	2.675393
_cons	0.14	0.0779165	1.86	0.07	0.0120633	0.3014323

Linear regression				Number of obs	=	65
				F(17, 47)	=	398.59
				Prob > F	=	0
				R-squared	=	0.992
				Root MSE	=	0.11502

agg_b	Coef.	Robust Std. Err.	t	P>t	[95% Conf.	Interval]
nrca	0.01	0.0815704	0.1	0.918	0.1556389	0.1725582
year						
2007	−0.02	0.0861026	−0.24	0.809	0.1941547	0.1522775
2008	−0.09	0.0727237	−1.29	0.202	0.2404213	0.0521811
2009	−0.01	0.0402654	−0.13	0.898	0.0861881	0.0758188
2010	−0.07	0.038554	−1.71	0.095	0.1433329	0.0117882
2011	−0.07	0.0380365	−1.9	0.064	0.1488071	0.0042321
2012	−0.16	0.0525021	−3.14	0.003	0.2703057	−0.0590646
2013	−0.09	0.0429696	−2.19	0.034	0.1803574	−0.0074701
2014	−0.05	0.0812497	−0.56	0.581	0.2085678	0.118339
2015	0.07	0.0933019	0.71	0.482	0.1215699	0.2538284
2016	−0.02	0.0453482	−0.51	0.611	0.1144422	0.0680155
2017	−0.06	0.0496415	−1.24	0.222	0.1613643	0.0383671
2018	−0.27	0.0679098	−3.95	0	−0.404621	−0.1313872
econ_block						
2	2.95	0.171256	17.21	0	2.603319	3.292364
3	2.40	0.0696353	34.53	0	2.264414	2.54459
4	2.81	0.0609747	46.06	0	2.685889	2.931219
5	1.58	0.1693407	9.32	0	1.237467	1.918806
_cons	−1.91	0.0559317	−34.13	0	2.021413	−1.796372

Source: Asian Development Bank estimates.

Dependent variable: NRCA
Inpendent variable: Total agglomeration (agg_t), forward agglomeration (agg_f), backward agglomeration (agg_b)
Control: Economic block, year

Linear regression				Number of obs	=	65
				F(17, 47)	=	588.8
				Prob > F	=	0
				R-squared	=	0.989
				Root MSE	=	0.1048

		Robust				
agg_t	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
nrca	0.09	0.1006893	0.89	0.38	0.1133481	0.2917733
year						
2007	0.13	0.1142029	1.12	0.269	0.1021291	0.357364
2008	0.05	0.1281759	0.39	0.696	0.2073806	0.3083328
2009	0.14	0.1154762	1.17	0.248	0.0971732	0.367443
2010	0.07	0.113486	0.65	0.518	0.1543235	0.3022852
2011	0.07	0.1149012	0.59	0.561	0.1638846	0.2984181
2012	−0.00	0.1147967	−0.02	0.987	0.2327937	0.2290887
2013	0.04	0.1147076	0.34	0.735	0.1916957	0.269828
2014	0.06	0.1229452	0.51	0.613	0.1847539	0.3099139
2015	0.14	0.1157386	1.25	0.218	0.0881741	0.377498
2016	0.09	0.1138902	0.83	0.409	0.1342711	0.3239641
2017	0.05	0.1134788	0.44	0.662	0.1784077	0.2781722
2018	−0.12	0.1247257	−0.99	0.327	0.3743346	0.127497
econ_block						
2	1.27	0.2137108	5.94	0	0.8389985	1.69886
3	1.13	0.0580004	19.45	0	1.01127	1.244634
4	1.85	0.0426991	43.25	0	1.760711	1.93251
5	−0.48	0.2314757	−2.07	0.044	−0.945361	−0.0140231
_cons	−0.89	0.1158598	−7.7	0	1.125659	−0.6594992

Linear regression				Number of obs	=	65
				F(17, 47)	=	281.36
				Prob > F	=	0
				R-squared	=	0.9788
				Root MSE	=	0.17909

		Robust				
agg_f	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
nrca	0.17	0.2056773	0.83	0.413	0.2438036	0.5837349
year						
2007	0.28	0.2174624	1.27	0.21	0.1613045	0.7136513
2008	0.20	0.2293299	0.85	0.399	0.2662799	0.6564245
2009	0.28	0.2184786	1.26	0.214	0.1640678	0.7149766
2010	0.21	0.2158035	0.99	0.327	0.2204065	0.6478746
2011	0.21	0.2182211	0.95	0.348	0.2321833	0.6458252
2012	0.16	0.2134565	0.75	0.455	0.2684388	0.5903991
2013	0.17	0.2133973	0.81	0.424	−0.257254	0.601346
2014	0.17	0.2169493	0.78	0.436	0.2661713	0.6067201
2015	0.22	0.2174562	1.03	0.31	0.2142708	0.6606601
2016	0.21	0.2153497	0.99	0.328	0.2203213	0.646134
2017	0.16	0.2156006	0.75	0.458	0.2724694	0.5949957
2018	0.02	0.2213411	0.1	0.924	0.4241144	0.4664473
econ_block						
2	−0.41	0.4432624	−0.92	0.36	1.301713	0.4817452
3	−0.15	0.1056257	−1.41	0.166	0.3610891	0.0638939
4	0.88	0.0802402	11.03	0	0.7232443	1.046089
5	−2.54	0.470846	−5.39	0	−3.48474	−1.5903
_cons	0.12	0.2224622	0.56	0.581	0.3238019	0.5712704

Linear regression				Number of obs	=	65
				F(17, 47)	=	202.85
				Prob > F	=	0
				R-squared	=	0.9811
				Root MSE	=	0.14643

		Robust				
nrca	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
agg_b	0.01	0.1322815	0.1	0.918	−0.252406	0.2798262
year						
2007	0.09	0.1063478	0.89	0.38	0.1196681	0.3082205
2008	0.06	0.0905631	0.7	0.488	0.1189062	0.2454726
2009	0.12	0.1205951	0.96	0.341	0.1265483	0.3586636
2010	0.11	0.1076647	1.03	0.308	0.1057043	0.3274824
2011	0.10	0.1062117	0.91	0.366	0.1166903	0.3106503
2012	0.11	0.100462	1.08	0.287	0.0938579	0.310349
2013	0.07	0.0901905	0.81	0.421	0.1081607	0.2547191
2014	0.06	0.1007775	0.56	0.577	0.1461261	0.2593501
2015	0.06	0.1297094	0.44	0.662	0.2038551	0.3180283
2016	0.07	0.1108686	0.65	0.517	0.1507289	0.2953486
2017	0.08	0.1073983	0.79	0.434	−0.131224	0.3008909
2018	0.10	0.1195245	0.82	0.418	0.1427889	0.3381158
econ_block						
2	2.06	0.4075422	5.05	0	1.237165	2.876903
3	0.42	0.3171099	1.32	0.192	0.2178843	1.058001
4	0.24	0.3731063	0.64	0.526	0.5122075	0.9889785
5	1.97	0.2267801	8.7	0	1.516525	2.42897
_cons	0.19	0.2614253	0.72	0.476	−0.338229	0.7136106

Source: Asian Development Bank estimates.

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The Evolution of Indonesia's Participation in Global Value Chains

Indonesia is the largest economy in the Association of Southeast Asian Nations, and its exports and evolving role in global value chains (GVCs) contribute notably to its economic performance. However, in a highly globalized environment, the fragmentation of production processes across geographical borders calls for a reevaluation of countries' contributions to global production. This report analyzes Indonesia's participation in—and contribution to—GVCs during 2000–2017 using recent empirical and theoretical frameworks in GVC analysis and multi-regional input–output tables compiled by the Asian Development Bank.

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