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AGRICULTURAL GLOBAL VALUE CHAINS OF ASEAN: PARTICIPATION, POSITION, AND PERSPECTIVES FROM KEY PARTNERS

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Summary

The Agricultural Global Value Chain (AGVC) is of a vital importance for the increase of export competitiveness, growth of rural income, and achievement of an overall inclusive growth. Its role is particularly significant for ASEAN member states (AMS), seeing that their agricultural sectors account for about 25% of GDP in general. While remarkable strides in agricultural cooperation, trade liberalization, and market integration of the AMS have been presented in previous reports of the 'ASEAN-CGIAR Innovate for Food Program', this report provides a comprehensive analysis of their performance in the AGVC. Enhancement of AGVC, typically through increased participation and higher positions in value-chain activities, is the main channel for market integration and trade expansions to deliver an inclusive growth. Thus, developing AGVC is paramount for AMS policymakers to unlock these benefits.

This report presents a comprehensive assessment of ASEAN's engagement in the AGVC, particularly with regards to the participation rate, production length, as well as positions at the global, intra- and extra-regional levels. The report starts with an exhaustive literature review, which covers the definition, characterization, status, drivers and impacts of the AGVC. Key indicators of the AGVC for AMS are then calculated using the latest OECD-ICIO database, based on the production-side input-output approach for the period from 1995 to 2020. We then delineate distinctive features of ASEAN's AGVC, in terms of the overall participation level, production length, and positions within the global context. A comparison of intra- and extra-regional AGVC dynamics is undertaken, with a particular focus to identify flows of intermediate goods which are pivotal to understanding the regional trade intricacies. Finally, we provide an in-depth investigation of ASEAN's AGVC with each of its major trade partners, offering insights into the development of collaboration and division of labor in the international agricultural production that shape their trade relationships.

Framework

The report includes six sections. As an introduction, Section 1 highlights the significance of ASEAN in the global agricultural market and its engagement with the AGVC. It also points out the benefits and challenges associated with the development of the AGVC. Section 2 is a literature review on studies of the definition, characterization, status, drivers and impacts of the AGVC. In Section 3, we outline the methodology and data sources utilized in this report to measure the AGVC participation, length and positions. Section 4 presents a broad assessment of ASEAN's AGVC with the world. Section 5 delves into the analysis of ASEAN's AGVC with five key trade partners. Finally, Section 6 synthesizes the findings and concludes the report.

Data and Methodologies

Data Sources: Sector-level value added, cross-country input-output flows, final demand, and output data for 45 unique sectors and 76 countries from 1995-2020 by OECD (2023).

Methodologies: Measurements of the forward and backward participation, forward and backward production length, and position indices of AGVC are based on the production-side input-output approach.

Key Findings

- **ASEAN's AGVC Participation:** a) An increasing forward participation rate together with a stable and much greater backward participation rate between 1995 and 2006. This indicates that ASEAN has become a more important supplier of agricultural intermediate goods to the world, but it still primarily remains as a user of intermediate goods produced in other countries. b) The Global Financial Crisis (GFC) caused notable shifts in participation rates, particularly affecting forward participation due to its greater impact on global demand compared to supply. c) Noted increase of both forward and backward participation in intra-regional AGVC, suggesting a trend towards regionalization. However, the international market remains crucial, as extra-regional participation levels remains higher than that in intra-regional engagements. d) In both intra-and extra-regional AGVC, AMS exhibit complex bilateral intermediate flows both across partners and sectors. ASEAN's agricultural intermediates predominantly flow into sectors such as food and beverage, accommodation and food service, agriculture, wholesale and construction. Concurrently, it imports intermediates from wholesale, agriculture, mining, and financial services to support its agricultural production.
- **ASEAN's AGVC Production Length and Position:** a) Both forward and backward production lengths increase over time, with a rate more pronounced for the forward length. This shift reflects ASEAN's rising position as it transitions from relatively downstream to more upstream roles in the value chain. In essence, ASEAN's exported agricultural intermediates are undergoing more stages of production and processing globally. b) Positions within both intra-and extra-regional AGVC have generally improved over time. Intra-regional AGVC position is predominantly upstream while extra-regional positions are situated at mid-to-upstream.

- **ASEAN's AGVC with Key Partners:** ASEAN engages in various modes of value chain cooperation with five key partners: China, EU, US, Japan and India. These partners primarily use ASEAN's agricultural intermediates for food processing as well as construction and catering industry. Conversely, ASEAN mainly imports intermediates from these partners related to wholesale and retail trade, motor vehicle repair, and chemical products, while also sourcing science and technology and financial services from the EU and US, and importing primary agricultural intermediates from India due to differences in each country's industrial structure.

Recommendations

- **Focus on Agricultural Global Value Chains:** Prioritize the enhancement of ASEAN's AGVC by conducting a thorough analysis of participation rates, production lengths, and positions at the global, intra-regional, and extra-regional levels. The goal is to foster the development of equitable, sustainable, and inclusive agricultural value chains that benefit developing countries both within ASEAN and beyond.
- **Policy Implications:** The findings suggests that ASEAN should prioritize strengthening intra-regional cooperation to create resilient supply chains. This includes investing in domestic production of essential agricultural inputs to reduce dependence on imports and diversifying export markets to mitigate economic risks. Given the significant shift towards regionalization, ASEAN can reinforce its position in the AGVC by establishing regional trade agreements that promote the free flow of goods and services while harmonizing regulatory standards across member states. At the same time, fostering strategic partnerships with key global players is crucial. These collaborations should focus on technology transfer, market access, and collaborative research to maintain a competitive advantage. Additionally, policies should encourage cross-sector collaboration and expand production lengths upstream to capture higher value-added activities and enhance the region's position in the global economy.

1. Introduction

The Association of Southeast Asian Nations (ASEAN), a dynamic economic community comprising ten Southeast Asian countries, has long been recognized for its pivotal role in the global agricultural sector. With a collective population of over 600 million people and a shared history of agricultural development, ASEAN represents a significant segment of the world's food producers and consumers. Agriculture, deeply ingrained in the region's way of life, remains a key economic sector for eight out of ten ASEAN nations (ASEAN, 2023). The region's agricultural sector is diverse, ranging from rice cultivation in paddy fields to the production of tropical fruits and fisheries, which are integral to the livelihoods of many communities and the backbone of the regional economy.

In the contemporary landscape of global manufacturing, the production process for a multitude of goods has become decentralized, with individual activities dispersed across various countries (Antras and Chor, 2022). This trend is mirrored in the agricultural trade, which is increasingly organized within global value chains like that in other sectors, with the production of food occurring increasingly across countries and making use of inputs sourced from around the globe (OECD, 2020). Aligning with their economic advancement, ASEAN Member States (AMS) have significantly expanded their participation in international agro-food markets over recent decades (OECD, 2018). Their integration into the global economy is particularly evident in the Agricultural Global Value Chains (AGVC), where ASEAN has become an essential link. These chains describe the full range of activities involved in the production of a good or service, from the extraction of raw materials and the transformation of intermediate inputs to the final delivery to consumers. AMS contribute substantially to the upstream stages of these chains, supplying key agricultural commodities that are essential for the production of food products on a global scale (OECD, 2019). Meanwhile, to sustain their domestic agricultural production, they actively import a range of intermediate goods and services from around the world, highlighting their dual role as both key producers and substantial consumers within the AGVC.

While the integration of AMS into the AGVC offers numerous benefits such as increased market access, job creation, knowledge exchange, economic growth and structural transformation (World Bank Group, 2019; OECD, 2019, 2020; Lim, 2021; Lim and Kim, 2022b), many challenges are still facing the region to promote further agricultural value chain development amidst long-run supply and demand transitions as well as increased near-term uncertainties (Chen and Mao, 2023). Empirical studies have highlighted the complexity of AGVC participation, which is not uniformly beneficial and often excludes smallholders and family farms due to their inability to meet stringent global market standards (Nadvi, 2008; Montalbano et al., 2022). Moreover, there is a concern that the surge in global supply chains for key crops could lead to a loss of domestic industrialization opportunities and sovereignty over production within ASEAN (Devesh et al., 2023). To fully realize the benefits of the agricultural value chain for ASEAN economies, it is therefore urgent to address the multifaceted challenges and promote an inclusive and sustainable development of ASEAN's AGVC. Particularly, a systematic description and assessment of the current status and characteristics of ASEAN's AGVC, examining both global interactions and key partnerships, is imperative to establish a foundation for policymakers to enhance the region's agri-food system integration and sustainability.

This report presents a comprehensive assessment of ASEAN's engagement in the AGVC, particularly with regards to the participation rate, production length, as well as positions at the global, intra- and extra-regional levels. The report starts with an exhaustive literature review, which covers the definition, characterization, status, drivers and impacts of the AGVC. Key indicators of the AGVC for AMS are then calculated using the latest OECD-ICIO database, based on the production-side input-output approach of Wang et al. (2017, 2022) for the period from 1995 to 2020. We then delineate distinctive features of ASEAN's AGVC, in terms of the overall participation level, production length, and positions within the global context. A comparison of intra- and extra-regional AGVC dynamics is undertaken, with a particular focus to identify flows of intermediate goods which are pivotal to understanding the regional trade intricacies. Finally, we provide an in-depth investigation of ASEAN's AGVC with each of its major trade partners, offering insights into the development of collaboration and division of labor in the international agricultural production that shape their trade relationships.

Our report offers a distinctive contribution to the body of knowledge on ASEAN's AGVC by providing a detailed examination of the agricultural production sectors, which form the backbone of the regional economy. Building upon the foundational work of OECD (2018, 2019, 2020) and FAO (2020), which have shed light on the agri-food GVC and their impact on economic growth through various databases and methodologies, our study delves deeper into the specifics of each member state's role and contribution to the AGVC. Utilizing an updated dataset as of November 2023, our research presents a more current and expansive perspective, including a broader range of ASEAN member states and their primary trade partners over a longer time span. A key differentiator of our study is the application of the production decomposition method by Wang et al. (2017, 2022), which allows for a more precise identification and measurement of AGVC activities within a coherent analytical framework. To our knowledge, this report is the first to employ this particular method in assessing the ASEAN's AGVC.

These enhancements not only deepen our understanding of ASEAN's AGVC dynamics but also offer policymakers and industry stakeholders a nuanced understanding that can inform more targeted and effective policy interventions.

We find that ASEAN exhibited steady and more pronounced backward participation and increasing forward participation, especially between 1995 and 2006. This indicates that ASEAN has become a more important supplier of agricultural intermediate goods to the world, but it still primarily remains as a user of intermediate goods produced in other countries. Notable overturns remarked by the Global Financial Crisis (GFC), especially for forward participation seeing the GFC's more substantial impact on global demand than on supply (Benguria and Taylor, 2020). Concurrently, there is been a strategic shift towards regionalization in ASEAN's AGVC engagement, aimed at enhancing intra-regional cooperation and reducing supply chain vulnerabilities, yet the importance of international markets for ASEAN's agricultural exports persists, indicating a continued reliance on external markets. Most AMS exhibit complex bilateral intermediate flows both across partners and sectors. Overall, ASEAN's agricultural intermediates are predominantly channeled into global sectors like food products and construction, while the region also actively utilizes a range of global intermediates for serving its agricultural production, showcasing the region's economic integration and the diversification of its agricultural industrial chain. From production length standpoint, both forward and backward production lengths increase over time, with a rate more pronounced for the forward length. This shift reflects ASEAN's rising position as it transitions from relatively downstream to more upstream roles in the value chain. In other words, ASEAN's exported agricultural intermediates are undergoing more stages of production and processing globally. Furthermore, ASEAN has different modes of value chain cooperation with its key five partners, i.e. China, EU, US, Japan and India. These partners primarily use ASEAN's agricultural intermediates for food processing as well as construction and catering industry. Conversely, ASEAN mainly imports intermediates from these partners related to wholesale and retail trade, motor vehicle repair, and chemical products, while also sourcing science and technology and financial services from the EU and US, and importing primary agricultural intermediates from India due to differences in each country's industrial structure.

The rest of this report is organized as follows. Section 2 is a review of the literature on agricultural global value chains. Section3 introduces the methods and data on the measurement of AGVC participation, length and position we used in this report. Second 4 conducts an overall assessment of ASEAN's AGVC with the world. Section 5 investigate the ASEAN's AGVC with its top five partners. Section 6 concludes the report.

2. Literature Review

2.1 Concept and definition of AGVC

The concept of value chain was initiated by Michael Porter in 1985 to describe the passage of raw materials from production to final consumption (Simatupang et al., 2017). It not only include all production steps ranging from physical transformations to the incorporation of producer services, but also activities such as the delivery and post-use disposal on the side of final consumers (Kaplinsky, 2000). With an increasing international division of economic activities (Dellink et al., 2020), Gereffi and Korzeniewicz (1993) introduced the concept of global commodity chains, which provides a foundation to characterize the system of interconnected production and distribution activities. Since early 2000s, the concept of global value chains has been further developed to describe the range of activities dispersed globally, which links firms and workers to bring a product from conception to end use.

Agricultural Global Value Chains (AGVC) have seen significant growth since the mid-1900s, transforming agricultural food production globally (Lim and Kim, 2022; Paus et al, 2023). The concept of AGVC is an extension of the broader Global Value Chains (GVC) framework, specifically tailored to encompass the unique characteristics of the agricultural sector. At its core, AGVC refers to the entire sequence of value-adding activities that transform agricultural raw materials into consumable products for the global market, which includes the various stages such as production, harvesting, processing, transportation, marketing, and distribution that span across different countries (Greenville et al., 2017; OECD, 2019). In term the concept of AGVC, many scholars studied related agri-food products relies on Eora dataset. Nenci (2020) described the EORA dataset for 'Agriculture' and 'Food and Beverages' industries - ISIC correspondence and disaggregation in their report. According to Eora's sector descriptions, agriculture encompasses activities such as agriculture, hunting, forestry, and related services, while the food and beverages sector includes the manufacturing of food and tobacco products.

Understanding the AGVC is crucial for policymakers and stakeholders as it provides insights into how agricultural products are produced and traded globally, the roles that different countries and regions play within these chains, and the potential for strategic interventions to enhance the competitiveness and sustainability of the agricultural sector.

2.2 Method and data to measure AGVC

Advances in the field of macro-measurement of global value chains theory have been realized in recent years due to the successful development of Inter Country Input-Output (ICIO) tables. In order to utilize these ICIO data such as WIOD, EORA, OECD-TiVA, GTAP-ICIO or ADB-MRIO, a growing recent literature have developed new methodologies to decompose gross trade flows into different value-added components to calculate new GVC indicators at country and sector levels (Hummels et al., 2001; Antràs et al., 2012; Fally, 2012a; Johnson and Noguera, 2012; Koopman et al., 2014, 2010; Los et al., 2016; Wang et al., 2017, 2022; Borin and Mancini, 2019). Two of the most important questions in the empirical GVC literature are answered by calculating these GVC indicators: (1) To what extent are countries and industry sectors involved in GVC (GVC participation)? (2) What is the position of countries and industry sectors in GVC (GVC position)?

The GVC participation measures the degree of a country's participation in GVC. There are two dominant branches in the latest literature based on the accounting framework of Koopman et al. (2014), who decomposed gross exports into various sources and first proposed a simple measurement of GVC participation that calculated by comparing indirect value added exports and foreign value added. One approach is the production-based approach of Wang et al.(2022), who extended the Koopman et al. (2014) to country-sector level and defined GVC is a production process involving at least two countries, where the embodied factors of production cross borders multiple times. They put up the forward and backward participation as new GVC participation indexes, the former measures the share of domestic value added for a particular country/sector that is used for the GVC segment of global production chains in other countries, while the latter measures the share of foreign and domestic value added from GVC-related production chains of other countries in a particular country/sector output. A higher level of forward participation indicates a higher share of intermediate goods supplied to other countries as a proportion of the country's GDP, while a higher level of backward participation indicates a higher share of the use of intermediate goods from other countries as a proportion of the country's final output. Another is the trade-based approach of Borin and Mancini (2019), who measure GVC activities as all the traded items that cross at least two international borders. They define the forward participation as the share of intermediates indirectly exported to the final destination through third countries, while the backward participation as share of imported intermediate inputs in exports. The higher the indicator, the greater the degree of participation of a country in global value chains.

To determine a country or sector's position in the GVC, the literature outlines three primary measurement approaches. The first, by Koopman et al. (2010), involves calculating the GVC position index by comparing a country's indirect value added exports to its foreign value added, where a higher index indicates an upstream position. The second approach, developed by Fally (2012), Antràs et al. (2012) and Antràs and Chor (2013), introduces the upstreamness (U) and downstreamness (D). Upstreamness measures the production stages remaining before final consumption, while downstreamness measures the distance from primary production factors. A high U and low D suggest an upstream position, whereas high values for both U and D indicate participation in long and complex chains. The third approach, by Wang et al. (2017), proposes a GVC position index based on production length consistent with their production decomposition. An economy is deemed upstream if its forward GVC length surpasses its backward length. This method, which excludes stages within domestic and traditional trade value chains compare with the measurement of U and D, offers a more precise and valuable measure of GVC position and has seen recent application (Ni, 2019; Asian Development Bank, 2021).

2.3 Current status of AGVC

The development of AGVC has witnessed transformative shifts in recent decades, influencing the structure and functioning of the global agricultural sector (FAO, 2020). In terms of the participation of AGVC, the recent literature has confirmed a significant increase in global trend overall and varies by region. There is an increasing trend for GVCs to participate in the agri-food sector (Nenci, 2020), including many developing countries, despite their lower share of trade at the global level (Balié et al., 2019). By scale and trends, the average AGVC participation rate in 1995-2015 ranged from 30% to 40% (Dellink et al, 2020). Montalbano and Nenci (2022) found that European countries have the highest AGVC participation rates on average, accounting for about 40-45% of their total exports while the African region has the next highest participation in AGVC, averaging about 37 percent, which is higher than the Americas and Asia averages. The larger increases for AGVC participation were in sub-Saharan Africa, Latin America and South Asia. AGVC participation has grown faster in Europe and Central Asia, but declined in the Middle East, North Africa and North America (Greenville et al., 2017; Raimondi et al., 2023). Moreover, a OECD report highlights ASEAN's integration into agro-food GVCs, especially with China, South America, and South Asia, with forward linkages contributing 9% to global AGVC trade growth and backward linkages contributing 14% between 2004 and 2014 (OECD, 2018).

Compared to other sectors, agriculture sector features more forward links in GVC participation, in spite of a lower participation rate in general (Raimondi et al., 2023). Within the agriculture sector itself, agricultural production has even more forward links in contrast to the food processing industry. Dellink et al. (2020) showed that agriculture is predominantly characterized by forward linkages, while the food processing industry is positioned more towards the middle and end of the value chain, indicating a greater prominence on backward linkages. The change in AGVC position was relatively smooth from 2009-2012. According to OECD (2019), China's position in the AGVC increased significantly and it is both a major seller and buyer of intermediates for agricultural and food production. Estimates of centrality during this period suggest that China, the United States and Germany are the three main hubs of agri-food GVCs.

Some studies have explored the potential bottlenecks in improving the standing of AGVCs from different perspectives. An important perspective is from trade protection. A report from OECD shows that policies restricting trade and limiting market openness can reduce participation of countries' agricultural sectors in global value chains (OECD, 2019). Greenville et al. (2017) show that both import and export tariffs reduce a country's participation in AGVCs and its ability to create value added. The tariff effect is likely to be amplified because each export of intermediate inputs is likely to be subject to tariffs before transformation and re-export. Tariffs also stifle the broader gains from participation in global value chains by restricting competition, stifling productivity growth and slowing employment growth (OECD, 2020). Disdier et al. (2008) show that non-tariff measures (NTMs), such as sanitary and phytosanitary measures (SPS) and technical barriers to trade (TBT), restrict the free movement of agricultural products to some extent, affecting the global efficiency of agricultural value chains. Moreover, some studies pointed that weak infrastructure, resource scarcity and institutional weaknesses as the main factors hindering the climb up the AGVCs in developing countries (Alsamawi et al, 2020).

2.4 Drivers of AGVC development

The development of AGVC is propelled by a variety of drivers that influence the integration and competitiveness of agricultural sectors globally. Technological advancements have been pivotal, with information and communication technologies (ICT) linking farmers to broader markets and enabling more efficient supply chain management (Colman, 2013; OECD, 2017; Ayim et al., 2022). Trade policies and liberalization have opened up new markets, allowing for the expansion of AGVC for agricultural products through reduced tariffs and the establishment of trade agreements (Greenville et al., 2017; Balié et al., 2019; Mao et al., 2024). Additionally, infrastructure and logistics investments are critical for reducing costs and improving the quality of traded goods as they move through the value chain (OECD, 2020). Institutional and regulatory environments are also key, providing a stable environment that support AGVC operations through property rights, contract enforcement, and quality standards (Mishra and Dey, 2018; OECD, 2019; Feyaerts et al., 2020).

Further drivers include climate and environmental factors, which are reshaping agricultural practices and the sustainability of AGVC (FAO, 2016; IPCC, 2018). Godde et al. (2021) found that climate change impacts every link in the food supply chain, from production to consumption, yet the precise nature and severity of these effects are still uncertain. Besides, financial access and investment, essential drivers for AGVC growth, are particularly challenging for smallholder farmers from developing countries, who also grapple with scale limitations, higher transaction costs, and increased price volatility (Birthal et al., 2017; Villalba et al., 2023). The importance of skilled labor and human capital in adding value within AGVC is increasingly recognized, with education and training being key for competitiveness (OECD, 2020). Despite extensive research, gaps remain, particularly in understanding the long-term sustainability of AGVC development and the differential impacts of drivers across regions (Baliè et al., 2017).

2.5 Socioeconomic impacts of AGVC development

The socioeconomic implications of AGVC development have been a focal point for researchers, who have utilized various datasets and methodologies to assess the multifaceted impacts on global economies (Balié et al, 2019; Lim, 2021; Paus et al, 2023). Much empirical evidence on AGVC relies on case studies at the product level to assess the impact on national economies (FAO, 2020; Salvatici and Nenci, 2017), with findings that agri-food chain development can significantly raise rural incomes, alleviate poverty, and promote growth that benefits the poor (Rao et al., 2012; UNCTAD, 2020; VOS and CATTANEO, 2021; Liu et al., 2023). As world input-output tables and methodologies for measuring global value chains advance, the literature on the impact of AGVC development continues to grow. Researchers, such as Obeng et al. (2022) and Lim (2021), have shed light on how countries' participation in AGVC is related to the economic fundamentals that drive patterns of specialization and comparative advantage. These investigations reveal that AGVC participation can stimulate inclusive growth through job creation and income growth, particularly benefiting the food and beverage sector and fostering structural economic transformation. Lim and Kim (2022) also provided similar result based on built panel data set of 140 countries for the period 1991-2015 and identified evidence that the positive job creation effect is mainly driven by the downstream processed food sector of GVCs rather than the raw sector upstream of GVCs. Moreover, the export product quality is a critical determinant of a country's global market competitiveness, with AGVC engagement shown to elevate the quality of exported goods (Ndubuisi and Owusu, 2021). They found that GVC participation had a positive effect on the quality of export products, bringing the quality level closer to the quality frontier. Although this result held in the sub-sample that included developed countries, developing countries only benefited from backward participation in GVC. The participation of the agri-food sector in GVC support the continued transformation of agricultural and food markets in developing countries. Participation in AGVC help developing countries move from subsistence and farm-centered agricultural systems to more commercial, productive and open agricultural systems (Del Prete et al., 2017; Greenville et al., 2017; Montalbano and Nenci, 2022). Participating in AGVC also bring knowledge exchange, capital flows, and many complex inputs (OECD, 2020).

Despite the potential benefits, AGVC participation presents challenges, particularly for smallholders and family farms that often cannot meet stringent global standards, leading to limited inclusiveness in GVC production benefits, especially in downstream sectors of developing countries (Nadvi, 2008; Montalbano et al., 2022). Putra et al. (2022) used both input-output (IO) analysis and qualitative methods, found that commodities like rice, palm oil, fisheries, and coffee in Vietnam, Indonesia, the Philippines, and Thailand were not inclusive, with unfair distribution of benefits and minimal value addition upstream. The push for higher global market standards can further exclude these small-scale producers (Berdegué et al., 2005; Belton et al., 2011; Montalbano and Nenci, 2022). Additionally, the impact of AGVC on local value chains can be double-edged, with Feyaerts et al. (2020) highlighting potential negative effects from resource competition and positive spillover effects. The debate on the consistency of positive impacts from AGVC participation remains, with evidence suggesting that such benefits may be more readily attainable by middle and high-income countries, while smaller or less developed nations may experience marginal economic advantages (Kummritz, 2015; Fagerberg et al., 2018; Zi, 2020). This is partly attributed to the governance structures and power dynamics inherent in the value chains (Greenville et al., 2017; Nadvi, 2008).

3. Methods and Data

3.1 Methods to measure AGVC participation

Different methods have been developed in the literature to measure the degree of forward and backward participation levels in global value chains. We adopt the approach of Wang et al. (2022) from the production side, which can provide a more comprehensive profile of GVC activities compared to alternative methods such as Koopman et al. (2010) and Borin and Mancini (2019). To be specific, we define the forward participation degree of a country as the share of agricultural value added that is used for the GVC segment of agricultural production chains in other countries. In contrast, the backward participation degree is defined as the share of value added from the agricultural GVC production chains of other countries in a particular country's agricultural output. Mathematically, the forward and backward participation degrees can be expressed as:

$$GVCPt_f = V\_GVC/Va' \text{ and } GVCPt_b = Y\_GVC/Y'. \tag{1}$$

In Equation (1) , the two denominators Va' and Y' are the total value added and final output of a country's agricultural sector respectively. The two nominators V_GVC and Y_GVC are the total value added of the country's intermediate exports to the world and domestic and foreign value added embodied in its intermediate imports respectively.

We follow the three-step procedure of Wang et al. (2022) to derive the above two nominators in Equation (1). First, we use value added coefficients to covert the total value added to total outputs. Second, we use the invers Leontief matrix to decompose total outputs into the domestic final demand, foreign final demand, and other components that would enter the GVC. Finally, we use intermediate input coefficients to derive intermediate exports of each country from its foreign final demand, i.e. V_GVC for the calculation of forward participation degrees. And similarly, we also use intermediate input coefficients to derive intermediate imports with trade partners from each country's domestic final demand, i.e. Y_GVC for the calculation of backward participation degrees. As highlighted by Leontief (1936), Koopman et al. (2014) and Wang et al. (2022), value added coefficients, the inverse Leontief matrix, and intermediate input coefficients could all be calculated with ICIO tables.

In order to distinguish the participation of AMS countries in intra- and extra-regional agricultural global value chains, we follow the World Bank Group (2017, 2019) and Sun et al. (2023) to decompose aggregate participation degrees in Equation (1) as follows:

$$\begin{aligned} GVCPt_f &= (V\_RVC + V\_ERVC)/Va' \triangleq RVCPt_f + ERVCPt_f, \\ GVCPt_b &= (Y\_RVC + Y\_ERVC)/Y' \triangleq RVCPt_b + ERVCPt_b. \end{aligned} \tag{2}$$

In Equation (2), nominators V_RVC and V_ERVC are the domestic value added that is embodied in intermediate exports to trade partners within and out of ASEAN respectively, whereas nominators Y_RVC and Y_ERVC are the domestic and foreign value added that is embodied in intermediate imports from partners within and out of ASEAN respectively. These terms can be directly derived from the three-step procedure above, by restricting the calculation of intermediate exports and imports to intra- and extra-regional partners in the last step.

3.2 Methods to measure AGVC length and position

We adopt the approach of Wang et al. (2017) to calculate a country's production length and position in AGVC, which can provide more desirable properties than the existing ones in the literature compared to alternative measures such as the upstreamness (Fally, 2012b; Antràs et al., 2012; Antràs and Chor, 2018), the downstreamness (Fally, 2012b) and the GVC position index proposed by Koopman et al. (2010). According to Wang et al. (2017), we define AGVC position as the ratio of the AGVC forward production length to the AGVC backward production length. The forward production length is defined as the accumulated global gross output per unit of domestic value added embedded in intermediate goods exported by a country's agricultural sector. When a country's intermediate goods need to pass through multiple countries to become the final product, this part of value added will be reflected in the gross output of these countries and result in a larger ratio. In contrast, the backward production length is defined as the accumulated global gross output per unit of domestic and foreign value added embedded in intermediate goods imported by a country's agricultural sector. When a final product produced in one country uses intermediate goods that pass through multiple countries, this part of value added will also be reflected in the gross output of these countries and result in a larger ratio. Thus, the forward production length is the average number of times the value added of intermediate goods exported by a country is counted as gross output, and backward production length is the average number of times the value added of intermediate goods imported by a country is counted as gross output. Mathematically, the AGVC position and forward and backward production length can be expressed as:

$$\begin{gathered} GVCPs = PLv\_GVC/PLy\_GVC, \\ PLv\_GVC = Xv\_GVC/V\_GVC \text{ and } PLy\_GVC = Xy\_GVC/Y\_GVC. \end{gathered} \tag{3}$$

In Equation (3), PLv_GVC and PLy_GVC are a country's agricultural forward and backward production length respectively. The two denominators V_GVC and Y_GVC are consistent with Equation (1), whereas two nominators Xv_GVC and Xy_GVC are the accumulated global gross output by a country's forward and backward AGVC production activities respectively.

We compute two nominators first using the three-step procedure of Wang et al. (2022) to derive intermediate exports of each country from its foreign final demand and intermediate imports with trade partners from each country's domestic final demand. And then using the Leontief inverse matrix to derive the global gross output of each country from its intermediate exports, i.e. Xv_GVC for calculation of accumulated global gross output of the corresponding value added of forward AGVC production activities. And similarly, we also use the Leontief inverse matrix to derive the global gross output of each country from intermediate imports with trade partners, i.e. Xy_GVC for the calculation of accumulated global gross output of the corresponding value added of backward AGVC production activities.

In order to distinguish the position of AMS countries in intra- and extra-regional agricultural global value chains, we follow World Bank Group (2017, 2019) and restrict the calculation of intermediate exports and imports to intra and extra-regional partners in the last step.

3.3 Data

Currently, four input-output tables (IOTs) are used widely – namely the Organization for Economic Co-operation and Development's Inter-Country Input-Output (OECD-ICIO), the World Input-Output Database (WIOD), the Eora multi-region Input-Output Database (Eora MRIO), and the Asian Development Bank's Multi-Regional Input-Output Database (ADB-MRIO). The latest edition of OECD ICIO (2023) has 45 unique industries based on the ISIC Revision 4 and provides for 76 countries (and Rest of the World) that including all ASEAN's countries from 1995 to 2020. It details subsectors such as 'agriculture, hunting, forestry' and 'fishing and aquaculture', making it our chosen source for analyzing the characteristics of ASEAN's agricultural global value chain.

4. AGVC with the World

4.1 Overall AGVC participation

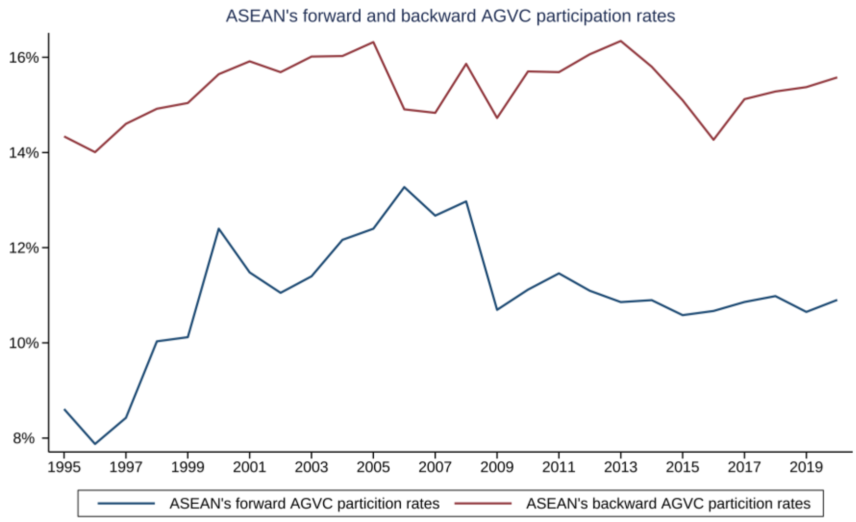

Figure 4-1. Evolution of ASEAN's forward and backward participation levels.

Figure 4-1 depicts the trajectory of ASEAN's forward and backward participation levels in the Agricultural Global Value Chain (AGVC) from 1995 to 2020. For forward participation, the period was marked by three distinct phases: rapid growth, followed by a downturn, and finally a plateau. From 1995 to 2006, there was a swift rise in ASEAN's participation. This suggests that the region's agricultural sector was increasingly integrated into the global value chain, serving as a 'supplier' of intermediate goods. The period from 2007 to 2009 saw a sharp decline due to the impact of the global financial crisis, after which the trade of intermediate goods noticeably decelerated.

For backward participation, the overall trend during this period is characterized by a fluctuating upward. This trend indicates an increasing degree of involvement by ASEAN's agricultural sectors in utilizing intermediate goods for agricultural production, thereby participating in the agricultural global value chain's production division of labor. The upward trajectory signifies that ASEAN is playing an escalating role as a 'user' of intermediate goods within the global agricultural production network.

Overall, ASEAN has predominantly integrated into the AGVC through backward participation, which is similar to the GVC development pattern as a whole (Global Value Chain Development Report, 2023). This suggests that the agricultural sector in ASEAN has increasingly utilized intermediate products and services from around the world during its production processes, indicating a reliance on imported intermediate inputs within the global value chain. Specifically, agricultural production in ASEAN largely depends on intermediate inputs provided by the global supply chain, such as seeds, fertilizers, feed, and agricultural machinery. There is a strong emphasis on leveraging global resources and technological support to enhance agricultural production efficiency and the quality of output.

In terms of dynamic trends, Figure 4-1 shows that agricultural globalization was evident from 1995 to the peak of the global financial crisis in 2008. Over this 13-year period, forward AGVC participation increased from 8.61% to 12.97%, and backward AGVC participation grew from 14.34% to 15.86%. This suggests that during this phase, globalized trade experienced rapid expansion, significantly promoting international trade in agricultural products and intermediate goods. In 2009, as the world grappled with the aftermath of the global financial crisis, both participation rates for ASEAN declined and appeared to stagnate in the years that followed, especially for forward linkages. This reduction in demand for final goods also influenced trade trends through the decrease in intermediate goods needed to produce those goods (Eaton et al., 2016), which was reflected by the drop in both forward and backward AGVC participation rates. However, the backward AGVC participation rate was more resilient than the forward rate, a difference can be explained by evidence that the GFC's more substantial impact on global demand than on supply (Benguria and Taylor, 2020). This is because forward participation is more susceptible to influences from global gross demand, whereas backward participation is more anchored in the stability of global gross supply.

To assess and compare the impact of the shift in production patterns following the global financial crisis on AGVC participation across countries, we refer to Wang et al. (2022) to present the forward and backward AGVC participation indicators jointly in a scatter plot based on OECD-ICIO tables (Figure 4-2). The two black dotted lines indicate the world's average forward and backward AGVC participation rates and divide the plot into four quadrants, and blue points represent AMS, red points represent other countries. Overall, the world average forward AGVC participation rate increased from 11.93% to 14.41%, and the backward AGVC participation rate rose from 14.93% to 17.85%, indicating that the extent of global participation in the AGVC is on the rise. For ASEAN, its forward AGVC participation rate slightly increased from 10.9% to 11.1%, while the backward rate rose marginally from 15.3% to 15.5%.

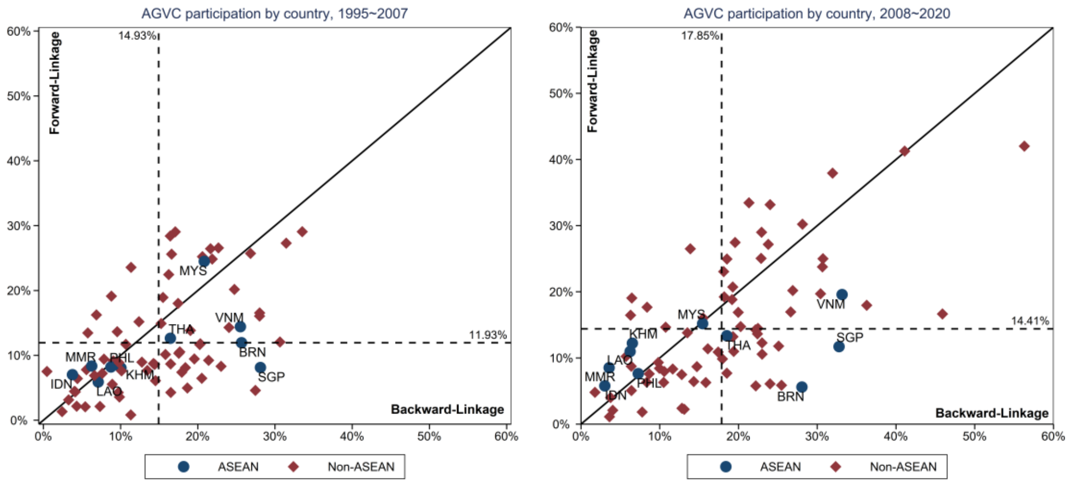

Figure 4-2. Cross-sectional and Intertemporal Comparisons for AMS and Other Countries.

A comparison of the two graphs in Figure 4-2 shows that, firstly, a decrease in ASEAN countries in the first quadrant, with some experiencing downward shifts such as Malaysia, Brunei, Indonesia and the Philippines, and some experiencing leftward shifts, like Malaysia, Cambodia, Myanmar, the Philippines, Laos, and Indonesia, suggesting a post-financial crisis slowdown in AGVC engagement in different modes of participation. Secondly, the number of ASEAN countries located above the diagonal has increased, suggesting a growing focus on forward participation, where they are integrated into the production activities of other countries through the provision of agricultural intermediates. Notably, Vietnam, Singapore and Thailand demonstrated active participation in the AGVC, with notable upward and rightward shifts indicating their roles as producers and purchasers of intermediate goods. Particularly, Vietnam stands out as a leading participant in the AGVC, with its forward participation rate climbing from 14.42% to 25.52% and its backward rate increasing from 19.58% to 33.15%. As one of ASEAN's fastest-growing agricultural traders post-crisis, Vietnam has seen its imports surge, occasionally outpacing exports since the global financial crisis

(Mao et al., 2024). Vietnam's forward participation is bolstered by key exports including rice, coffee, pepper, tea, cashews, rubber, cassava, aquatic products, and furniture, as noted in the Vietnam Import Export Report of 2022, while its backward participation is elevated by efforts in agricultural modernization, sustainable practices, and the adoption of advanced technologies and management expertise. Singapore and Brunei both have high backward AGVC participation rates, largely due to their limited domestic agricultural production, most processing relies on imported intermediates (OECD, 2018).

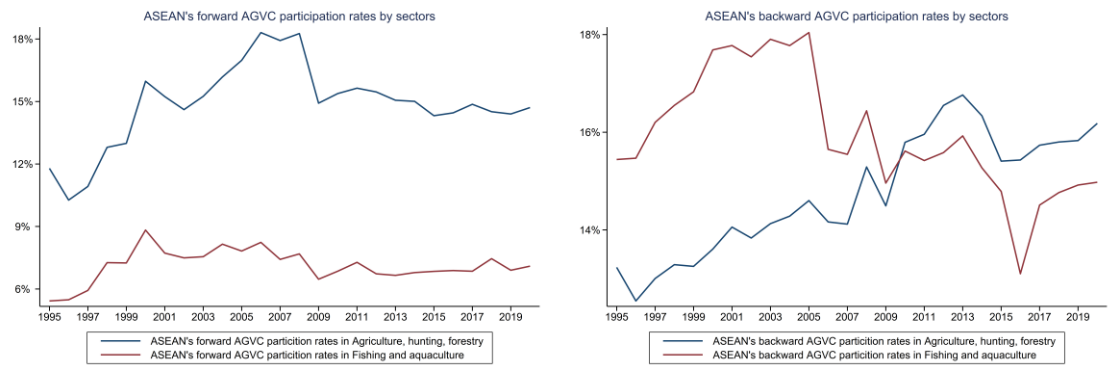

Figure 4-3. Sector-specific Participation Levels.

Figure 4-3 shows the levels of ASEAN's AGVC participation across various agricultural sectors. From 1995 to 2020, the forward participation rate in the sectors of the agriculture, hunting and forestry is higher than that in the fishing and aquaculture. This disparity can likely be attributed to the more stable and substantial global market demand for agroforestry products as opposed to those of aquaculture. As agroforestry products, such as grains, meat and timber, typically have long production cycles and sustained market demand, ASEAN have been able to take advantage of their abundant land resources and relatively well-developed agricultural production systems to efficiently produce and supply these commodities, and thus play an important role in AGVC through the export of resources. In comparison, the fishing and aquaculture is relatively small in production and trade volumes, and more susceptible to seasonal, environmental and ecological influences, thus ASEAN contribute fewer fishery and aquaculture intermediates than agricultural, livestock and forestry intermediates to participate in the transnational division of labor in production.

The right panel of Figure 4-3 shows the sector-specific backward participation levels. From 1995 to 2009, the agriculture, hunting and forestry had a lower backward participation rate than the fishing and aquaculture, but later exceeded it from 2010 to 2020. The initial lower rate may indicate less reliance on global supply chains and a preference for local resources in these sectors. Conversely, fishing and aquaculture's higher rate suggests greater global supply chain dependence, with significant imports of feed, fingerlings, fishing gear, and farming equipment from world by ASEAN, which elevated the backward participation rate through global procurement of these intermediate products. However, since 2005, the aquaculture industry's backward rate has declined despite a surge in fishery production, as detailed in *The Southeast Asian State of Fisheries and Aquaculture 2022*. From 2005 to 2019, ASEAN's fishery production rose from 22.99 million to 46.77 million metric tons, and the fishing vessels grew from 438,500 to 753,900 (South East Asian Fisheries Development Center, 2022). This decline likely results from a substitution effect, where local production has increasingly replaced intermediate imports due to the maturing fisheries industry and enhanced domestic manufacturing in ASEAN.

4.2 Overall AGVC length and position

The ASEAN's AGVC production length and position used in this report is derived from the OECD-ICIO tables (2023) based on the methodology of Wang et al. (2017). Figure 4-4 shows the evolution of ASEAN's AGVC production length and position. The results in left panel show that between 1995 and 2020, the ASEAN's AGVC exhibited a sustained increase in both forward and backward production lengths, reflecting an expanding engagement in the international division of labor for agricultural production stages. The growth in forward production length indicates that agricultural intermediates exported from ASEAN are utilized multiple times in the global production network and go through more complex processing and re-export stages globally, while the growth in backward production length indicates that ASEAN's agricultural sector increasingly integrates intermediate inputs that pass through multiple countries globally. These findings align with the observed trend of the ongoing elongation of global agricultural value chains (Montalbano and Nenci, 2022; Nenci, 2020).

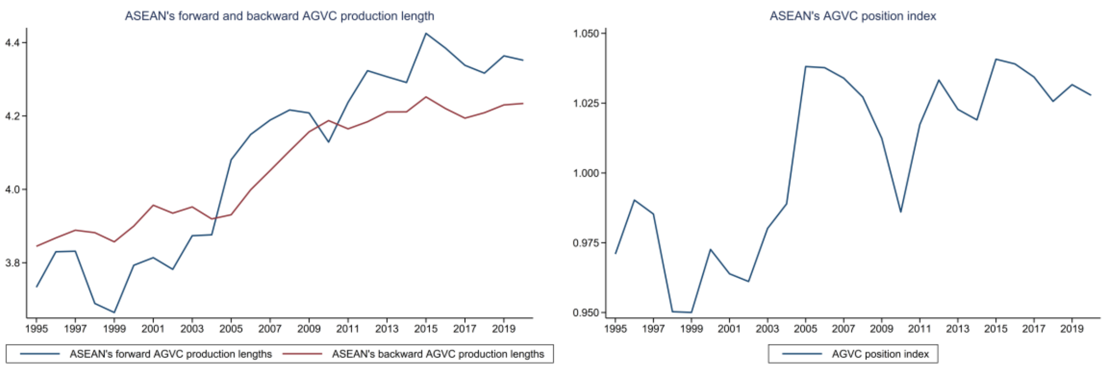

Figure 4-4. Evolution of ASEAN's AGVC Production Length and Position.

Analyzing AGVC lengths from both the forward and backward perspectives is crucial for positioning an economy within the value chain. An economy is considered to be relatively upstream if its forward length exceeds its backward length, and vice versa (Wang et al., 2017). The right panel of Figure 4-4 illustrates a fluctuating upward trend in the ASEAN AGVC position index from 1995 to 2020. This upward trajectory signifies a transformation in the positioning of ASEAN's agricultural global value chain, evolving from a relative downstream role to a more upstream one. It also implies that a faster extension of the value chain from the provision of intermediate inputs based on agricultural natural resources to agricultural-processing and non-agricultural processing, as agriculture is generally linked to GVCs as an upstream provider of food, fibre and fuel (OECD, 2020).

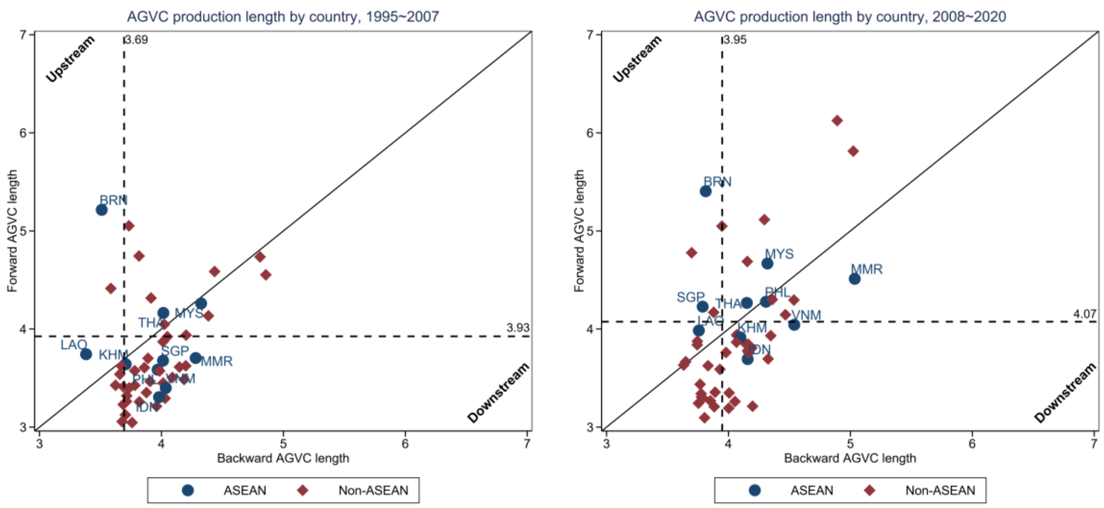

Figure 4-5. Cross-sectional and Intertemporal Comparisons for AMS and Other Countries.

Figure 4-5 demonstrates cross-sectional and intertemporal comparisons of the AGVC lengths for AMS and other countries, with backward production lengths on the horizontal axis and forward production lengths on the vertical axis by referencing the Global Value Chain Development Report 2021. The two black dotted lines indicate the world's average forward and backward AGVC production lengths and divide the plot into four quadrants, and blue points represent AMS, red points represent other countries. Overall, the world average forward AGVC production length increased from 3.93 to 4.07, and the average backward AGVC production length rose from 3.69 to 3.95, this indicates that the AGVC production length is lengthening in countries around the world, which is largely in line with the trend of globalization (World Bank Group, 2019). For ASEAN, its average forward production length increased from 3.87 to 4.30, while the average backward production length rose from 3.92 to 4.20.

The transition from the left to the right panel illustrates two key observations. Firstly, the increase in the number of ASEAN countries in the first quadrant indicates that, compared to most countries worldwide, the AGVC length in ASEAN is extending more rapidly. This suggests that ASEAN agriculture is actively participating in the global value chain division of labor, promoting the extension of the agricultural value chain towards both production and consumption sides. Secondly, the rise in the number of countries fall above the diagonal signifies a more pronounced relative upstream trend for ASEAN's AGVC. This implies that agricultural intermediates exported by ASEAN undergo more production and processing stages in global, with the agricultural value progressively extending into other sectors such as non-agricultural processing or agricultural processing.

Figure 4-6. Sector-specific Production Length and Position.

Figure 4-6 categorizes the production length and position of ASEAN's AGVC by sector. The left panel, which focuses on production length, firstly, reveals that the forward and backward production lengths for both subsectors of the agriculture, hunting, forestry and the fishing and aquaculture have been consistently increasing. This trend suggests that ASEAN is taking on a more significant role in these subsectors of the AGVC. On the one hand, there is the more frequent use of the agriculture, hunting, forestry and the fishing and aquaculture intermediates in global production networks for further processing and production. On the other hand, there is the continued deepening of the agriculture, hunting, forestry and the fishing and aquaculture production in terms of the introduction of foreign intermediate products, technologies and services. Secondly, the fishing and aquaculture has experienced a particularly rapid growth in production length, notably in the forward direction. This is largely due to the rapid development of ASEAN's fisheries industry over the past two decades, with a trade surplus and an average annual growth of 2.70% in export volume and 5.50% in export value from 2005 to 2019 (South East Asian Fisheries Development Center, 2022). Additionally, the development of transportation technology for fresh and live aquatic products has made it easier for ASEAN's fisheries products to be transported to other countries for further processing and production (Greenville et al., 2017).

The right panel of Figure 4-6 shows that ASEAN's agriculture, hunting, forestry and fishing and aquaculture are moving upstream in the global value chain, signifying their role in supplying intermediate natural resources and extending the value chain to other sectors. However, the fishing and aquaculture, unlike the agriculture, hunting, forestry, was more affected by the 2008-2010 global financial crisis and has been gradually moving downstream since 2012. This shift may indicate a strategic post-crisis move towards downstream activities such as processing and retail instead of just the upstream production of raw materials, aimed at increasing value addition, market resilience, and responsiveness to global consumer demand.

4.3 Intra- and extra-regional participation

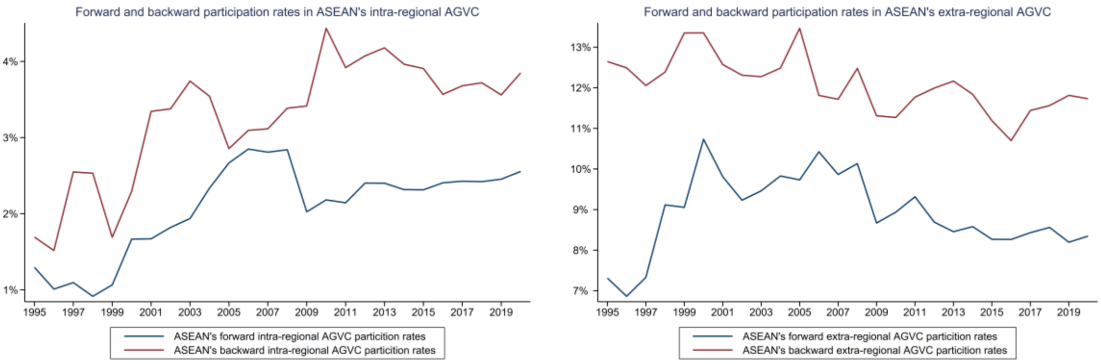

Figure 4-7. Cross-sectional and Intertemporal Comparisons of the Intra-regional AGVC Participation by Country.

Figure 4-7 illustrates the evolution of forward and backward participation levels in intra- and extra-regional AGVC. The results show that from 1995 to 2020, the intra-regional AGVC participation rate in ASEAN has fluctuated upwards, while the extra-regional AGVC participation rate has fluctuated downwards. This reflects a regionalization trend in ASEAN's AGVC, indicating a continuous deepening of the agricultural value chain network within the ASEAN region. Some ASEAN countries may be strengthening cooperation within the region, shifting from a past model that was export-oriented and reliant on external markets, towards one that places greater emphasis on intra-regional integration and collaboration. This shift could be attributed to the growth of domestic market demand, the development of regional economic integration for AFTA, and a reduced dependence on markets outside the region (ADB, 2023).

The higher extra-regional AGVC participation rate from 1995 to 2020 suggests that ASEAN agriculture remains heavily reliant on the demand and trade flows of the global market. Despite growing intra-regional collaboration, international markets continue to be key outlets for ASEAN's agricultural exports, highlighting the reality that the sector's deep integration in the global value chain and its ongoing external market dependence.

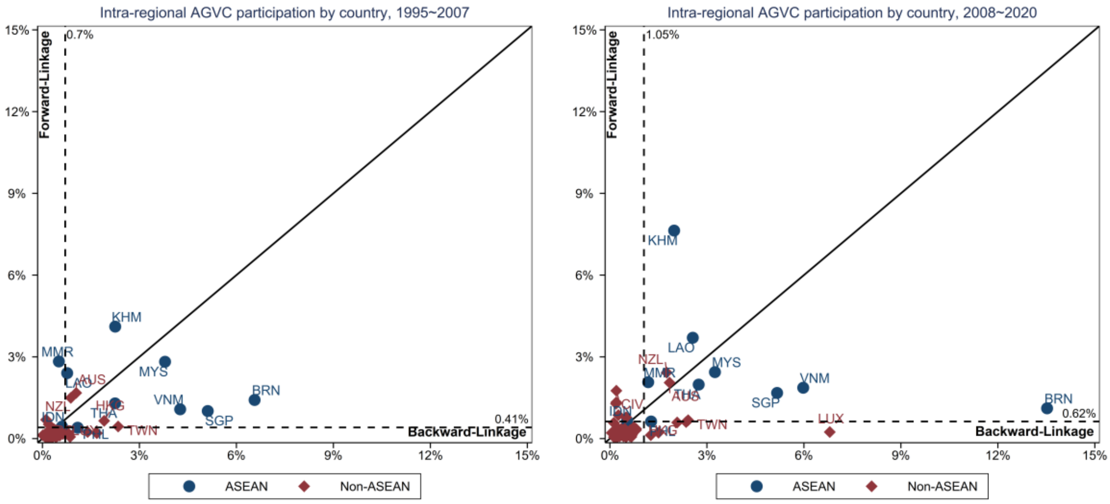

Figure 4-8. Cross-sectional and Intertemporal Comparisons of the Intra-regional AGVC Participation by Country.

Figure 4-8 demonstrates the cross-sectional and intertemporal comparisons of the intra-regional AGVC participation by country, similar to the Figure 4-2. Most ASEAN countries have a higher level of participation in the intra-regional AGVC compared to other countries worldwide, indicating that the level at which ASEAN provides intermediate goods for its own agriculture or uses intermediate goods from other ASEAN countries in the production of final agricultural products is relatively higher. This result is intuitive, as the level of ASEAN's participation in its own intra-regional AGVC tends to be higher than that of other countries participating in ASEAN's intra-regional AGVC. This is primarily due to the geographical proximity of ASEAN nations, facilitating convenient trade and shared economic integration policies that collectively promote agricultural trade and investment among member states. The complementarity in agricultural production, similar climate conditions, and synchronized development stages among ASEAN countries foster a frequent exchange of final products and intermediates within the region. Furthermore, policy support, technical cooperation, and enhanced infrastructure among ASEAN nations have also improved the efficiency and competitiveness of the intra-regional AGVC. These factors collectively contribute to a higher level of participation in the ASEAN intra-regional AGVC compared to other countries' participation in ASEAN's regional AGVC.

The shift from left to right panel of Figure 4-8 shows an increase in intra-regional AGVC participation among most ASEAN countries over time, with regional intermediate goods supplanting some imported inputs from outside the region. Cambodia exhibited the largest growth in forward participation, rising from 4.11% (1995-2007) to 7.63% (2007-2020), actively supplying agricultural intermediates for regional production. Meanwhile, Brunei has experienced the largest increase in backward participation, jumping from 6.56% to 13.52% over the same periods, indicating a growing reliance on intermediate products and services from other countries within the region due to its limited local resource, and a shift towards a geographically closer regional value chain.

Figure 4-9 demonstrates the cross-sectional and intertemporal comparisons of the extra-regional AGVC participation by country. Blue points represent the participation rates that AMS import or export intermediate out of ASEAN, red points represent the participation rates that other countries import or export intermediate out of ASEAN. Overall, ASEAN's participation in extra-regional AGVC is lower than that of other countries participating in ASEAN's extra-regional AGVC. The shift from left to right panel can see that countries such as Vietnam and Singapore are actively involved in AGVC beyond the ASEAN region. To be specific, Vietnam's forward participation rate has increased from 13.34% to 17.71% and its backward participation rate has risen from 21.26% to 27.71%, while Singapore's forward participation rate increased from 7.11% to 10.04% and its backward participation rate has also grown from 23.00% to 27.60%. In contrast, a decline in the extra-regional participation rate has been observed in most ASEAN countries, suggesting a shift towards greater intra-regional cooperation and production specialization within ASEAN. This further reflects the strengthening regionalization of the AGVC and a gradual decline in its globalization aspect.

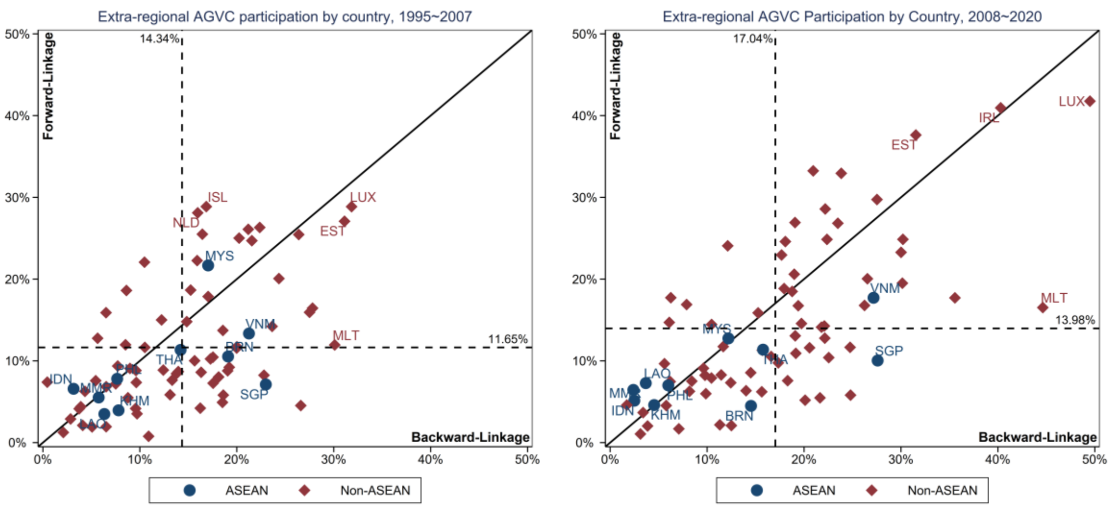

Figure 4-9. Cross-sectional and Intertemporal Comparisons of the Extra-regional AGVC Participation by Country.

Figure 4-10 provides an overview of ASEAN's intra- and extra-regional participation levels across different agricultural subsectors. The participation rates within the region have risen for both the agriculture, hunting, forestry and the fishing and aquaculture, while extra-regional rates have initially increased before declining. This trend reflects the evolving regionalization of both the agricultural and fisheries value chains within ASEAN. Regardless of being intra- or extra-regional, the forward participation rate for the fishing and aquaculture sector is significantly lower than the backward rate, which is consistent with the overall participation levels depicted in Figure 4-3.

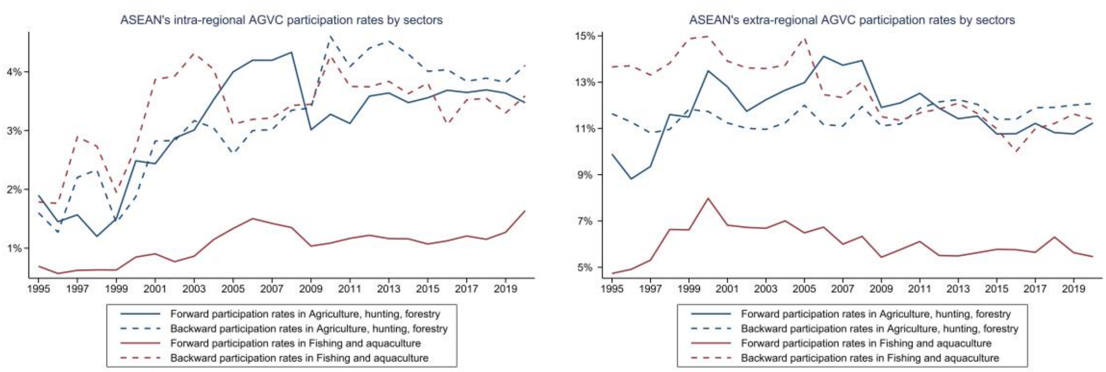

Figure 4-10. Sector-specific Participation Levels in Intra- and Extra-regional AGVC.

4.4 Intra- and extra-regional length and position

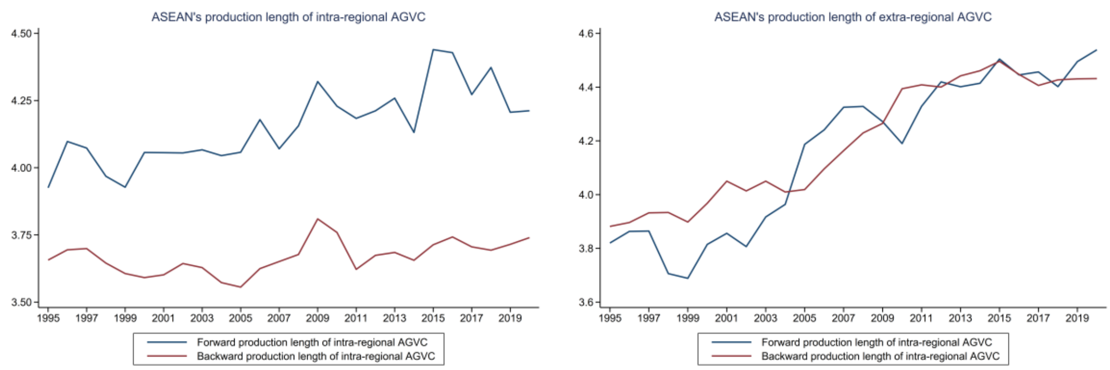

Figure 4-11. Evolution of Forward and Backward Production Length of Intra- and Extra-regional AGVC.

Figure 4-11 demonstrates the evolution of forward and backward production length of intra and extra-regional AGVC. The left panel indicates that from 1995 to 2020, ASEAN's intra-regional forward production length consistently surpassed its backward length, with a slightly more rapid growth. This suggests that ASEAN's agricultural sector is more actively involved in the upstream stages of the intra-regional AGVC, with intermediate goods undergoing extensive production and processing among the ASEAN countries. The right panel shows a rapid increase in both forward and backward production lengths for ASEAN's extra-regional AGVC during the same period. This bidirectional growth suggests that ASEAN's exported agricultural intermediates are used by businesses in multiple countries for further processing and production, and there is an increasing integration of intermediate inputs from outside the region in the production of final agricultural products.

Comparing the left and right panels, it is evident that the division of labor in ASEAN's AGVC is more complex outside the region than within it. ASEAN's exported agricultural intermediate products require the involvement of multiple countries outside the region to become final products, or the final agricultural products produced in ASEAN require intermediates that have passed through multiple countries outside the region. This indicates a higher degree of interconnectedness of ASEAN's agricultural sector within the global economy.

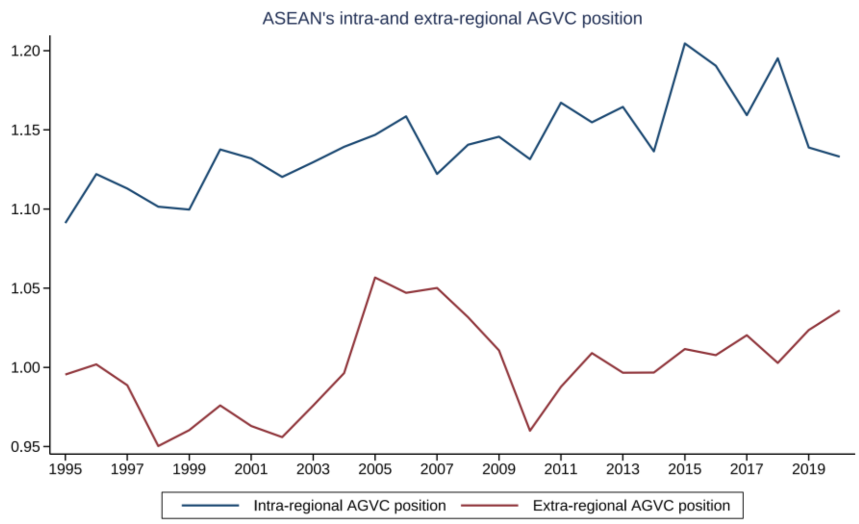

Figure 4-12. Evolution of Intra-and Extra-regional AGVC Position.

By comparing the forward and backward production lengths, we have depicted ASEAN's intra and extra-regional AGVC position as shown in Figure 4-12. ASEAN is positioned relatively upstream within the intra-regional AGVC, while it occupies a mid-to-upstream position in the extra-regional AGVC. Agricultural products are inherently perishable and high-risk in international trade (Jaffee and Henson, 2004). Within the region, the geographical proximity of ASEAN countries and the recent decline in trade costs have made it easier for their agricultural intermediates to be transported to other countries and sectors for further participation in the internation division. This means its agricultural value chain can more readily extend to include processing, manufacturing, and marketing stages as a starting point for production in other sectors. As a result, ASEAN agriculture is positioned relatively upstream within the regional value chain, supplying essential inputs such as food, fibre and fuel to downstream sectors within the region (OECD, 2018).

For the transportation of ASEAN agricultural products to more distant extra-regional countries, leveraging cold chain logistics, antiseptic techniques, and storage facilities is essential. This enhances the backward production stages to maintain the freshness and prevent spoilage of the goods to the greatest extent possible. As a result, ASEAN is positioned at a relatively mid-to-upstream position in the extra-regional AGVC. Along the whole agricultural value chain, intermediate goods manufactured by ASEAN often necessitate the integration of elements sourced from other countries at first—such as advanced cold chain logistics and preservation technologies—prior to their export for further processing or direct consumption in extra-regional markets.

4.5 Top countries and sectors within AGVC

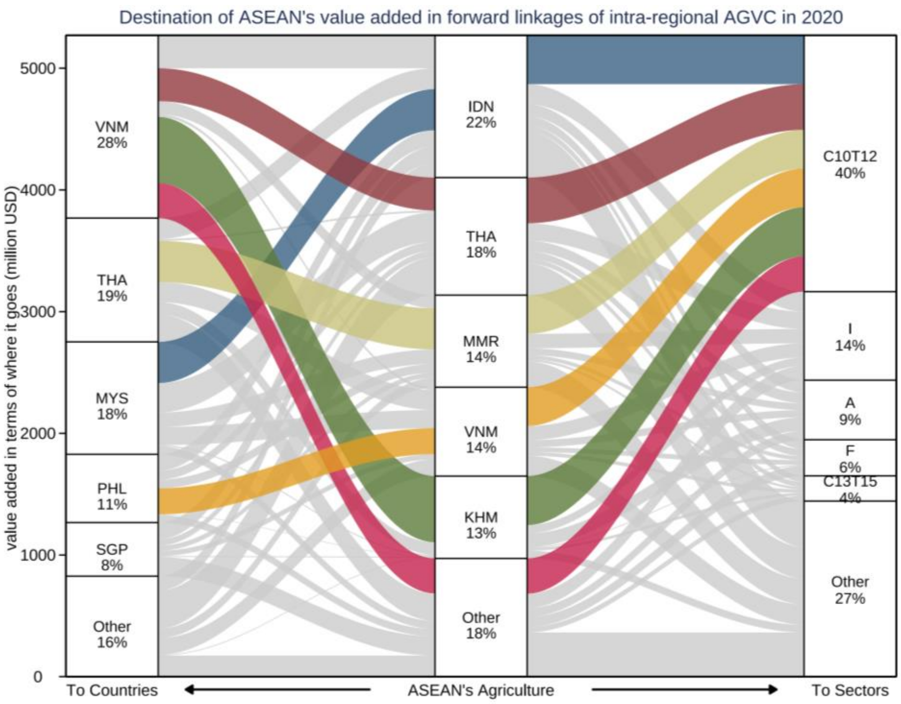

Figure 4-13. Top countries and Sectors in Forward Linkages of Intra-regional AGVC.

Notes: C10T12: Food products, beverages and tobacco; I: Accommodation and food service activities; A: Agriculture, hunting, forestry and fishing; F: Construction; C13T15: Textiles, textile products, leather and footwear; Other: All sectors except the top five above.

Figure 4-13 shows the top countries and sectors in forward linkages of intra-regional AGVC in 2020 by mapping the destination of ASEAN value added within the region. According to the vertical coordinate, the total value added embodied in ASEAN's agricultural sector's export of intermediate goods within the region amounted to $5,270.29 million. In terms of the share of intermediate goods exported, Indonesia had the largest export share within ASEAN (22%), followed by Thailand (18%), Myanmar (14%), Vietnam (14%), and Cambodia

(13%), with the remaining countries accounting for approximately 18%. Despite being the largest economy in ASEAN, Indonesia has the lowest participation rate, as shown in Figure 4-8. The 2020 data show that Indonesia's agricultural sector's total value added was $1,455,522.62 million, with an intra-regional AGVC contribution of $1,169.18 million, leading in ASEAN in both. As a key producer and supplier, Indonesia's agricultural sector, with its diverse products, significantly supplies agricultural intermediate goods to other ASEAN countries, especially for the sector of food products, beverages and tobacco (C10T12). However, due to its large agricultural output, Indonesia's participation level in the intra-regional AGVC may be diluted, resulting in a relative low rate. In terms of trade volume, its contribution is still huge. In contrast, ASEAN countries with smaller agricultural output may have higher AGVC involvement due to more targeted regional engagement. These differences reveal the diverse strategies and positioning of ASEAN countries within the AGVC.

The flow of agricultural intermediate goods exported by ASEAN's agricultural sector reflects the dynamics of intra-regional trade and the specific roles of countries within the agricultural value chain. In terms of the distribution of value-added, the top five countries receiving agricultural intermediate goods exports from ASEAN's agricultural sector are Vietnam (28%), Thailand (19%), Malaysia (18%), the Philippines (11%), and Singapore (8%), with the remaining countries accounting for approximately 16%. The highest proportion flowing to Vietnam can likely be attributed to its rapidly growing agricultural processing capabilities and the level of regional market integration, particularly its competitiveness in the processing and export of food products. The higher shares of Thailand and Malaysia suggest that they possess comparative advantages in the processing and distribution of certain agricultural products. Meanwhile, the shares of the Philippines and Singapore reflect their key roles in regional trade and logistics. Singapore, in particular, as a trade hub, may play a role in the trade of agricultural intermediate goods that is more focused on providing trade facilitation, financial services, and market access. Overall, this pattern of flow reveals a high degree of integration within the ASEAN regional agricultural value chain and complementary trade relationships among member countries based on their respective economic characteristics and strategic positioning.

The distribution of value added flows within ASEAN's intra-regional AGVC reveals its interconnectedness with various economic sectors. Notably, around 40% of the value-added flows to the food, beverages, and tobacco sector (C10T12), underscoring ASEAN's pivotal role in the global food supply chain through its focus on food processing and manufacturing. The accommodation and food service activities sector (I) sees 14% of the value added flows, likely associated with the flourishing tourism and catering industries within ASEAN, which have a considerable demand for processed foods and agricultural products. The agriculture, hunting, forestry and fishing sector (A), accounts for 9% of the value added flows, indicating that traditional agricultural production continues to be a part of value creation even as some agricultural activities are integrated into transnational production networks. 6% of the value added flows to the construction sector (F), which may be related to agricultural infrastructure development. Meanwhile, 4% flows to the textiles, textile products, leather, and footwear sector (C13T15), reflecting the utilization of agricultural by-products in the manufacturing process. The remaining 27% of the value added flows to other sectors, possibly including trade, transportation, and financial services, which provide essential services and support for the operation of the agricultural value chain. Overall, the flow of ASEAN's agricultural intermediates highlights the regional economic integration and the diversification of the agricultural industry chain, as well as the complementarity and synergy among ASEAN countries in the intra-regional AGVC.

On a country-specific basis, Indonesia's agricultural intermediates are primarily directed towards Malaysia, while Myanmar's agricultural intermediates predominantly flow to Thailand. Vietnam's intermediates are mainly exported to the Philippines, and agricultural intermediates from other countries within ASEAN are largely flow to Vietnam. The top sector of agricultural intermediates flows in ASEAN countries are all in the food, beverages and tobacco sector (C10T12). These trade flow profile of trade in agricultural intermediates among ASEAN countries reveals the specialization and strong economic linkages within ASEAN in the area of food production and processing.

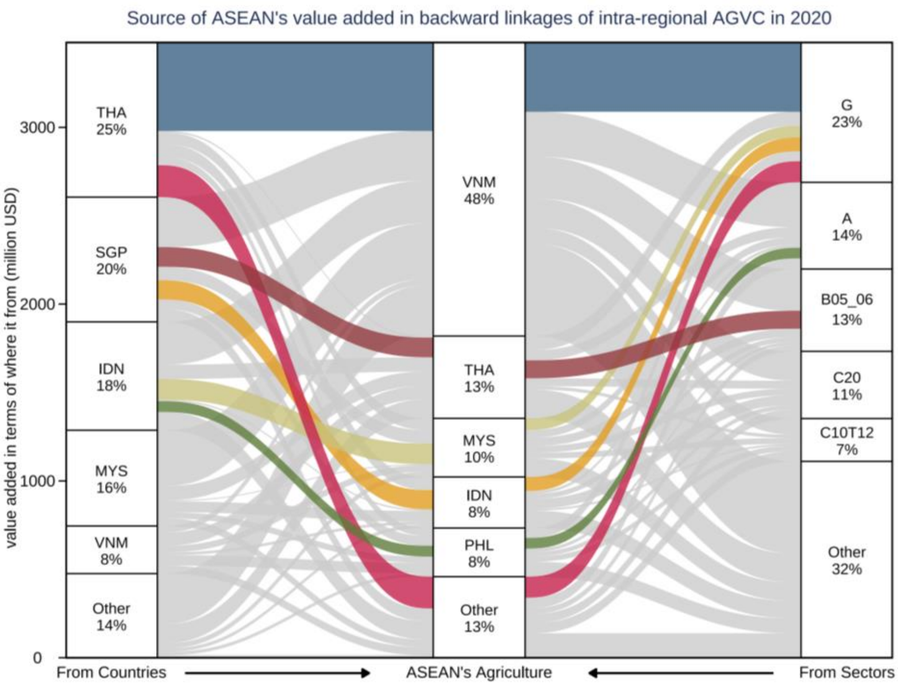

Figure 4-14. Top countries and Sectors in backward linkages of intra-regional AGVC

Notes: G: Wholesale, retail trade and repair of motor vehicles; A: Agriculture, hunting, forestry and fishing; B05_06: Mining and quarrying, energy producing products; C20: Chemical and chemical products; C10T12: Food products, beverages and tobacco; Other: All sectors except the top five above.

Figure 4-14 shows the top countries and sectors in backward linkages of intra-regional AGVC in 2020 by mapping the source of ASEAN value added within the region. According to the vertical coordinate, the ASEAN agricultural sector utilized intermediate products and services from within the region to produce final products and services, generating a total value added of $3,479.44 million. Among these, Vietnam had the largest share of imports, accounting for nearly half (48%) of the total for ASEAN. Following in order were Thailand with 13%, Malaysia with 10%, Indonesia with 8%, the Philippines with 8%, and the remaining countries accounting for approximately 13%.

When examining the sources of value added by country, the top five countries that are the main sources of total value added in final goods and services produced by the ASEAN agricultural sector that use intermediate goods and services supplied by countries in the region are Thailand (25%), Singapore (20%), Indonesia (18%), Malaysia (16%), Vietnam (8%), and the rest of the countries accounted for about 16%. The intermediate goods are predominantly from sectors such as wholesale, retail trade and repair of motor vehicles (G), agriculture, hunting, forestry and fishing (A), mining and quarrying; energy producing products (B05_06), chemical and chemical products (C20), and food products, beverages, and tobacco (C10T12).

The source of value added from intermediate products and services within the ASEAN agricultural sector's final offerings, supplied by regional countries, underscores the sector's broad linkages and dynamic interactions with various economic sectors. Specifically, the wholesale, retail trade and repair of motor vehicles sector (G) had the highest contribution of 23%, which may reflect the activity of ASEAN countries in the distribution of agricultural products and market access, as well as the importance attached to enhancing the value added of agricultural products. The agriculture, hunting, forestry and fishing sector (A) accounts for 14%, and is directly connected to agricultural production itself. This underscores the pivotal role that core agricultural activities play in contributing to the value chain. The Mining and quarrying, energy producing products sector (B05_06) accounts for 13%, which may be related to the demand for energy and raw materials in agricultural production. The chemical and chemical products sector (C20), with a share of about 11%, may point to the production of agricultural inputs such as fertilizers and pesticides. The food products, beverages, and tobacco sector (C10T12) accounts for about 7%, reflecting the importance of these final products in ASEAN agricultural exports. An additional 32% of value added comes from other sectors, which may include services, transport, etc. They provide ancillary services and support to the agricultural value chain. Although agriculture is the traditional sector of the ASEAN economy, its integration with the modern service sector and the energy and chemical industries is contributing to the diversification and value addition of the regional economy.

In terms of country-specific dependencies, agricultural production in Thailand and Indonesia relies mainly on Singapore's intermediate goods, which may be related to Singapore's strong trade and logistics service capacity, particularly in wholesale and retail trade (Yean and Das, 2017). Agricultural production in Malaysia and the Philippines relies mainly on intermediates from Indonesia, reflecting Indonesia's strength in the production of certain agricultural raw materials. The remaining ASEAN countries are mainly dependent on Thailand's intermediate goods. In terms of country-sector dependencies, Thailand's significant dependence on intermediates of the mining and quarrying, energy producing products (B05_06) may be linked to its high demand for energy and raw materials in its agricultural production activities. The Philippines' primary reliance on intermediates of the agriculture, hunting, forestry and fishing (A) reflects the basic character of its agricultural production. Whereas the reliance of other ASEAN countries on the intermediates of the wholesale, retail trade and repair of motor vehicles (G) may be indicative of specialization in market distribution and value-added services for agricultural products in these countries.

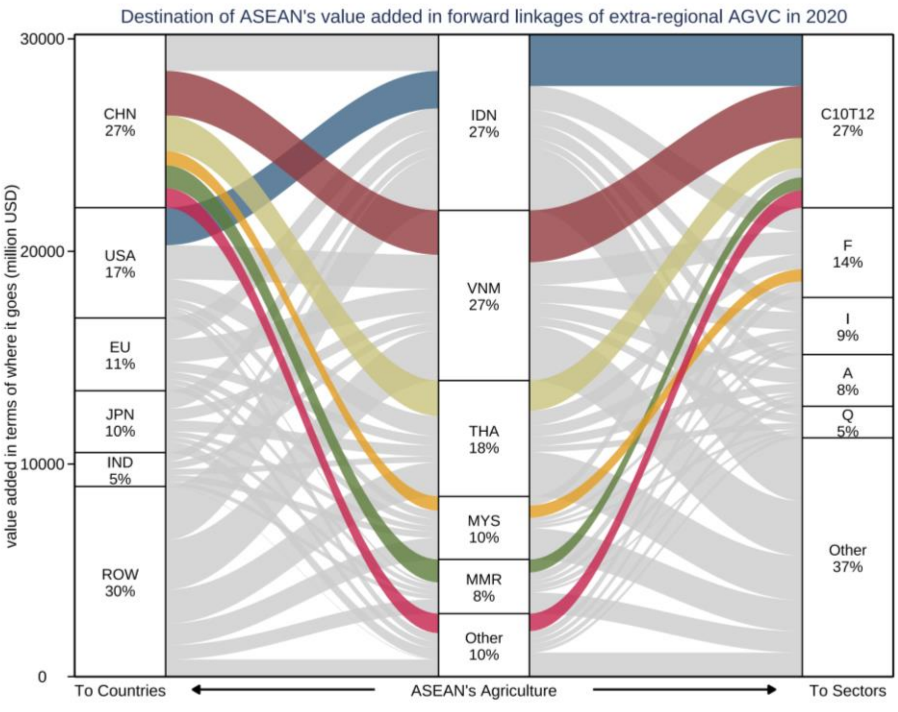

Figure 4-15. Top Countries and Sectors in Forward Linkages of Extra-regional AGVC.

Notes: In To Sectors column: C10T12: Food products, beverages and tobacco; F: Construction; I: Accommodation and food service activities; A: Agriculture, hunting, forestry and fishing; Q: Human health and social work activities; Other: All sectors except the top five above. In To Countries column: ROW is rest of the world except for the top countries of CHN, USA, EU, JPN, IND.

Figure 4-15 depicts the top countries and sectors in forward linkages of extra-regional AGVC in 2020 by mapping the destination of ASEAN value added outside the region. According to the vertical coordinate, the total value added embodied in ASEAN's agricultural sector's export of intermediate goods outside the region amounted to $30,200.80 million. In terms of the share of intermediate goods exported, Indonesia and Vietnam have the largest share of ASEAN exports (27%), followed by Thailand (18%), Malaysia (10%), Myanmar (8%) and the remaining countries with about 10%.

In terms of the flow of value added by destination country, the top five regions to which the ASEAN agricultural sector exports agricultural intermediates outside the region are mainly destined are China (27%), the United States (17%), the European Union (11%), Japan (10%), and India (5%), with the remaining countries accounting for approximately 30%. This aligns with the top five major trading partner countries for ASEAN agriculture (Mao et al., 2024). The agricultural intermediate goods exports to these key partners constitute 70% of ASEAN's total exports of such goods to countries outside the region. The prominence of China, the United States, the European Union, Japan, and India as primary export destinations for ASEAN's agricultural intermediate goods reflects the strong market demand for ASEAN agricultural products in these areas.

In terms of the distribution of value-added flows by sector, approximately 27% of the agricultural intermediate goods exported by the ASEAN agricultural sector to areas outside the region are directed towards the food products, beverages, and tobacco sector (C10T12). Another 14% flows into the construction sector (F), while 9% goes into the accommodation and food service activities sector (I). Besides, 8% flows into the agriculture, hunting, forestry and fishing sector (A), 5% flows into the Human health and social work activities sector (Q). The remaining 37% is directed towards other sectors. This distribution reflects the multifaceted role of ASEAN agriculture in the global economy and its comprehensive contributions to various economic sectors within the AGVC.

From a country-to-country flow perspective, aside from Indonesia's agricultural intermediate goods being primarily directed towards the United States, the majority of agricultural intermediate goods from other countries flow towards China, demonstrating China's significant position within the regional agricultural value chain. From a country-to-sector flow perspective, Malaysias top sector is construction (F), which may be related to the country's specialization in the production of agricultural raw materials such as palm oil, which are importantly used in the construction industry. For the rest of the countries, the top sectoral flow is still towards food products, beverages and tobacco (C10T12), highlighting ASEAN's key role in the global food supply chain.

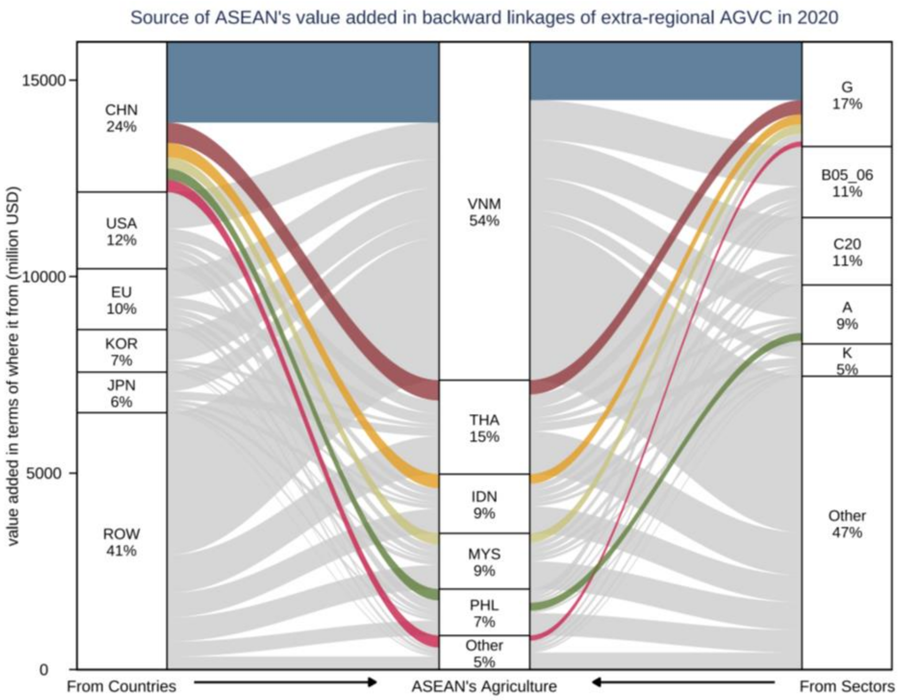

Figure 4-16. Top Countries and Sectors in Backward Linkages of extra-regional AGVC.

Notes: In To Sectors column: G: Wholesale, retail trade and repair of motor vehicles; B05_06: Mining and quarrying, energy producing products; C20: Chemical and chemical products; A: Agriculture, hunting, forestry and fishing; K: Financial and insurance activities; Other: All sectors except the top five above. In To Countries column: ROW is rest of the world except for the top countries of CHN, USA, EU, KOR, JPN.

Figure 4-16 demonstrates the top countries and sectors in backward linkages of extra-regional AGVC in 2020 by mapping the source of ASEAN value added outside the region. According to the vertical coordinate, the ASEAN agricultural sector's utilization of intermediate products and services sourced from countries outside the region totalled $15,974.57 million. Vietnam leads in terms of import share, constituting 54% of the ASEAN total. It is then followed by Thailand at 15%, Malaysia at 9%, Indonesia at 9%, and the Philippines at 7%, with the remaining countries collectively accounting for about 5%.

From the perspective of the country of source for value added, China, with a 24% share, emerges as the largest contributor. This likely reflects China's significant position in the global supply chain and its close economic ties and trade relations with ASEAN countries. The United States and the European Union follow as major contributors, accounting for 12% and 10% respectively. As technology- and capital-intensive economies, they possess advantages in the production and export of agricultural technology, biotechnology, and energy product intermediates. South Korea and Japan then follow, accounting for 7% and 6% respectively, and are likely to support ASEAN's agricultural production by providing high-quality agricultural machinery, fertilizers, and other agricultural inputs. These intermediates mainly from the sectors of wholesale and retail trade, energy products, chemical products, agricultural and financial services. This demonstrates ASEAN's strategic placement in the global agricultural production network to integrate external resources in order to enhance local agricultural production and processing capacity.

From a country-to-country source perspective, agricultural production in ASEAN countries utilizes the largest share of intermediate goods from China. From a country-to-sector source perspective, it is observed that, with the exception of Malaysia, the remaining countries primarily rely on the sector of wholesale, retail trade and repair of motor vehicles (G).

5. ASEAN's AGVC with Key Partners

The report on the *TRADE LIBERALIZATION AND MARKET INTEGRATION OF ASEAN'S AGRI-FOOD SYSTEMS* identifies China, the EU, the US, Japan, and India as the region's top five partners based on the share of agricultural trade (Mao et al., 2024). In this section, we will delve into the development of the AGVC for ASEAN in collaboration with these key partners.

5.1 ASEAN-China AGVC

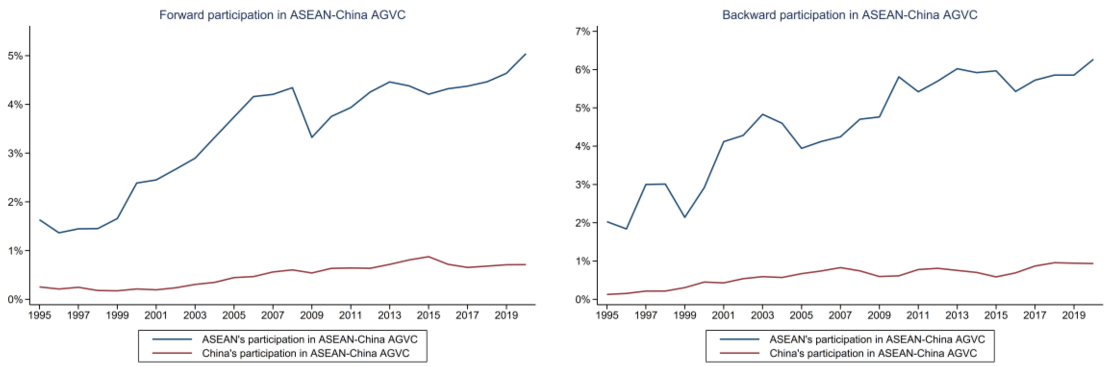

Figure 5-1. Evolution of Forward and Backward Participation in ASEAN-China AGVC.

Figure 5-1 illustrates the evolution of forward and backward participation in ASEAN-China AGVC. From 1995 to 2020, both the forward and backward participation rates have seen a continuous rise, with ASEAN's rates increasing more rapidly. This upward trend signifies the strengthening of economic connections and an enhanced collaboration in the trade of intermediate goods between the two regions.

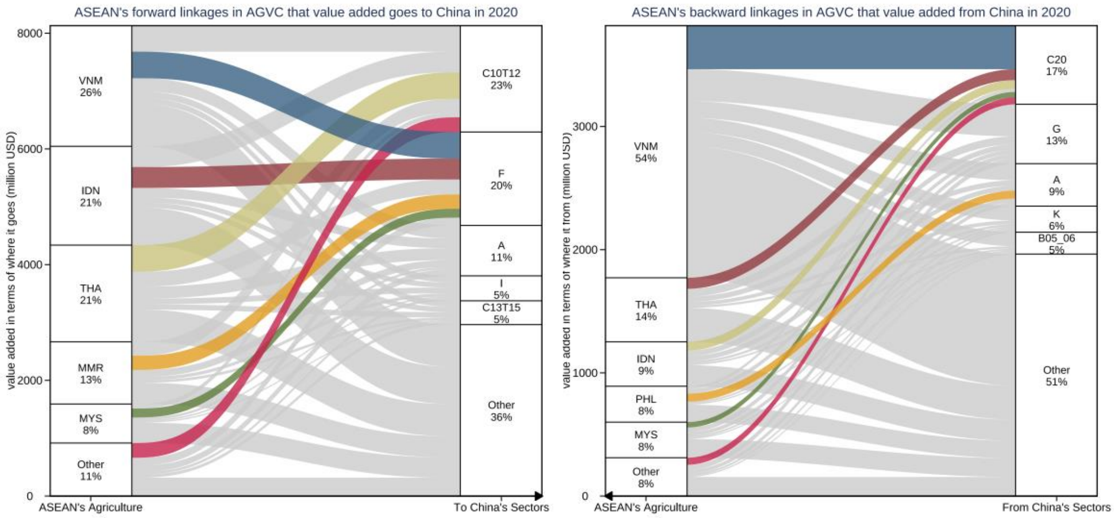

Figure 5-2. Top sectors in Forward and Backward AGVC Linkages of ASEAN with China in 2020.

Notes: In To China's Sectors column, C10T12: Food products, beverages and tobacco; F: Construction; A: Agriculture, hunting, forestry and fishing; I: Accommodation and food service activities; C13T15: Textiles, textile products, leather and footwear; Other: All sectors except the top five above. In From China's Sectors column, C20: Chemical and chemical products; G: Wholesale, retail trade and repair of motor vehicles; A: Agriculture, hunting, forestry and fishing; K: Financial and insurance activities; B05_06: Mining and quarrying, energy producing products; Other: All sectors except the top five above.

Figure 5-2 plots the top sectors in forward and backward AGVC linkages of ASEAN with China in 2020. The ASEAN's agricultural sector channeled a total of $8,141.72 million worth of intermediate goods into China's agricultural industry according to the left panel. The contributions were predominantly from Vietnam (26%), Indonesia (21%), Thailand (21%), Malaysia (13%), and Myanmar (8%). These goods were largely directed towards key sectors in China, including the food products, beverages, and tobacco at 23%, the construction at 20%, the agriculture, hunting, forestry and fishing at 11%, the accommodation and food service activities at 5%, and the textiles, textile products, leather and footwear at 5%. This indicates a significant market demand in China for these areas, while ASEAN countries play a crucial role in meeting these demands.

In terms of flows as show in the left panel, it is observed that Agricultural intermediates from Vietnam, Indonesia, Malaysia, and Myanmar are mainly directed to China's construction sector, while other ASEAN countries primarily supply the food products, beverages, and tobacco sector. This trend highlights China's construction industry's demand for cost-effective ASEAN agricultural raw materials. For example, Vietnam's wood and bamboo are used in Chinese construction and furniture due to their sustainability. Indonesia's rubber is key in making construction sealants and waterproofing materials. Thailand's cassava, converted into bioplastics, serves as an eco-friendly construction material. Malaysia's palm oil derivatives are used in coatings and adhesives, and Myanmar's hemp fibers are ideal for insulation materials. Trade in these agricultural intermediates strengthens ASEAN-China economic ties and the regional supply chain's stability.

In terms of source, the value added embodied in agricultural intermediate goods and services supplied by China is used in ASEAN's agricultural final products and services in 2020, amounting to $3,823.08 million, as shown in the right panel. Vietnam is the top intermediates importer that accounts for 54% of ASEAN, then followed by Thailand (14%), Indonesia (9%), the Philippines (8%), and Malaysia (8%), with the remaining countries accounting for 8%. The intermediate goods are mainly sourced from several sectors in China, including chemical and chemical products, which account for 17% (C20), followed by the wholesale, retail trade and repair of motor vehicles at 13% (G), agriculture, hunting, forestry and fishing at 9% (A), financial and insurance activities at 6% (K), and mining and quarrying, energy producing products at 5% (B05_06).

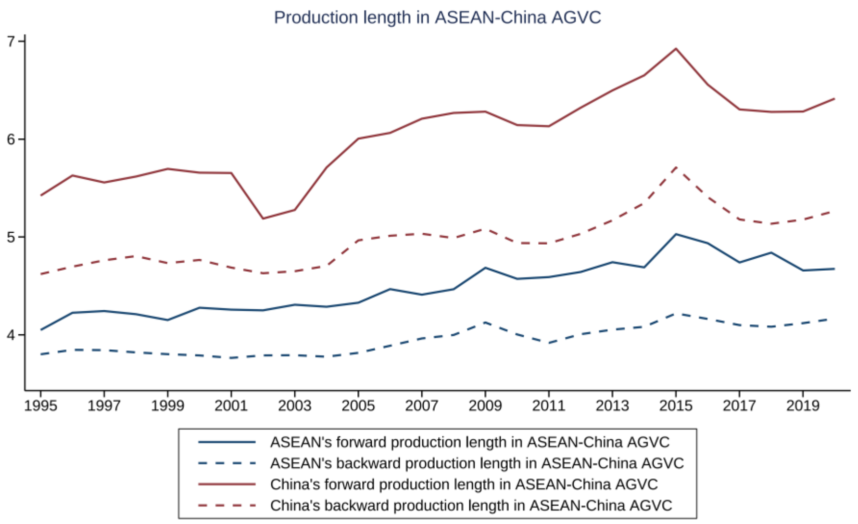

Figure 5-3. Evolution of Forward and Backward Production Length in ASEAN-China AGVC.

Figure 5-3 shows the evolution of forward and backward production length in ASEAN-China AGVC from 1995-2020. The forward and backward production lengths in agriculture for both ASENA and China are getting longer. This indicates that the division of labor in production between the two countries is becoming increasingly refined, with strong links between intermediate inputs and uses.

Compare to ASEAN, the forward and backward production lengths of China agriculture are longer, especially the forward length. This is likely attributable to China's comprehensive agricultural industry chain and its extensive production and processing capacity. Exports from China to ASEAN are often reabsorbed into the domestic production chain, with segments of the production process located both abroad and domestically, leading to an elongated production chain(Cieślik, 2023; World Bank Group, 2019). Conversely, agricultural products from ASEAN are typically finalized at the export destination and subsequently have less return back into the domestic market, which results in a relatively shorter stage production stages compare to China.

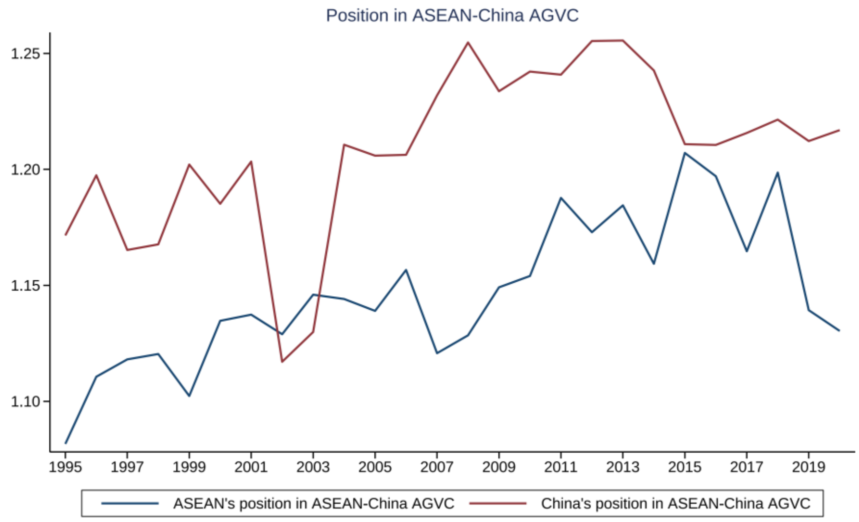

Figure 5-4. Evolution of Position in ASEAN-China AGVC

Comparing forward to backward production length, we plot the evolution of ASEAN's and China's positions in their AGVC as shown in Figure 5-4. From 1995 to 2020, in the ASEAN-China AGVC, both regions were in relatively upstream position, signifying their roles as major providers of agricultural raw materials and intermediates. This positioning is likely due to their rich agricultural resources. Their agricultural sectors mainly serve as intermediate inputs for other industries within their AGVC, thus they are involved in a relatively upstream processes, with the value of agriculture itself being continuously extended to the non-agricultural or agricultural processing sectors.

Comparison shows that China's position index is higher in the ASEAN-China AGVC, which indicates that China is positioned closer to the production origin relative to ASEAN. This is primarily due to China's comparative advantages in various sectors of agricultural production, primary processing, and agricultural science and technology, enabling it to produce and export substantial quantities of agricultural raw materials and primary products as intermediate goods to ASEAN countries. ASEAN nations, with their specialized production expertise in specific agricultural aspects, are capable of further processing these intermediate goods and adding value to them. By leveraging their abundant local agricultural resources and processing technologies, they transform China's intermediate products into a diversified high-value-added agricultural products, which can then be re-exported to Southeast Asia and China. This division of labor illustrates the complementarity between the two economies in the agricultural value chain.

5.2 ASEAN-EU AGVC

Figure 5-5 illustrates the evolution of forward and backward participation in ASEAN-EU AGVC. Results indicates that within the ASEAN-EU AGVC from 1995 to 2020, ASEAN's forward participation rate experienced a swift increase until it suffered a significant decline due to the global financial crisis, followed by a gradual deceleration in intermediate goods trade. Meanwhile, ASEAN's backward participation rate consistently fluctuated around the 5%. Although the EU's participation in the ASEAN-EU AGVC was at a relatively high level, the majority of intermediate goods trade was actually conducted among EU member states, rather than with the ASEAN members. According to calculation, within ASEAN-EU AGVC, above 90% of the intermediate goods are sourced from within the EU region itself.

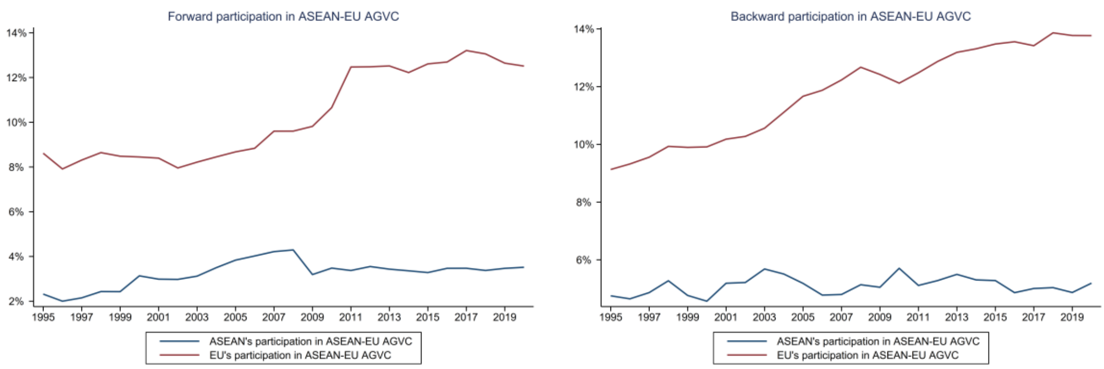

Figure 5-5. Evolution of Forward and Backward Participation in ASEAN-EU AGVC.

Figure 5-6 plots the top sectors in forward and backward AGVC linkages of ASEAN with EU in 2020. According to the left panel, the ASEAN agricultural sector provided a total of $3,492.98 million worth of agricultural intermediate goods to the EU, mainly supplied by Vietnam (31%), Indonesia (29%), Thailand (13%), Malaysia (10%), and Myanmar (7%). These intermediate goods predominantly flowed into the EU's sectors of food products, beverages and tobacco (C10T12, 34%), accommodation and food service activities (I, 10%), human health and social work activities (Q, 7%), construction (F, 7%), and agriculture, hunting, forestry and fishing (A, 5%). This indicates a significant market demand within the EU for products in these areas, with ASEAN countries playing a crucial role in meeting these demands. Furthermore, the sectoral flow reveals that agricultural intermediate goods from all ASEAN nations are predominantly directed towards the EU's food products, beverages and tobacco sector. Collectively, ASEAN's agricultural intermediate goods have solidified the region's status as a dependable and vital trade partner by addressing the EU's varied requirements for ingredients, processing adjuncts, and specific consumer products. Overall, the agricultural intermediate goods from ASEAN countries have reinforced their position as reliable and important trade partners by satisfying the EU's diverse needs for food ingredients, processing aids, and certain specific consumer goods.

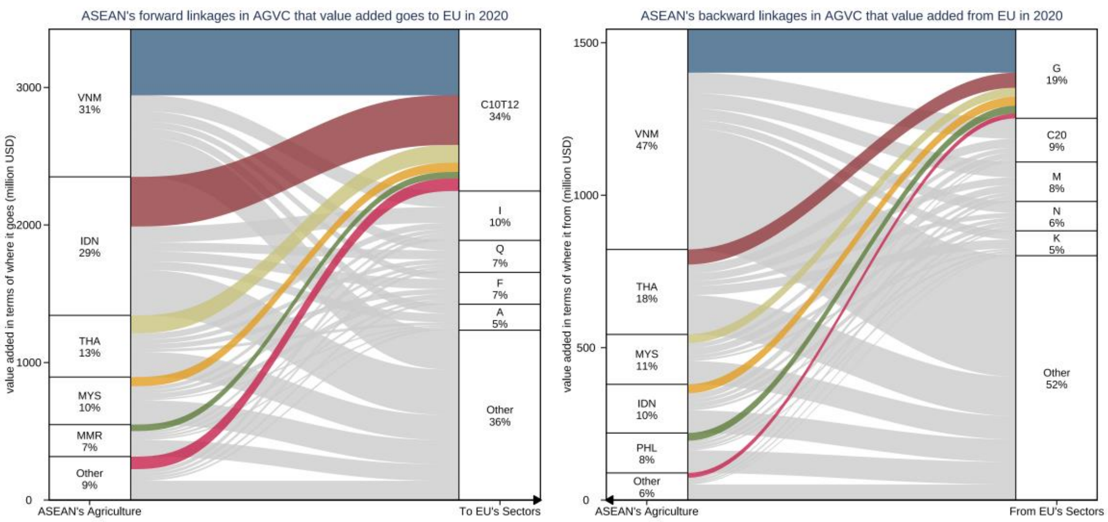

Figure 5-6. Top sectors in Forward and Backward AGVC Linkages of ASEAN with EU in 2020.

Notes: In To EU's Sectors column, C10T12: Food products, beverages and tobacco; I: Accommodation and food service activities; Q: Human health and social work activities; F: Construction; A: Agriculture, hunting, forestry and fishing; Other: All sectors except the top five above. In From EU's Sectors column, G: Wholesale, retail trade and repair of motor vehicles; C20: Chemical and chemical products; M: Professional, scientific and technical activities; N: Administrative and support services; K: Financial and insurance activities; Other: All sectors except the top five above.

According to right panel of the Figure 5-6, value added embodied in intermediate goods and services supplied by EU is used in ASEAN's agricultural final products and services in 2020, amounting to $3,823.08 million. Vietnam led with the highest import share at 47% of ASEAN's total, suggesting significant utilization of EU-produced intermediates in its agricultural production. This reliance may encompass advanced machinery, superior seeds, fertilizers, and chemical products. Thailand (18%), Malaysia (11%), Indonesia (10%), and the Philippines (8%) followed, with other countries constituting about 6%. The intermediate goods were mainly sourced from the EU's top sectors, including wholesale, retail trade and repair of motor vehicles (G, 19%), chemical and chemical products (C20, 9%), professional, scientific, and technical activities (M, 8%), administrative and support services (N, 6%), and financial and insurance activities (K, 5%).

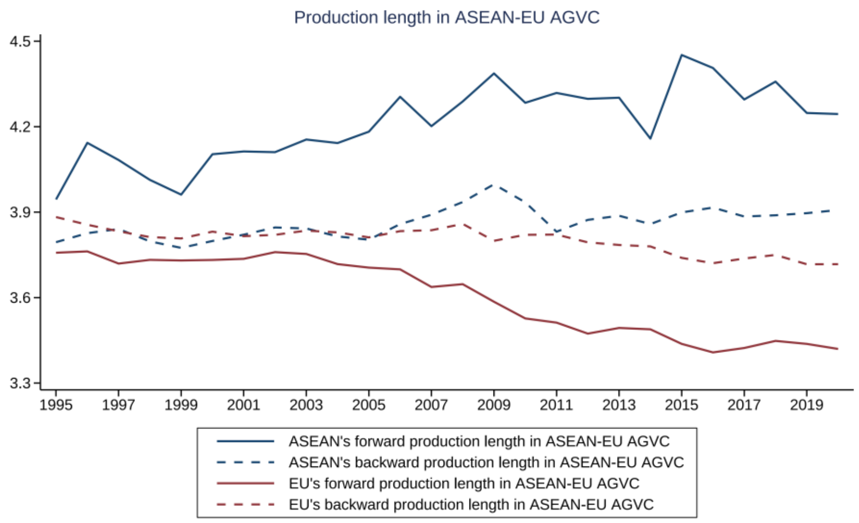

Figure 5-7. Evolution of Forward and Backward Production Length in ASEAN-EU AGVC.

Figure 5-7 shows the evolution of forward and backward production length in ASEAN-EU AGVC from 1995-2020. For ASEAN, there is a slight increase in forward production length, while the backward production length remains relatively stable. This suggests an enhanced role for ASEAN in providing agricultural intermediate products that undergo more processing stages within the ASEAN-EU production network before becoming final products. It reflects an increased dependency on the provision and use of EU intermediate goods within ASEAN agriculture. For the EU, however, there is a rapid decline in forward production length coupled with a slight decrease in backward production length, indicating a reduced dependency on ASEAN intermediate goods. This could be attributed to the EU's efforts to find closer suppliers or increase self-sufficiency, as well as a potential shift towards higher-value production activities.

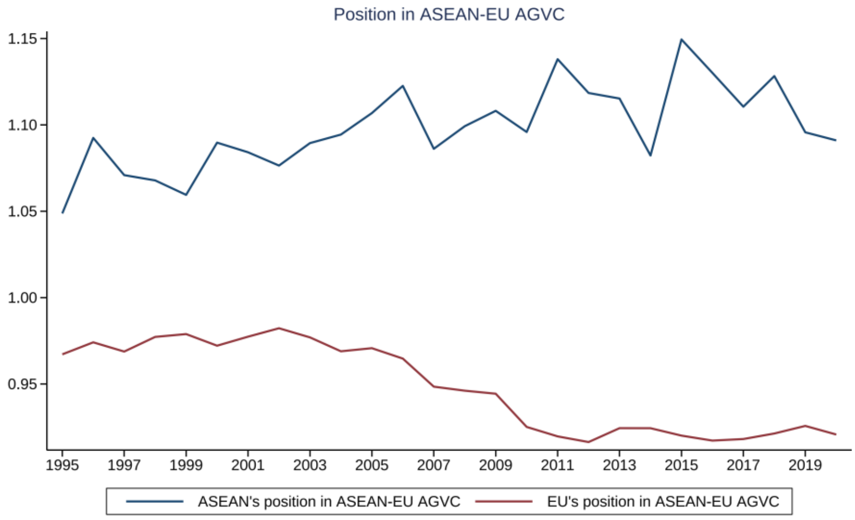

Figure 5-8. Evolution of Position in ASEAN-EU AGVC.

Comparing forward to backward production length, we plot the evolution of ASEAN's and the EU's positions in their AGVC as shown in Figure 5-8. Results shows that from 1995 to 2020, ASEAN has been moving upstream, supplying intermediate goods and materials to the ASEAN-EU partnership. In contrast, the EU has been positioned downstream, focusing more on the processing and utilization of these intermediate goods, thus being relatively closer to the market and consumers.

5.3 ASEAN-US AGVC

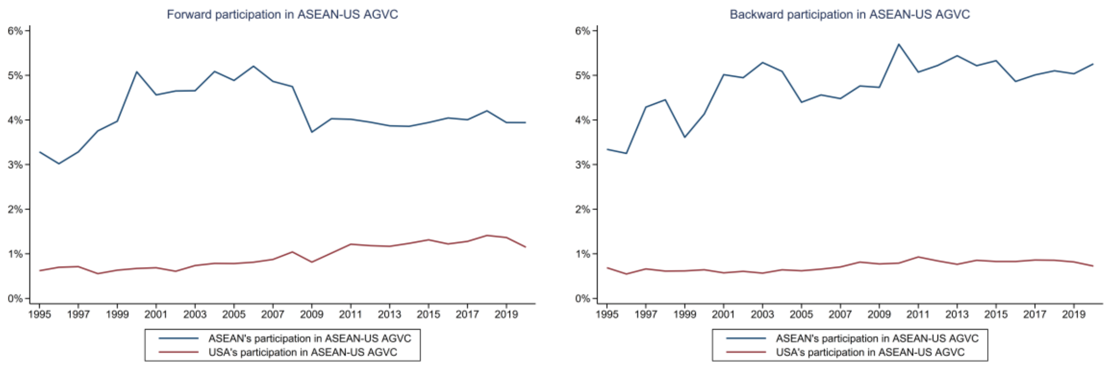

Figure 5-9. Evolution of Forward and Backward Participation in ASEAN-US AGVC.

Figure 5-9 shows the evolution of forward and backward participation in ASEAN-US AGVC. For the ASEAN, from 1995 to 2020, the forward participation rate rapidly increased until it was sharply impacted by the financial crisis, leading to a subsequent slowdown in intermediate goods trade. Meanwhile, the backward participation rate has shown a fluctuating upward trend, which may reflect an increased demand for external inputs in ASEAN's agricultural production. This could include a growing reliance on advanced agricultural technology, seeds, fertilizers, and pesticides from the US, as well as a pursuit of deeper integration and participation in the AGVC.

For the US, the forward participation rate has risen gradually, indicating an increase in the provision of agricultural intermediate goods and services to ASEAN. The backward participation rate has remained relatively stable, suggesting a consistent level of dependency on ASEAN's supply chain. This may imply that the US has maintained a relatively stable supply chain relationship for sourcing necessary agricultural intermediates and raw materials, such as palm oil and rubber imported from ASEAN. These supply chain relationships are crucial to the US agricultural sector's production and further processing activities.

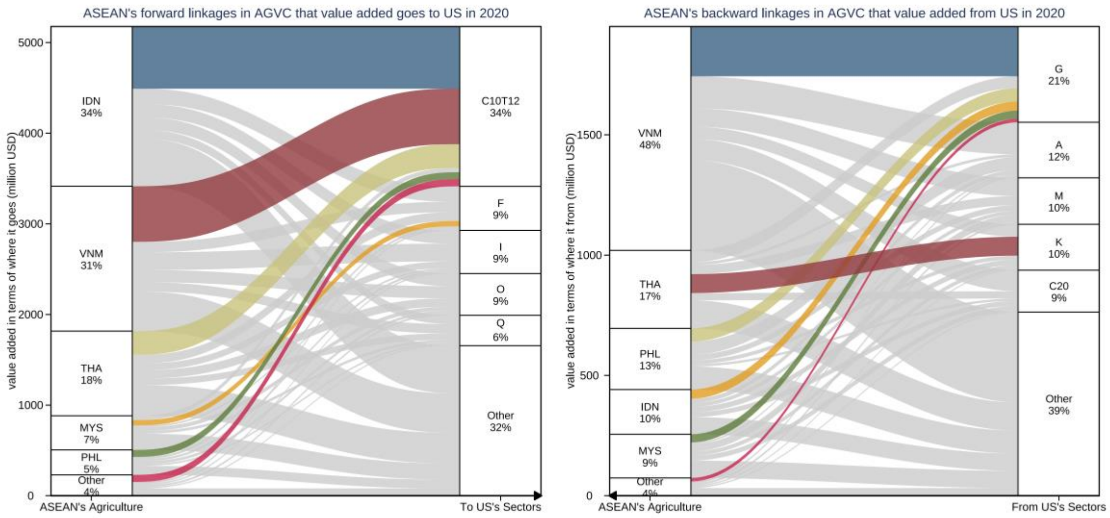

Figure 5-10. Top Sectors in Forward and Backward AGVC Linkages of ASEAN with US in 2020.

Notes: In To US's Sectors column, C10T12: Food products, beverages and tobacco; F: Construction; I: Accommodation and food service activities; O: Public administration, defence and compulsory social security; Q: Human health and social work activities; Other: All sectors except the top five above. In From US's Sectors column, G: Wholesale, retail trade and repair of motor vehicles; A: Agriculture, hunting, forestry and fishing; M: Professional, scientific and technical activities; K: Financial and insurance activities; C20: Chemical and chemical products; Other: All sectors except the top five above.

Figure 5-10 plots the top sectors in forward and backward AGVC linkages of ASEAN with US in 2020. According to the left panel, the ASEAN agricultural sector supplied agricultural intermediate goods to the US worth a total of \$5,184.06 million, mainly supplied by Indonesia (34%), Vietnam (31%), Thailand (18%), Malaysia (5%), and Myanmar (7%). These goods predominantly flowed into key sectors of the US economy, including food products, beverages and tobacco (C10T12, 34%), construction (F, 9%), accommodation and food service activities (I, 9%), public administration, defence and compulsory social security (O, 9%), and human health and social work activities (Q, 7%). This distribution reveals significant market demand in the US for products in areas such as food manufacturing, construction, catering services, public administration, and health and social work. As major suppliers, Indonesia, Vietnam, and Thailand likely export products such as palm oil, rubber, rice, and tropical fruits, which are crucial for the US food and beverage manufacturing industry, meeting its substantial demand for raw materials and processed foods. Additionally, the US construction industry's demand for wood, bamboo, and other plant-based materials from ASEAN countries reflects a trend towards sustainable and environmentally friendly building materials. The role of ASEAN countries in meeting the needs of these US sectors not only underscores their importance in the global agricultural supply chain but also reflects the US market's reliance on high-quality, cost-effective agricultural intermediate products. Overall, the interaction between ASEAN and the US in the trade of agricultural intermediate goods demonstrates the complementarity and mutually beneficial cooperation between the two parties in the globalized economy.

According to right panel, the value added embodied in intermediate goods and services supplied by the US is used in ASEAN's agricultural final products and services in 2020, amounting to $1,952.27 million. Vietnam had the largest import share at 48%, followed by Thailand (17%), the Philippines (13%), Indonesia (10%), and Malaysia (9%), with other ASEAN countries at 4%.The intermediate goods were mainly sourced from the US's top sectors, including wholesale and retail trade and repair of motor vehicles (G, 21%), agriculture, hunting, forestry, and fishing (A, 12%), Professional, scientific, and technical activities (M, 10%), Financial and insurance activities (K, 10%), and Chemical and chemical products (C20, 9%). This indicates US strengths in agricultural technology and finance. Vietnam's large share reflects its reliance on US agricultural machinery, biotechnology, and sophisticated agricultural management and technical know-how. Other ASEAN countries' imports highlight their need for US professional, chemical, and financial services, crucial for agricultural efficiency and risk management. The US's notable role in wholesale and retail trade (G) underscores its significance in distribution and market access for the ASEAN agricultural sector. The US's significant role in trade underscores its importance to ASEAN's market access. Moreover, the US's contribution to the chemical products (C20) sector highlights its ability to supply high-quality agricultural chemicals, including fertilizers and pesticides, which are instrumental in improving crop yields and ensuring the quality of agricultural produce. Collectively, these US sectors bolster the ASEAN agricultural sector's development and competitiveness on the global stage by providing specialized services and premium intermediate products.

Figure 5-11 shows the evolution of forward and backward production length in ASEAN-US AGVC from 1995-2020. For ASEAN, the forward production length has seen a significant increase, while the backward production length has remained relatively stable. This trend indicates that ASEAN has been involved in more production and processing activities in the supply of agricultural intermediate goods to the US market, suggesting that ASEAN's exports are more frequently integrated into the manufacturing of final products in the US. For the US, in contrast, the forward production length is continuously decreasing. This suggests a reduced demand for ASEAN's intermediate inputs, which could be attributed to the US optimizing its supply chain, enhancing efficiency, or diversifying its suppliers. Meanwhile, the US maintains a relatively stable and high backward production length, consistent with its developed and stable agricultural industry processing chain. This stability reflects the US's strong position in agricultural processing and distribution, where high levels of production standardization enable the efficient conversion of intermediate goods into final products for consumer markets.

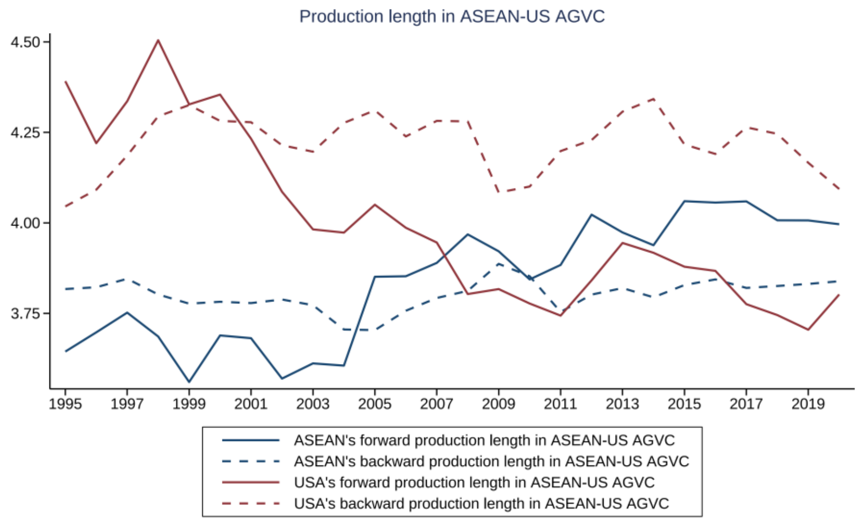

Figure 5-11. Evolution of Forward and Backward Production Length in ASEAN-US AGVC.

Comparing forward to backward production length, we plot the evolution of ASEAN's and the US's positions in their AGVC as shown in Figure 5-12. Results shows that from 1995 to 2020, ASEAN's position in the value chain shifted from a relatively downstream to an upstream position, closer to the production origin. This shift signifies that ASEAN countries have become net suppliers of agricultural intermediates and raw materials, primarily serving their own needs and those of the US. In contrast, during the same period, the US has been moving downstream, focusing more on the processing and utilization of these intermediates, positioning itself closer to the consumer end. This trend may reflect the continuous optimization of the US agricultural structure to meet the demand for processed foods and branded products in both domestic and international markets.

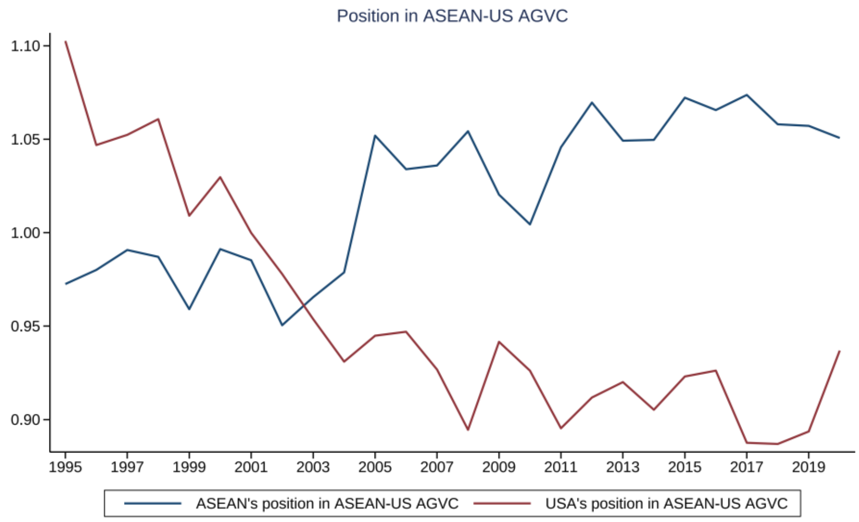

Figure 5-12. Evolution of Position in ASEAN-US AGVC

5.4 ASEAN-Japan AGVC

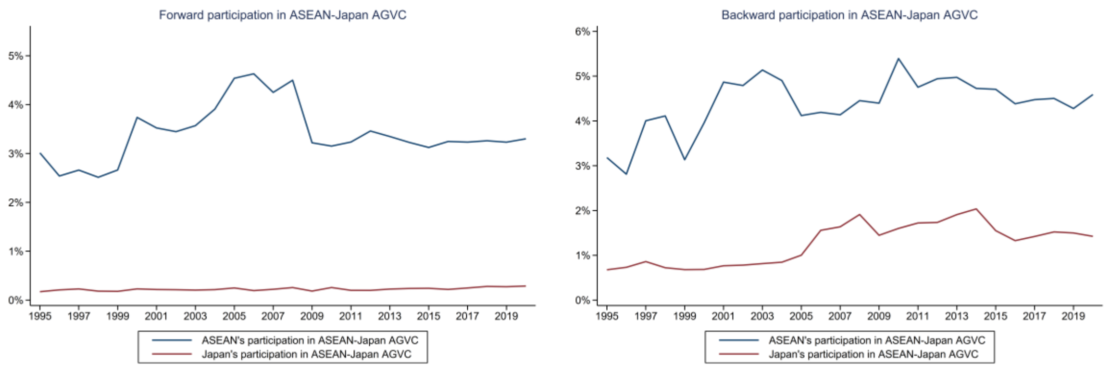

Figure 5-13. Evolution of Forward and Backward Participation in ASEAN-Japan AGVC.

Figure 5-13 illustrates the evolution of forward and backward participation in ASEAN-Japan AGVC. For ASEAN, from 1995 to 2020, the forward participation rate followed an inverse U-shaped trajectory, increasing with fluctuations, then dropping sharply post-financial crisis, with a subsequent gradual deceleration in intermediate goods trade. The backward participation rate saw a fluctuating rise, peaking before a decline set in after 2010. For Japan, the forward participation rate in the ASEAN-Japan AGVC has remained relatively low, which is closely related to the limited agricultural resources within Japan. In contrast, its backward participation rate has been consistently rising, indicating a growing demand for ASEAN's intermediate goods and services. This reflects Japan's role as a user and demander of intermediates in the ASEAN-Japan AGVC.

Figure 5-14 plots the top sectors in forward and backward AGVC linkages of ASEAN with Japan in 2020. According to the left panel, the ASEAN agricultural sector supplied agricultural intermediate goods to the Japan worth a total of $2,903.57 million, mainly supplied by Indonesia (29%), Vietnam (19%), Thailand (18%), the Philippines (16%) and Malaysia (9%). These goods predominantly flowed into key sectors of Japan economy, including food products, beverages and tobacco (C10T12, 25%), construction (F, 16%), accommodation and food service activities (I, 11%), human health and social work activities (Q, 7%) and wholesale, retail trade and repair of motor vehicles (G, 6%). From the sectoral flow, it is observed that, with the exception of Malaysia, which directs its agricultural intermediate goods towards Japan's construction sector (F), the majority of agricultural intermediate goods from other ASEAN countries are predominantly channeled into Japan's food, beverage, and tobacco sector (C10T12).

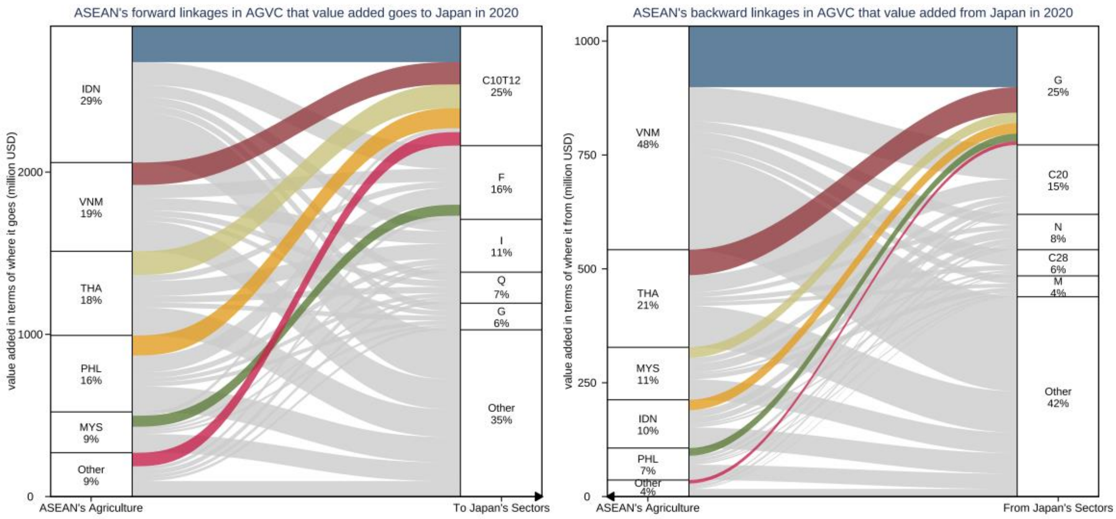

Figure 5-14. Top sectors in Forward and Backward AGVC Linkages of ASEAN with Japan in 2020.

Notes: In To Japan's Sectors column, C10T12: Food products, beverages and tobacco; F: Construction; I: Accommodation and food service activities; Q: Human health and social work activities; G: Wholesale, retail trade and repair of motor vehicles; Other: All sectors except the top five above. In From Japan's Sectors column, G: Wholesale, retail trade and repair of motor vehicles; C20: Chemical and chemical products; N: Administrative and support services; C28: Machinery and equipment, nec; M: Professional, scientific and technical activities; Other: All sectors except the top five above.

According to right panel of the Figure 5-15, the value added embodied in intermediate goods and services supplied by Japan is used in ASEAN's agricultural final products and services in 2020, amounting to $1,034.16 million. Vietnam had the largest import share at 48%, followed by Thailand (21%), Malaysia (11%), Indonesia (10%) and the Philippines (7%), with other ASEAN countries at 4%. These intermediate goods were mainly sourced from the Japan's top sectors, including wholesale, retail trade and repair of motor vehicles (G, 25%), chemical and chemical products (C20, 15%), administrative and support services (N, 8%), machinery and equipment, nec (C28, 6%), professional, scientific and technical activities (M, 4%). Japan's contributions in the sectors of administrative and support services (N), machinery and equipment, nec (C28), and professional, scientific, and technical activities (M) reflect its significant role in providing professional services, advanced agricultural machinery, and technical expertise.

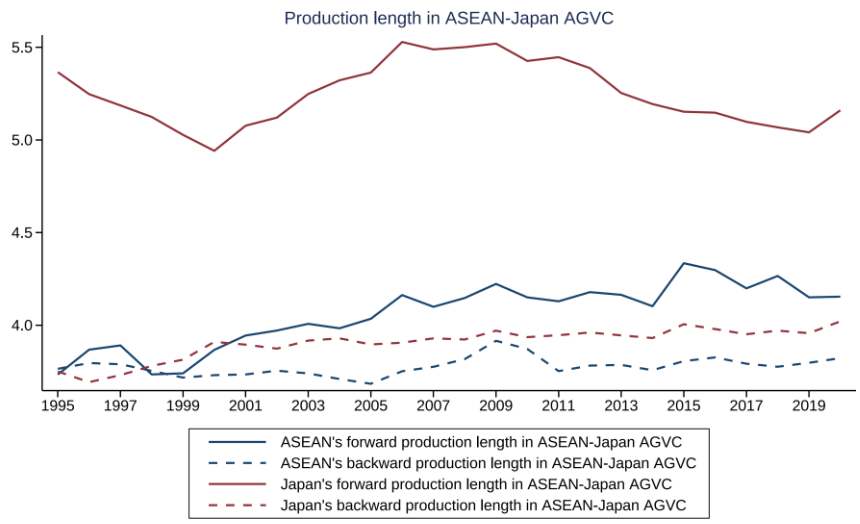

Figure 5-15. Evolution of Forward and Backward Production Length in ASEAN-Japan AGVC.

Figure 5-15 shows the evolution of forward and backward production length in ASEAN-Japan AGVC from 1995-2020. Both forward and backward production lengths in ASEAN have been continuously increasing, yet they remain below Japan's forward production length. Japan's longer forward production length indicates that its exported intermediate goods are extensively utilized in the creation of final products within the ASEAN-Japan context, undergoing more processing and production stages. This likely involves high-value activities such as the development of high-end products, the application of advanced processing technologies, and brand marketing. For instance, Japan may export high-value agricultural machinery or biotech products to ASEAN countries, where they are used to enhance agricultural production efficiency and product quality. The final agricultural products are then re-exported to Japan or other countries for further processing or direct consumption.

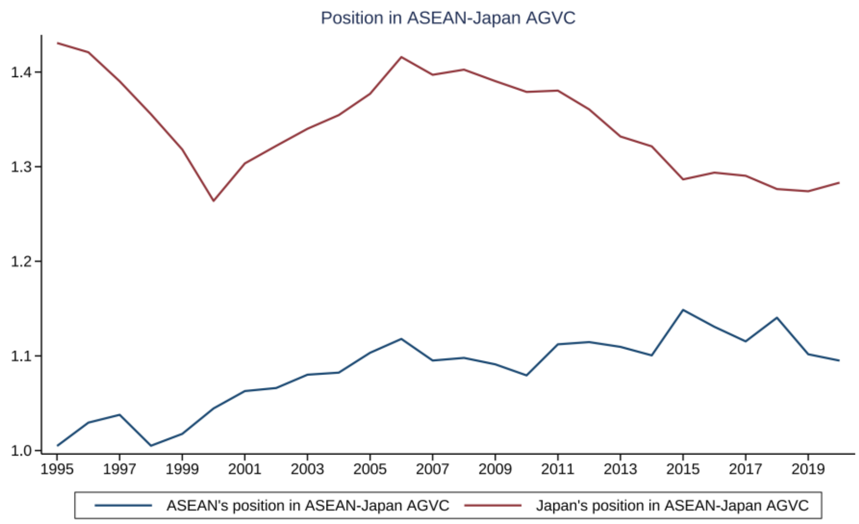

Figure 5-16. Evolution of Position in ASEAN-Japan AGVC

Comparing forward to backward production length, we plot the evolution of ASEAN's and the Japan's positions in their AGVC as shown in Figure 5-16. Results shows that from 1995 to 2020, ASEAN and Japan occupied upstream positions in the ASEAN-Japan AGVC, underscoring their roles as major producers and suppliers of agricultural intermediates. Japan, particularly, is closer to the production origin. As depicted in Figure 5-14, Japan supplies ASEAN with professional services and advanced agricultural machinery, constituting high-end intermediates in the value chain. Japan's strengths in agricultural R&D, quality seed development, and consulting give it a leading role regionally. These high-end services and products are adopted by ASEAN countries to enhance their agricultural production capabilities and product quality. This collaboration not only adds value to ASEAN's agricultural products but also secures Japan's place as a key supplier of critical intermediates in the AGVC.

Over time, the gap between the value chain positions of Japan and ASEAN has been narrowing, mainly in terms of the narrowing of the gap between their forward production lengths. This trend can be attributed to ASEAN's active advancements in agricultural technology innovation, increased production efficiency, enhanced agricultural processing capabilities, and expanded global market expansion, all of which have propelled ASEAN's position within the ASEAN-Japan AGVC. While Japan maintains advantages in certain high-value segments, ASEAN's progress is progressively diminishing the gap that exists between the two regions.

5.5 ASEAN-India AGVC

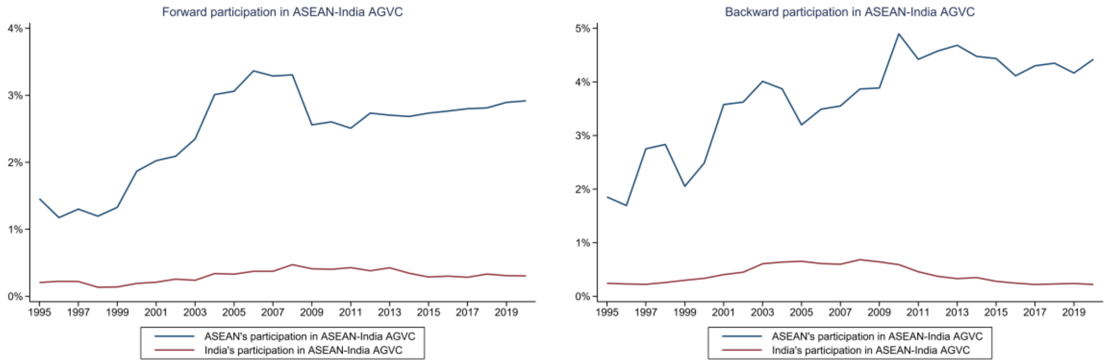

Figure 5-17. Evolution of Forward and Backward Participation in ASEAN-India AGVC.

Figure 5-17 illustrates the evolution of forward and backward participation in ASEAN-India AGVC from 1995 to 2020. For ASEAN, after experiencing a rapid rise, its forward participation rate fell sharply due to the impact of the financial crisis, followed by a slowdown in the growth of trade in intermediate goods. Meanwhile, ASEAN's backward participation rate showed a fluctuating upward trend over the period, but began to decline gradually after 2011. For India, its forward and backward participation rates have been slowly declining in the wake of the global financial crisis, suggesting a gradual reduction in its trade in intermediate goods with ASEAN.

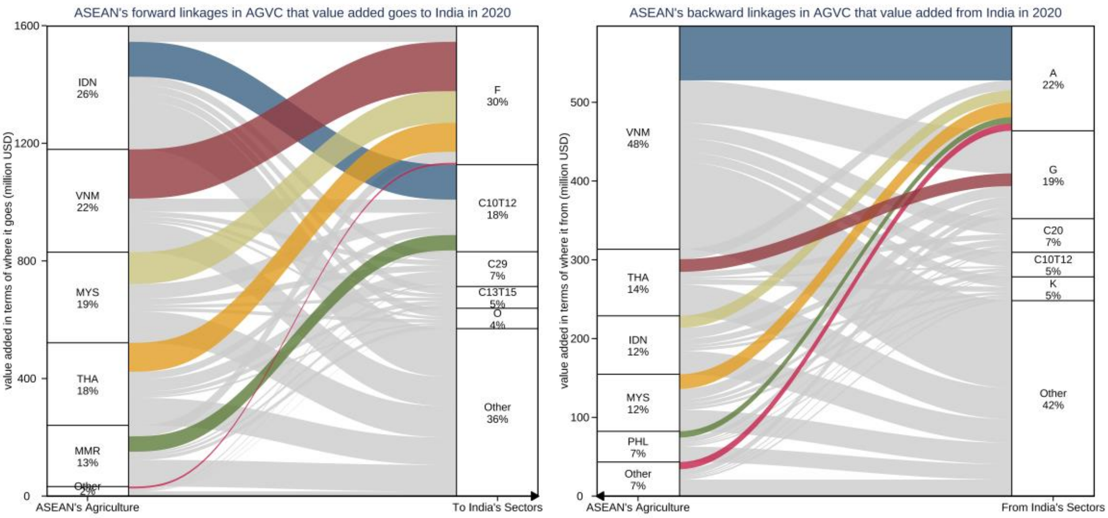

Figure 5-18. Top Sectors in Forward and Backward AGVC Linkages of ASEAN with India in 2020.

Notes: In To India's Sectors column, F: Construction; C10T12: Food products, beverages and tobacco; C29: Motor vehicles, trailers and semi-trailers; C13T15: Textiles, textile products, leather and footwear; O: Public administration, defence and compulsory social security; Other: All sectors except the top five above.

In From India’s Sectors column, A: Agriculture, hunting, forestry and fishing; G: Wholesale, retail trade and repair of motor vehicles; C20: Chemical and chemical products; C10T12: Food products, beverages and tobacco; K: Financial and insurance activities; Other: All sectors except the top five above.

Figure 5-18 plots the top sectors in forward and backward AGVC linkages of ASEAN with India in 2020. According to the left panel, the ASEAN agricultural sector supplied agricultural intermediate goods to the India worth a total of $1,600.54 million, mainly supplied by Indonesia (26%), Vietnam (22%), Malaysia (19%), Thailand (18%), and Myanmar (13%). These goods predominantly flowed into key sectors of India economy, including construction (F, 30%), food products, beverages and tobacco (C10T12, 18%), motor vehicles, trailers and semi-trailers (C29, 7%), textiles, textile products, leather and footwear (C13T15, 5%), public administration, defence and compulsory social security (O,4%).

According to right panel, the value added embodied in intermediate goods and services supplied by India is used in ASEAN’s agricultural final products and services in 2020, amounting to $5,97.42 million. Vietnam had the largest import share at 48%, followed by Thailand (24%), Indonesia (12%), Malaysia (12%), and the Philippines (7%), with other ASEAN countries at 2%. These intermediate goods were mainly sourced from the India’s top sectors, including agriculture, hunting, forestry and fishing (A, 22%), wholesale, retail trade and repair of motor vehicles (G, 19%), chemical and chemical products (C20, 7%), food products, beverages and tobacco (C10T12, 5%), financial and insurance activities (K, 5%).

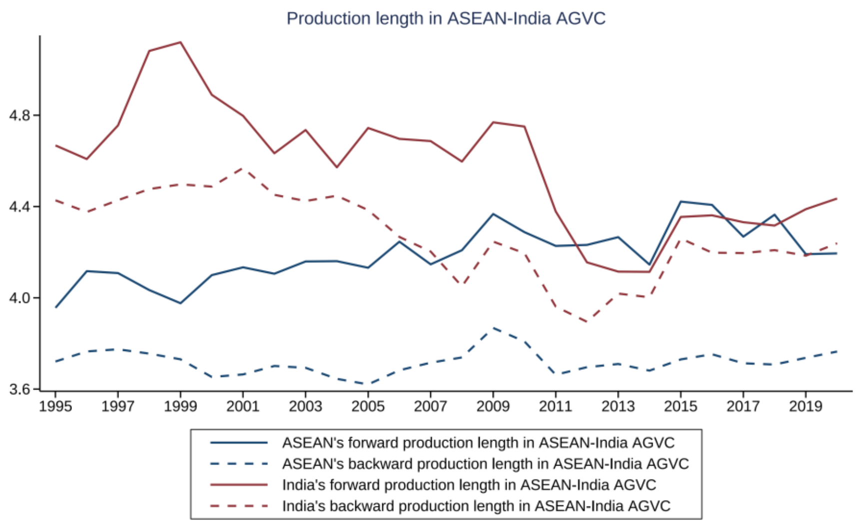

Figure 5-19. Evolution of forward and backward production length in ASEAN-India AGVC.

Figure 5-19 illustrates the evolution of forward and backward production length in ASEAN-India AGVC from 1995 to 2020. For ASEAN, the forward production length increases marginally while the backward production length is relatively flat. This suggests an increased role for ASEAN in providing agricultural intermediate products. These products go through more processing stages in the ASEAN-India production network before becoming final products, reflecting an increased reliance on the provision and use of Indian intermediates in ASEAN agriculture. For India, in contrast, its backward and forward production lengths are gradually shortening, possibly indicating India's increased self-sufficiency in agriculture and reduced reliance on ASEAN intermediates, consistent with the trend in its participation rates in Figure 5-17.

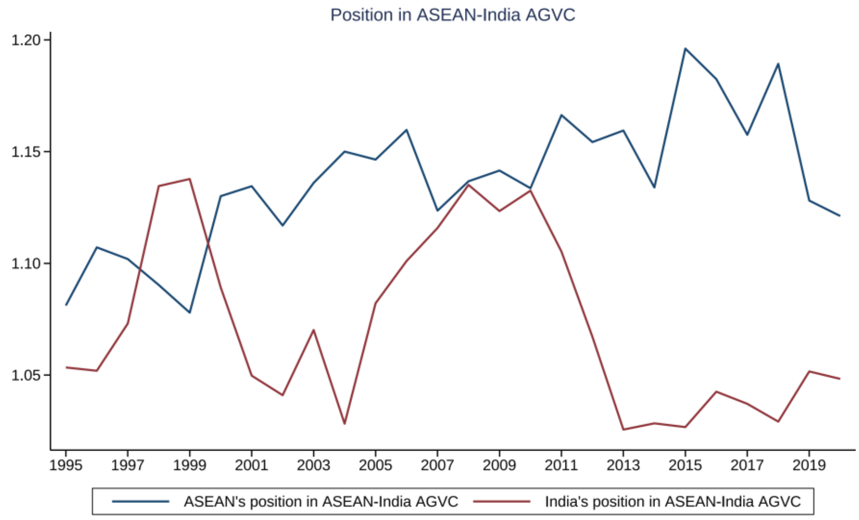

Figure 5-20. Evolution of Position in ASEAN-India AGVC.

Comparing forward to backward production length, we plot the evolution of ASEAN's and the India's positions in their AGVC as shown in Figure 5-20. Results shows that from 1995 to 2020, both ASEAN and India occupied relative upstream positions, underscoring their roles as important producers and suppliers of agricultural intermediates. Referring to Figure 5-18, this positioning is presumably linked to their rich endowments in agricultural resources. Over time, ASEAN has moved relatively closer to the starting point of production in the ASEAN-India AGVC. This shift implies that ASEAN nations, acting as upstream providers to India, have supplied an expanding base of fundamental agricultural intermediates. Meanwhile, India, being a densely populated country, has increasingly turned to external intermediates such as ASEAN to fulfill its agricultural production needs.

6. Conclusions

The report provides an in-depth analysis of ASEAN's Agricultural Global Value Chains (AGVC) from 1995 to 2020 by investigating ASEAN's AGVC with the world and with key partners based on its participation, production length and position at overall, intra- and extra-regional levels.

The report reveals that ASEAN exhibited steady and more pronounced backward participation and increasing forward participation, especially between 1995 and 2006. This indicates that ASEAN has become a more important supplier of agricultural intermediate goods to the world, but it still primarily remains as a user of intermediate goods produced in other countries. The agricultural sector in ASEAN has increasingly relied on intermediate products and services sourced globally, highlighting the region's integration into the AGVC and its dependence on imported intermediate inputs such as seeds, fertilizers, feed, agricultural machinery, energy, chemicals, and related technologies and services. Despite a rapid growth in forward participation rates prior to the 2008 financial crisis, the demand for final goods has since decreased, leading to a stagnation in the growth of ASEAN's forward AGVC participation. This underscores the impact of global economic shifts on the region's agricultural trade.

The report also identifies a notable shift from a global to a regional focus in ASEAN's AGVC participation. This regionalization reflects a strategic move towards strengthening intra-regional cooperation and integration, aiming to reduce supply chain risks and create a more cohesive regional value chain. While regional cooperation is on the rise, international market remains crucial as participations in extra-regional AGVC are still higher, which reflects the sector's deep integration in the AGVC and its reliance on external markets. This finding is consistent with the goals of the *Vision and Strategic Plan for ASEAN Cooperation in food, Agriculture and Forestry (2016-2025)*, which highlights to deepen regional integration, enhance access to global markets as well as ensure equitable, sustainable and inclusive growth (ASEAN Secretariat, 2015).

In terms of intermediates trade flows, most AMS exhibit complex bilateral intermediate flows both across partners and sectors. Overall, ASEAN's agricultural intermediates are predominantly supplied to global sectors such as food products, beverages and tobacco, accommodation and food service activities, agriculture, hunting, forestry and fishing, wholesale, retail trade, and repair of motor vehicles, and construction. Concurrently, the region utilizes intermediates from global sectors including wholesale, retail trade, and repair of motor vehicles, agriculture, hunting, forestry and fishing, mining, quarrying and energy producing products, chemical and chemical products, financial and insurance activities for its agricultural production. This dynamic highlights the regional economic integration and the diversification of the agricultural industry chain within ASEAN.

From the perspective of production length and position, ASEAN's AGVC has seen a continuous increase in both forward and backward production lengths from 1995 to 2020, with a rate more pronounced for the forward length. The position is rising as it shifts from relatively downstream to relatively upstream positions, signifying that ASEAN's exported agricultural intermediates undergo more production and processing stages globally. This extension of the value chain from the provision of intermediate inputs based on agricultural natural resources to agricultural processing and non-agricultural processing is occurring at a faster pace for ASEAN.

We also find that ASEAN has different modes of value chain cooperation with its key five partners, i.e. China, EU, US, Japan and India. Overall, five key partners mainly use ASEAN's agricultural intermediates for food processing, construction and catering industry. ASEAN mainly uses intermediates from wholesale and retail trade, motor vehicle repair, and chemical products from five key partners, while importing science and technology, financial services from the EU and US, and primary agricultural intermediates from India due to differences in the industrial structure of each country. The synergy between ASEAN and these key partners has been instrumental in shaping the regional AGVC landscape. Each partner brings unique strengths and capacities to the table, contributing to a more integrated and competitive global agricultural sector.

The findings suggests that ASEAN should prioritize strengthening intra-regional cooperation to create resilient supply chains. This includes investing in domestic production of essential agricultural inputs to reduce dependence on imports and diversifying export markets to mitigate economic risks. Given the significant shift towards regionalization, ASEAN can reinforce its position in the AGVC by establishing regional trade agreements that promote the free flow of goods and services while harmonizing regulatory standards across member states. At the same time, fostering strategic partnerships with key global players is crucial. These collaborations should focus on technology transfer, market access, and collaborative research to maintain a competitive advantage. Additionally, policies should encourage cross-sector collaboration and expand production lengths upstream to capture higher value-added activities and enhance the region's position in the global economy.

Our research, by providing a comprehensive measurement of the ASEAN AGVC, offers a valuable tool for policymakers to design strategies that can better achieve the Secretariat's goals of building inclusive and competitive AGVC. The insights gained from this report can benefit to targeted policies that foster inclusivity for small farmers, enhance the competitiveness of the agricultural sector, and ensure that the benefits of AGVC integration are equitably distributed.

The analysis conducted in this report also serves as a foundation for designing policies that align with the ASEAN Secretariat's vision for a more cohesive and integrated regional value chain. It provides a basis for future research into areas such as sustainable practices, poverty alleviation, food security, financial services and the impact of environment and climate change on AGVC, which are the concerns of ASEAN (ASEAN Secretariat, 2015). By building on the comprehensive picture provided by this report, future studies can offer more nuanced recommendations for policy and practice.

In conclusion, the report not only offers a detailed examination of ASEAN's AGVC but also provides a basis for policy design and future research. By focusing on strengthening intra-regional cooperation, investing in domestic production, diversifying export markets, and nurturing strategic partnerships, ASEAN can build AGVC that are resilient, competitive, and inclusive. The findings of this report are a testament to the potential of ASEAN's agricultural sector to contribute to the region's economic prosperity and to the global agricultural landscape.

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