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Advancing Free Trade
for Asia-Pacific Prosperity

APEC TiVA Initiative Report Two

Better Understanding Global Value Chains in the APEC Region

APEC Committee on Trade and Investment

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Produced by
The APEC TiVA Core Technical Task Force

and

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China General Administration of Customs

China State Administration of Foreign Exchange (SAFE)

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Introduction

APEC is home to some of the world's most integrated production networks. Recognizing the importance of global value chains (GVCs) in the APEC region, in 2013, APEC economic leaders agreed upon the GVC framework, *Global Value Chain (GVC) Development and Cooperation in the APEC region on the Basis of Previous Work on Connectivity*, encouraging APEC economies to work strategically and take action in creating an enabling environment for GVC development and cooperation.

In May 2014, the Meeting of APEC Ministers Responsible for Trade Qingdao Statement endorsed *the Strategic Framework on Measurement of Trade in Value Added (TiVA) under GVCs*, which called for the development of a TiVA database for the APEC region. In November 2014, APEC economic leaders and ministers approved *APEC Strategic Blueprint for Promoting Global Value Chains Development and Cooperation*, which identified improving statistics related to measuring GVCs as one of the action items among APEC economies. As a result, China and the United States kicked off the APEC TiVA Database Initiative in 2014, aiming to construct the APEC TiVA database by 2018 while also building APEC economies' capacity in TiVA statistics compilation and policy application of GVC analysis.

The first APEC TiVA Initiative Report (the Report One) was published by APEC in November 2019. Documents the methodologies and best practices developed during the five-year course of the APEC TiVA database project, the publication of the Report One contributes to a better understanding of the TiVA compilation process, encourages more statistical capacity building in APEC economies, and enhances the future global and regional TiVA collaboration effort.

This is the second report coming out of the APEC TiVA Initiative (the Report Two). The Report Two consists of three sections. Section one provides background information on the key concepts and approaches related to GVC analysis, describes the three TiVA-based analytical frameworks, and explains the major APEC TiVA indicators as well as their applications in GVC analysis. Section two provides GVC analysis in the APEC region. And section three consists of 21 APEC economy profiles.

It is important to recognize that although TiVA measures are derived from official statistics, the indicators themselves are estimated, typically derived via assumptions. In this sense therefore, the quality of TiVA statistics is subject to the availability of underlying input data, as well as the compilation methodologies and assumptions. TiVA statistics are not meant to replace official statistics. Instead, they supplement official statistics by providing additional information on trade and economic activities.

Section I

Trade in Value Added Approach for GVC Analysis

Chapter 1: Key Concepts and Approaches in Global Value Chain Analysis[1]

Lin JONES, Erika BETHMANN, Meryem DEMIRKAYA (USITC)[2]

World economies are becoming more deeply integrated and interdependent, with global production networks and global value chains (GVCs) among the major drivers of structural economic changes at the global, regional, domestic, industry, and firm levels (Sturgeon and Memedovic 2011). Aiming to give readers an overview of relevant material to facilitate their understanding of APEC TiVA indicators, this chapter highlights some of the key concepts and approaches used in GVC analysis, including trade in value added (TiVA) approach that underlies the APEC TiVA database initiative.

Global Value Chain (GVC) Concepts

Michael Porter first presented the concept of value chains in his influential 1985 book, *Competitive Advantage: Creating and Sustaining Superior Performance*. Porter identifies a value chain as a set of activities that a firm performs to deliver a valuable product or service to the market. A value chain can be broken down into five primary activities:

- *Inbound logistics:* such as receiving raw materials, warehousing, and managing inventory;
- *Operations:* all activities in the process of converting raw materials into a finished product or services;
- *Outbound logistics:* such as delivering the final product or service to the end user;
- *Marketing and sales:* all strategies and activities aimed at incentivizing potential customers to purchase the final product or services, including distribution channel selection, advertising, and pricing;
- *Post-sale services:* all activities that intend to improve consumer experiences, such as customer services, repairs, or maintenance services.

A value chain could also include secondary or support activities that facilitate the efficiency of the primary activities, such as procurement, technology research, product development, human resource management, and firm infrastructure building.

Porter notes that these activities form a firm's value chain, each creating and adding value at every stage toward the end product or service. He suggests that a firm must understand its own value chain to develop and sustain a competitive advantage (Porter 1985).

Supply chain is another commonly used term. Early discussions on supply chains were more logistics-oriented. Since the mid-1990s, however, global manufacturing networks have become increasingly integrated and interdependent. As a result, supply chains have been increasingly associated with business functions and processes beyond logistics within and across companies.[3] The Council of Supply Chain Management Professions (CSCMP)[4] defines a supply chain as the links between companies which interchange materials and information in the logistics process, stretching from acquiring

[1] This chapter is based on Jones, Lin, Meryem Demirkaya, and Erika Bethmann, "The Concepts and Approaches for Global Value Chain Analysis." Journal of International Commerce and Economics, April 2019, https://www.usitc.gov/sites/default/files/publications/332/journals/concepts_approaches_in_gvc_research_final_april_18.pdf.

[2] This article is the result of the ongoing professional research by US International Trade Commission (USITC) staff and is solely meant to represent the opinions and professional research of its author. It is not meant to represent in any way the views of the USITC, any of its individual Commissioners, or U.S. Government.

[3] Recognizing the new dynamics and extended content in supply chains, Council of Logistics Management changed its name to the Council of Supply Chain Management Professionals (CSCMP) in 2005. Robinson (2015).

[4] Formerly the Supply Chain Council.

unprocessed raw materials to delivering finished goods to end users (Vitasek 2013). These links generally encompass three functions: (1) supply of materials to a manufacturer; (2) the manufacturing process; and (3) the distribution of finished goods to final customers through a network of distributors and retailers.[5] Similarly, Stacy Fredrick (2010 and 2014) defines supply chains as production-related input-output links, which she illustrates within the value chain ecosystem using her value-chain reference model (VCRM) diagram (box 1).

The concept of global value chains (GVCs) or global supply chains (GSCs) is the international extension of these definitions, responding to the growing phenomenon of global production fragmentation—the fact that business functionalities and production activities along a value chain are increasingly carried out by various entities located in different economies. As a result, GVC-related international transactions have become an important aspect of cross-border trade, and GVCs have been recognized as an important driver of structural change in the world economy (Sturgeon and Memedovic 2011).

Decreasing trade costs are among the major factors that have contributed to the recent GVC expansion. Trade costs include the whole range of costs that companies face to move goods or services from where they are produced to final consumers (OECD 2012). Global trade liberalization in the past few decades has significantly reduced costs associated with tariffs and some nontariff trade barriers. Regulatory reforms in transport and infrastructure sectors encouraged investment in roads and ports in many economies, improving logistical efficiencies.

The emergence of mega-scale ocean-going vessels and the adoption of standardized containers expanded shipping capacities and reduced average international shipping costs (UNESCAP report 2194). Advancement in information telecommunication technology, such as the Internet, enabled a new breed of logistics, distribution, finance, and business services providers, which facilitated the efficient configuration of GSCs and made the real-time management of GVC activities both feasible and inexpensive.

Corresponding to this more favorable trading environment were increases in offshoring and outsourcing activities, the use of imported intermediate inputs, and trade in intermediate goods. Three hypotheses attempt to explain these phenomena (Kleinert 2003):

- "The *outsourcing hypothesis* argues that companies in industrialized economies respond strategically to increasing import competition from low-wage economies by relocating labor-intensive stages of their production process to foreign economies with abundant labor and lower wages." (Feenstra and Hanson 1996).

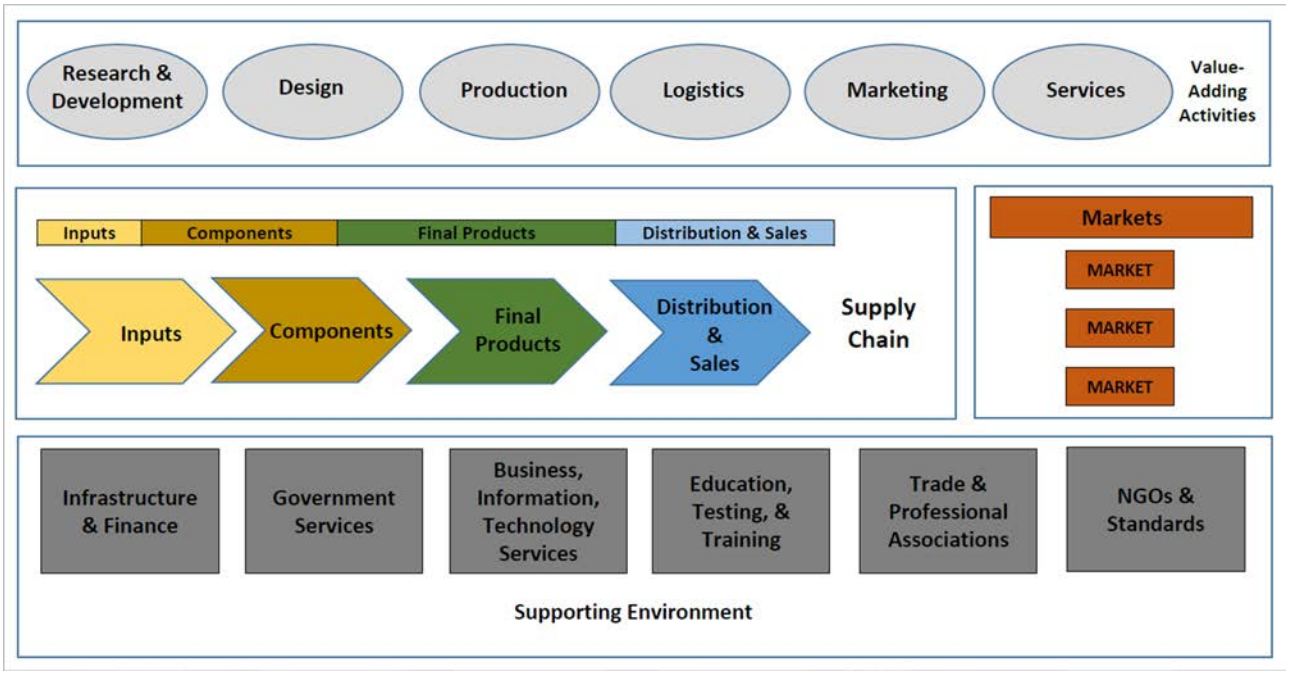
  The *multinational enterprise (MNE) network hypothesis* argues that increasing intermediate goods trade is due to the rising intrafirm trade within the trading networks of MNEs, occurring between MNEs' affiliates in foreign and home economies as well as with parent companies (Anderson and Fredriksson 2000).

- The *global sourcing hypothesis* argues that the increasing use of imported inputs is facilitated by international integration, whose factors, such as migration, proximity, former colonial ties, and common language, help achieve the best match between buyers and sellers (Rauch 1999).

[5] Canadian Supply Chain Sector Council, "Supply chain definitions," http://www.supplychaincanada.org/en/supply-chain.

Box 1.1.1 The value-chain reference model (VCRM) diagram

Introduced by Stacy Frederick (2010 and 2014), the value-chain reference model (VCRM) provides a comprehensive picture of value chain ecosystem. It consists of four parts: *value-adding activities*, *the supply chain*, *end-use markets*, and the *business supporting environment*.



Source: Fredrick (2010 and 2014).

Value-adding activities include the six broad steps that may be required to bring a product or service from a concept to end users. These activities include research and development, design, production, logistics, marketing, and services.

The supply chain describes the input-output process with four basic stages—raw inputs, components and parts, final products, and distribution and sales—which make up production-related links in the value chain. These stages can be linked to the International Standard Industry Classification system (ISIC) or the North American Industrial Classification System (NAICS), and can be used to map the participants in the value chain. These input-output relations may differ substantially for different industries or products.

End-use markets include consumer retail markets, public-use markets, and industrial markets. Each market consists of many different products, but serves different purchasing purposes, whether for private household consumption, public and institutional expenditure, or business capital investment.

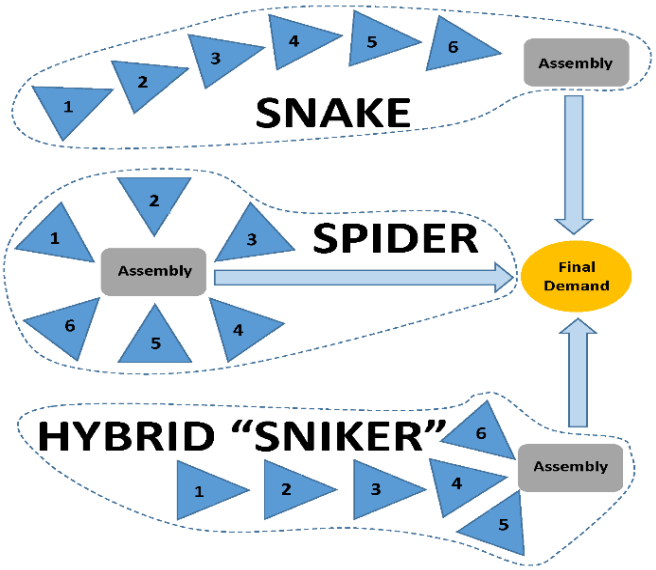
Supporting business environments can be separated into six broad categories: infrastructure and finance; government services; business, information, and technology services; education, testing, and training; trade and professional associations; and nongovernmental organizations (NGOs) and standards. Together they provide the basic structure for all economic activities, and can facilitate or hinder the movement of products along the value chain (Fredrick 2014).

While these hypotheses provide evidence for and arguments about motivations and enabling factors for the development of GVCs, it is rather the fundamental change in production processes that underlies the recent development of international outsourcing and trade. The traditional notion of production for foreign trade is horizontal, meaning that firms or economies are specialized in producing particular final goods or services from scratch within the firm or economy and exporting them. Today, the notion of production is more akin to a highly complex network structure in which components and parts are produced at multiple stages across different economies that are linked horizontally, vertically, and diagonally (Henderson et al. 2002). Firms or economies are specialized in some but not all stages of the production process (Hummels, Rapport, and Yi 1998).

Such intra-product specialization is possible only when various tasks of a production process are physically separable and tradable, enabled by technological change (Grossman and Rossi-Hansberg 2006). Productivity gains, economies of scale, and potential savings in learning costs encourage the creation of firms focusing on component production. International fragmentation of production processes is a precondition for outsourcing and offshoring, and it creates a vertical intra-industry international trade of components and unfinished products, with a good share of this trade generated within MNEs (Andreff 2009).

Baldwin and Venables (2013) identify two different configurations commonly existing in global production sharing: "spiders" and "snakes" (figure 1.1.1). The "spider" refers to multiple limbs (parts) coming together to form a body (assembly), being either the final product itself, or a component. The "snake" refers to the goods moving in a sequence from upstream to downstream, with value added at each stage. Most production networks are complex mixtures of the two, or a so-called "sniker." These configurations affect production locations as well as interactions between firms. The changes in trade frictions could have different outcomes for these two types of configurations (Escaith 2017).

Figure 1.1.1 An illustration of the "Snake, Spider, and Sniker" production configurations



Major Global Value Chain Analytical Approaches

Based on the business and economics literature reviewed, GVC analytical approaches can be grouped into the following four major categories (table 1.1.1). Each approach is discussed in further detail in the subsections below.

Table 1.1.1 Major global value chain (GVC) analytical approaches

Analytical approach	Description	Measurement method[a]
Supply chain management	A business analytical framework from the firm's perspective on how a firm can enhance competitiveness in the context of GVCs.	Specific business/industry expertise
Industry or product case studies	In-depth GVC analysis from the industry's perspective, such as value distribution along a supply chain, key players, the main characteristics of the value chain, etc.	Micro-level firm survey;[b] refined Broad Economic Categories by end use classification[6] to trade statistics.[c]
Input-output based analytical approach	Quantitative analysis from a macro perspective, by applying the input-output framework to measure an economy's specialization in global production networks and its GVC participation.	Trade in value-added (TiVA) measurement based on inter-economy input-output tables.
Other analytical approaches	Applications of general and partial equilibrium models, as well as gravity models, for GVC-related analysis.	Industry or firm data; trade statistics; inter-economy input-output tables, etc.

[a] Daudin, Rifflart, and Schweisguth (2011).

[b] Hanson, Mataloni, and Slaughter (2005).

[c] The Broad Economic Categories (BEC) is a 3-digit classification by U.N. Statistics Division that groups goods according to their main end use. The 4th revision includes seven top categories: food and beverage; industry supplied not elsewhere specified; fuel and lubricants; capital goods, parts and accessories; transport equipment, parts and accessories; consumer goods not elsewhere specified; goods not elsewhere specified. It is linked to the basic classes of goods in the System of economies NA which include consumption goods, intermediate goods, and capital goods. Source: U.N. Statistics Division, "Classification by Broad Economic Categories," http://ec.europa.eu/eurostat/ramon/other_documents/bec/BEC_Rev_4.pdf.

[c] Sturgeon and Memedovic (2011) and Ferrantino and Schmidt (2018).

Supply chain management framework

One major branch of business literature on supply chains is supply chain management (SCM), a business analytical framework from the firm's perspective on how a firm can enhance competitiveness in the context of GVCs. First introduced by business consultants in the 1980s, the concept of SCM has developed significantly over the past two decades, drawing from other branches of literature such as logistics or marketing (Park, Nayyar, and Low 2013; Lambert and Cooper 2000).

There have been various definitions of SCM in the literature. According to New and Payne (1995), SCM encompasses the entire value chain, linking the manufacturing and supply process from raw materials through to the end users. Harland (1996) described SCM as managing business activities and relationships internally within an organization, and externally with suppliers and customers along the supply chain. Farley (1997) reckons SCM is about how firms use their suppliers' processes, technology, and capability to enhance competitive advantage. Lee and Billington (1992) argue SCM is about the coordination of the manufacturing, logistics, and materials management functions within an organization. Park, Nayyar, and Low (2013) and Stadtler (2005) define SCM as "the task of integrating

[6] The Broad Economic Categories (BEC) is a 3-digit classification by U.N. Statistics Division that groups goods according to their main end use. The 4th revision includes seven top categories: food and beverage; industry supplied not elsewhere specified; fuel and lubricants; capital goods, parts and accessories; transport equipment, parts and accessories; consumer goods not elsewhere specified; goods not elsewhere specified. It is linked to the basic classes of goods in the System of economies NA which include consumption goods, intermediate goods, and capital goods. Source: U.N. Statistics Division, "Classification by Broad Economic Categories," http://ec.europa.eu/eurostat/ramon/other_documents/bec/BEC_Rev_4.pdf.

organizational units along a supply chain and coordinating materials, information and financial flows in order to fulfil (ultimate) customer demands with the aim of improving competitiveness of the supply chain as a whole."

In short, SCM can be summarized as a cross-functional, integrated business approach to actively manage supply chain processes for maximizing value creation and achieving sustainable competitive advantages. It is the firm's conscious effort to coordinate supply chains activities in the most efficient way, and to cultivate collaborative supplier-customer relationships to ensure a seamless operation process. Such supply-chain activities include everything from product development, component and part outsourcing, and production to storage and logistics, as well as the information systems needed to coordinate these activities.

Within the past decades, SCM has emerged as a well-adopted business framework that promotes the enhancement of a firm's competitiveness through improvements in the organizational structure and process of a supply chain (Lambert and Cooper 2000; Mentzer et al. 2011). Important aspects of the SCM framework are the relationship between different "nodes" or organizations and their network effect within the supply chains, as well as the integrated nature of organization network that influences business functions (Park, Nayyar, and Low 2013; Mentzer et al. 2011). Forrester (1958) points out the importance of five flows (information, materials, money, manpower, and capital equipment) to the performance of business functions. Developing integrated business functions to effectively manage these flows between different entities in a supply chain is the essence of the SCM framework.

The Supply Chain Operations Reference (SCOR) model is the most recognized management tool under the SCM framework that can be used to evaluate, address, improve, and communicate SCM decisions within a company and with suppliers and customers (SCC 2004). This model is a cross-functional process-reference model developed and endorsed by the Supply Chain Council (SCC). SCOR integrates business concepts of process reengineering, benchmarking, and measurement into its framework (Huan, Sheoran, and Wang 2004), focusing on five distinct management processes of the supply chain: plan, source, make, deliver, and return (SCC 2007).

Industry or product case studies

Industry or product case studies are a common approach offering in-depth GVC analysis with sectoral perspective. Such literature usually maps value distribution along a supply chain, delineates the GVC characteristics, identifies the key actors, and discusses the evolution of GVCs in the corresponding sectors (Sturgeon et al. 2009). This subsection highlights some of the more well-known works.

Gary Gereffi is among an earlier group of researchers who have done considerable work analyzing GVCs at the industry level. Gereffi introduces the perspective of the global commodity chain (GCC), and argues that the governance structure of GCCs is essential to the coordination of the global production system. Two types of GCCs are identified, based on their governance structure: producer-driven and buyer-driven. In producer-driven GCCs, MNEs or integrated industrial enterprises play a central role in controlling the production system, including the forward and backward linkages, through their domestic and foreign subsidiaries and subcontractors. This type of GCC is more common in capital- or technology-intensive industries, such as automotive, computers, aircraft, and electrical machinery. In buyer-driven GCCs, large retailers, brand-named companies, and trading companies play a pivotal role in setting up the production networks through different tiers of contractors, though production is generally carried out by independent factories. This type of GCC is more common in labor-intensive, consumer-goods industries, such as apparel, footwear, toys, consumer electronics, and housewares (Gereffi 1994 and 1999).

Sturgeon et al. (2009) often uses GVC analysis in studies that break out industries into two broad types of firms: *lead firms* and *suppliers*. *Lead firms* focus on product and brand development, marketing, distribution, and sometimes late-stage manufacturing, such as final assembly. *Suppliers* focus on selling products and related services, many of them the result of value-chain activities that lead firms have decided to outsource (Sturgeon 2003; Sturgeon et al. 2009). Sturgeon (2003) introduces the concept of value-chain modularity, which states that distinct breaks in the value chain tend to form at points where information about product or process specifications can be formalized and standardized, largely determined by technical factors. Modular production networks emerge, encompassing nodes of value-

chain activities linked through codified interfirm exchange, to create a global-scale production system. Such networks allow suppliers to take advantage of economy of scale and scope while offering lead firms cost-saving benefits as well as operational flexibility (Sturgeon 2003).

Apparel and textiles

Applying the GCC approach, Gereffi (1994) conducts a case study on the apparel industry, which he identifies as a buyer-driven GCC with two dimensions: textile versus garment manufacturing, and the standardized versus fashion-oriented segments. He discusses the development of the upstream textile and downstream retail industries in the United States, and analyzes the impact of these forward and backward linkages on garment producers as well as outsourcing practices in these industries. He notes the combination of concentrated buying power in the US.. retailing and wholesale sector and excess capacity in overseas factories has permitted large buyers to dictate outsourcing prices and terms with their vendors. Although large buyers are sensitive to factors that could affect the global supply network, they are in a strong position to respond to changing economic and political factors by altering overseas production patterns.

Electronics

The electronics industry is arguably the goods-producing industry with the most dynamic value chain activities. Sturgeon and Kawakami (2011) find that in the past 20 years, East Asia in general and China in particular have become increasingly important in the electronics industry, both as production locations and final markets. Compared to other technology-intensive industries, there is less need for co-location of engineering or design with manufacturing in the electronics industry, and thus it is relatively easy for electronics firms to pursue the strategies of outsourcing and offshoring. As a result, GVCs in the electronics industry are the most geographically extensive and dynamic.

Sturgeon and Kawakami (2011) identify three principal actors in the electronics GVCs: *lead firms*, *platform leaders*, and *contract manufacturers*.

- *Lead firms*, such as Dell, Apple, and Cisco, place orders with suppliers and sell branded products and systems in final markets. These lead firms usually earn market powers through their technological research and development, and big investment in brand development, which allows them to select alternative vendors and capture the lion's share of value created within the chains.

- *Platform leaders*, such as Intel, are the companies which have been successful in implanting their technology into the products of other companies. They have the technological capability and market power to influence the value chains and capture a bulk of the profits. However, platform leaders are not common in electronics sectors other than personal computer (PC) and mobile phone industries.

- *Contract manufacturers* make products for lead firms by providing either production services, or so-called electronics manufacturing services (EMS), or manufacturing plus production design services, or so-called original design manufacturing (ODM) services. Contract manufacturers carry out component purchasing, circuit-board assembly, final assembly, and testing. Since the technology used in electronics manufacturing processes is quite generic, substitutability is relatively high, so contract manufacturers usually face fierce competitions as well as low market power and profit margins. Nonetheless, the rapid rise of contract manufacturers is the most notable feature in the electronics value chains (Sturgeon and Kawakami 2011).

Sturgeon (2003) notes that the production structure of the electronics industry is extremely modular, with semiconductor foundries carrying out chip fabrication, full-services contract manufacturers assembling circuitboards and final products, and the vendors of production equipment, such as Applied Materials and Siemens, driving process technology. This type of industry structure allows "virtual" lead firms and "fabless" design houses without in-house production to carry out global production strategies,

while creating a new class of globally operating suppliers with vast capabilities in production as well as cross-border value chain activity integration (Sturgeon 2003; Sturgeon and Kawakami 2011).

Automotive industry

Sturgeon and his co-authors have also written a number of papers on the automotive industry. They find that the opening of new markets in emerging economies such as India and China has resulted in a surge of foreign direct investment (FDI), and the automotive industry has been transformed from discrete domestic industries into a more integrated global industry (Sturgeon et al. 2009).

As a producer-driven GVC, several unique features distinguish the automotive industry from buyer-driven industries such as textiles. These features include the extreme concentration of lead firms; the lack of open, industry-wide technical standards, which undermines the wide application of modular production; the implementation of lean production techniques and just-in-time (JIT) parts deliveries; the increasing adoption of "build-to-order" and product customization; the wide range of local market differences, such as different emission standards, safety regulations, and road conditions; and the closer proximity of parts production to final assembly and end markets.

The concentrated firm structure gives substantial coordination and buying power to a few giant lead firms, and allows each of them to create its own standards. The lack of industry standardization forces close interaction between lead firms and suppliers, which in turn shapes the structure and relations of value chains. As a result, although the lead firms and largest suppliers have become global with multinational operations, the need for close collaboration on producing customized vehicles for a specific geographic market has led to the development of multiple regional production systems (e.g, North America, East Asia, Latin America). These are characterized by strong regional integration of the production structure and the tight linkage of local and domestic value-chain activities within the region. Because of heavy investment in capital equipment and skills, as well as tight value-chain linkages, these automotive producing clusters tend to be more stable and long-lived than other industries (Sturgeon et al. 2009).

Apple Inc's. products

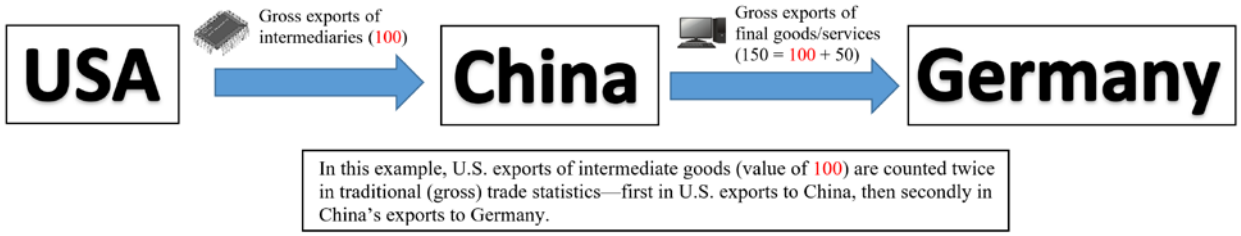
Apple's products are a popular subject for GVC case studies. Dedrick, Kraemer, and Linden (2010) apply a micro-level analytic methodology to measure, map, and analyze the distribution of the value embedded in Apple products along the supply chain. They identify and isolate components used in the products, and obtain the corresponding factory prices and/or costs for these components and parts. They use operating margin rates of suppliers as a proxy to estimate the value captured by these input suppliers. Similarly, they estimate gross profit margins for manufacturing, distribution, and retail services as a proxy to estimate the value captured by these services providers. They find that after these estimates are deducted from the price of Apple products, the residual value—roughly about 30 percent for iPods or iPads, and 56 percent for iPhones—went to Apple, the lead firm in the value chain.

Input-output based analytical approaches

Although qualitative or microdata-based product or industry case studies provide in-depth information on the configuration and characteristics of a specific supply chain, they do not offer a comprehensive picture at the macro level of the gap between value added and gross trade, as well as an economy's participation in global production chains (Koopman, Wang, and Wei 2014, hereafter KWW). Because of the "double-counting" problem in conventional gross trade statistics, mainly caused by intermediate goods crossing borders multiple times, approaches based on conventional trade data risk overstating domestic value-added content of exports (Johnson and Noguera 2012).

Using inter-economy input-output (ICIO) tables that link production processes within and across economies has been recognized as the most feasible, consistent, and comprehensive approach to measure trade in value-added (TiVA) terms globally (Degain et al. 2014).

Figure 1.1.2 An example of the double-counting problem in intermediate goods trade



Source: Authors modified based on a diagram from World Trade Organization (WTO) Secretariat.

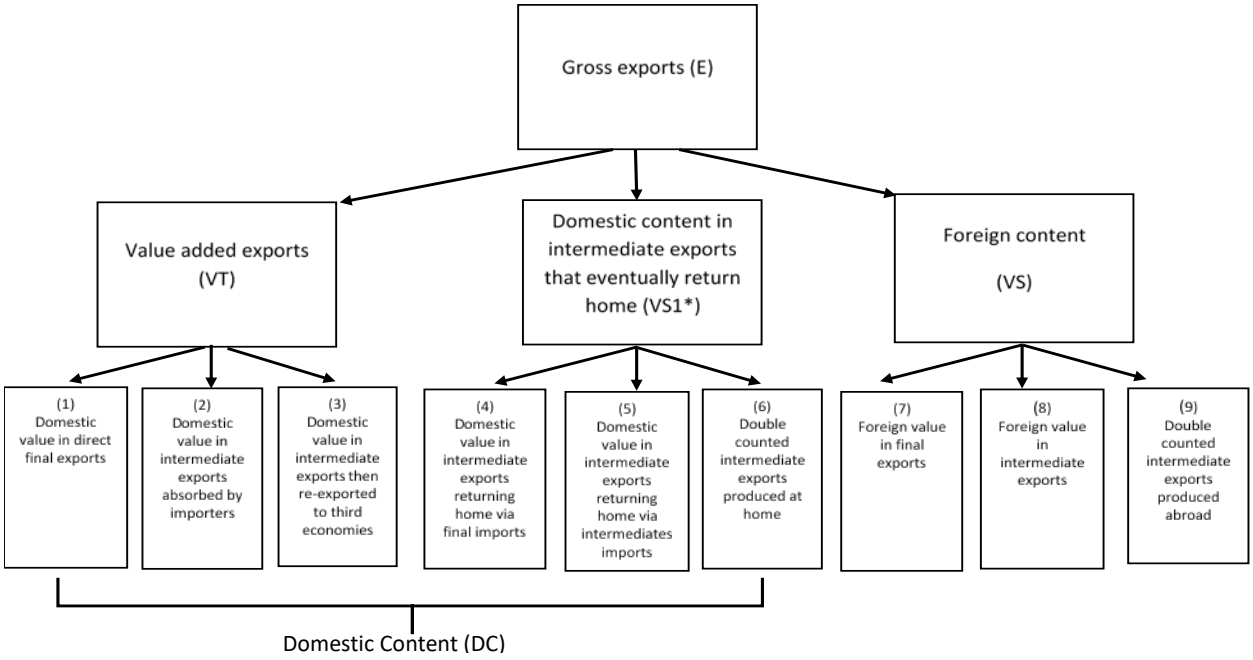
Hummels, Ishii, and Yi (2001, hereafter HIY) are among the early researchers who propose using the input-output framework to estimate foreign value-added content embodied in intermediate imports used for producing exports as a way of measuring vertical specialization (VS). In their computation, they take into account imported inputs that are used directly for the production of exports, as well as indirectly for the production of domestic inputs that are subsequently used in the production of exports. From an export point of view, HIY (2001) proposed an alternative VS measure (VS1) referring to an economy's intermediate exports that are used as inputs into another economy's production of exports.

Johnson and Noguera (2012) pointed out that HIY's (2001) VS measure was applied under the strict assumption that an economy's exports are entirely absorbed in final demand abroad. KWW (2014) had a similar comment regarding the HIY (2001) approach. First, they pointed out a problem with the first assumption in HIY's (2001) VS estimation, which states that the intensity in the use of imported inputs is the same between production for exports and production for domestic sales; KWW (2014) noted that this assumption does not hold in the presence of processing trade. They also pointed out a problem with HIY's (2001) second assumption, which holds that imported inputs are 100 percent foreign sourced. Again, KWW (2014) showed that this assumption does not hold when an economy's initial intermediate goods exports eventually return to the home economy for the next stage of production.

Following HIY (2001), a growing literature uses a similar input-output framework, but adopts different approaches to estimate TiVA measures. Daudin, Rifflart, and Schweisguth (2011) take the HIY (2001) approach further and propose VS1*, defined as the initial exports that come back to the economy of origin as embedded in imported goods that are either consumed, invested, or used as inputs for domestic final use. Using input-output and bilateral trade data from the Global Trade Analysis Project (GTAP), Johnson and Noguera (2012) estimate the ratio of value added to gross exports (VAX) as a way of measuring the intensity of production sharing. Also based on GTAP input-output data but with additional refinement, Koopman, Powers, Wang, and Wei (2010, hereafter KPWW) make the initial effort to decompose gross exports at the economy-sector level, and propose a new way to measure revealed comparative advantage (RCA), bilateral trade balance, and trade-cost effects in value-added terms. Based on the World Input-Output Database (WIOD), Stehrer, Foster, and de Vries (2012) decompose value-added content by splitting production factors into capital and labor with different education attainment.

KWW (2014) extend the gross export decomposition methodology in KPWW (2010), integrating different TiVA measures in the literature. They then provide a unified accounting framework (figure 1.1.3) that breaks gross exports into various value-added components, including value-added exports (VT), domestic value added that returns home (VS1*), foreign value-added (VS), and additional double-counting terms. One of the major contributions of KWW's (2014) gross export accounting framework is that it makes possible to quantify and allocate different types of double-counted terms in gross exports. KWW (2014) differentiates the definitions of "domestic value-added in exports" and "domestic content in exports." The former excludes domestic value added in intermediate exports that eventually returns home (VS1*), but the latter includes VS1*. Another contribution of this framework is bridging the gap between official trade statistics, which are in gross terms, and NA, which are in value-added terms.

Figure 1.1.3 The gross-export accounting framework



Source: Koopman, Wang, and Wei (2014).

Using the gross export accounting framework in KWW (2014), a set of key TiVA measures have been developed and adopted, such as the TiVA measures used in the OECD TiVA database (table 1.1.2). Among them are GVC participation indices reflecting the upstream and downstream links in the GVCs. *Forward participation* refers to domestic value added embodied in foreign exports as a share of total exports of the source economy (OECD, 2017). *Backward participation* refers to foreign value added embodied in exports as a share of total gross exports of the exporting economy (OECD, 2017). *Forward participation* provides the supplier or seller perspective, where an upstream economy exports intermediate inputs for downstream production, and *backward participation* provides buyer or sourcing perspective, where a downstream economy imports intermediate inputs for its production of exports (WTO, accessed December 3, 2018).

Building upon the KWW framework, Wang, Wei, Yu, and Zhu (2017, hereafter WWYZ) propose two additional analytical frameworks, the *GDP decomposition frameworks* and *final goods production decomposition framework*. The *GDP decomposition framework* provides a producer-perspective, forward linkage-based analytical framework, which breaks GDP down into three segments: (1) a pure domestic segment, where production activities directly satisfy domestic final demand; (2) a traditional trade segment related to final goods exports, where production activities are for direct final consumption abroad; and (3) a GVC segment related to intermediate exports, where production activities are for intermediate trade that would be further processed along GVCs. In addition, WWYZ (2017) break down the GVC segment further into simple and complex GVCs: the former refers to production of intermediate inputs that cross borders once; and the latter refers to production of intermediate inputs that cross borders multiple times. The *final goods production decomposition framework* provides a user-perspective, backward linkage-based analytical framework. This framework breaks final-goods production down into domestic and foreign final uses, with embedded value derived from domestic and foreign sources. Under these two frameworks, WWYZ (2017) proposed a new TiVA measure, the production length index, that measures a production chain length from primary inputs in sector i of economy s to final products of sector j in economy r. WWYZ (2017) also revised the measurement of forward and backward GVC participation index: the forward participation index measures the share of production factors employed in an economy-sector pair that are involved in cross economy production sharing activities; the backward participation index measures the share of final products produced by an economy-sector that comes from GVC activities.

Other analytical approaches

A considerable number of papers use other approaches to analyze certain aspects of international trade that are relevant to GVCs. For instance, the Eaton and Kortum model, a Ricardian general equilibrium (GE) trade model (Eaton and Kortum 2002), is often adapted to analyze the impact of production fragmentation and offshoring (Rodríguez-Clare 2010) or the optimal location of production and the specialization of economies within GVCs facing trade barriers (Antràs and de Gortari 2017). Standard computable general equilibrium (CGE) models such as the GTAP model (Tsigas, Wang, and Gehlhar 2012), partial equilibrium (PE) models (Barbe and Riker 2017), gravity models (Baldwin and Taglioni 2011), and econometric approaches (Antràs and Chor 2013) have also been adapted for GVC-related analysis. These methodologies are not provided in further detail, though the results from some of these papers are presented and discussed in the next section.

Table 1.1.2 Selected OECD principal TiVA indicators

Variable	Description
EXGR_DVA	Domestic value added content of gross exports
EXGR_DDC	Direct domestic value added content of gross exports
EXGR_IDC	Indirect domestic value added content of gross exports
EXGR_FVA	Foreign value added content of gross exports
FFD_DVA	Domestic value added embodied in foreign final demand
DFD_FVA	Foreign value added embodied in domestic final demand
DEXFVAPSH	Backward participation in GVCs: Foreign value added embodied in exports, as % of total gross exports of the exporting economy
FEXDVAPSH	Forward participation in GVC: Domestic value added embodied in foreign exports, as % of total gross exports of the source economy

Source: the OECD TiVA database

The Economic Impact of Global Value Chains

While these major analytical approaches provide a variety of tools for better understanding how GVCs have developed and functioned, there remains a great deal of nuance to be explored regarding their local and global externalities. Because GVCs function at such a refined level—linking stages of production for various goods and services across time and space—their economic, social, and political effects vary based on the unique combination of value-chain position and linkage, production stage, location, and product type found in each one. Existing literature has thus far attempted to study the economic impact of GVCs through the lens of familiar indicators, which are generally outlined below as competitiveness, economic development, labor effects, and trade costs.

Competitiveness

Competitiveness is both a driver and a consequence of GVCs. Fully understanding how GVCs affect competitiveness first requires clarification of the concept itself. At the macro level, competitiveness is "the set of institutions, policies and factors that determine the level of productivity of an economy," as defined by the World Economic Forum (WEF), an international organization which has been measuring competiveness among economies since 1979 (Cann 2016). At the micro level, competitiveness is the ability of a given firm to successfully compete in a given business environment (Porter 1990) and outperform its competitors in terms of profitability, sales growth, or market share (Lall 2001). Four main factors contribute to a firm's competitiveness: (1) production and delivery capabilities, (2) production and delivery costs, (3) operational capacity, and (4) innovation and product differentiation

(David, Semanik, and Torsekar 2018). Whether at the economy or firm level, the common parameters for measuring competitiveness have long been relative productivity or efficiency (Reinert 1995).

In the context of international trade, competitiveness has been defined as the measure of an economy's advantage or disadvantage in selling products or services in international markets (OECD 2014). Based on traditional trade statistics, Balassa (1965) develops the *revealed comparative advantage* (RCA) *index* as a measure of an economy's relative trade performance and competitiveness by comparing the share of a sector in an economy's total exports relative to the world average of the same sector in world total exports. The resulting index reveals the economy's comparative advantage (disadvantage) in exporting a product if the index's value is greater (less) than one (Pelzmen 2016).

Just as the rise of GVCs has fundamentally changed the structure of international trade, their emergence also demands new approaches to measuring competitiveness in international trade. Standard RCA applications, which are in gross terms and thus double-count intermediate input trade flows, often over- or underestimate an economy's comparative advantage. Recognizing this double-counting problem in using traditional trade statistics, KPWW (2010) and KWW (2014) apply the RCA approach to TiVA statistics and use domestic value added instead of gross exports. They find notable differences between the results obtained using these two measures.

For instance, with standard RCA indices, both China and India have strong revealed comparative advantage in the finished-metal products sector and are ranked first and fourth, respectively, among the set of economies KPWW (2010) and KWW (2014) study. However, using value-added RCA indices, both economies' revealed comparative advantage as well as their rankings decline, while the rankings for some other economies move up. In fact, India even shifts from having a comparative advantage to having a comparative disadvantage in this sector. Applying similar methodology, Escaith and Miroudot (2016) calculate the differences between the standard and value-added RCAs at sector level for 61 economies, and their results show that the differences can be significant for some economies. Such revelations have spurred the discussion on expanding competitiveness measures to incorporate market accessibility, productivity performance, training and research levels, infrastructure, and regulatory environments in the context of GVCs (Timmer et al. 2013).

The impacts on competitiveness from GVC participation are dynamic and not universally felt. For example, small and medium-sized enterprises (SMEs), which account for 90 percent of all firms in most economies, face dual issues with regard to competitiveness (Park, Nayyar, and Low 2013). As SMEs are relatively less burdened by massive production chains and bureaucratic processes, GVCs offer increased opportunities for flexible SMEs to enter the global market at various production niches. However, SMEs in niche markets also face encroachment from larger enterprises with superior resources and market power (Park, Nayyar, and Low 2013). Ultimately, the outcome on competitiveness depends on SMEs' ability to increase productivity, a topic covered in the following subsection on economic development.

Economic development

The rise of GVCs has led to changes in international trade and economic development paradigms (Taglioni and Winkler 2016). Policy makers increasingly recognize that the economic opportunities from GVC participation go beyond the traditional notion of increasing exports; opportunities also include technology and knowledge transfer, rising FDI, and human capital upgrading. These benefits can lead to long-lasting productivity gains and sustainable economic growth. Low- and middle-income economies (LMICs) are particularly situated to benefit from GVCs, as their participation fosters an adeptness that enhances ongoing processes of industrialization and "servicification" (Taglioni and Winkler 2016).

At the economy or firm level, GVCs can stimulate productivity growth through four channels: (1) specialization, (2) foreign inputs, (3) technology spillovers, and (4) knowledge transfer. The expansion of GVCs allows greater specialization in specific activities within value chains (Criscuolo, Timmis, and Johnstone 2016). Participating firms are able to capture productivity gains by specializing in core tasks that represent their most efficient allocation of resources, while offshoring tasks at which they are comparatively less efficient (Grossman and Rossi-Hanberg 2008).

Such specialization is enabled and facilitated by the increasing accessibility of foreign intermediate inputs (Criscuolo, Timmis, and Johnstone 2016). Based on having comparative advantage in a value chain, firms can participate as upstream suppliers of inputs to foreign firms through forward linkage, and/or as downstream producers using foreign inputs in their own production and exports through backward linkage. GVC linkages allow greater economies of scale in specialization and better leveraging of cross-border complementarities. GVC participation provides not only competitive alternatives to domestic sourcing, but also greater variety and quality of foreign inputs available to a local economy (Amiti and Konings 2007; Topalova and Khandelwal 2011; Bas and Strauss-Kahn 2015). These participation benefits can lead to productivity gains in GVC-participating firms.

GVC participation also brings local firms into closer contact with "open innovation" systems, as well as advanced knowledge, technologies, and standards set by major GVC participants, thus inducing technology/knowledge spillovers (Teece et al. 1997; Sturgeon and Memedovic 2010; Ketels and Memedovic 2008). Such benefits can be realized through three mechanisms in GVCs. The first mechanism—*the diffusion effect*—states that MNEs can assist local firms through knowledge and technology sharing. The second mechanism—*the availability and quality effect*—states that GVC participation increases the availability and quality of inputs in the buyer's industry. The third mechanism—*the demonstration effect*—states that technology and knowledge spillovers happen by firms "imitating or reverse engineering GVC products, business models, marketing strategies, production processes, and export processes" (Taglioni and Winkler 2016).

Though participating in GVCs allows developing economies to capture productivity gains in the global market, some economies may eventually experience a slowdown—also known as the middle-income trap (Engel and Taglioni 2017). According to the OECD, such a slowdown can be offset by moving towards higher-value added activities within or across industries (OECD 2013). Depending on an economy's relative level of economic development, it can use such upgrading to maintain or improve its position in the global economy (Gereffi and Fernandez-Stark 2016). Within the GVC framework, Humphrey and Schmitz (2002) identify four types of upgrading: (1) process upgrading; (2) functional upgrading; (3) product upgrading; and (4) chain or inter-sectoral upgrading. Process and functional upgrading focus on productivity improvements, such as improving organizational or technological efficiencies. Product and chain upgrading emphasize moving vertically or horizontally along value chains (Humphrey and Schmitz 2002). Both product and chain upgrading require developing specialization in new tasks with a higher value added (Humphrey and Schmitz 2002). Bamber et al. (2014) present three upgrading opportunities in GVCs: entry into the value chain, upgrading backward linkages, and upgrading the end market. Most literature uses improvement in export volume or export unit value as a common measure of upgrading (Milberg and Winkler 2011).

Labor effects

It is challenging to assess the net effects of GVCs on labor demand, wages, skills, and levels of inclusion (Farole 2016). Because most of the structural changes in labor markets are triggered by technological innovations or changes in consumer demand, isolating GVC effects from other contributing factors can be quite difficult (Escaith, Inomata, and Miroudot 2018).

Developed economies

The labor impact associated with outsourcing and offshoring in advanced economies is well established. Early work by Feenstra and Hanson (1996 and 1999) finds that outsourcing of non-skill-intensive activities in goods-producing sectors accounts for 31−51 percent of the increase in relative demand for skilled labor, contributing to the rising wage inequality between skilled and non-skilled workers in the United States. Their follow-up work argues that the labor effect of trade—especially trade in intermediate inputs—is larger than most studies give credit for, thereby reaffirming that production sharing and foreign outsourcing has contributed to increases in the share of wages paid to skilled workers in the cases of the United States; Japan; Hong Kong, China; and Mexico (Feenstra and Hanson 2001). Acemoglu and Autor (2010) shares a similar finding that offshoring and outsourcing reinforces the skill-biased labor effects of technical change in advanced economies. Hummels et al. (2014) finds that offshoring contributes to the widening wage gap between skilled and less skilled employees in Denmark. The recent study by Farole, Hollweg, and Winkler (2018) confirms that this polarized labor skill effect is most evident in high-income economies, but also appear to a lesser degree, in emerging economies.

While the GVC effect of skill polarization in relative labor demand and wages seems indisputable, the effect on total labor demand in advanced economies is less straightforward because of the conflicting results generated through different channels. First, *the substitution effect*: offshoring moves a portion of production activities overseas and replaces domestic labor with foreign labor, thus reducing domestic labor demand. Secondly, *the productivity effect:* outsourcing allows a greater degree of specialization and improves labor productivity, thus reducing labor demand for each unit of output. Lastly, *the scale effect*: offshoring reduces production cost, leading to lower prices and higher demand, which in turn increases demand for labor to produce higher output (Amiti and Wei 2009; Farole, Hollweg, and Winkler 2018). The net effect on labor demand should be determined by how these three effects play out in an economy.

With the GE approach, Antràs, Fort, and Tintelnot (2017) illustrate a net-negative direct impact on US domestic employment given increased outsourcing opportunity from China. Their analysis concludes that the gains from increased production and domestic outsourcing by US manufacturing firms outweigh the loss from non-outsourcing firms that either contracted or exited the market. With the input-output approach, Wang et al. (2018) find a net positive impact on US total employment and real wages from imports of intermediate inputs from China. The negative labor effect in directly competing manufacturing and related upstream industries is was more than offset by the positive gains in the downstream industries, which benefited from lower-priced Chinese intermediate inputs, especially in services sectors.

Developing economies

Theoretically, GVC participation creates more exporting opportunities for firms in developing economies; and exporting firms generally employ more workers and pay higher wages, which should lead to a positive labor effect (Shepherd 2013). Taglioni and Winkler (2016) argue the labor markets in developing economies can benefit from GVC integration through three effects: (1) the *demand effect:* GVC-participating MNEs increase demand for skilled labor in the local labor market; (2) the *skill-upgrading effect*: local labor receives trainings and the types of skill upgrading from MNEs; and (3) the *spillover effect*: local labor moves from MNEs to local firms, bringing acquired skills and knowledge with them.

However, Farole (2016) finds these effects do not always translate into broad positive outcomes in the labor markets of developing economies. Instead, Farole (2016) finds some winners and losers in the

process. Economies with a large labor surplus and low wages see strong job growth following GVC integration. But as sectors and economies upgrade, wages rise while net employment falls, with skilled workers gaining and women losing. The paper identifies several key factors shaping labor outcomes in developing economies, including the type of sectors involved, lead firms' strategies, the domestic skills base, and the institutional environment.

Farole, Hollweg, and Winkler (2018) proceed a step further by differentiating an economy's GVC participation into two types: one as buyers through backward linkage, and the other as sellers through forward linkage. The authors show that the overall labor demand is positively correlated with GVC participation either as a buyer or a seller, but the latter with a much lower magnitude. The intensity of backward GVC integration, measured by the share of foreign value added in exports, is negatively correlated with labor demand in the direct sector, though the positive effect in the indirect sectors is large enough to offset the negative direct effect, resulting in greater aggregate labor demand.[7] The intensity of forward GVC integration, measured by the share of domestic value added in third economies' exports, is negatively associated with labor demand in both direct and indirect sectors.

It is worth noting that the studies on GVC labor effects in developing economies remain somewhat limited, largely due to the availability and quality issues in labor statistics.

Trade costs

In the past decades, many trade barriers have been reduced or addressed through unilateral trade liberalization, bilateral or regional trade agreements, and multilateral negotiations. However, trade barriers continue to matter, especially in the context of GVCs in which intermediate inputs often cross borders multiple times, potentially causing trade costs that accumulate with a cascading effect along the value chain (Rouzet and Miroudot 2013; Escaith 2017; USITC 2017). Such trade costs include applied tariffs, border taxes, transportation and insurance costs, and un-harmonized regulatory measures. These costs increase production costs by 18 percent, on average, at each stage of the value chain (Escaith 2017). Ferrantino (2012) finds the average ad valorem trade cost of 10 percent leads to a compound ad valorem tariff equivalent to 34 percent by the end of a five-stage supply chain. As the number of production stages increases, the compounded effect escalates. Hence, as these costs accumulate, the expected gains associated with GVC participation are eroded.

Studies find that the costs associated with these barriers are disproportionately burdensome to economies specializing in downstream activities, which exhibit more foreign content in their exports (Escaith 2017). As gross value increases along a GVC, downstream industries typically face relatively larger trade costs from barriers regardless of their own value added (Ferrantino 2012; Rouzet and Miroudot 2013). Antràs and de Gortari (2017) term this relationship between downstreamness and trade costs—which increases along the GVC—as "stage-specific trade cost elasticity."

The compounding effect of trade cost along GVCs has both macro- and micro-economic implications, ranging from the effectiveness and externalities of economies' trade-protection policies to lead firms' decisions on optimal production locations. Diakantoni et al. (2017) find that asymmetrical nontariff measures (NTMs), such as regulations, licensing requirement, contract and institutional weaknesses, and consumer preferences, account for two-thirds of compounded trade costs. These NTMs are found to disproportionately burden developing economies (Ghodsi and Stehrer 2016). Using simulations, Diakantoni et al. (2017) find that trade costs erode 27 percent of the gross profit margin of the highly

[7] The direct sector, defined as the exporting sector, is generally located towards the end of the domestic production chain. Likewise, the indirect sector supplies the direct sector with the inputs and can be located upstream in the domestic production chain.

integrated German automotive industry. Additionally, reductions in direct tariffs on imputs from upstream industries reduces the indirect tariffs faced by downstream industries by 5−10 percentage points (Diakantoni et al. 2017; Rouzet and Miroudot 2013).

Summary

The development of GVCs and their economic impact on participating economies, industries, or firms have been widely discussed in business and economics literature. This introductory paper reviews and highlight some of the key topics covered in the GVC literature, aiming to provide readers with broad coverage of the relevant material to develop their understanding of GVC research.

This paper covers key concepts and major analytical approaches commonly used in the GVC literature. It discusses important economic and technical factors driving recent GVC development, and highlights characteristics found in many GVCs, such as producer- and buyer-driven commodity chains, the "snake and spider" value-chain configurations, the rise of contract manufacturing, and modular production. This paper also discusses the economic implications of GVCs on competitiveness, economic development, the labor market, and trade costs.

Although this paper surveys a wide scope of GVC-related literature, and highlights topics central to developing a comprehensive understanding of existing GVC research, it is by no means exhaustive. Nonetheless, we offer this paper as an accessible work that will help industry analysts, trade researchers, and students alike to embark on their own GVC journeys.

Bibliography

Acemoglu, Daron, and David Autor. 2010. "Skills, Tasks and Technologies: Implications for Employment and Earnings." NBER Working Paper 16082. https://www.nber.org/papers/w16082h.

Amiti, Mary, and Jozef Konings. 2007. "Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia." *American Economic Review* 97 (5): 1611–38. http://www.imf.org/external/pubs/ft/wp/2005/wp05146.pdf.

Amiti, Mary, and Shang-Jin Wei. 2009. "Service Offshoring and Productivity: Evidence from the US." *World Economy* 32 (2): 203–20. https://doi.org/10.1111/j.1467-9701.2008.01149.x.

Anderson, Thomas, and Torbörn Fredriksson. 2000. "Distinction between Intermediate and Finished Products in Intra-firm Trade." *International Journal of Industrial Organization* 18 (5): 773–92. https://doi.org/10.1016/S0167-7187(98)00041-1.

Andreff, Wladimir. 2009. "Outsourcing in the New Strategy of Multinational Companies: Foreign Investment, International Subcontracting and Production Relocation." *Papeles de Europa* 18: 5–34. https://www.researchgate.net/publication/28250237/download.

Antràs, Pol, and Davin Chor. 2013. "Organizing the Global Value Chain." *Econometrica* 81, no. 6, 2127–2204. https://scholar.harvard.edu/files/antras/files/antraschorecma.pdf.

Antràs, Pol, and Alonso de Gortari. 2017. "On the Geography of Global Value Chains." NBER Working Paper 23456. https://www.nber.org/papers/w23456.

Antràs, Pol, Teresa C. Fort, and Felix Tintelnot. 2017. "The Margins of Global Sourcing: Theory and Evidence from U.S. Firms." *American Economic Review* 107 (9): 2514–64. https://doi.org/10.1257/aer.20141685d.

Balassa, Bela. 1965. "Trade Liberalisation and 'Revealed' Comparative Advantage." *Manchester School of Economic and Social Studies* 33 (2): 99–123. https://doi.org/10.1111/j.1467-9957.1965.tb00050.x.

Baldwin, Richard, and Daria Taglioni. 2011. "Gravity Chains: Estimating Bilateral Trade Flows When Parts and Components Trade is Important." NBER Working Paper 16672. https://doi.org/10.3386/w16672d.

Baldwin, Richard, and Anthony J. Venables. 2013. "Spiders and Snakes: Offshoring and Agglomeration in the Global Economy." *Journal of International Economics* 90 (2): 245–54. https://doi.org/10.1016/j.jinteco.2013.02.005.

Bamber, Penny, Karina Fernandez-Stark, Gary Gereffi, and Andrew Guinn. 2014. "Connecting Local Producers in Developing Countries to Regional and Global Value Chains." OECD Trade Policy Paper No. 160. https://www.oecd-ilibrary.org/trade/connecting-local-producers-in-developing-countries-to-regional-and-global-value-chains_5jzb95f1885l-enhttps:/doi.org/10.1787/18166873.

Barbe, Andre, and David Riker. 2017. "The Effects of Tariff on Employment in Global Value Chains." USITC Working Paper 2017-07-A. https://www.usitc.gov/publications/332/working_papers/ecwp-2017-07-a-07-13-17-as-pdf_0.pdf.

Bas, Maria, and Vanessa Strauss-Kahn. 2015. "Input-trade Liberalization, Export Prices and Quality Upgrading." *Journal of International Economics* 95 (2): 250–62. https://doi.org/10.1016/j.jinteco.2014.12.005.

Cann, Oliver. 2016. "What Is Competitiveness?" World Economic Forum. https://www.weforum.org/agenda/2016/09/what-is-competitiveness/.

Criscuolo, Chiara, Jonathan Timmis, and Nick Johnstone. 2016. "The Relationship between GVCs and Productivity." Background paper prepared for the 2016 OECD Global Forum on Productivity, Lisbon. http://www.oecd.org/global- forum- productivity/events/Draft_Paper_Relationship_Between_GVCs_and_Productivity_Final_v12.pdf.

Daudin, Guillaume, Christine Rifflart, and Danielle Schweisguth. 2011. "Who Produces for Whom in the World Economy?" *Canadian Journal of Economics* 44 (4): 1403−37. https://doi.org/10.1111/j.1540-5982.2011.01679.x.

David, Andrew, Mitchell Semanik, and Mihir Torsekar. 2018. "Framework for Analyzing the Competitiveness of Advanced Technology Manufacturing Firms." U.S. International Trade Commission (USITC) Working Paper ID-057. https://www.usitc.gov/publications/332/working_papers/competitiveness_of_advanced_technology_manufacturing_firms_id_18_057_091718.pdf.

Dedrick, Jason, Kenneth L. Kraemer, and Greg Linden. 2010. "Who Profits from Innovation in Global Value Chains? A Study of the iPod and Notebook PCs." *Industrial and Corporate Change* 19 (1): 81−116. https://doi.org/10.1093/icc/dtp032.

Degain, Christophe, Lin Jones, Zhi Wang, and Li Xin. 2014. "The Similarities and Differences among Three Major Inter-Country Input-Output Databases and Their Implications for Trade in Value-Added Estimates." USITC Working Paper 2014-12B. https://www.usitc.gov/publications/332/ec201412b.pdf.

Diakantoni, Antonia, Hubert Escaith, Michael Roberts, and Thomas Verbeet. 2017. "Accumulating Trade Costs and Competitiveness in Global Value Chains." World Trade Organization (WTO) Economic Research and Statistics Division (ERSD) Working Paper 2017-2. https://doi.org/10.13140/RG.2.2.13663.66726.

Eaton, Jonathan, and Samuel Kortum. 2002. "Technology, Geography, and Trade." *Econometrica* 70 (5): 1741−79. https://doi.org/10.1111/1468-0262.00352d.

Engel, Jakob, and Darcia Taglioni. 2017. "The Middle-Income Trap and Upgrading Along Global Value Chains." Chap. 5 in World Bank et al., *Measuring and Analyzing the Impact of GVCs on Economic Development*. Washington, DC. World Bank. http://www.worldbank.org/en/topic/trade/publication/global-value-chain-development-report-measuring-and-analyzing-the-impact-of-gvcs-on-economic-development.

Escaith, Hubert. 2017. "Accumulated Trade Costs and their Impact on Domestic and International Value Chains." Chap. 4 in World Bank et al., *Measuring and Analyzing the Impact of GVCs on Economic Development*. Washington, DC. World Bank. http://www.worldbank.org/en/topic/trade/publication/global-value-chain-development-report-measuring-and-analyzing-the-impact-of-gvcs-on-economic-development.

Escaith, Hubert, Satoshi Inomata, and Sébastien Miroudot. 2018. "Evolution of Production Networks in the Asia-Pacific Region: A Vision in Value-Added and Employment Dimensions." Chap. 6 in *Asian Economic Integration In An Era Of Global Uncertainty*. Australian National University Press (ANU). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3105290.

Escaith, Hubert, and Sebastian Miroudot. 2016. "Industry-level Competitiveness and Inefficiency Spillovers in Global Value Chains." Paper presented at the 24th International Input-Output Conference, Seoul, South Korea. https://www.iioa.org/conferences/24th/papers/files/2437_20160523071_HESMTiVAandSupplySideSeoul2016finaldraft.pdf.

Farley, GA. 1997. "Discovering Supply Chain Management: A Roundtable Discussion." APICS - The Performance Advantage 7 (1), 38−39. http://www.sciepub.com/reference/44383.

Farole, Thomas. 2016. “Do Global Value Chains Create Jobs?” IZA World of Labor. https://wol.iza.org/articles/do-global-value-chains-create-jobs/long.

Farole, Thomas, Claire Hollweg, and Deborah Winkler. 2018. “Trade in Global Value Chains: An Assessment of Labor Market Implications.” World Bank Working Paper 30249. http://hdl.handle.net/10986/30249.

Feenstra, Robert C., and Gordon H. Hanson. 1996. “Globalization, Outsourcing, and Wage Inequality.” NBER Working Paper 5424. https://www.nber.org/papers/w5424.

Feenstra, Robert C., and Gordon H. Hanson. 1999. “The Impact of Outsourcing and High-Technology Capital on Wages: Estimates for the United States, 1979−1990.” *Quarterly Journal of Economics* 114 (3): 907−40. https://academic.oup.com/qje/article- abstract/114/3/907/1848125?redirectedFrom=fulltexthttps://doi.org/10.1162/003355399556179.

Feenstra, Robert C., and Gordon H. Hanson. 2001. “Global Production Sharing and Rising Inequality: A Survey of Trade and Wages.” NBER Working Paper w8372. https://www.nber.org/papers/w5424h.

Ferrantino, Michael. 2012. “Using Supply Chain Analysis to Examine the Costs of Non-Tariff Measures (NTMs) and the Benefits of Trade Facilitation.” World Trade Organization (WTO) Economic Research and Statistics Division (ERSD) Working Paper 2012-02. https://doi.org/10.2139/ssrn.2006290.

Ferrantino, Michael, and Gabriela Schmidt. 2018. “Using Gross Trade Data to Map Archetypal GVCs.” World Bank Policy Research Working Paper 8296. http://documents.worldbank.org/curated/en/860011515427969143/pdf/WPS8296.pdf.

Forrester, J. W. 1958. “Industrial Dynamics: A Major Breakthrough for Decision Makers.” *Harvard Business Review* 36 (4): 37−66. https://www.scribd.com/doc/158721742/Industrial-Dynamics-A-Major-Breakthrough-for-Decision-Makers.

Frederick, Stacey. 2010. “Development and Application of a Value Chain Research Approach to Understand and Evaluate Internal and External Factors and Relationships Affecting Economic Competitiveness in the Textile Value Chain.” PhD dissertation, North Carolina State University, Raleigh, NC. https://repository.lib.ncsu.edu/handle/1840.16/6190.

Fredrick, Stacey. 2014. “Combing the Global Value Chain and Global I-O Approaches.” Discussion paper presented at the International Conference on the Measurement of International Trade and Economic Globalization, Aguascalientes, Mexico. https://unstats.un.org/mwg-internal/de5fs23hu73ds/progress?id=sFggtdMQ67Idiegug3iv7-fUYA55kkL8fAMd9BVs5V8,

Gereffi, Gary. 1994. “The Organization of Buyer-Driven Global Commodity Chains: How U.S. Retailers Shape Overseas Production Networks.” In *Commodity Chains and Global Capitalism*. Westport, CT: Praeger Publishers, 95–122. https://dukespace.lib.duke.edu/dspace/handle/10161/11457?show=full.

Gereffi, Gary. 1999. “International Trade and Industrial Upgrading in the Apparel Commodity Chain.” *Journal of International Economics* 48 (1): 37−70. https://doi.org/10.1016/S0022-1996(98)00075-0.

Gereffi, Gary, and Karina Fernandez-Stark. 2016. *Global Value Chain Analysis: A Primer*. 2nd Edit. Duke Center on Globalization, Governance & Competitiveness (CGGC). Durham, NC: Duke University. https://unstats.un.org/mwg-internal/de5fs23hu73ds/progress?id=aw8EESnQUepHdcNV9mRkc1-725lnbwgppyrQbcMi6h8,.

Ghodsi, Mahdi, and Robert Stehrer. 2016. “Non-Tariff Measures Trickling through Global Value Chains.” Productivity, Non-Tariff Measures and Openness (PRONTO) Working Paper 3.1, Vienna Institute for International Economic Studies, Vienna. http://pronto.wti.org/media/filer_public/bf/b2/bfb2e091-d3c8-4b3e-b4fb-9924bfd17165/d31_value_chains.pdf.

Grossman, Gene M., and Esteban Rossi-Hansberg. 2006. "The Rise of Offshoring: It's Not Wine for Cloth Anymore." In *The New Economic Geography: Effects and Policy Implications.* Proceedings, Federal Reserve Bank of Kansas City, 59–102. https://www.princeton.edu/~erossi/RO.pdf.

Grossman, Gene M., and Esteban Rossi-Hansberg. 2008. "Trading Tasks: A Simple Theory of Offshoring." *American Economic Review* 98 (5): 1978−97. https://doi.org/0.1257/aer.98.5.1978.

Hanson, Gordon H., Raymond J. Mataloni, and Matthew J. Slaughter. 2005. "Vertical Production Networks in Multinational Firms." *Review of Economics and Statistics* 87 (4): 664−78. https://doi.org/10.1162/003465305775098080d.

Harland, Christine M. 1996. "Supply Chain Management: Relationships, Chains and Networks." *British Journal of Management* 7: S63–80. https://doi.org/10.1111/j.1467-8551.1996.tb00148.xd.

Henderson, Jeffrey, Peter Dicken, Martin Hess, Neil Coe, and Henry Wai-Chung Yeung. 2002. "Global Production Networks and the Analysis of Economic Development." *Review of International Political Economy* 9 (3): 436−64. https://doi.org/10.1080/09692290210150842d.

Huan, Samuel, Sunil Sheoran, and Ge Wang. 2004. "A Review and Analysis of Supply Chain Operation Reference (SCOR) Model." *Supply Chain Management* 9 (1): 23−29. https://www.emeraldinsight.com/doi/abs/10.1108/13598540410517557h.

Hummels, David, Jun Ishii, and Kei-Mu Yi. 2001. "The Nature and Growth of Vertical Specialization in World Trade." *Journal of International Economics* 54 (1): 75–96. http://dx.doi.org/10.1016/S0022-1996(00)00093-3.

Hummels, David, Rasmus Jørgensen, Jakob Munch, and Chong Xiang. 2014. "The Wage Effects of Offshoring: Evidence from Danish Matched Worker-Firm Data." *American Economic Review* 104 (6): 1597–1629. https://doi.org/10.1257/aer.104.6.1597.d.

Hummels, David, Dana Rapoport, and Kei-Mu Yi. 1998. "Vertical Specialization and the Changing Nature of World Trade." *FRBNY Economic Policy Review* 4 (2): 79–99. https://www.newyorkfed.org/medialibrary/media/research/epr/98v04n2/9806humm.pdf.

Humphrey, John, and Hubert Schmitz. 2002. "How Does Insertion in Global Value Chains Affect Upgrading in Industrial Clusters?" *Regional Studies* 36 (9): 1017−1027. https://doi.org/10.1080/0034340022000022198d.

Johnson, Robert C., and Guillermo Noguera. 2012. "Accounting for Intermediates: Production Sharing and Trade in Value Added." *Journal of International Economics* 86 (2): 224–36. https://doi.org/10.1016/j.jinteco.2011.10.003d.

Ketels, Christian HM., and Olga Memedovic. 2008. "From Clusters to Cluster-based Economic Development." *International Journal of Technological Learning, Innovation and Development* 1 (3): 375–392. https://doi.org/10.1504/IJTLID.2008.019979.

Kleinert, Jörn. 2003. "Growing Trade in Intermediate Goods: Outsourcing, Global Sourcing, or Increasing Importance of MNE Networks?" *Review of International Economics* 11 (3): 464−82. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=421963.

Koopman, Robert, William Powers, Zhi Wang, and Shang-Jin Wei. 2010. "Give Credit Where Credit Is Due: Tracing Value Added in Global Production Chains." NBER Working Paper w16426. https://www.nber.org/papers/w16426.

Koopman, Robert, Zhi Wang, and Shang-Jin Wei. 2014. “Tracing Value-Added and Double Counting in Gross Exports.” *American Economic Review* 104 (2): 459–94. https://www.aeaweb.org/articles?id=10.1257/aer.104.2.459.

Lall, Sanjaya. 2001. *Competitiveness, Technology and Skills.* Cheltenham, UK: Edward Elgar Publishing. https://doi.org/10.4337/9781781950555.

Lambert, Douglas M., and Martha C. Cooper. 2000. “Issues in Supply Chain Management.” *Industrial Marketing Managemen*t 29 (1): 65−83. http://www.hatfieldandassociates.com/pdf/issues_in_scm.pdf.

Lee, Hau L., and Corey Billington. 1992. “Managing Supply Chain Inventory: Pitfalls and Opportunities.” *MIT Sloan Management Review* 33 (3): 65−73. https://sloanreview.mit.edu/article/managing-supply-chain-inventory-pitfalls-and-opportunities/.

Mentzer, John T., William DeWitt, James S. Keebler, Soonhong Min, Nancy W. Nix, Carlo D. Smith, and Zach G. Zacharia. 2011. “Defining Supply Chain Management.” *Journal of Business Logistics* 22 (2): 1−25. https://doi.org/10.1002/j.2158-1592.2001.tb00001.x.

Milberg, William, and Deborah Winkler. 2011. “Economic and Social Upgrading in Global Production Networks: Problems of Theory and Measurement.” *International Labour Review* 150 (3-4): 341−65. https://doi.org/10.1111/j.1564-913X.2011.00120.x.

New, Steve, and Philip Payne. 1995. “Research Frameworks in Logistics: Three Models, Seven Dinners and a Survey.” *International Journal of Physical Distribution and Logistics Management* 25 (10): 60−77. https://doi.org/10.1080/13675560903224970.

Organisation for Economic Co-operation and Development (OECD). 2012. “Mapping Global Value Chains.” https://www.oecd.org/dac/aft/MappingGlobalValueChains_web_usb.pdf.

Organisation for Economic Co-operation and Development (OECD). 2013. *Perspectives on Global Development 2013: Industrial Policies in a Changing World*, OECD Publishing, Paris. https://www.oecd-ilibrary.org/development/perspectives-on-global-development-2013_persp_glob_dev-2013-en.

Organisation for Economic Co-operation and Development (OECD). 2014. “OECD Glossary of Statistical Terms: Competitiveness (in international trade) Definition.” OECD. https://stats.oecd.org/glossary/detail.asp?ID=399.

Organisation for Economic Co-operation and Development (OECD). 2017. “TiVA 2016 Indicator: Definitions.” http://www.oecd.org/sti/ind/tiva/TIVA_2016_Definitions.pdf.

Park, Albert, Gaurav Nayyar, and Patrick Low. 2013. *Supply Chain Perspectives and Issues: A Literature Review*. Hong Kong: WTO and Fung Global Institute. https://www.scribd.com/document/178200730/WTO-Supply-Chain-Perspectives-and-Issues-A-Literature-Review.

Pelzman, Joseph. 2016. *Spillover Effects of China Going Global.* Singapore: World Scientific Publishing Pte. https://www.worldscientific.com/worldscibooks/10.1142/9171.

Porter, Michael. 1985. *Competitive Advantage: Creating and Sustaining Superior Performance*. New York: Free Press.

Porter, Michael. 1990. *The Competitive Advantage of Nations.* New York: Free Press.

Rauch, James E. 1999. “Networks Versus Markets in International Trade.” *Journal of International Economics* 48 (1): 7−35. https://doi.org/10.1016/S0022-1996(98)00009-9.

Reinert, Erik S. 1995. “Competitiveness and Its Predecessors: A 500-year Cross-national Perspective.” *Structural Change and Economic Dynamics* 6 (1): 23−42. https://doi.org/10.1016/0954-349x(94)00002-q.

Robinson, Adam. 2015. “The Evolution and History of Supply Chain Management.” Cerasis Rater Transportation Management System. https://cerasis.com/2015/01/23/history-of-supply-chain-management/.

Rodríguez-Clare, Andrés. 2010. “Offshoring in a Ricardian World.” *American Economic Journal: Macroeconomics* 2 (2): 227−58. https://www.aeaweb.org/articles?id=10.1257/mac.2.2.227.

Rouzet, Dorothée, and Sébastien Miroudot. 2013. “The Cumulative Impact of Trade Barriers along the Value Chain: An Empirical Assessment using the OECD Inter-Country Input-Output Model.” Paper presented at the 16th Annual GTAP Conference on Global Economic Analysis, Shanghai, China. https://portal.usitc.gov/ts/graylit/library/2013_Rouzet_Miroudot__The_Cumulative_Impact_of_Trade_Barriers_Along_the_Value.

Saia, Alessandro, Dan Andrews, and Silvia Albrizio. 2015. “Productivity Spillovers from the Global Frontier and Public Policy: Industry-level Evidence.” OECD Economics Department Working Paper 1238. Paris: OECD Publishing. https://www.oecd-ilibrary.org/economics/spillovers-from-the-global-productivity-frontier-and-public-policy_5js03hkvxhmr-enhttp:/dx.doi.org/10.1787/5js03hkvxhmr-en.

Shepherd, Ben. 2013. “Global Value Chains and Developing Country Employment: A Literature Review.” OECD Trade Policy Papers No. 156. Paris: OECD Publishing. https://www.oecd-ilibrary.org/trade/global-value-chains-and-developing-country-employment_5k46j0qw3z7k-en.

Stadtler, Hartmut. 2005. “Supply Chain Management and Advanced Planning: Basics, Overview and Challenges.” *European Journal of Operational Research* 163 (3): 575−88. https://doi.org/10.1016/j.ejor.2004.03.001.

Stehrer, Robert, Neil Foster, and Gaaitzen de Vries. 2012. “Value Added and Factors in Trade: A Comprehensive Approach.” The Vienna Institute for International Economic Studies (wiiw) Working Paper 80. https://econpapers.repec.org/paper/wiiwpaper/80.htm.

Sturgeon, Timothy J. 2003. “What Really Goes On in Silicon Valley? Spatial Clustering and Dispersal in Modular Production Networks.” *Journal of Economic Geography* 3 (2): 199–225. https://doi.org/10.1093/jeg/3.2.199.

Sturgeon, Timothy J., and Momoko Kawakami. 2011. “Global Value Chains in the Electronics Industry: Characteristics, Crisis, and Upgrading Opportunities for Firms from Developing Countries.” International *Journal of Technological Learning, Innovation, and Development* 4 (1/2/3): 120– 47. https://EconPapers.repec.org/RePEc:ids:ijtlid:v:4:y:2011:i:1/2/3:p:120-147.

Sturgeon, Timothy J., and Olga Memedović. 2011 “Mapping Global Value Chains: Intermediate Goods Trade and Structural Change in the World Economy.” United Nations Industrial Development Organization (UNIDO). Development Policy and Strategic Research Branch Working Paper 05/2010. https://www.unido.org/api/opentext/documents/download/9928658/unido-file-9928658.

Sturgeon, Timothy J., Olga Memedović, Johannes Van Biesebroeck, and Gary Gereffi. 2009. “Globalization of the Automotive Industry: Main Features and Trends.” *International Journal Technological Learning, Innovation and Development* 2 (1): 7−24. https://doi.org/10.1504/IJTLID.2009.021954.

Supply Chain Council (SCC). 2007. “Supply-Chain Operations Reference-Model.” http://people.ischool.berkeley.edu/~glushko/IS243Readings/SCORV8.pdf.

Supply Chain Council (SCC). 2004. "The SCOR Model for Supply Chain Strategic Decisions." https://scm.ncsu.edu/scm-articles/article/the-scor-model-for-supply-chain-strategic-decisions.

Taglioni, Daria, and Deborah Winkler. 2016. *Making Global Value Chains Work for Development*. Trade and Development series. Washington, DC: World Bank. http://www.worldbank.org/en/topic/trade/publication/book-making-global-value-chains-work-for-development.

Teece, David J., Gary Pisano, and Amy Shuen. 1997. "Dynamic Capabilities and Strategic Management." *Strategic Management Journal* 18 (7): 509−33. https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z.

Timmer, Marcel P., Bart Los, Robert Stehrer, and Gaaitzen J. de Vries. 2013. "Fragmentation, Incomes, and Jobs: An Analysis of European Competitiveness." *Economic Policy* 28 (76): 613−61. https://academic.oup.com/economicpolicy/article-abstract/28/76/613/2918413?redirectedFrom=fulltext.

Timmer, Marcel P., Erik Dietzenbacher, Bart Los, Robert Stehrer, and Gaaitzen J. de Vries. 2015. "An Illustrated User Guide to the World Input-Output Database: The Case of Global Automotive Production." *Review of International* Economics 23 (3): 575–605. https://doi.org/10.1111/roie.12178.

Topalova, Petia, and Amit Khandelwal. 2011. "Trade Liberalization and Firm Productivity: The Case of India." *Review of Economics and Statistics* 93 (3): 995−1009. https://www.mitpressjournals.org/doi/abs/10.1162/REST_a_00095.

Tsigas, Marinos, Zhi Wang, and Mark Gehlhar. 2012. "How a Global Inter-Country Input-Output Table with Processing Trade Account Can Be Constructed from GTAP Database." Paper prepared for the 15th GTAP Conference, Switzerland.

United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). 2002. "The Impact of Major Technological Advances and Changes." In *Commercial Development of Regional Ports as Logistics Centres*, Report 2194, 5–17. https://www.unescap.org/sites/default/files/pub_2194_fulltext.pdf.

U.N. Statistics Division. 2002. "Classification by Broad Economic Categories." http://ec.europa.eu/eurostat/ramon/other_documents/bec/BEC_Rev_4.pdf.

U.S. International Trade Commission (USITC). 2017. *The Economic Effects of Significant U.S. Import Restraints: Special Topic; Effects of Tariffs and of Customs and Border Procedures on Global Supply Chains, Ninth Update.* USITC Publication 4726, 133–137. Washington, DC. https://www.usitc.gov/publications/332/pub4726.pdf.

Vitasek, Kate. 2013. "Supply Chain Management Terms and Glossary." Council of Supply Chain Management Professionals. https://cscmp.org/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms/CSCMP/Educate/SCM_Definitions_and_Glossary_of_Terms.aspx?hkey=60879588-f65f-4ab5-8c4b-6878815ef921.

Wang, Zhi, Shang-jin Xinding Yu, and Kunfu Zhu. 2017. "Measures of Participation in Global Value Chains and Global Business Cycles." NBER Working Paper 23222. https://www.nber.org/papers/w23222.

Wang, Zhi, Shang-jin Xinding Yu, and Kunfu Zhu. 2017. "Characterizing Global Value Chains: Production Length and Upstreamness." NBER Working Paper 23261. https://www.nber.org/papers/w23261.

Wang, Zhi, Shang-jin Wei, Xinding Yu, and Kunfu Zhu. 2018. "Re-examining the Effects of Trading with China on Local Labor Markets: A Supply Chain Perspective." NBER Working Paper 24886. https://www.nber.org/papers/w24886.

World Trade Organization (WTO). n.d. “Trade in Value Added and Global Value Chains.” Profile Explanatory Notes. https://www.wto.org/english/res_e/statis_e/miwi_e/countryprofiles_e.htm (accessed December 3, 2018).

List of Acronyms

Acronym	Full wording
CGE model	Computable general equilibrium model
CSCMP	Council of Supply Chain Management Professions
EMS	Electronics manufacturing services
FDI	Foreign direct investment
GCC	Global commodity chain
GSC	Global supply chains
GTAP	Global Trade Analysis Project
GVC	Global value chain
ISIC system	International Standard Industry Classification system
JIT delivery	Just-in-time delivery
LMICs	Low- and middle-income economies
MNEs	Multinational enterprises
NAICS	North American Industrial Classification System
NGO	Non-government organization
ODM	Original design manufacturing
OECD	Organization for Economic Co-operation and Development
PE model	Partial equilibrium model
RCA	Revealed comparative advantage
SCC	Supply Chain Council
SCM	Supply chain management
SCOR model	Supply Chain Operations Reference model
SME	Small- and medium-sized enterprise
TiVA	Trade in value added
USITC	U.S. International Trade Commission
VCRM	Value-chain reference model
VS	vertical specialization
WEF	World Economic Forum
WIOD	World Input-Output Database
WTO	World Trade Organization

Chapter 2: Three IO-Based GVC Analytical Frameworks

Lin JONES (USITC)[8], CHEN Quan Run, WANG Fei (UIBE), and Zhi WANG[9]

The APEC TiVA falls into the input-output (IO) based analytical approach mentioned in chapter 1. This type of approaches uses the Leontief input-output model for estimating TiVA measures, which is discussed in detail in this chapter. However, the APEC TiVA database is slightly different from other major TiVA databases in its selection and estimation of key TiVA measures. This chapter presents the three IO based analytical frameworks that the APEC TiVA measures are based upon, aiming to help users better understand the definitions as well as applications of the APEC TiVA indicators.

The Leontief Input-Output Model

Measuring TiVA is directly relevant to the underlying IO structure. The Leontief IO model has been used to measure the inter–industry linkages and investigate the effect of final demand changes on production at the industry level in a single economy framework (Miller and Blair, 2009). Applying the IO model to inter-economy input-output tables (IEIOTs) allows to not only measure inter-industry linkage across economies, but also estimate the effect of final demand changes in one economy on the industry production of another economy.

Table 1.2.1 An inter-economy input-output table (IEIOT) with G economies

		Intermediate Uses				Final Use				Output
		Econ. 1	Econ. 2	…	Econ. G	Econ. 1	Econ. 2	…	Econ. G	
Intermediate Inputs	Econ. 1	$\mathbf{Z}^{11}$	$\mathbf{Z}^{12}$	…	$\mathbf{Z}^{1G}$	$\mathbf{Y}^{11}$	$\mathbf{Y}^{12}$	…	$\mathbf{Y}^{1G}$	$\mathbf{X}^{1}$
	Econ. 2	$\mathbf{Z}^{21}$	$\mathbf{Z}^{22}$	…	$\mathbf{Z}^{2G}$	$\mathbf{Y}^{21}$	$\mathbf{Y}^{22}$	…	$\mathbf{Y}^{2G}$	$\mathbf{X}^{2}$
	…	…	…	…	…	…	…	…	…	…
	Econ. *G*	$\mathbf{Z}^{G1}$	$\mathbf{Z}^{G2}$	…	$\mathbf{Z}^{GG}$	$\mathbf{Y}^{G1}$	$\mathbf{Y}^{G2}$	…	$\mathbf{Y}^{GG}$	$\mathbf{X}^{G}$
Value Added		$\mathbf{V}^{1'}$	$\mathbf{V}^{2'}$	…	$\mathbf{V}^{G'}$					
Output		$\mathbf{X}^{1'}$	$\mathbf{X}^{2'}$	…	$\mathbf{X}^{G'}$					

Matrix $\boldsymbol{Z}$ (with a dimension of NG*NG; N industries; G economies) denotes production-use flows of intermediate inputs. $\boldsymbol{Z}_{i,j}^{s,r}$ denotes industry *i* in sourcing economy *s* supplies product to industry *j* in receiving economy *r* for intermediate use. When the sourcing and receiving economies are different, it denotes inter-economy intermediate transactions; when they are the same, it denotes domestic intermediate transactions. For example, $\boldsymbol{Z}_{AGR,FOD}^{chn,chn}$ denotes China's domestic intermediate production-

[8] This article is the result of the ongoing professional research by US International Trade Commission (USITC) staff and is solely meant to represent the opinions and professional research of its author. It is not meant to represent in any way the views of the USITC, any of its individual Commissioners, or US Government.
[9] Zhi Wang led the technical effort of compiling the APEC region IEIOTs for the APEC TiVA Initiative under his four-year contract with USITC.

use transactions, which Chinese agricultural industry ($_{AGR}$) produces inputs to domestic food industry ($_{FOD}$); $\boldsymbol{Z}_{RBP,MTR}^{mex,usa}$ denotes cross border intermediate production-use transactions, which rubber and plastic industry ($_{RBP}$) in Mexico produces inputs to motor vehicle industry ($_{MTR}$) in the United States.

Matrix $\boldsymbol{Y}$ (with a dimension of G*NG) denotes production-use flows of final products. $\boldsymbol{Y}_i^{s,r}$ denotes the products produced by industry *i* in sourcing economy *s* to receiving economy *r* for final use (including final consumption and capital formation). For example, $\boldsymbol{Y}_{AGR}^{CHL,USA}$ denotes products produced by the agricultural industry in Chile to the United States for final consumption.

Vector $\boldsymbol{V}$ (with a dimension of NG*1) denotes industry value added in a specific economy. $\boldsymbol{V}_i^s$ denotes value added of industry *i* in economy *s*.

Vector $\boldsymbol{X}$ (with a dimension of NG*1) denotes industry gross output in a specific economy. $\boldsymbol{X}_i^s$ denotes gross output of industry *i* in economy *s*.

From the above matrices, the direct input coefficient matrix $\boldsymbol{A} = \boldsymbol{Z} * \widehat{\boldsymbol{X}}^{-1}$ (with a dimension of NG*NG) can be derived. Its element $\mathbf{A}_{i,j}^{s,r}$ indicates intermediate input sourced from industry *i* of economy *s* per unit gross output of industry *j* of receiving economy *r*. $\widehat{\boldsymbol{X}}$ is the diagonal matrix generated from gross output vector $\boldsymbol{X}$.

Based on the above input-output structure, the Leontief input-output model can be written as

$$\mathbf{X} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{Y} = \mathbf{B}\mathbf{Y}$$

Where $\boldsymbol{I}$ is an identity matrix; $\boldsymbol{B}$ is the Leontief inverse matrix. Elements of this matrix express the total output, used both directly and indirectly, required to produce $1 of final product.

When final use of product $\boldsymbol{Y_i}$ **is given**, the total gross output required to produce this bundle of final products is

$$\boldsymbol{X_i} = \mathbf{B}\boldsymbol{Y_i}$$

Value added created to produce this bundle of final products $\boldsymbol{Y_i}$ is

$$\boldsymbol{v_i} = \widehat{\mathbf{V}}\boldsymbol{X_i} = \widehat{\mathbf{V}}\mathbf{B}\boldsymbol{Y_i}$$

(1)

Where $\widehat{\mathbf{V}}$ is a diagonal matrix generated from value added ratio vector $\mathbf{w} = \boldsymbol{V} * X^{-1}$ (i.e. the value added per unit gross output).

Equation (1) also indicates that value added $\boldsymbol{v_i}$ goes to produce $\boldsymbol{Y_i}$.

The direct input coefficient matrix $\boldsymbol{A}$ can be broken down into $\boldsymbol{A^D}$, domestic input coefficient matrix, and $\boldsymbol{A^F}$, foreign or imported input coefficient matrix. Similar, $\boldsymbol{Y}$ can also be broken down into $\boldsymbol{Y^D}$, domestic final demand, and $\boldsymbol{Y^F}$, foreign final demand. Applying these matrices, $\widehat{\mathbf{V}}\mathbf{B}\boldsymbol{Y_i}$ can be decomposed into four matrices, presenting domestic value added or foreign value added used for producing domestic or foreign final demand. Various TiVA indicators can be derived by manipulating these calculations.

Three ICIO-Based GVC Analytical Frameworks

The APEC TiVA indicators are primarily based on three ICIO-based GVC analytical frameworks: Koopman, Wang, Wei, and Zhu (KWWZ 2018) gross trade accounting framework; Wang, Wei, Yu, and Zhu (WWYZ 2017) GDP and final production decomposition frameworks.

Gross Export Decomposition Framework

KWWZ (2018) revised KWW (2014) gross export accounting framework described in chapter 1, by separating double counted items from domestic and foreign value-added content, and thus making the resulting TiVA measures more consistent with GDP. This revised gross export decomposition framework breaks down gross exports (EXGR) into four major categories (diagram 1.2.1):

1) Domestic value added absorbed abroad, or value-added exports in gross exports (EXGR_VAX), which can be broken down into the following three subcategories:
    a. Domestic value added (DVA) embodied in final product exports and consumed by partner directly (DVA_FINdir);
    b. DVA embodied in intermediate product exports and absorbed by partner directly, (DVA_INTdir);
    c. DVA embodied in intermediate product exports to third economies first and then being re-exported to the partner economies, or domestic value embodied in intermediate product exports to the partner economy first, and then being re-exported to third economies (DVA_IND).
2) DVA first exported then returned home (EXGR_RDVA).
3) Foreign value added (EXGR_FVA); and
4) Pure double counted items (EXGR_PDC).

KWW (2014) decomposes DVA_VAX into three sub-terms: the first term (DVA_FIN)[10] and second term (DVAINT)[11] include both domestic value-added directly and indirectly absorbed by the partner economy. In KWWZ (2018) decomposition, DVA_FINdir is a portion of DVAFIN, and DVA_INTdir is a portion of DVAINT, in both of which domestic value added is directly absorbed by the partner economy. These two terms do not involve any additional production activity in third economies. And DVAIND here not only includes the third term (DVA_INTrex)[12] in KWW (2014), but also include domestic value added in intermediate exports indirectly absorbed by the partner economy, both involve production activities in third economies before DVA exports is finally absorbed abroad.

The relationship between these terms from KWW (2014) and KWWZ (2018) can be summarized as DVA_IND=(DVA_FIN + DVA_INT) – (DVA_FINdir + DVA_INTdir) +DVA_INTrex.

Decomposition in KWW (2014) shows which part in gross trade flow can be decomposed by applying the standard Leontief insight directly (final goods trade), which part cannot (intermediate goods trade), while the KWWZ(2018) described here shows which part of DVA of the exporting economy generated by domestic production activities only (DVAFINdir), and which part of DVA of the exporting economy involves production sharing activities in both home and the partner economy (DVAINTdir), and which part of DVA of the exporting economy involves third economies in either production or final demand.

[10] DVAFIN refers to domestic value added embodied in final exports and absorbed by the partner economy. It contains domestic value added embodied in intermediate exports to a third country for producing final products that are consumed by the partner economy.
[11] DVAINT refers to domestic value added embodied in intermediate exports absorbed by the partner economy. It contains indirect domestic value added embodied in intermediate exports to third countries and used by third countries produce intermediate exports absorbed by the partner economy.
[12] DVA_INTrex refers to domestic value added embodied in intermediate exports then being re-exported by the partner country to third economies.

Production Decomposition Frameworks

Building upon the KWW (2014) framework, based on whether production factors employed in the production process involve production sharing between two or more economies, WWYZ (2017) developed two additional analytical frameworks, the GDP and final production decomposition frameworks.

GDP decomposition provides a producer-perspective, forward linkage-based analytical framework. It breaks down GDP production activities (V) by economy or industry into three segments (diagram 1.2.2):

1) The pure domestic segment (V_D), referring to domestic value added in production activities which is to be directly absorbed by domestic final demand without involving international trade. No factor content crosses borders in the entire production and consumption process.
2) The traditional trade, or so-called Ricardian trade segment (V_RT), referring to domestic value added in production activities which is for producing final product exports consumed directly abroad. Therefore, factor content crosses the border only once for final consumption.
3) The forward GVC segment (V_GVC), referring to domestic value added in production activities which is for producing intermediate product exports, and, therefore, being forwarded for further downstream processing along GVCs. Therefore, factor content crosses the border for next stages of production.

   The forward GVC segment can be further broken down into two sub-segments: the simple and complex forward GVC. If intermediate exports are directly absorbed by importers, in which factor content is used in production outside the home economy and crosses the border only once for production, it is considered simple forward GVC (V_GVC_S). If intermediate exports are further re-exported to third economies or return to the home economy, in which factor content crosses the borders at least twice for production, it is considered the complex forward GVC (V_GVC_C).

Final production decomposition, on the other hand, provides a user-perspective, backward linkage-based analytical framework. It breaks down an economy's final production (Y) by economy or industry into three segments (diagram 1.2.3):

1) The pure domestic segment (Y_D), referring to domestic value added used in final production activities which is directly absorbed for domestic consumption without involving international trade. No factor content crosses borders in the entire production and consumption process.
2) The traditional trade or Ricardian trade segment (Y_RT), referring to domestic value added in final production activities which is for producing final product exports consumed abroad directly. Therefore, factor content crosses the border only once for final consumption.
3) The backward GVC segment (Y_GVC), referring to imported intermediate inputs used in final production (therefore the backward linkage) that contain domestic value added returning home and foreign value added.

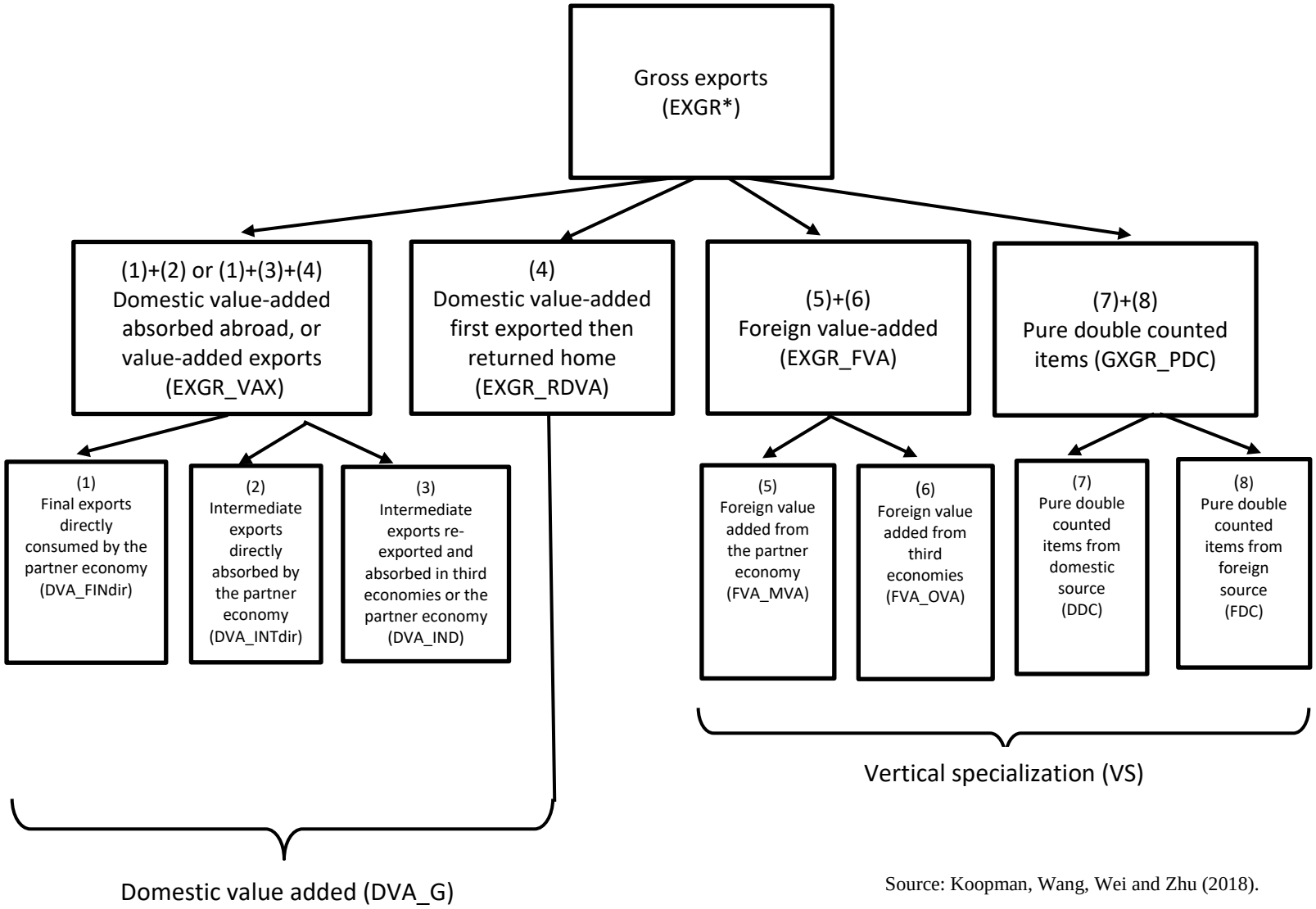
   The backward GVC segment can be further broken down into two sub-segments: the simple and complex backward GVC. If foreign value added embodied in imported intermediates is from direct trading partner and for final production consumed directly at home, it is considered the simple backward GVC (Y_GVC_S). If foreign value added embodied in imported intermediates is from the third economy instead of direct trading partner, or domestic value added embodied in imported intermediates is returning home, regardless whether it is used in final production for meeting domestic final demand, or exported for meeting foreign final

demand, since factor content crosses the borders at least twice, it is considered complex backward GVC (Y_GVC_C).[13]

The key difference between these segments is concerning production sharing. Production activities in the first two segments—the D and RT segments—are entirely conducted within an economy's border, with no cross-economy production sharing. The difference between these two segments is whether they satisfy domestic or foreign final demand. The GVC segment contains cross-economy production sharing activities. The difference between the simple and complex GVC is the number of times that factor content crosses economy borders. In the simple GVC, factor content crosses economy border only once for further production. In the complex GVC, factor content crosses economy borders at least twice. Domestic and import IO coefficient matrixes in ICIO tables are used to distinguish domestic and foreign factor content in various production activities.

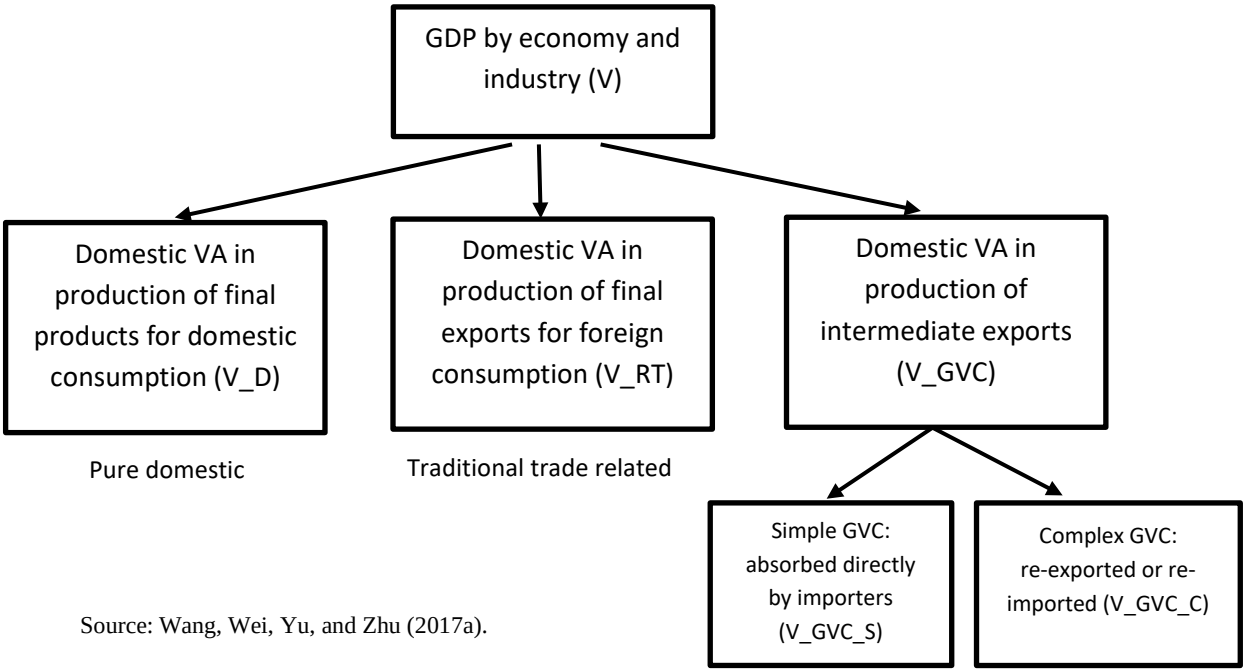
[13] These two measures provide the backward view of V_GVC_S and V_GVC_C.

Diagram 1.2.1 KWWZ (2018) gross exports decomposition framework



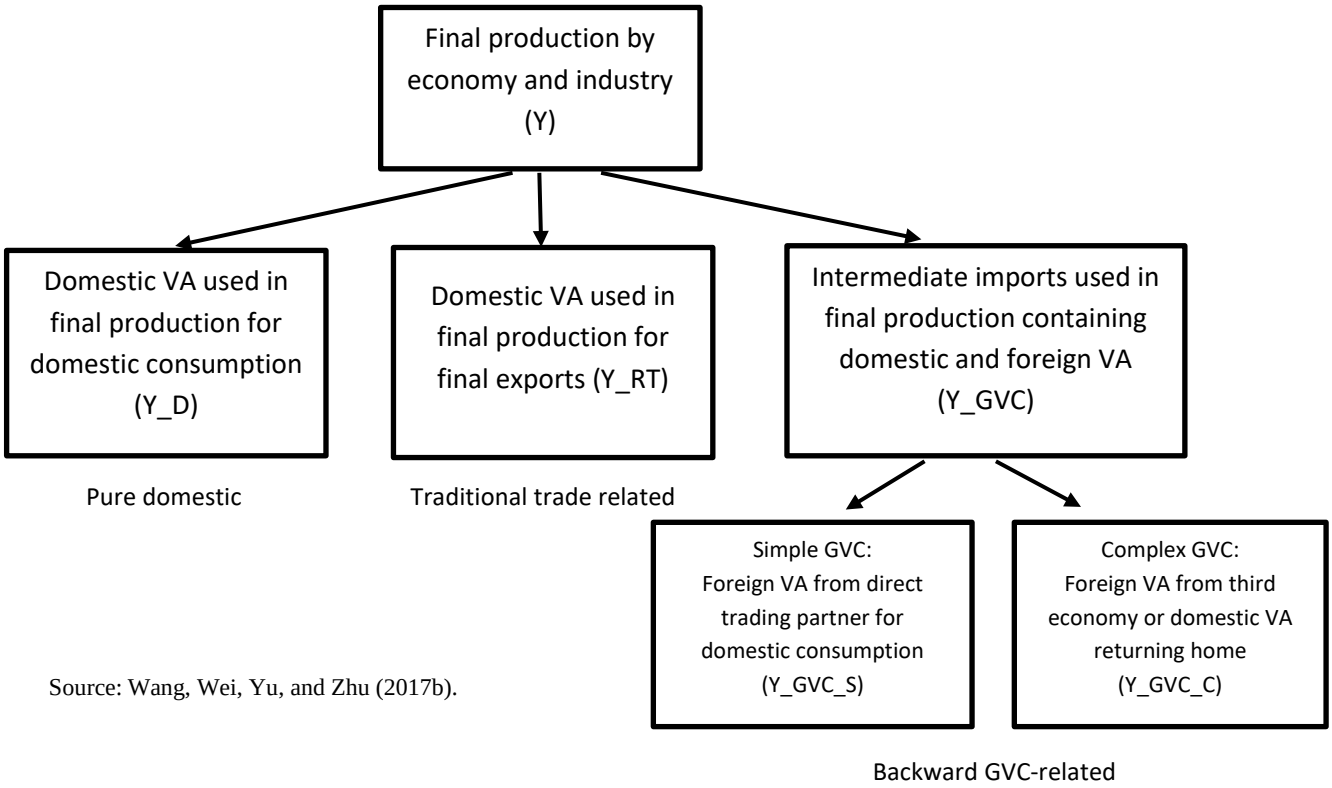
Source: Koopman, Wang, Wei and Zhu (2018).

Diagram 1.2.2 GDP decomposition framework



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

Diagram 1.2.3 Final production decomposition framework



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

Chapter 3: the APEC TiVA Index System

Lin JONES (USITC)[14], CHEN Quan Run, WANG Fei (UIBE)[15], Zhi WANG

The APEC TiVA Index System incorporates six sets of TiVA indicators. They include gross trade indicators; value added trade indicators; gross exports decomposition indicators; GDP production indicators; final production indicators; and global production indicators. This chapter discusses major indicators in each set.

Gross Trade Indicators

Gross trade indicators can be used to measure trade relations in the nominal term. Seven gross trade indicators are available in the absolute value term (millions of US dollar) at the global, bilateral, and sectoral level in the APEC TiVA database (table 1.3.1).

Table 1.3.1 APEC TiVA gross trade indicators

Index	APEC indicator	Definition
1-a	EXGR	Gross exports
1-b	EXGR_INT	Gross exports of intermediate products
1-c	EXGR_FIN	Gross exports of final products
1-d	IMGR	Gross imports
1-e	IMGR_INT	Gross imports of intermediate products
1-f	IMGR_FIN	Gross imports of final products
1-g	BALGR	Gross trade balance

where

$$EXGR = EXGR_{FIN} + EXGR_{INT}$$

$$IMGR = IMGR_{FIN} + IMGR_{INT}$$

$$BALGR = EXGR - IMGR$$

Conceptually, these gross trade indicators are not different from those derived from traditional trade statistics, both of which are in the nominal term. However, gross trade measures in the APEC TiVA database are derived from the symmetric inter-economy input output (IEIOTs) tables, in which global, bilateral, and sectoral trade have been harmonized and balanced at the same valuation.[16] As a result, the values of the APEC TiVA gross trade indicators most likely differ somewhat from the official trade statistics.

[14] This article is the result of the ongoing professional research by US International Trade Commission (USITC) staff and is solely meant to represent the opinions and professional research of its author. It is not meant to represent in any way the views of the USITC, any of its individual Commissioners, or US Government.

[15] The UIBE team, mainly WANG Fei and CHEN Quan Run, compiled the APEC TiVA indicators for the APEC TiVA database.

[16] For more information on the IEIOT compilation methodologies and trade balancing process, please see APEC, *The APEC TiVA Initiative Report One: Methodologies of Constructing the APEC TiVA Database for Better Understanding Global Value Chains in the APEC Region*, November 2019, https://www.apec.org/Publications/2019/11/Methodologies-of-Constructing-the-APEC-TiVA-Database.

Value Added Trade Indicators (Forward Linkage based)

Value added trade indicators can be used to measure trade relations in value added term. Three value-added trade indicators are available in the absolute value term at the global, bilateral, and sectoral level in the APEC TiVA database (table 1.3.2).

Table 1.3.2 APEC TiVA value added trade indicators

Index	APEC indicator	Definition
2-a	EXVA	Value added (VA) exports, or domestic VA embodied in foreign final demand and absorbed abroad
2-b	IMVA	Value-added imports, or foreign VA embodied in domestic final demand
2-c	BALVA	Value added trade balance

Where

$$BALVA = EXVA - IMVA$$

Gross Exports Decomposition Indicators (Backward Linkage based)

Gross exports decomposition indicators can provide useful information on an anatomy of an economy or industry's gross exports. Based on KWW (2014) and KWWZ (2018) gross exports account framework described in chapter 2, this set of the APEC TiVA indicators is available in the absolute value (millions of US dollar) and percentage terms at the bilateral, sectoral and economy aggregate levels (table 1.3.3).

Table 1.3.3 APEC TiVA gross export decomposition indicators

Index	APEC indicator	Definition
3-a	EXGR_VAX[1]	Domestic VA (DVA) in gross exports that is absorbed abroad
3-b	EXGR_DVA_FIN	DVA in gross exports that is consumed as final products by the partner economy
3-b1	EXGR_DVA_FINdir	DVA in final exports that is consumed directly by the partner economy,
3-c	EXGR_DVA_INT	DVA in intermediate exports that is absorbed by the partner economy
3-c1	EXGR_DVA_INTdir	DVA in intermediate exports that is directly absorbed by the partner economy
3-d	EXGR_DVAINTrex	DVA in intermediate exports being re-exported and absorbed in third economies
3-d1	EXGR_DVAINTind	DVA in intermediate exports via third economies indirectly absorbed by the partner economy
3-e	EXGR_RDVA	Domestic VA in gross exports eventually returning home
3-f	EXGR_DVA	Total domestic value added in gross exports, or GDP from export production
3-g	EXGR_FVA	Foreign value added in gross exports
3-g1	EXGR_MVA	Foreign VA (FVA) from the partner economy used in export production that return to and absorbed by the partner; Partner's GDP satisfies final demand in partner economy
3-g2	EXGR_OVA	FVA from third economies used in export production that is finally absorbed by the partner; Third economies' GDP satisfies final demand in the partner economy
3-h	EXGR_PDC	Pure double counted items in gross exports
3-h1	EXGR_DDC	Domestic double counted items in gross exports
3-h2	EXGR_FDC	Foreign double counted items in gross exports
3-i	EXGR_RT	Traditional trade
3-j	EXGR_GVC	GVC-related trade
3-j1	EXGR_GVC_S	Simple GVC-related trade
3-j2	EXGR_GVC_C	Complex GVC-related trade

Note:

[1] At economy aggregate level, $EXGR_{VAX} = EXVA$. At sectoral or bilateral level, they differ.

Where

$$EXGR_{VAX} = EXGR_{DVAFINdir} + EXGR_{DVAINTdir} + EXGR_{DVArex} + EXGR\_DVAind$$

$$EXGR_{DVAind} = EXGR_{DVAFIN} + EXGR_{DVAINT} - EXGR_{DVAFINdir} - EXGR_{DVAINTdir}$$

$$EXGR_{DVA} = EXGR_{VAX} + EXGR_{RDVA}$$

$$EXGR_{FVA} = EXGR_{MVA} + EXGR_{OVA}$$

$$EXGR_{PDC} = EXGR_{DDC} + EXGR_{FDC}$$

$$EXGR_{RT} = EXGR_{DVAFINdir} = Y_{RT}$$

$$EXGR_{GVC} = EXGR - EXGR_{RT}$$

$$EXGR_{GVC\_S} = EXGR_{DVAINTdir}$$

$$EXGR_{GVC\_C} = EXGR_{GVC} - EXGR_{GVC\_S}$$

GDP Production Decomposition Indicators

GDP production decomposition indicators can provide useful information on an anatomy of an economy or industry's value-added production activities. They provide a producer perspective and can be used to measure an economy or industry's forward linkage, such as how susceptible an economy is to external demand, and how integrated an economy is in global or regional production network. Based on the WWYZ (2017a) GDP production decomposition framework described in chapter 2, this set of the APEC TiVA indicators is available in the absolute value (millions of US dollar) and relative value (percent) terms at the economy and sectoral level (table 1.3.4).

Table 1.3.4 APEC TiVA GDP production decomposition indicators (Forward Linkage based)

Index	APEC indicator	Description
4-a	V_D	Domestic VA in production activities directly absorbed by domestic final demand without involving international trade
4-b	V_RT	Domestic VA in production activities for final product exports consumed directly abroad
4-c	V_GVC	Forward GVC participation: domestic VA in production activities for producing intermediate product exports
4-d	V_GVCS	Simple forward GVC participation: domestic VA in intermediate exports directly absorbed by importers
4-e	V_GVCC	Complex forward GVC participation: domestic VA in intermediate exports further re-exported to third economies or return to the home economy

Where

$$V_{GVC} = V_{GVCS} + V_{GVCC}$$

Final Production Decomposition Indicators (Backward Linkage based)

Final production decomposition indicators can provide useful information on an anatomy of an economy or industry's final production activities. They provide a user perspective and can be used to measure an economy or industry's backward linkage, such as how sensitive an economy is to upstream

production activities in other economies, and how important imported intermediates is to an economy's final production. Based on the WWYZ (2017b) final production decomposition framework described in chapter 2, this set of the APEC TiVA indicators is available in the absolute value (millions of US dollar) and relative value (percent) terms at the economy and sectoral level (table 1.3.5).

Table 1.3.5 APEC TiVA final production decomposition indicators

Index	APEC indicator	Description
5-a	Y_D	Domestic VA in final production directly absorbed by domestic final demand without involving international trade
5-b	Y_RT	Domestic VA in final production for final product exports consumed directly abroad
5-c	Y_GVC	Backward GVC participation: imported intermediate inputs used in final production
5-d	Y_GVCS	Simple backward GVC participation: foreign VA in imported intermediates from direct trading partner and absorbed directly at home
5-e	Y_GVCC	Complex backward GVC participation: foreign VA in imported intermediates from the third economy, or domestic value added in imported intermediates returning home

Where

$$Y_{GVC} = Y_{GVCS} + Y_{GVCC}$$

Global Production Indicators

Based on GDP and final production decomposition as well as gross trade decomposition frameworks, the APEC TiVA database provides an additional set of global production indicators more targeted at measuring GVC impact. This set of the APEC TiVA indicators is available in the relative term (percent) at the sector and economy aggregate level (table 1.3.6).

Table 1.3.6 APEC TiVA global production indicators

Index	APEC indicator	Description
6-a	GDP_byFD	Interdependence indicator: GDP driven by final demand from a specific economy, as a share of total GDP
6-b	GDP_byGVC	GVC income indicator: income generated from GVC participation of a specific industry, as a share of total GDP
6-c	GVC_FWD	Forward GVC participation rate: domestic VA in production activities for producing intermediate product exports, as a share of total GDP or sector VA
6-c1	GVCS_FWD	Simple forward GVC participation rate: domestic VA in intermediate exports directly absorbed by importers, as a share of total GDP or sector VA
6-c2	GVCC_FWD	Complex forward GVC participation rate: domestic VA in intermediate exports further re-exported to third economies or return to the home economy, as a share of total GDP or sector VA
6-d	GVC_BWD	Backward GVC participation rate: imported intermediate inputs used in final production, as a share of final production
6-d1	GVCS_BWD	Simple backward GVC participation rate: foreign VA in imported intermediates from direct trading partner and absorbed directly at home, as a share of final production
6-d2	GVCC_BWD	Complex backward GVC participation rate: foreign VA in imported intermediates from the third economy, and domestic value added in imported intermediates returning home, as a share of final production

6-e	Third_FWD	The importance of third economies as a transfer platform for home economy's exports production, as a share of gross exports
6-f	Third_BWD	The importance of third economies' factor content for home economy's export production, as a share of gross exports
6-g	V_EX	GDP from gross export production, as a share of total GDP or sector VA

Where

$$GVC_{FWD} = V_{GVC}/V$$

$$GVCS_{FWD} = V_{GVCS}/V$$

$$GVCC_{FWD} = V_{GVCC}/V$$

$$GVC_{FWD} = GVCS_{FWD} + GVCC_{FWD}$$

$$GVC_{BWD} = Y_{GVC}/Y$$

$$GVCS_{BWD} = Y_{GVCS}/Y$$

$$GVCC_{BWD} = Y_{GVCC}/Y$$

$$GVC_{BWD} = GVCS_{BWD} + GVCC_{BWD}$$

$$Third_{FWD} = (EXGR_{DVAINTrex} + EXGR_{DVAind})/EXGR$$

$$Third_{BWD} = EXGR_{OVA}/EXGR$$

$$V_{EX} = (V_{RT} + V_{GVC})/V$$

Selected OECD TiVA indicators

The APEC TiVA database also provides selected OECD TiVA indicators, which largely are based on KWW (2014) gross export decomposition. In these measures, value added content is presented, which contains double counted items. Therefore, the APEC TiVA database uses different notations from OECD to differentiate value added content from value added (excluding double counted items).[17]

Table 1.3.7 Selected OECD TiVA indicators

Index	APEC indicator	OECD measure	Description
7-a	EXGR_DC	EXGR_DVA	Domestic VA content of gross exports
7-b	EXGR_VS	EXGR_FVA	Foreign VA content of gross exports
7-c	DEXFVAPSH	DEXFVAPSH	OECD backward participation in GVCs: foreign VA content embodied in exports, as % of total gross exports of the exporting economy
7-d	FEXDVAPSH	FEXDVAPSH	OECD forward participation in GVC: domestic VA content embodied in foreign exports, as % of total gross exports of the source economy

[17] For more information on the 2018 OECD TiVA indicators, see OECD TiVA database, "Indicators Guide" http://stats.oecd.org/wbos/fileview2.aspx?IDFile=88076c6d-d86a-4f18-8cd9-923c26fb4c98.

Bibliography

Ahmad, Nadim. “Creating Global Input-output tables.” For the Organisation for Economic Cooperation and Development (OECD), Paris, 2017.

Chen, Q., K. Zhu, P., Liu, X. Chen, K. Tian, L. Yang, and C. Yang (2018) Distinguishing China’s processing trade in the world input-output table and quantifying its effects. *Economic Systems Research*, online: https://doi.org/10.1080/09535315.2018.1535225.

European Commission, International Monetary Fund, Organisation for Economic Cooperation and Development, United Nations, World Bank. “System of National Accounts 2008.” New York, 2009.

International Monetary Fund (IMF). Services Trade Statistics. https://data.imf.org/?sk=07109577-E65D-5CE1-BB21-0CB3098FC505 (accessed various dates).

Johnson, R. C. and G. Noguera (2012) Accounting for Intermediates: Production Sharing and Trade in Value added. *Journal of International Economics*, 86, 225–236.

Koopman, R., Z. Wang and S.J. Wei (2015) Tracing Value-Added and Double Counting in Gross Exports. *American Economic Review*, 105, 559–595.

Miller, R.E. and P.D. Blair (2009) *Input-Output Analysis: Foundations and Extensions*. New York, Cambridge University Press.

Organisation for Economic Cooperation and Development (OECD), OECDstat. Balanced International Merchandise Trade Statistics (by CPA). https://stats.oecd.org/Index.aspxI?DataSetCode=BIMTS_CPA (accessed various dates).

OECD. International Transport and Insurance Costs of Merchandise Trade (ITIC). https://stats.oecd.org/Index.aspx?DataSetCode=CIF_FOB_ITIC (accessed various dates).

OECD. Trade in Services Data. https://data.oecd.org/trade/trade-in-services.htm (accessed various dates).

Streicher, Gerhard and Robert Stehrer. “Whither Panama? Constructing a Consistent and Balanced World SUT System Including International Trade and Transport Margins.” Austrian Institute of Economic Research (WIFO). WIFO Working Paper No. 539. Vienna, 2012.

Timmer, M.P., B. Los, R. Stehrer and G.J. de Vries (2013) Fragmentation, Incomes and Jobs: An Analysis of European Competitiveness. *Economic Policy*, 28, 613-661.

Temurshoev, U. and M. Timmer (2011). Joint Estimation of Supply and Use Tables. *Papers in Regional Science*, 2011, vol. 90, issue 5, 863–882.

Wang, Z., S.J. Wei, X.D. Yu, and K.F. Zhu. 2017. “Measures of Participation in Global Value Chains and Global Business Cycles.” NBER Working Paper 23222. https://www.nber.org/papers/w23222.

World Bank. Trade in Services Databases. https://datacatalog.worldbank.org/dataset/trade-services-database (accessed various dates).

World Bank. World Integrated Trade Solution (WITS). https://wits.worldbank.org/ (accessed various dates).

World Trade Organization – Organisation for Economic Cooperation and Development (WTO-OECD). Balanced Trade in Services Database. https://stats.oecd.org/Index.aspx?DataSetCode=BATIS_EBOPS2002 (accessed various dates).

World Trade Organization (WTO). Services Trade Data. https://www.wto.org/english/res_e/statis_e/tradeserv_stat_e.htm (accessed various dates).

SECTION II

Better Understanding GVC Development in the APEC Region[18]

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Erika Bethmann, USITC

Zhi Wang, George Mason University

This section is based on the TiVA data provided by WANG Fei and CHEN Quan Run (UIBE) in collaboration with Zhi Wang, who compiled the APECSUTs and APECIOTs.[20]

[18] Data source for this section is the APEC TiVA database. Since the APEC TiVA Initiative produced data for only two benchmark years (2005 and 2012), the analysis focuses on the trend between these two benchmark years.
[19] This article is the result of the ongoing professional research by US International Trade Commission (USITC) staff and is solely meant to represent the opinions and professional research of its author. It is not meant to represent in any way the views of the USITC, any of its individual Commissioners, or US Government.
[20] For more information on the SUT/IEIOT compilation methodologies and trade balancing process, please see APEC, *The APEC TiVA Initiative Report One: Methodologies of Constructing the APEC TiVA Database for Better Understanding Global Value Chains in the APEC Region*, November 2019, https://www.apec.org/Publications/2019/11/Methodologies-of-Constructing-the-APEC-TiVA-Database.

Chapter 1: GDP Production Decomposition

GDP production decomposition provides a producer-perspective, forward linkage-based GVC analytical framework. It breaks down GDP production activities into three segments: the pure domestic segment, the traditional trade segment, and the forward GVC segment. The forward GVC segment can be further broken down into two sub-segments: the simple and complex forward GVC. For more information on GDP production decomposition, see Section 1 Chapter 2. For the definitions and detailed information of these segments, see the sections in this chapter below.

Summary: In 2012, the pure domestic segment accounted for the largest share, 83.1 percent of APEC GDP production, while the traditional trade and the forward GVC segments accounted for 3.1 percent and 13.8 percent, respectively. Between 2005 and 2012, the forward GVC segment grew at the fastest pace and with the largest increase in its share of APEC GDP production, the share of traditional trade merely increased 0.1%, while the share of pure domestic production declined.

Large economies, such the United States; Japan; and Australia, had a relatively high share of GDP production in the pure domestic segment and a relatively low share of GDP production in the traditional trade and GVC segments, as their economies typically are driven by their large domestic markets. Small economies, such as Brunei Darussalam; Singapore; Hong Kong, China; and Viet Nam, on the other hand, had a relatively low share of GDP production in the pure domestic segment, and a relatively high share of GDP production in the traditional trade and GVC segments, as they have small domestic markets and rely more on international trade, GVCs, and foreign markets.

In 2012, about 33.8 percent of GDP production in the GVC segment was in the form of the complex forward GVC participation, and while 66.2 percent was in the form of the simple forward GVC participation. The complex forward GVC participation experienced a relatively faster growth rate than the simple forward GVC participation between 2005 and 2012.

Pure Domestic Segment

The pure domestic segment refers to domestic VA in production activities which is to be directly absorbed by domestic final demand without involving international trade. No factor content crosses border in the entire production and consumption process.

In 2005, about $22.1 trillion, or 85.1 percent of total GDP in the APEC region was in the pure domestic segment. In 2012, GDP in this segment increased by 56.2 percent to $34.4 trillion, though its share in total GDP decreased to 83.1 percent. In 2012, the United States had $14.5 trillion, the largest GDP value in the pure domestic segment, followed by China ($6.7 trillion) and Japan ($5.2 trillion). China experienced the largest increase of GDP production in this segment, as its domestic market grew significantly during this period (figure 2.1.1).

Large economies, such the United States; Japan; and Australia, had a relatively high share of GDP in the pure domestic segment, as their economies typically are driven by their large domestic markets and thus less dependent on exports. In comparison, small economies, such as Brunei Darussalam; Singapore; Hong Kong, China; and Viet Nam, had a relatively low share of GDP in the pure domestic segment, as their domestic markets are relatively small, and their economies thus rely more on international trade and foreign markets (figure 2.1.2).

Figure 2.1.1 The pure domestic segment of GDP production (V_D), 2005 and 2012, APEC

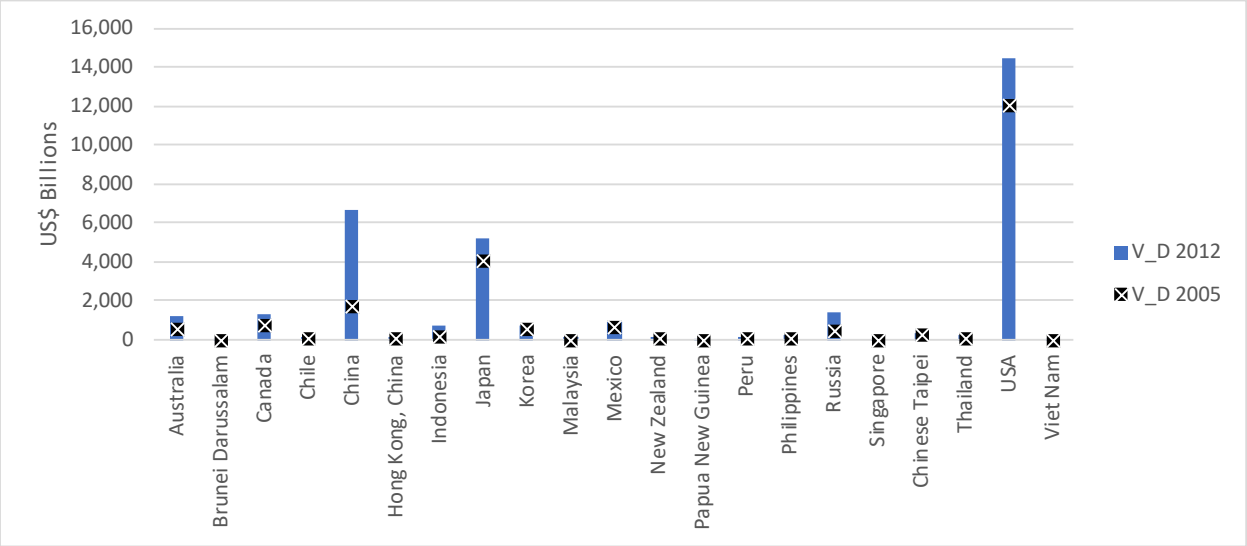
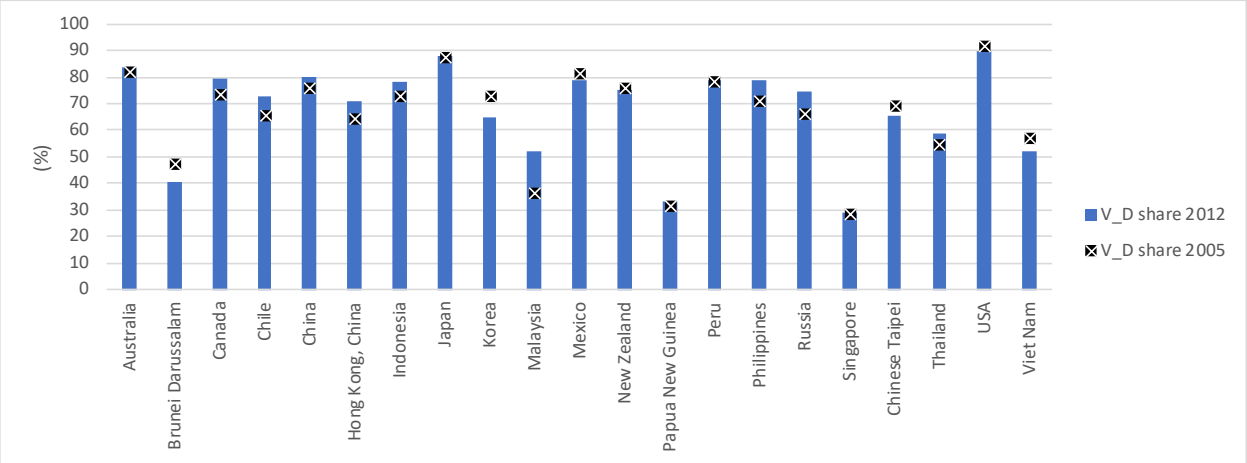


Figure 2.1.2 The pure domestic segment as a share of total GDP (V_D_share), 2005 and 2012, APEC



Traditional Trade Segment

The traditional trade, or so-called Ricardian trade (RT) segment, refers to domestic VA in production activities for final product exports consumed directly abroad. In the traditional trade segment, domestic factor content crosses the border only once for final consumption. [21]

In 2005, about $781.9.6 billion, or 3 percent of total GDP in the APEC region was in the traditional trade segment. In 2012, GDP in this segment increased by 66.4 percent to $1.3 trillion, though its share in total GDP barely changed at 3.1 percent.

In 2005, Japan had the largest GDP value of $159.6 billion in the traditional trade segment, followed by the United States ($145.9 billion) and China ($120.3 billion). Since then, China experienced a large increase of GDP production in the traditional trade segment while Japan experienced a modest decline. As a result, in 2012, China surpassed both Japan and the United States to become the top APEC

[21] In terms of absolute value, the traditional trade segment in gross exports decomposition, GDP production decomposition, and final production decomposition are the same, as they refer to the same domestic VA in production activities for final product exports consumed directly abroad. In terms of relative value, they are different, as the denominators used in these three decompositions were gross exports, GDP, and final production, respectively.

economy in the traditional trade segment with GDP value of $374..3 billion, followed by the United States ($237.8 billion) and Japan ($137.7 billion) (figure 2.1.3).

In terms of the traditional trade segment as a share of total GDP, most APEC economies were relatively stable during this period. Among the few exceptions were Hong Kong, China; Papua New Guinea; Peru; Singapore; and Viet Nam. Small economies, such as Papua New Guinea; Malaysia; Singapore; Thailand; and Viet Nam, had the highest shares of traditional trade in total GDP. In comparison, large economies, such as the United States; Australia; and Japan, had the lowest shares of traditional trade in total GDP. Although China's GDP production in the traditional trade segment experienced the largest increase during this period, as a share, it decreased from 5.2 percent in 2005 to 4.5 percent in 2012 (figure 2.1.4).

Figure 2.1.3 The traditional trade segment of GDP production (V_RT), 2005 and 2012, APEC

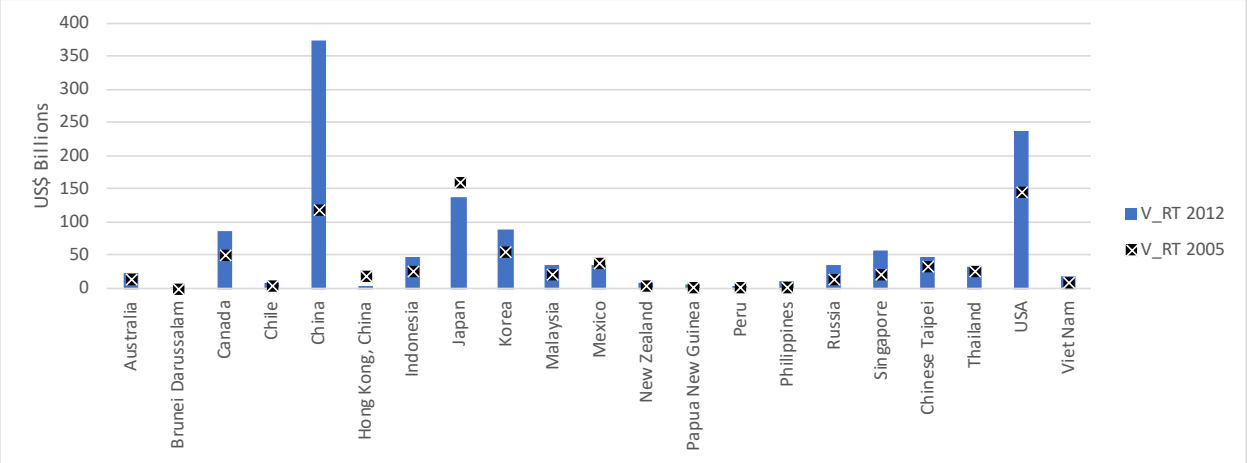
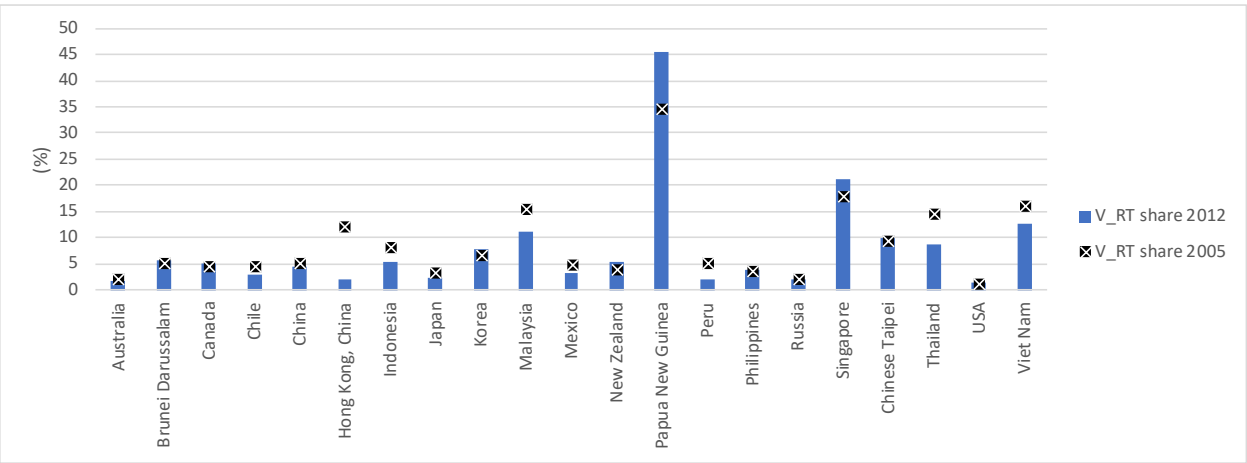


Figure 2.1.4 The traditional trade segment as a share of total GDP (V_RT_share), 2005 and 2012, APEC



Forward GVC Segment

The forward GVC segment refers to domestic VA in production activities for intermediate product exports, and, therefore, being forwarded for downstream processing along GVCs. In this forward GVC segment, domestic factor content crosses the borders once or more for production. It can be broken down into two sub-segments: the simple and complex GVCs. If intermediate exports are directly absorbed by importing economies, in which domestic factor content used in production outside the

home economy crosses the border only once for production, it is considered as the simple GVC. If intermediate exports are further re-exported to third economies or return to the home economy, in which domestic factor content crosses the borders more than once for production, it is considered as the complex GVC.

Of the three segments in GDP decomposition, the forward GVC segment experienced the fastest growth. In 2005, about $3.1 trillion, or 11.9 percent of total GDP in the APEC region was in the forward GVC segment. In 2012, GDP production in this segment increased by 90.3 percent, to $5.7 trillion, and its share in total GDP increased to 13.8 percent.

In 2005, the United States had the largest GDP value of $909.2 billion in the forward GVC segment, followed by China ($426.2 billion) and Japan ($417.0 billion). In 2012, the United States remained the top APEC economy in this segment with GDP value of $1.4 trillion, seconded by China with $1.3 trillion. Japan became the distant third with $583.2 billion (figure 2.1.5).

Measured by the forward GVC segment as a share of GDP, Small APEC economies, such as Brunei Darussalam; Singapore; Malaysia; Thailand; and Viet Nam had some of the highest forward GVC participation rates that were over 30 percent, reflecting their deep forward integration in GVCs as well as the importance of GVCs to their economies. Big APEC developed economies, such as the United States, and Japan, on the other hand, had some of the lowest forward GVC participation rate that were around only 10 percent. However, instead of indicating that these large economies are less integrated into GVCs, it reflects the overall relatively less importance of GVCs to their economies, as their economies rely much more on their large domestic markets, as previously discussed (figure 2.1.6). However, it is worth to note that at the sectoral level, the importance of GVCs could vary significantly within an economy, which will be discussed more in detail in chapter five of this section as well as economy profiles in Section Three.

Figure 2.1.5 The forward GVC segment of GDP production (V_GVC), 2005 and 2012, APEC

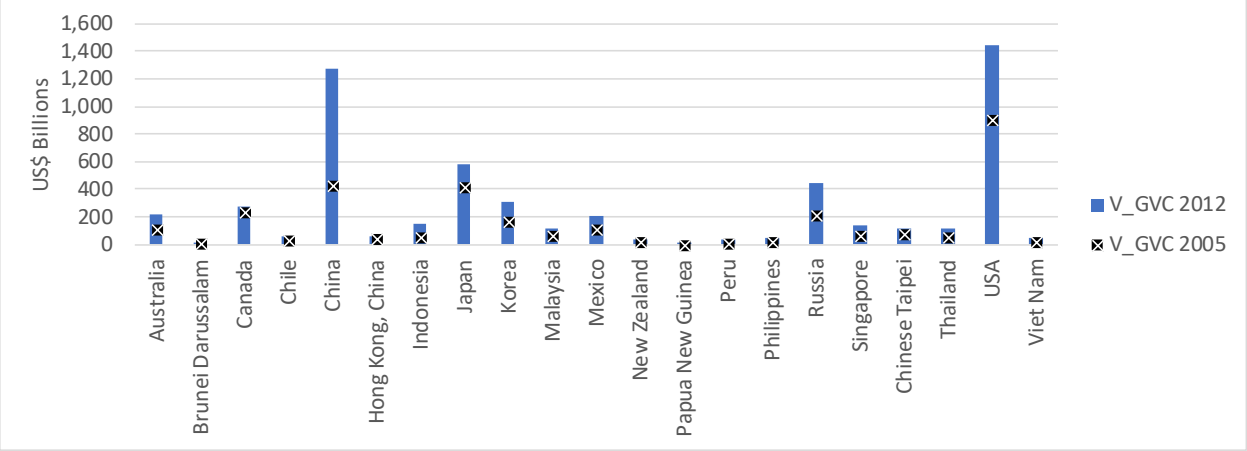
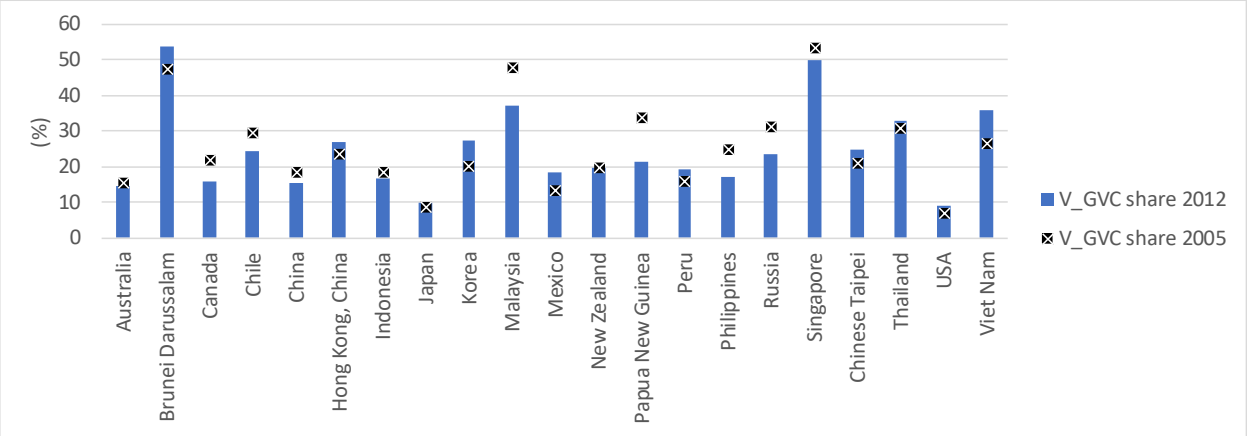


Figure 2.1.6 The forward GVC participation rate (V_GVC_share), 2005 and 2012, APEC



Simple and Complex Forward GVC Participation

In 2005, 32.9. percent of APEC GDP production in the GVC segment were in the form of complex forward GVC participation, and 67.1 percent were in the form of simple forward GVC participation. By 2012, the share of complex GVCs increased to 33.8 percent while the share of simple GVCs decreased to 66.2 percent.

The APEC economies with the top simple forward GVC participation rate in 2012 were Brunei Darussalam; Singapore; Malaysia; Thailand; and Viet Nam that were more than 20 percent (figure 2.1.7). The APEC economies with the top complex forward GVC participation rate in 2012 were Brunei Darussalam; Singapore; Malaysia; Chinese Taipei; and Viet Nam that were above 10 percent (figure 2.1.8).

Figure 2.1.7 The simple forward GVC participation rate (V_GVC_S), 2005 and 2012, APEC

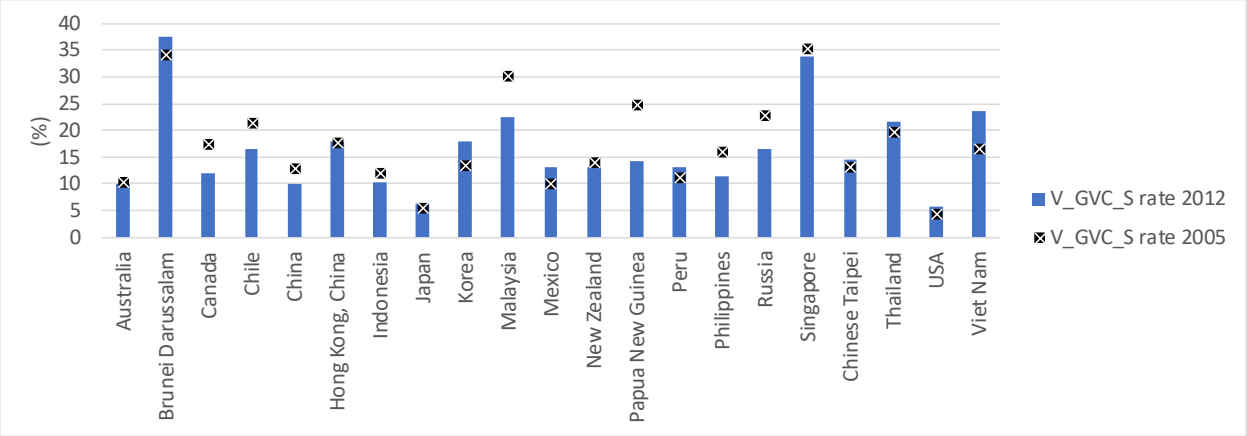
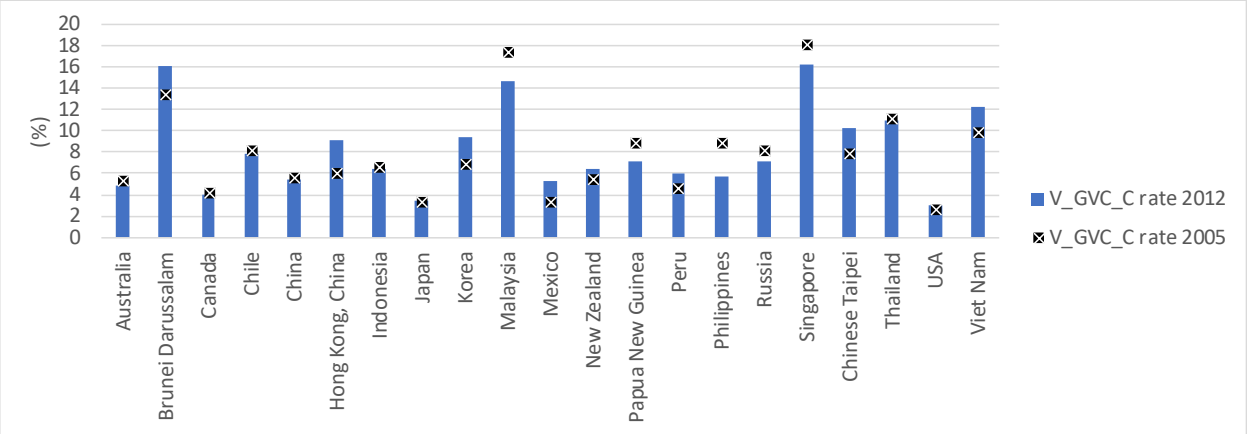


Figure 2.1.8 The complex forward GVC participation rate (V_GVC_C), 2005 and 2012, APEC



Chapter 2: Final Production Decomposition

Final production decomposition provides a user-perspective, backward linkage-based GVC analytical framework. It breaks down final production activities into three segments: the pure domestic segment, the traditional trade segment, and the backward GVC segment. The backward GVC segment can be further broken down into two sub-segments: the simple and complex backward GVC. For more information on final production decomposition, see Section 1 Chapter 2. For the definitions and detailed information of these segments, see the sections in this chapter below.

Summary: In 2012, the pure domestic segment accounted for the largest share, 84.1 percent of APEC final production, while the traditional trade and the backward GVC segments accounted for 3.2 percent and 12.8 percent, respectively. Between 2005 and 2012, the backward GVC segment grew at the fastest pace with its share of APEC final production increased by 1.1 percentage point.

Large developed economies, such the United States; Japan; and Australia, had a relatively high share of final production in the pure domestic segment and a relatively low share of final production in the traditional trade and GVC segments, as their final productions use more domestic-sourced inputs and primarily serve their own large domestic markets. Small economies, such as Papua New Guinea; Singapore; Hong Kong, China; and Viet Name on the other hand, had a relatively low share of final production in the pure domestic segment, and a relatively high share of final production in the traditional trade and GVC segments, as their final productions primarily serve foreign markets, and also rely more on imported intermediate inputs.

In 2012, about 37.7 percent of final production in the GVC segment was in the form of the complex backward GVC participation, and while 62.2 percent was in the form of the simple backward GVC participation. The complex backward GVC participation experienced a relatively faster growth rate than the simple backward GVC participation between 2005 and 2012.

Pure Domestic Segment

The pure domestic segment refers to domestic VA in final production activities which is directly absorbed for domestic consumption without involving international trade. No factor content crosses border in the entire production and consumption process.[22]

In 2005, about $22.1 trillion, or 85.3 percent of total final production in the APEC region was in the pure domestic segment. In 2012, final production in this segment increased by 58.5 percent to $34.4 trillion, though its share in total final production decreased to 84.1 percent. In 2012, the United States had $13.2 trillion, the largest value in the pure domestic segment, followed by China ($8.2 trillion) and Japan ($6.0 trillion). China experienced the largest increase in this segment, as its domestic market grew significantly during this period (figure 2.2.1).

In 2012, large economies, such the United States; Japan; and Australia, had a relatively high share of final production in the pure domestic segment that were over 85 percent, as their final productions use more domestic-sourced inputs and primarily serve their own large domestic markets. In comparison,

[22] In terms of absolute value, the pure domestic segment in GDP production decomposition and final production decomposition are the same, as they refer to the same domestic VA in production activities which is directly absorbed for domestic consumption without involving international trade. In terms of relative value, they could be different, as the former denominator is GDP, and the latter denominator is final production.

small economies, such as Papua New Guinea; Singapore and Viet Nam, had a relatively low share of final production in the pure domestic segment that were less than 50 percent, as their final production primarily serve foreign markets, and they rely more on imported intermediate inputs for their final production (figure 2.2.2).

Figure 2.2.1 The pure domestic segment of final production (Y_D), 2005 and 2012, APEC

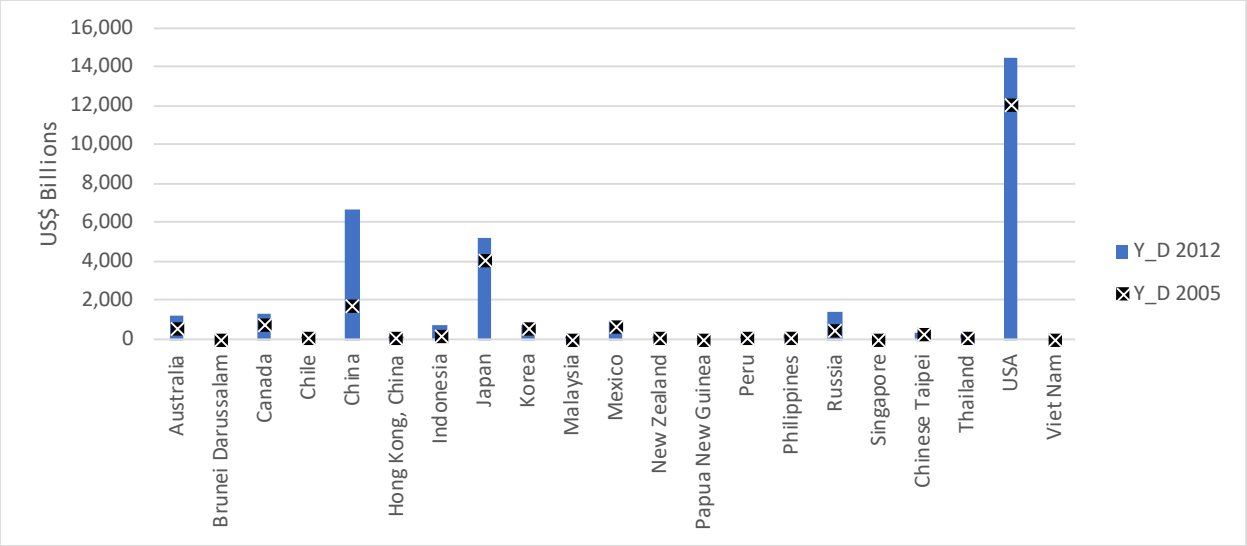
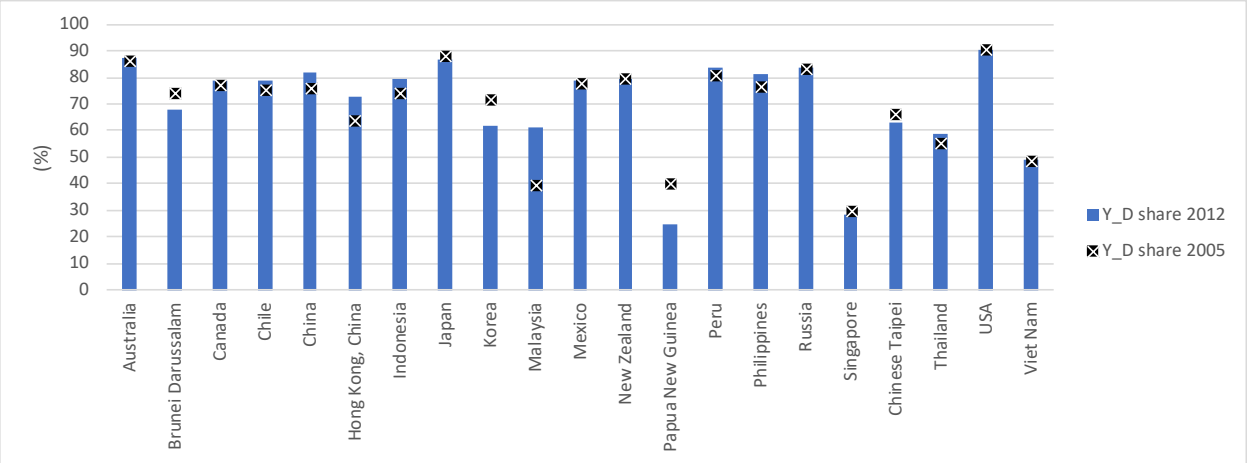


Figure 2.2.2 The pure domestic segment as a share of final production (Y_D_share), 2005 and 2012 APEC



Traditional Trade Segment

The traditional trade, or so-called Ricardian trade (RT) segment, refers to domestic VA in production activities for final product exports consumed directly abroad. In the traditional trade segment, domestic factor content crosses the border only once for final consumption.[23]

[23] In terms of absolute value, the traditional trade segment in gross exports decomposition, GDP production decomposition, and final production decomposition are the same, as they refer to the same domestic VA in production activities for final product exports consumed directly abroad. In terms of relative value, they are different, as the denominators used in these three decompositions were gross exports, GDP, and final production, respectively.

Of the three segments in final production decomposition, the traditional trade segment experienced the slowest growth. In 2005, about $781.9 billion, or 3 percent of total final production in the APEC region was in the traditional trade segment. In 2012, final production in this segment increased by 66.4 percent to $1. trillion, though its share in total final production barely increased by 0.2 percentage point.

In 2005, Japan had the largest final production value of $159.6 billion in the traditional trade segment, followed by The United States ($145.9 billion) and China ($120.3 billion). Since then, China experienced a large increase of final production in the traditional trade segment while Japan experienced a modest decline. As a result, in 2012, China surpassed both Japan and the United States to become the top APEC economy in the traditional trade segment with a value of $374.3 billion, followed by the United States ($237.8 billion) and Japan ($137.7 billion) (figure 2.2.3).

As a share of total final production, most APEC economies experienced a decrease during this period, including China. Small economies, such as Papua New Guinea; Malaysia; Singapore; and Viet Nam, had the highest shares of traditional trade in final production that were over 10 percent. In comparison, large economies, such as the United States; Australia; and Japan, had the lowest shares of traditional trade in final production (figure 2.2.4).

Figure 2.2.3 The traditional trade segment of final production (Y_RT), 2005 and 2012, APEC

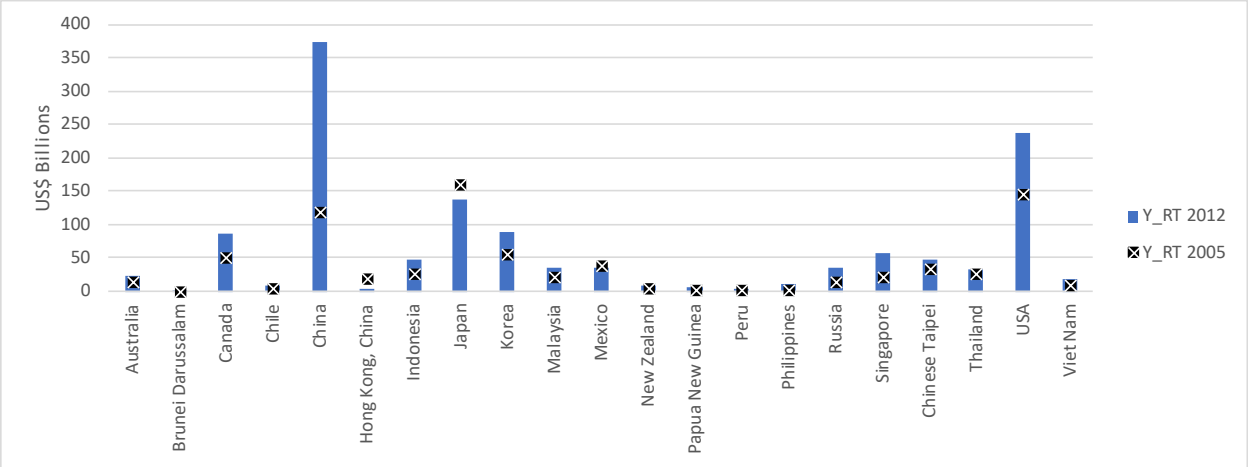
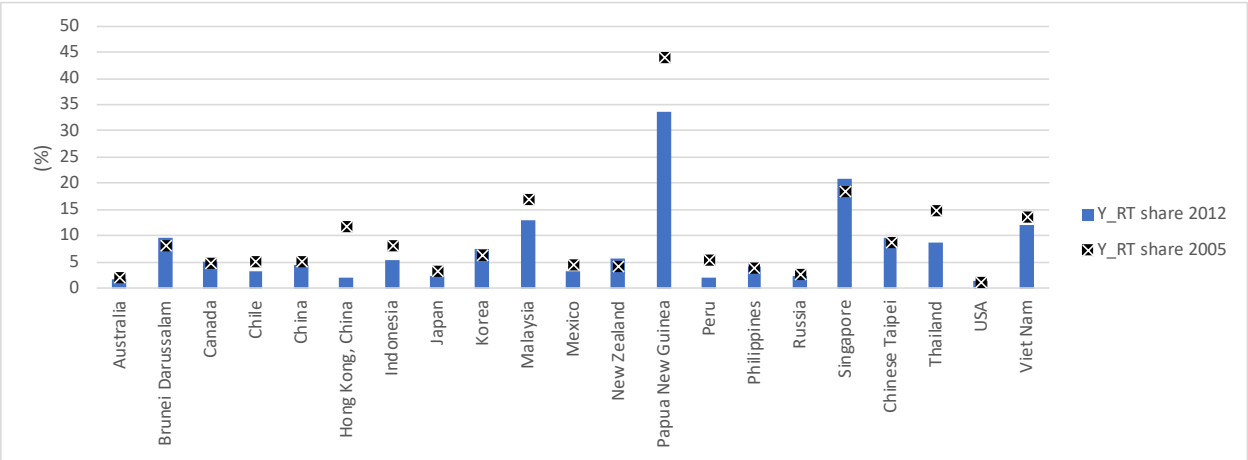


Figure 2.2.4 The traditional trade segment as a share of final production (Y_RT_share), 2005 and 2012, APEC



Backward GVC Segment

The backward GVC segment refers to imported intermediate inputs used in final production (therefore the backward linkage) that contain domestic VA returning home and foreign VA. The backward GVC segment can be further broken down into two sub-segments: the simple and complex backward GVC. If foreign VA embodied in imported intermediates is from direct trading partner and for final production consumed directly at home, in which factor content crosses border only once for production, it is considered the simple backward GVC. If foreign VA embodied in imported intermediates is from the third economy instead of direct trading partner, or domestic VA embodied in imported intermediates is returning home, regardless whether it is used in final production for meeting domestic final demand, or exported for meeting foreign final demand, since factor content crosses the borders more than once for production, it is considered complex backward GVC.

Of the three segments in final production decomposition, the backward GVC segment experienced the fastest growth. In 2005, about $3.0 trillion, or 11.7 percent of total final production in the APEC region was in the backward GVC segment. In 2012, this segment increased by 73.3 percent, to $5.2 trillion, and its share in total final production increased to 12.7 percent.

In 2005, the United States had the largest final production value of $1.1 trillion in the backward GVC segment, followed by China ($439.5 billion) and Japan ($386.5 billion). In 2012, the United States remained the top APEC economy in this segment with value of $2.8 trillion, seconded by China with $1.1 trillion. Japan was the distant third with $649.4 billion (figure 2.2.5).

In 2012, APEC economies with the highest backward GVC participation rates, measured by the backward GVC segment as a share of final production, were Singapore; Hong Kong, China; Papua New Guinea; Viet Nam; Malaysia; Chinese Taipei; Thailand; and Korea that were over 25 percent, reflecting their deep backward integration in GVCs, and their reliance on imported intermediate products for final production. APEC economies with the lowest backward GVC participation rates were the United States; Japan; and Australia that were around 10 percent, reflecting their final productions were more services-based and domestic-oriented, which relied less on imported intermediate inputs (figure 2.2.6).

Figure 2.2.5 The backward GVC segment of final production (Y_GVC), 2005 and 2012, APEC

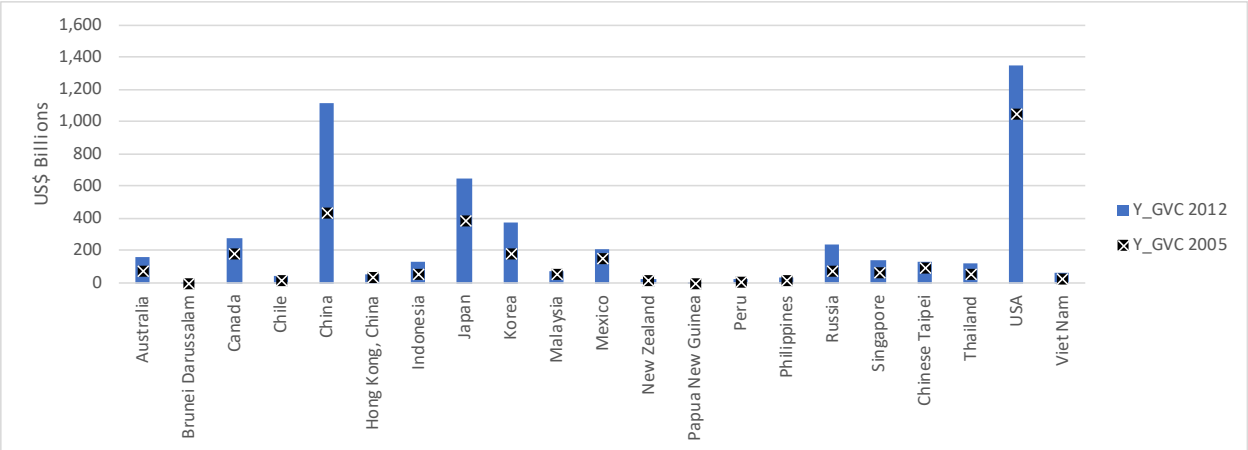
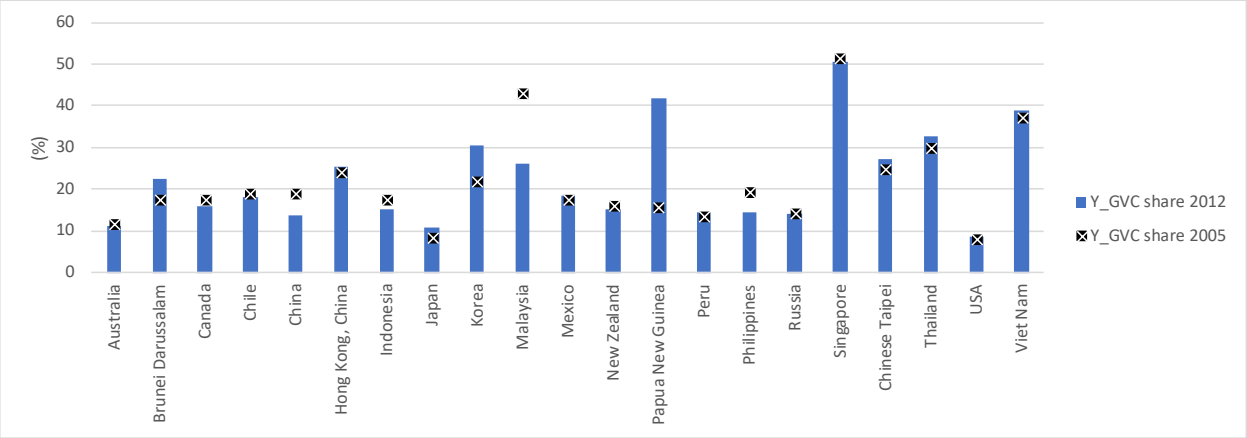


Figure 2.2.6 The backward GVC participation rate (Y_GVC_share), 2005 and 2012, APEC



Simple and Complex Backward GVC Participation

In 2005, 33.7 percent of the GVC segment of final production in the APEC region was in the form of complex backward GVC participation, and 66.3 percent were in the form of simple backward GVC participation. By 2012, the share of complex GVCs increased to 37.7 percent while the share of simple GVCs decreased to 62.3 percent.

The APEC economies with the top simple backward GVC participation rate in 2012 were Korea; Singapore; Hong Kong, China; China; Viet Nam; and Thailand that were over 15 percent (figure 2.2.7). The APEC economies with the top complex backward GVC participation rate in 2012 were Korea; Singapore; Hong Kong, China; Chinese Taipei; Papua New Guinea; Viet Nam; and Malaysia that were over 10 percent (figure 2.2.8).

Figure 2.2.7 The simple backward GVC participation rate (Y_GVC_S), 2005 and 2012, APEC

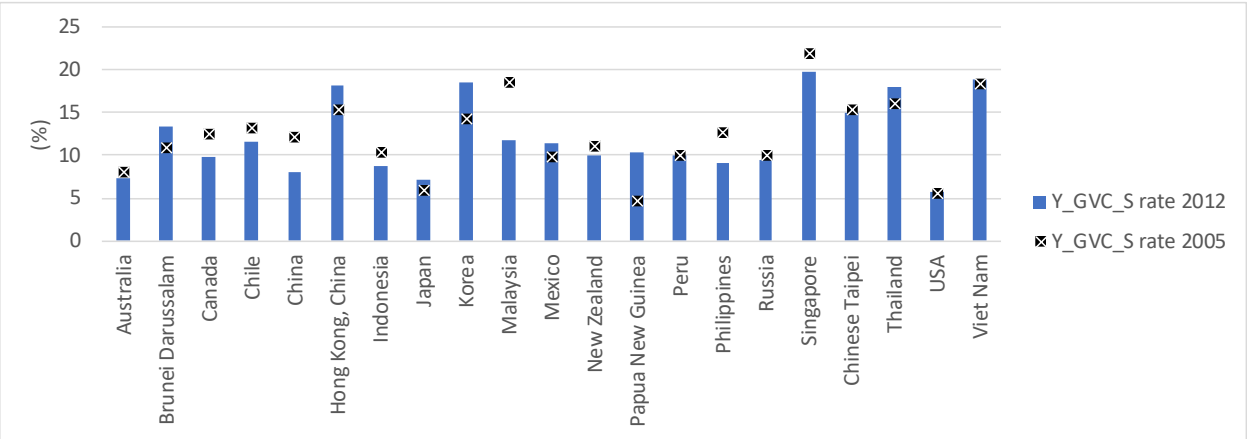
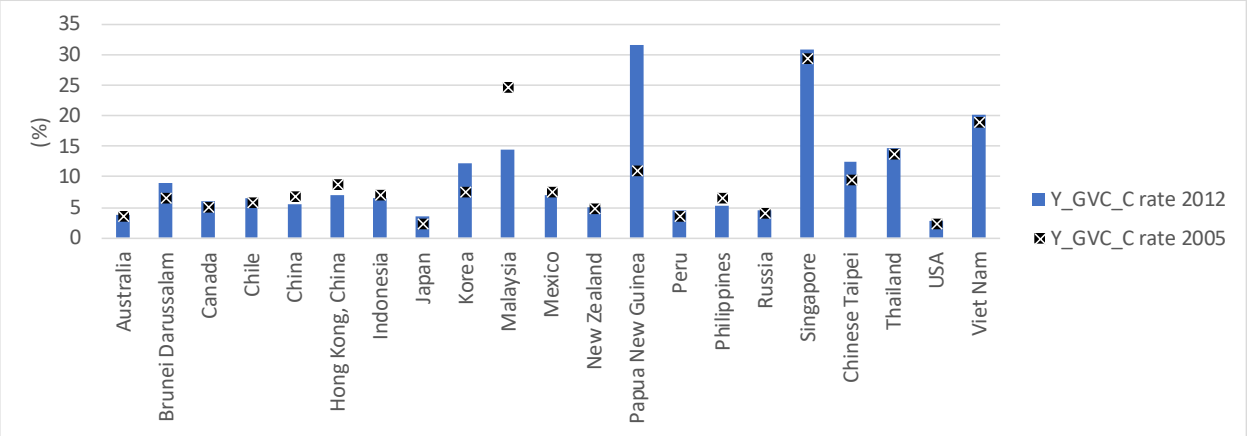


Figure 2.2.8 The complex backward GVC participation rate (Y_GVC_C), 2005 and 2012, APEC



Chapter 3: Gross Exports Decomposition

Gross exports decomposition provides a GVC analytical framework from trade perspective. It breaks down gross exports into various value-added components. These components can be grouped into two major segments: traditional trade and GVC-related trade. Traditional trade refers to domestic VA embodied in final product exports consumed abroad, in which domestic factor content crosses border only once for final consumption. It does not include domestic VA embodied in imported intermediate inputs that are used to produce final product exports, in which domestic factor content crosses border more than once for production, and thus is considered as GVC-related trade.[24] GVC-related trade can be further broken down into the simple and complex GVC related trade, which contains both forward and backward GVC participation. There is significant portion of GVC-related trade involve third economies, which is part of complex GVC activities involve production sharing with at least a third economy besides the home and partner economies. For more information on gross export decomposition, see Section 1 Chapter 2. For the definitions and detailed information of GVC-related trade and third economy related GVC trade, see the sections in this chapter below.

Summary: GVC-related trade had become a dominant feature of gross exports in the APEC region, and grew at a faster pace than traditional trade between 2005 and 2012. In 2012, traditional trade only accounted for 13.7 percent of gross exports in the APEC region. In comparison, GVC-related trade accounted for 86.3 percent of gross exports, and 46.7 percent of gross exports was in complex GVC activities. China and the United States led GVC-related trade in the APEC region, while other APEC economies also experienced a notable growth.

In 2012, about 37 percent of GVC-related trade at least related to a third economy. Natural-resource rich economies, such as Russia; Brunei Darussalam; Peru; and Australia, had a relatively higher share of simple GVCs in gross exports that were over 50 percent. Small Asia-Pacific economies, such as Hong Kong, China; China; Singapore; and Chinese Taipei, had a comparatively higher share of complex GVC-related trade in gross exports that were over 60 percent, as these economies are active participants in global and regional value chains of certain industries, such as computer, electronic and optical equipment.

GVC-Related Trade

GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It includes trade related to both the forward and backward GVC participation. GVC-related trade can be broken down into two sub-segments: the simple and complex GVC. If factor content crosses a border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by direct importing economies to produce final products consumed within the importing economies. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importing economies to produce gross exports (backward perspective),

[24] In terms of absolute value, the traditional trade segment in gross exports decomposition, GDP production decomposition, and final production decomposition are the same, as they refer to the same domestic VA in production activities for final product exports consumed directly abroad. In terms of relative value, they are different, as the denominators used in these three decompositions were gross exports, GDP, and final production, respectively.

or domestic VA embodied in intermediate product exports that are re-exported to third economies for production (forward perspective).[25]

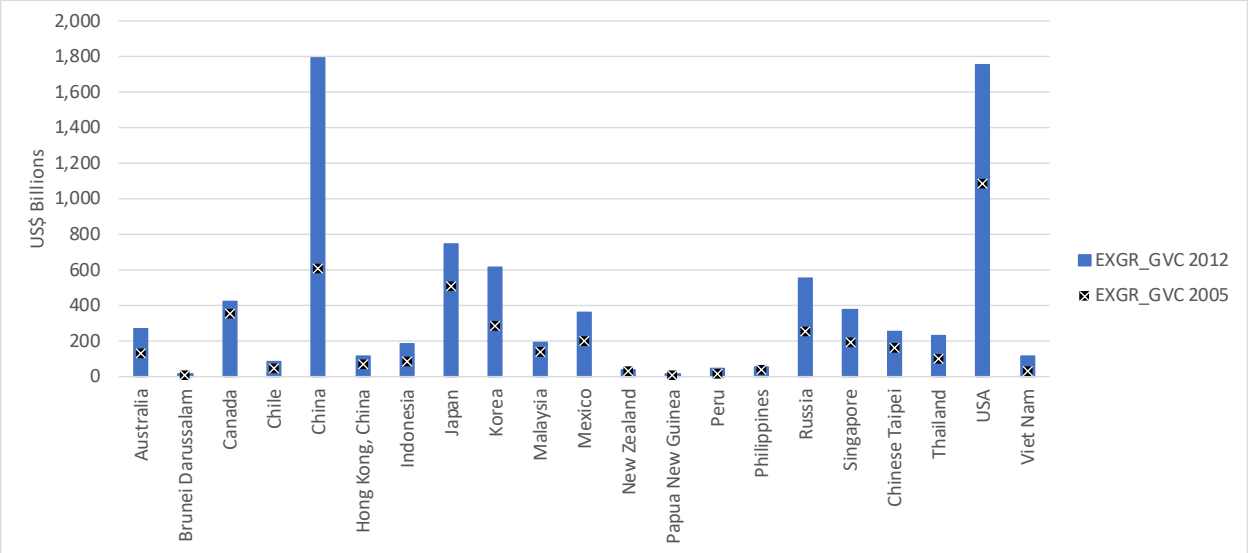
Compared to traditional trade, GVC-related trade grew at a much faster rate in the APEC region. In 2005, GVC-related trade in the APEC region were $4.3 trillion, accounting for 84.7 percent of gross exports. In 2012, GVC-related trade almost doubled to $8.2 trillion, accounting for 86.3 percent of gross exports.

In 2005, the United States topped all APEC economies in GVC-related trade, amounted to $1.1 trillion and accounting for 25.1 percent of GVC-related trade in the APEC region. It was followed by China ($605.1 billion, 14.0 percent); Japan ($508.1 billion, 11.8 percent); Canada ($353.3 billion, 8.2 percent); and Korea ($282.6 billion, 6.5 percent).

In 2012, China caught up with the United States and became the top economy in APEC region engaged in GVC-related trade, accounting for 21.8 percent ($1.79 trillion). The share of the United States declined to 21.3 percent ($1.75 trillion). They were followed by Japan ($746.1 billion, 9.1 percent); Korea ($612.3 billion, 7.4 percent); and Russia ($525.4 billion, 6.7 percent). Other APEC economies which experienced a notable growth in GVC-related trade included Papua New Guinea; Viet Nam; Peru; Thailand; and Indonesia, though from a low base (figure 2.3.1).

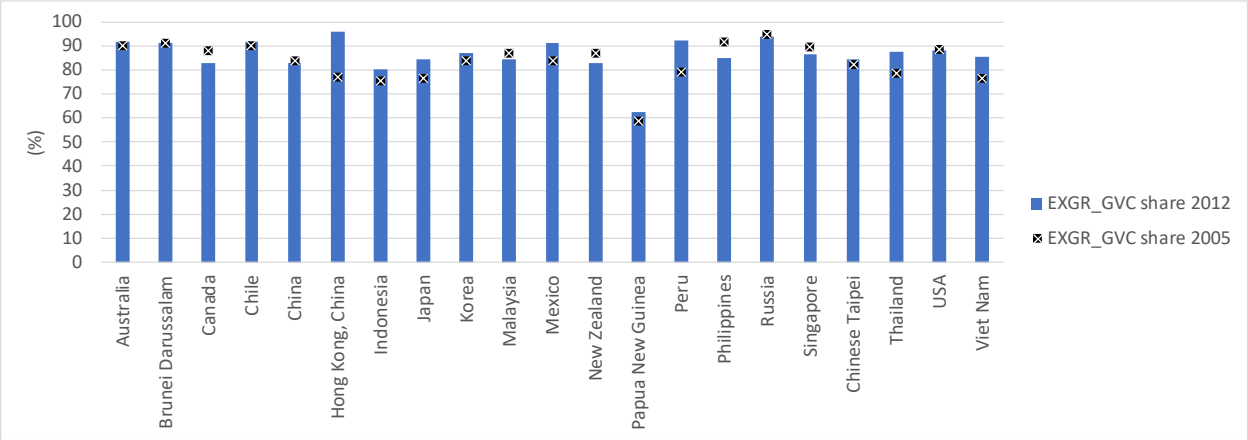
Most APEC economies had an increased share of GVC-related trade in gross exports. The APEC economies with the highest share in 2012 were Hong Kong, China; Russia; Peru; Chile; and Australia that were over 90 percent (figure 2.3.2).

Figure 2.3.1 GVC-related trade of gross exports (EXGR_GVC), 2005 and 2012, APEC



[25] The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

Figure 2.3.2 GVC-related trade as a share of gross exports (EXGR_GVC_share), 2005 and 2012, APEC



Simple and Complex GVC-Related Trade

In 2005, 52.2 percent of APEC GVC-related trade were in the form of complex GVCs, and 47.8 percent of GVC-related trade were in the form of simple GVCs. By 2012, the share of complex GVCs increased to 54.1 percent while the share of simple GVCs decreased to 45.9 percent.

These APEC economies rich in natural resources, such as Russia; Brunei Darussalam; Peru; and Australia, had comparatively higher shares of simple GVC-related trade in gross exports that were over 50 percent in 2012, as they predominantly export primary commodities to other economies for further processing and consumption (figure 2.3.3).

Newly industrialized Asia-Pacific economies, such as Hong Kong, China; Korea; Mexico; Singapore; Chinese Taipei; Malaysia; Thailand; and Viet Nam had comparatively higher shares of complex GVC-related trade in gross exports that were over 50 percent, as these economies are active participants in global and regional value chains of certain industries, such as appeals, computer, electronic and optical equipment (figure 2.3.4).

Figure 2.3.3 Simple GVC-related trade (EXGR_GVC_S) as a share of gross exports, 2005 and 2012, APEC

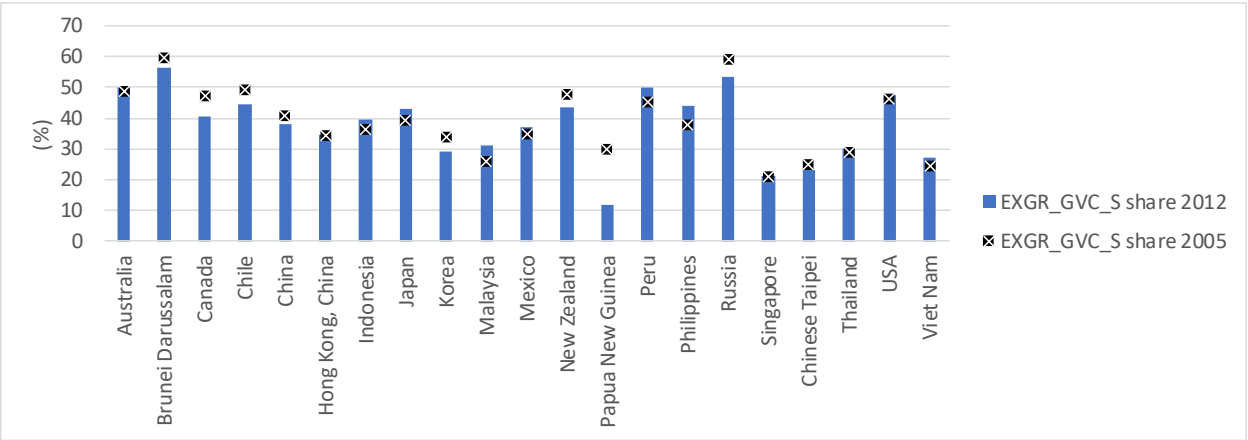
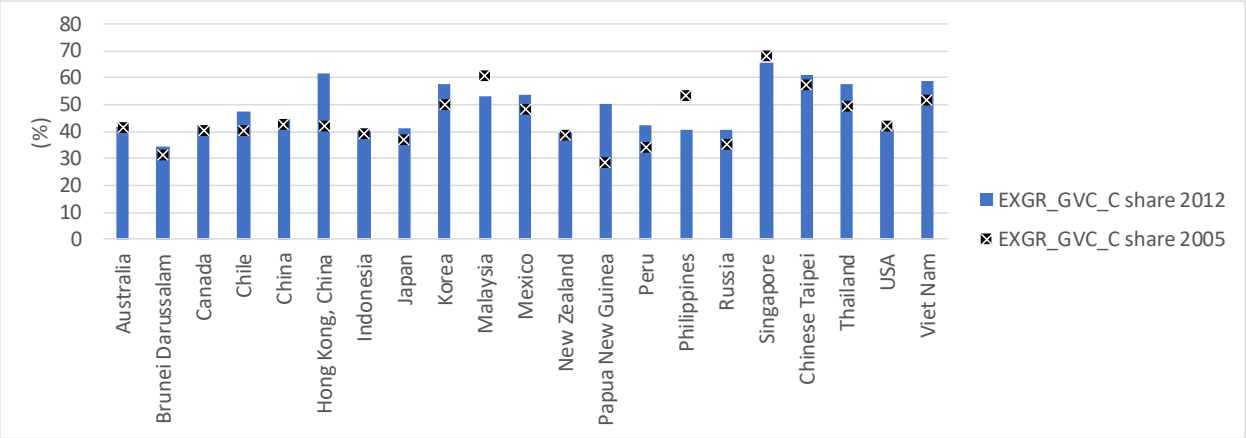


Figure 2.3.4 Complex GVC-related trade (EXGR_GVC_C) as a share of gross exports, 2005 and 2012, APEC



Third Economy-Related Trade

Trade typically is recorded at the bilateral level involving two direct trading partners. However, in the age of GVCs, third economies can play an important role in international trade, serving either as a transfer platform for the home economy's DVA embodied in its intermediate imports used other economies in producing exports (the backward linkage), or provide its own production factors via intermediate exports to the home economy for its export production to satisfy demand in partner economies (the forward linkage). Third economy-related trade is a measure of the importance of third economies in bilateral gross trade, which is the portion of complex GVC trade involves at least three economies.

In 2012, third economy- related trade in the APEC region were $3.1 trillion, about doubled from $1.6 trillion in 2005. Its share in gross exports increased from 30.3 percent to 32.1 percent during this period, indicating GVC in the APEC region became more complex.

In 2005, the United States had the largest third economy related trade, amounted to $286.9 billion, and accounting for 18.6 percent of third economy related trade in the APEC region. It was followed by China ($229.9 billion, 14.9 percent) and Japan ($194.5 billion, 12.6 percent). By 2012, China surpassed the United States to become the top APEC economy in third economy related trade, amounted to $688.8 billion, and accounting for 22.5 percent of third economy related trade in the APEC region. Both the United States ($512.8 billion, 16.8 percent) and Japan ($279.1 billion, 9.1 percent) experienced a decrease in third economy- related trade during this period and became the second and third largest APEC economies in third economy-related trade in 2012.

Other than China, several APEC economies also experienced a notable growth rate in third economy-related trade during this period, such as Papua New Guinea; Brunei Darussalam; Indonesia; Peru; Russia; and Viet Nam, though from a low base (figure 2.3.5).

Most APEC economies experienced an increase of third economy- related trade as a share of gross exports during this period, including China. Among the exceptions were Malaysia; New Zealand; the Philippines; Singapore; and Chinese Taipei (figure 2.3.6).

Figure 2.3.5 Third economy related trade (TCT), 2005 and 2012, APEC

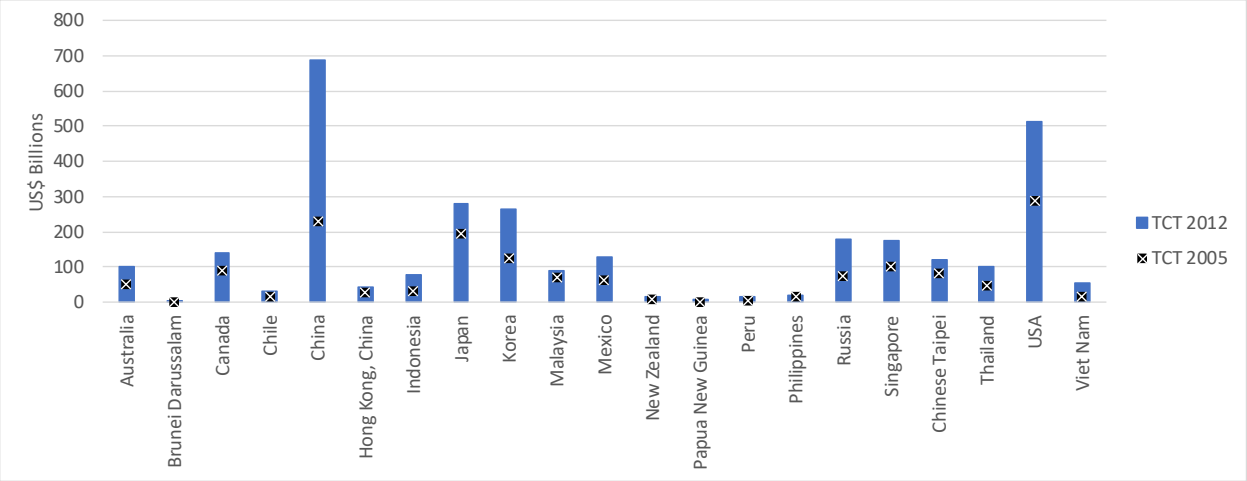
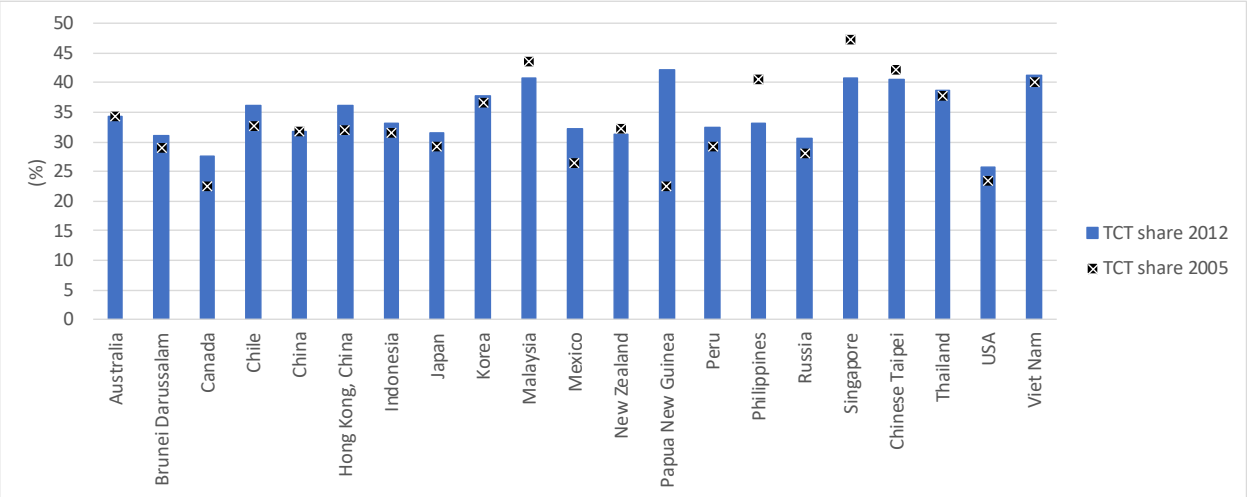


Figure 2.3.6 Third economy related trade as a share of gross exports (TCT_share), 2005 and 2012, APEC



Chapter 4: Gross and Value-Added Trade

Value-added exports and imports are among the most used TiVA measures in GVC analysis. Value-added exports refers to domestic value added embodied in intermediate or final product exports that are absorbed abroad. It can measure how much an economy's GDP is driven by foreign demand. Value-added imports refer to foreign value added embodied in intermediate or final product imports that are absorbed domestically. It can measure how much an economy's final demand is dependent on foreign supply. Value added trade balance refers to the difference between value-added exports and imports. At economy aggregate level, it equals gross trade balance, which is the conventional measure of the impact of trade on an economy.

Summary: In years 2005-12, value added trade in the APEC region experienced a robust growth. In 2012, the three largest APEC economies, the United States; Japan; and China, dominated value-added exports in the region, together accounting for 56.6 percent of APEC total value-added exports. The United States was also the largest value-added importer in the region, accounting for 27.4 percent of APEC value-added imports. The United States had the largest trade deficit while China had the largest trade surplus. On average, value-added exports constituted 72 percent of gross exports for all APEC economies in 2005, but this ratio declined to 71 percent in 2012. In 2012, APEC economies with lowest value-added exports to gross exports ratio was Singapore (44.6 percent); Chinese Taipei (55.0 percent); Viet Nam (55.3 percent); and Hong Kong, China (55.9 percent). In comparison, APEC economies with the highest value-added exports to gross exports ratio was Brunei Darussalam (89.4 percent); Indonesia (83.6 percent); the Philippines (81.9 percent); Australia (81.8 percent); and Russia (81.5 percent).

Value added trade was also important to small APEC economies, including Singapore; Hong Kong, China; China; Papua New Guinea; Brunei Darussalam; Malaysia; Thailand; Viet Nam; and Chinese Taipei. Compared to big economies, they rely more on exports for their GDP, and on imports for their final demand.

Gross and Value-Added Exports

In 2012, gross and value-added exports from the APEC region amounted to $9.5 and $6.8 trillion, increasing by 86.7 and 83.8 percent from $5.1 and $3.7 trillion in 2005, respectively. Two largest APEC economies—China and the United States —dominated both gross and value-added exports in the region, with $2.16 /$1.59 trillion and $1.99/$1.53 trillion respectively. Together they accounted for 43.7 percent of APEC gross exports and 46.2 percent of APEC value-added exports. Japan was a distant third with $838.8 Billion (9.3 percent) gross exports and $705.3 billion (10.4 percent) value-added exports respectively. Other than China; Viet Nam; Papua New Guinea; and Peru also experienced a high growth rate of both gross and value-added exports during this period, albeit from a low base (figure 2.4.1).

In 2012, APEC economies with the highest shares of GDP for value-added exports were Singapore (70.1 percent); Papua New Guinea (66.8 percent); Brunei Darussalam (59.3 percent); Viet Nam (48.2 percent); Malaysia (48.1 percent); Thailand (41.3 percent); Korea (34.7 percent); and Chinese Taipei (34.5 percent). In comparison, APEC economies with the lowest shares of GDP for value-added exports were the United States (9.5 percent); Japan (11.8 percent); Australia (16.2 percent); and China (19.0 percent) (figure 2.4.2).

Figure 2.4.1 Gross exports (EXGR) and value-added exports (EXVA), 2005 and 2012, APEC

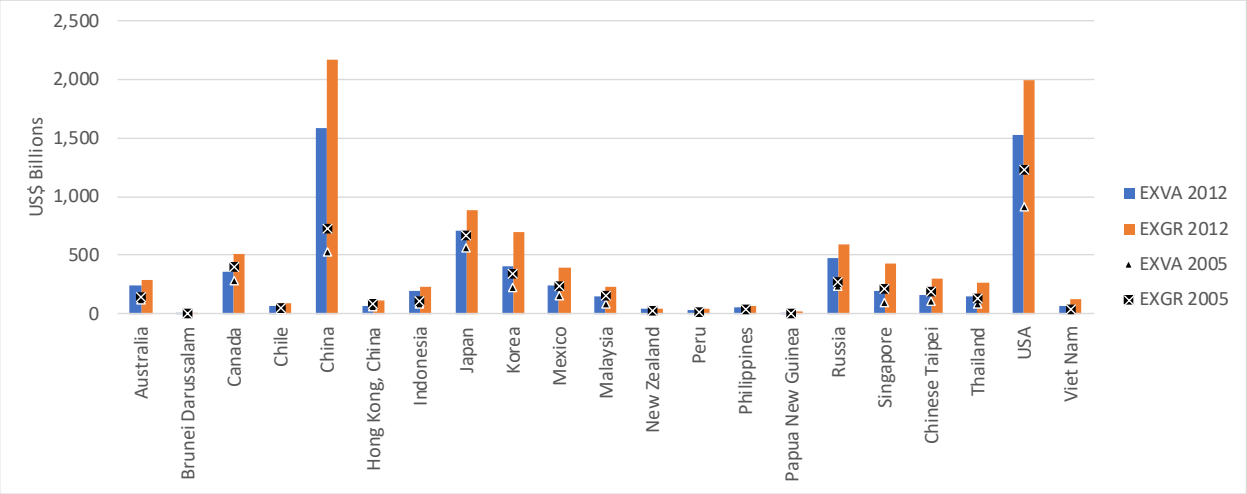
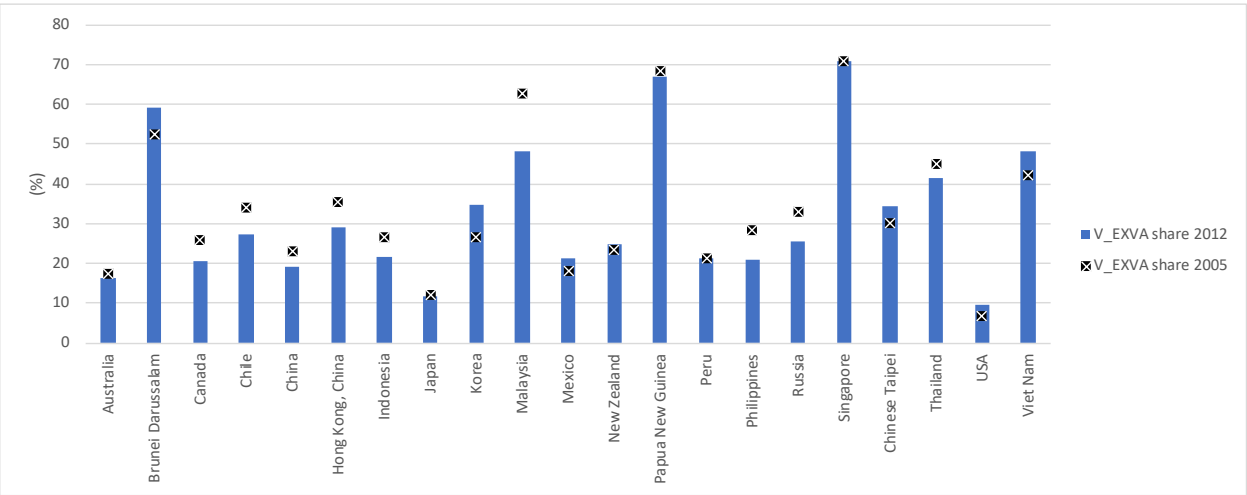


Figure 2.4.2 Value-added exports as a share of GDP (V_EXVA_share), 2005 and 2012, APEC



Gross and Value-Added Imports

In 2012, gross and value-added imports in the APEC region amounted to $9.5 trillion and $6.7 trillion, increasing by 76.3 percent and 69.9 percent from $5.4 and $3.9 trillion in 2005, respectively. The largest APEC economy—the United States—had the largest amount of gross and value-added imports at $2.6 trillion and 2.1 trillion, accounting for 27.2 and 31.5 percent of APEC gross and value-added imports respectively. It was followed by China at $1.7 trillion (17.6 percent) and $1.1 trillion (16.1 percent), and Japan at $997.1 billion (10.5 percent) and $818.5 billion (12.2 percent), respectively (figure 2.4.3).

In 2012, APEC economies with the highest shares of final demand from value-added imports were Papua New Guinea (85.3 percent); Singapore (61.8 percent); Viet Nam (46.5 percent); Brunei Darussalam (38.3 percent); Thailand (35.6 percent); Korea (33.5 percent); Malaysia (32.9 percent); and Chinese Taipei (32.8 percent). In comparison, APEC economies with the lowest shares of final demand from value-added imports were the United States (12.6 percent); Japan (13.5 percent); China (13.8 percent); Australia (17.9 percent); and Russia (19.4 percent) (figure 2.4.4).

Figure 2.4.3 Value-added imports (IMVA), 2005 and 2012, APEC

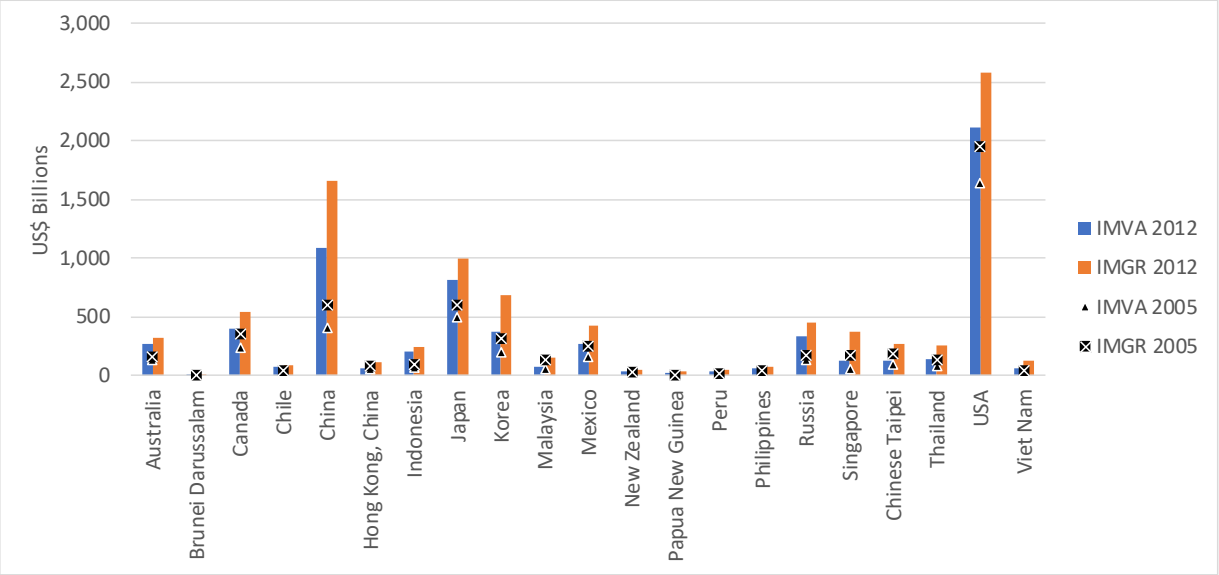
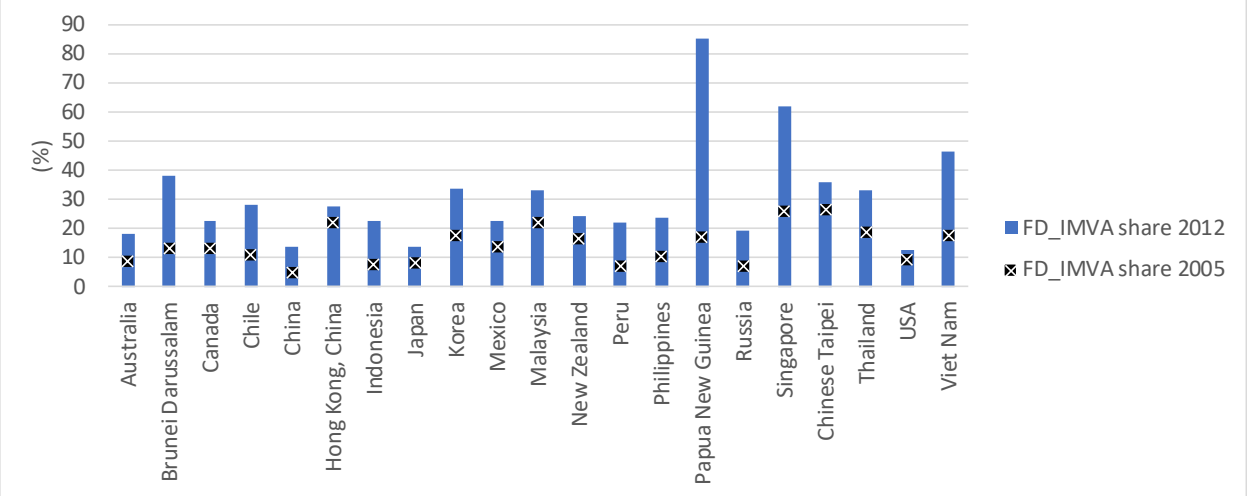


Figure 2.4.4 Value-added imports as a share of final production (FD_IMVA_share), 2005 and 2012, APEC



Trade Balance

In 2012, the APEC region had a trade surplus of $41.6 billion, shift from a deficit $277.1 billion in 2005. The United States had the largest trade deficit of $585 billion, while China had the largest trade surplus of $504 billion (figure 2.4.5). However, as a share of GDP, Singapore; Malaysia; and Brunei Darussalam had the largest share of trade surplus in GDP (figure 2.4.6).

Figure 2.4.5 Trade balance (BALVA), 2005 and 2012, APEC

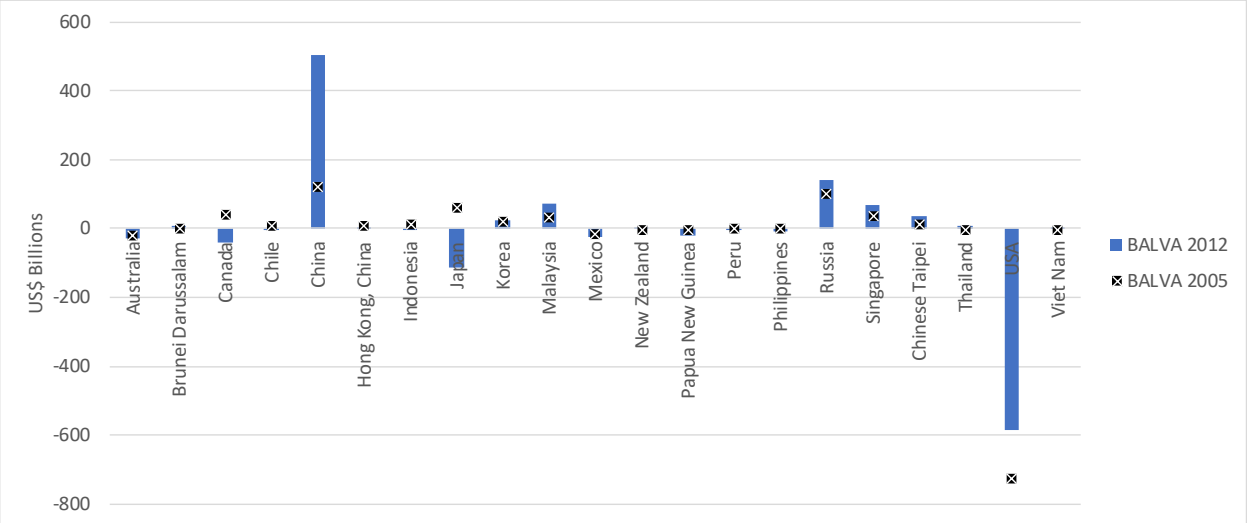
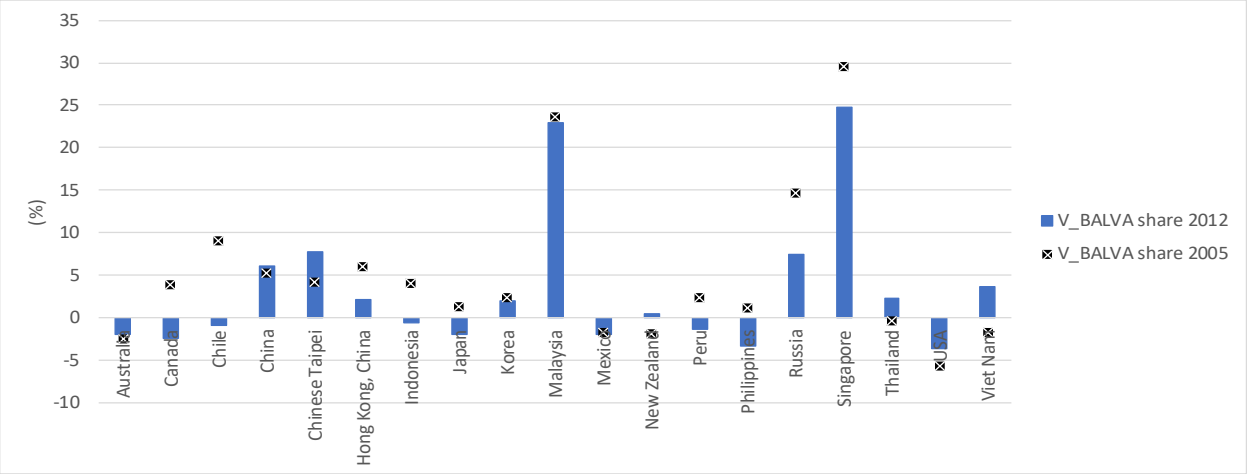


Figure 2.4.6 Trade balance as a share of GDP (V_BALVA_share), 2005 and 2012, APEC



[a] Brunei Darussalam and Papua New Guinea (PNG) were omitted in order to improve the scale of the figure. Brunei's V_BALVA share in 2012 was 34.2 percent, decreasing from 36.0 percent in 2005.

Chapter 5: Key GVC Industries in the APEC Region

This chapter presents three key GVC industries in the APEC region based on their high values of GVC-related trade. They are computer, electronic and optical equipment (CEQ), chemicals (CHM), and motor vehicle, trailers and semi-trailers (MTR). These case studies highlight the major APEC GVC participating economies in the industry, as well as their relative positions within that industry GVC.

Summary: In 2012, the major APEC GVC participating economies of the CEQ industry were China; Korea; the United States; Chinese Taipei; Japan; Singapore; and Mexico. The CEQ GVC-related trade was heavily concentrated on the Asia-Pacific region, centered around China, the largest electronics producer in the world. The United States and Mexico consisted of a smaller CEQ cluster in the North America region with strong linkage to the Asia-Pacific cluster. The United States topped the APEC economies in the forward GVC segment, and China topped the APEC economies in the backward GVC segment.

The major APEC GVC participating economies of the CHM industry are the United States; China; Japan; Singapore; Korea; Russia; and Mexico. The United States topped the APEC economies in both the forward and backward GVC segments.

The major APEC GVC participating economies of the MTR industry are Japan; the United States; Mexico; China; Thailand; Canada; and Korea. The APEC MTR GVCs form two regional clusters—one in the North America region that consists of the United States; Canada; and Mexico, and the other in the Asia-pacific region that consists of Japan; China; Thailand; and Korea. Japan topped the APEC economies in the forward GVC segment, and China and the United States topped the APEC economies in the backward GVC segment.

Computer, electronic and optical equipment (CEQ)

GVC-related trade

In 2012, the computer, electronic and optical equipment industry (CEQ) generated $1.0 trillion, the largest GVC-related trade by industry in the APEC region. About 86.3 percent of gross exports in this industry was GVC-related, and over 70 percent of GVC-related trade within CEQ was in the form of complex GVCs.

In 2012, China topped the APEC economies with $386.1 billion of GVC-related trade in the CEQ industry, accounting for over one third of CEQ GVC-related trade in the APEC region. It was followed by Korea ($126.7 billion, 12.3 percent); the United States ($125.9 billion, 12.2 percent); Chinese Taipei ($86.1 billion, 8.4 percent); Japan ($80.5 billion, 7.8 percent); Singapore ($75.1 billion, 7.3 percent); and Mexico ($48.2 billion, 4.7 percent) (figure 2.5.1 and figure 2.5.2). The CEQ GVC-related trade is heavily concentrated on the Asia-Pacific region, centered around China, the largest electronics producer in the world. The United States and Mexico consist of a smaller CEQ cluster in the North America region with strong linkage to the Asia-Pacific cluster.

In 2005, the United States; Korea; Japan; and Chinese Taipei led APEC economies, together accounting for about 63.8 percent of GVC-related trade within CEQ in the region. In 2012, the shares of these four economies all declined, and they together accounted for only 40.7 percent of GVC-related trade within CEQ in the region. China, on the other hand, emerged as the largest GVC participant in the CEQ

industry during this period. In 2005, its share of GVC-related trade within CEQ in the APEC region was only 3.4 percent. By 2012, it increased to 37.5 percent, while all other APEC economies experienced decreases in their shares of GVC-related trade within CEQ between 2005 and 2012 (figure 2.5.2).

Figure 2.5.1 GVC-related trade (EXGR_GVC), CEQ, 2005 and 2012, APEC

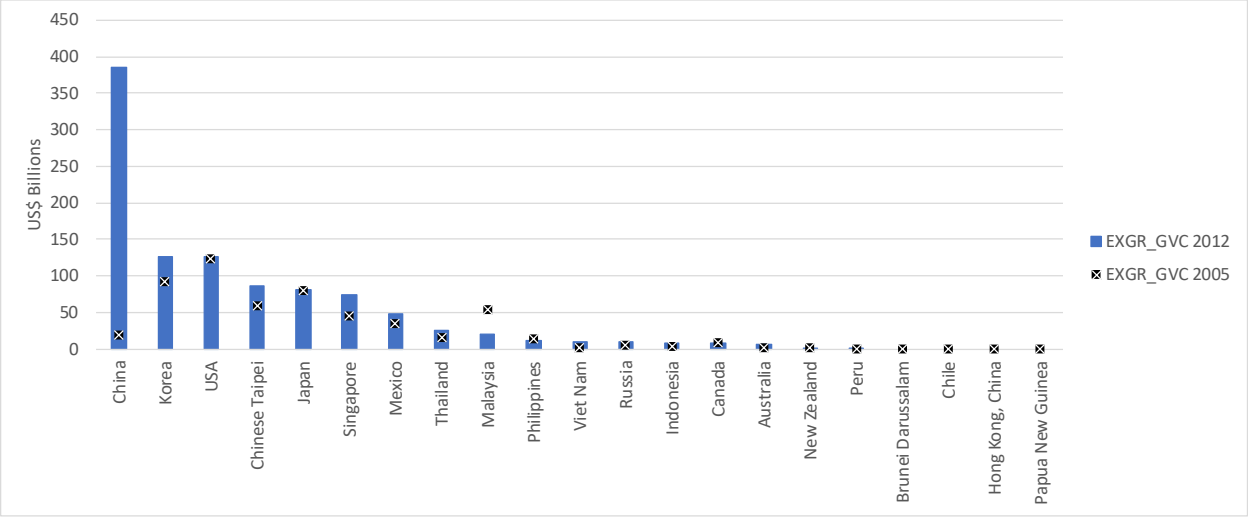
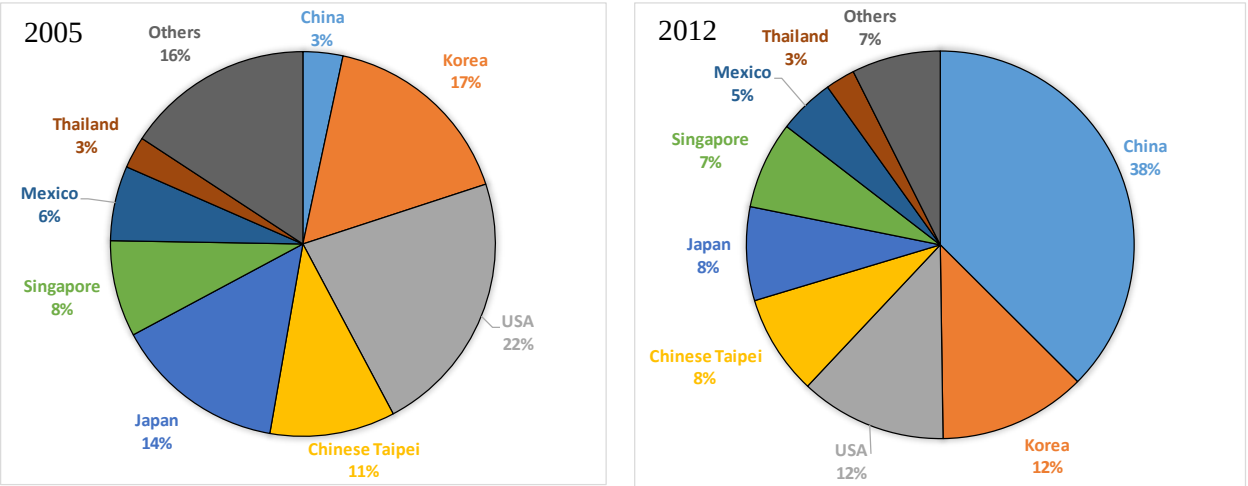


Figure 2.5.2 Share of APEC GVC-related trade, CEQ, 2005 and 2012, APEC



Forward GVC Participation

In 2012, the forward GVC participation segment of the CEQ industry—measured by domestic VA used in producing intermediate exports for the next stage of production in other economies—amounted to $346.6 billion in 2012, increasing substantially from $194.6 billion in 2005. The United States generated the highest industry GDP from the forward GVC participation at $97.2 billion, followed by China with $84.8 billion (figure 2.5.3).

The average forward GVC participation rate of the CEQ industry in the APEC region increased from 40.0 percent in 2005 to 43.9 percent in 2012, suggesting the growing forward GVC integration in this industry within the region. Peru; Singapore; and Australia were among the APEC economies with the highest forward GVC participation rate in CEQ. Most APEC economies experienced increases in their forward GVC participation rates for the CEQ industry (figure 2.5.4).

Figure 2.5.3 Forward GVC Participation segment (V_GVC), CEQ, 2005 and 2012, APEC

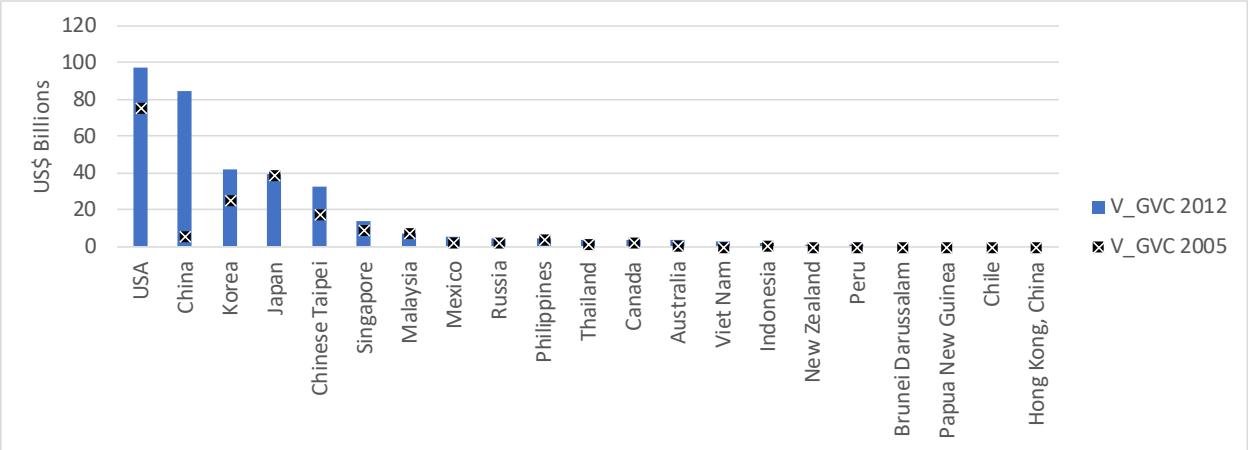
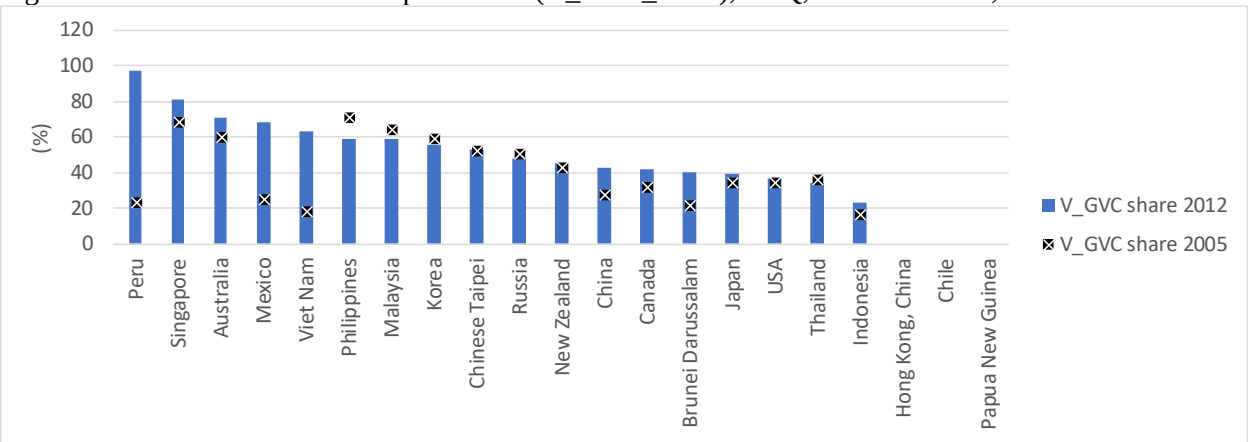


Figure 2.5.4 Forward GVC Participation rate (V_GVC_share), CEQ, 2005 and 2012, APEC



Backward GVC Participation

In 2012, the backward GVC participation segment of the CEQ industry—measured by imported intermediate inputs used in final production—amounted to $283.9 billion in 2012, nearly doubling from $158.3 billion in 2005, indicating an increasing use of imported intermediate inputs in CEQ final production. China dwarfed the rest of the APEC economies with the largest value of backward GVC participation segment in this industry at $120.4 billion, owing to its specialization in the final assembly of electronic products (figure 2.5.5).

The average backward GVC participation rate of the CEQ industry in the APEC region increased from 32.9 percent in 2005 to 36.7 percent in 2012. Mexico had one of the highest backward GVC participation rate in CEQ at 80.0 percent, demonstrating its specialization in the downstream segment of the CEQ GVCs. Although their CEQ final production was dwarfed by China's dominance in this segment, small economies such as Singapore; Viet Nam; Thailand; and Chinese Taipei had some of the highest backward GVC participation rates in the APEC region during this period (figure 2.5.6).

Figure 2.5.5 Backward GVC Participation segment (Y_GVC), CEQ, 2005 and 2012, APEC

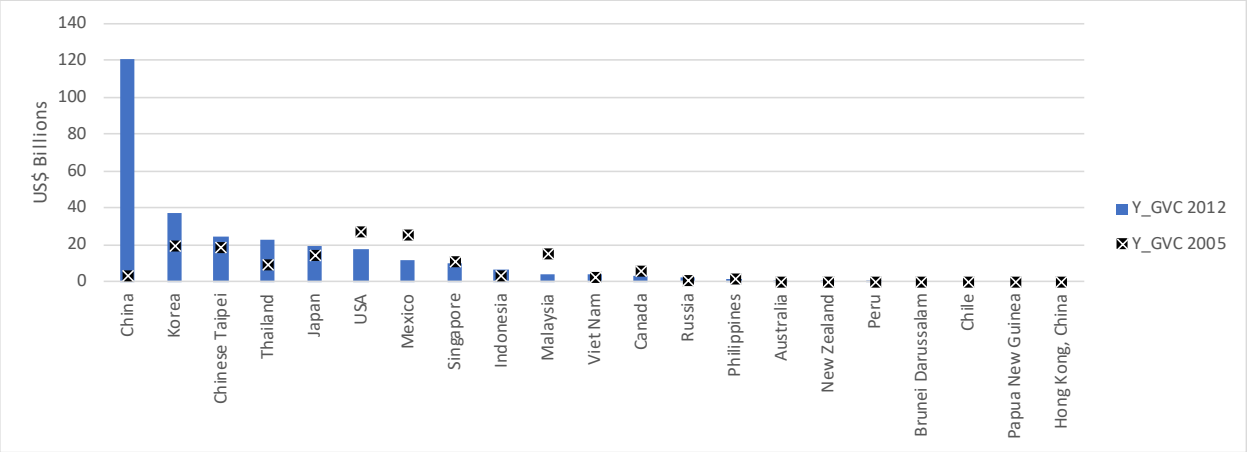
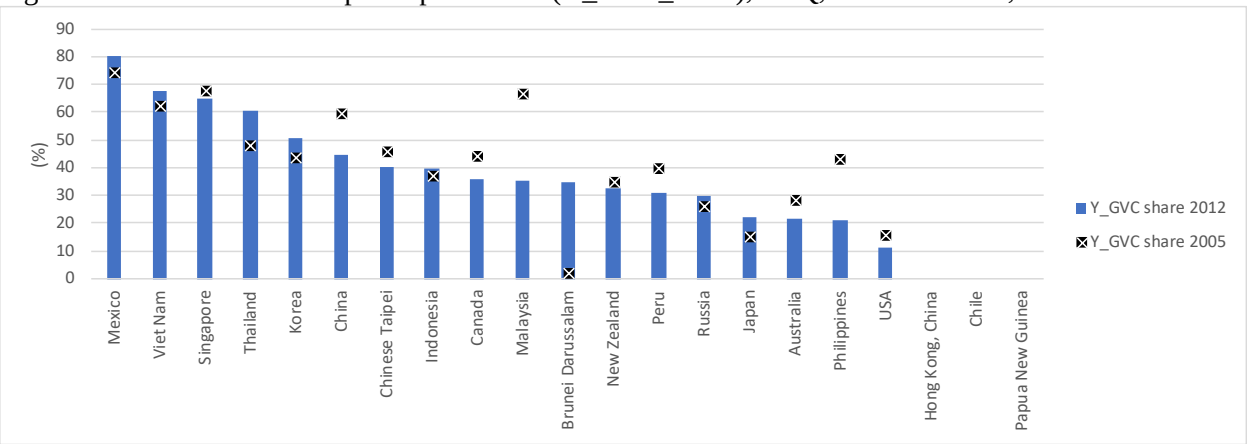


Figure 2.5.6 Backward GVC participation rate (Y_GVC_share), CEQ, 2005 and 2012, APEC



Chemicals (CHM)

GVC-related trade

In 2012, the chemicals industry (CHM) generated $482.4 billion of GVC-related trade in the APEC region. About 94.5 percent of gross exports in this industry was GVC-related, and over 55 percent of GVC-related trade within CHM was in the form of complex GVCs.

In 2012, the United States topped the APEC economies with $112.0 billion of GVC-related trade in the CHM industry, accounting for 23.2 percent of CHM GVC-related trade in the APEC region. It was followed by China ($80.6 billion, 16.7 percent); Japan ($69.8 billion, 14.5 percent); Singapore ($49.9 billion, 10.4 percent); Korea ($34.7 billion, 7.2 percent); Russia ($25.3 billion, 5.2 percent); Mexico ($20.7 billion, 4.3 percent); and Canada ($15.3 billion, 3.2 percent) (figure 2.5.7 and figure 2.5.8).

Among the top GVC participating economies in the CHM industry, the shares of the United States; Japan; Canada; and Singapore in the GVC-related trade of the CHM industry decreased while the shares of China; Russia; Korea; and Mexico increased (figure 2.5.8).

Figure 2.5.7 GVC-related trade (EXGR_GVC), CHM, 2005 and 2012, APEC

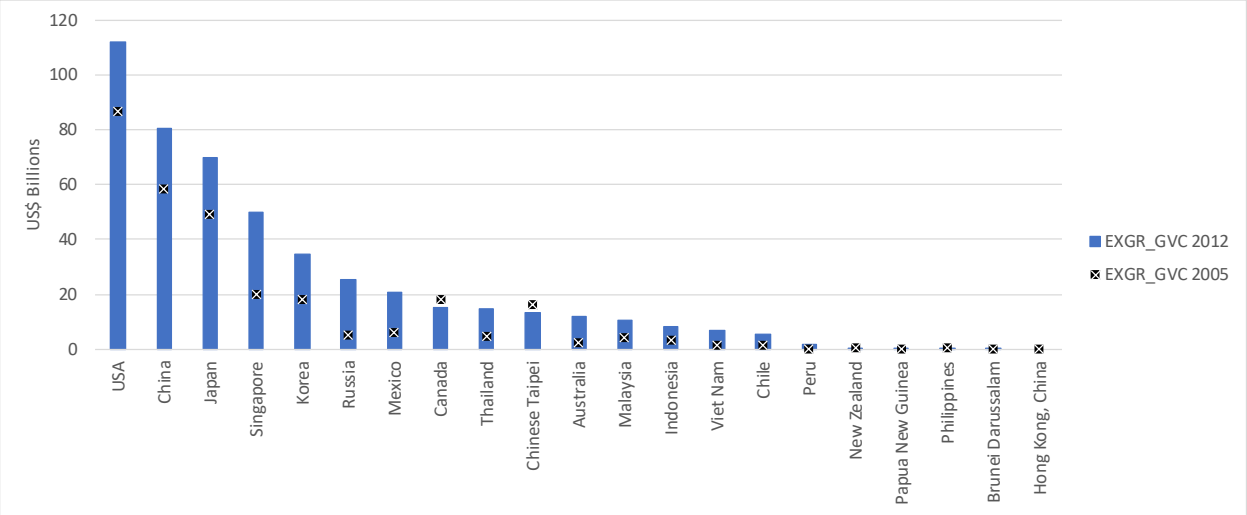
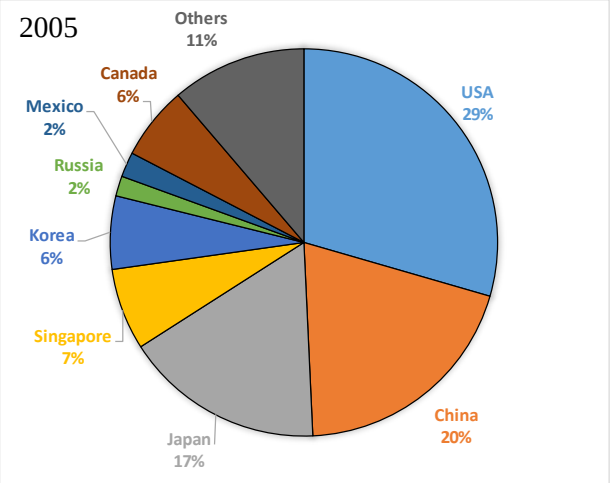
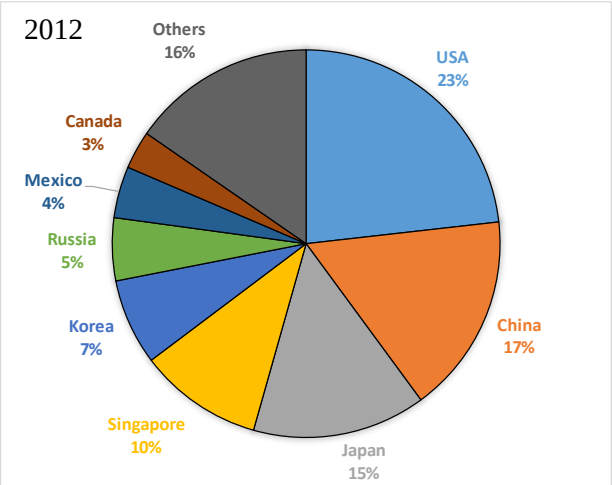


Figure 2.5.8 Share of APEC GVC-related trade, CHM, 2005 and 2012, APEC





Forward GVC Participation

In 2012, the forward GVC participation segment of the CHM industry—measured by domestic VA used in producing intermediate exports for the next stage of production in other economies—amounted to $268.5 billion in 2012, nearly doubling from $141.8 billion in 2005. The United States generated the highest industry GDP from the forward GVC participation at $87.2 billion, followed by China with $68.6 billion (figure 2.5.9).

The average forward GVC participation rate of the CHM industry in the APEC region increased from 28.4 percent in 2005 to 29.4 percent in 2012, suggesting a modest growth in the forward GVC integration in this industry within the region. Singapore; Viet Nam; Thailand; and Russia were among the APEC economies with the highest forward GVC participation rates in CHM. Most APEC economies experienced increases in their forward GVC participation rates for the CHM industry. Among the exceptions were Canada; Korea; Japan; Indonesia; and China (figure 2.5.10).

Figure 2.5.9 Forward GVC participation segment (V_GVC), CHM, 2005 and 2012, APEC

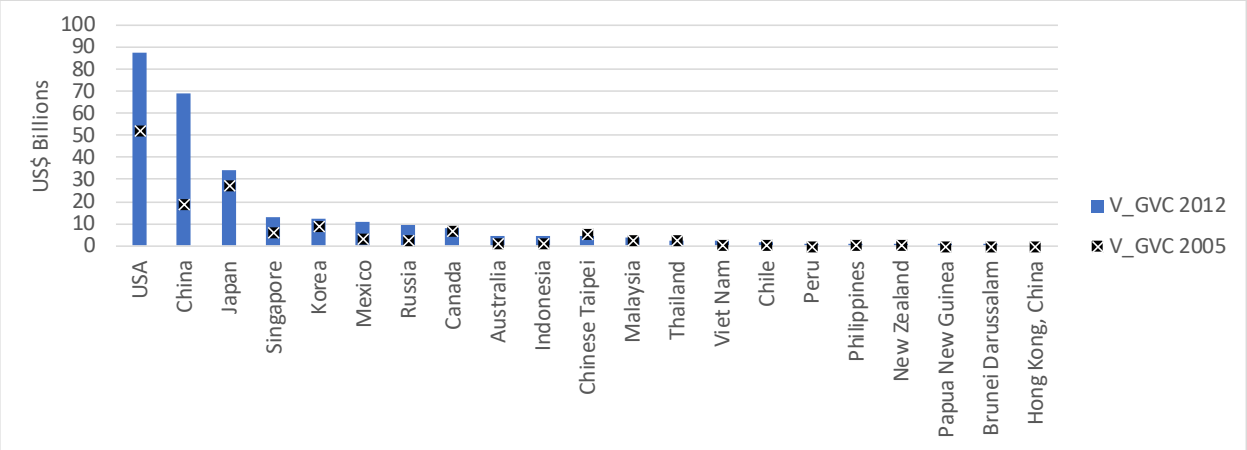
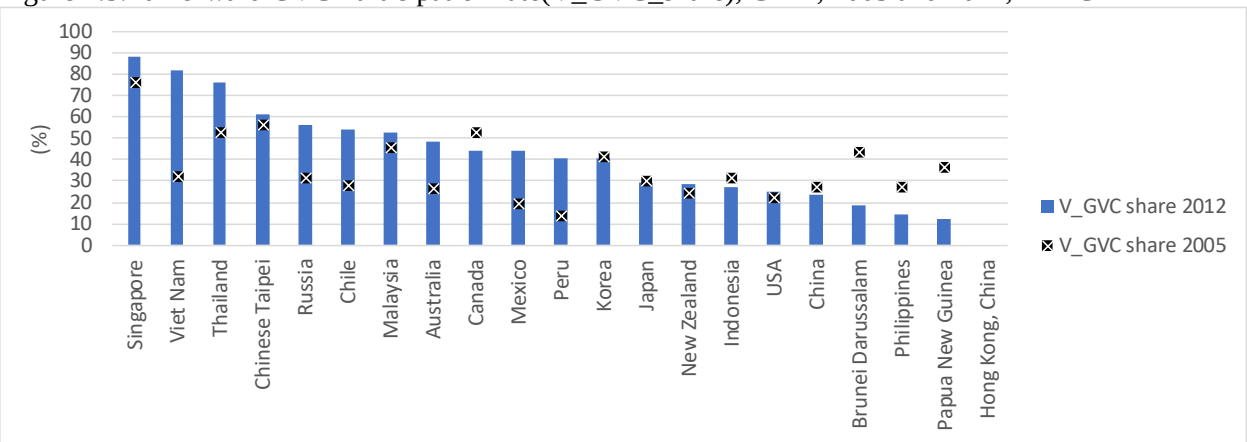


Figure 2.5.10 Forward GVC Participation rate(V_GVC_share), CHM, 2005 and 2012, APEC



Backward GVC Participation

In 2012, the backward GVC participation segment the CHM industry—measured by imported intermediate inputs used in final production—amounted to $102.4 billion in 2012, increasing from $96.0 billion in 2005, indicating an increasing use of imported intermediate inputs in the final production of the CHM industry. The United States had the highest value of the backward GVC participation segment of $27.1 billion, followed by Korea ($20.5 billion) and China ($13.7 billion) (figure 2.5.11).

The average backward GVC participation rate of the CHM industry in the APEC region remained almost unchanged at 24.3 percent between years 2005 and 2012. Korea had one of the highest backward GVC participation rate in CHM at 60.9 percent. Most APEC economies experienced an increase in the backward GVC participation rate during this period. Among the exceptions were Singapore; Canada; China; and the United States (figure 2.5.12).

Figure 2.5.11 Backward GVC Participation segment (Y_GVC), CHM, 2005 and 2012, APEC

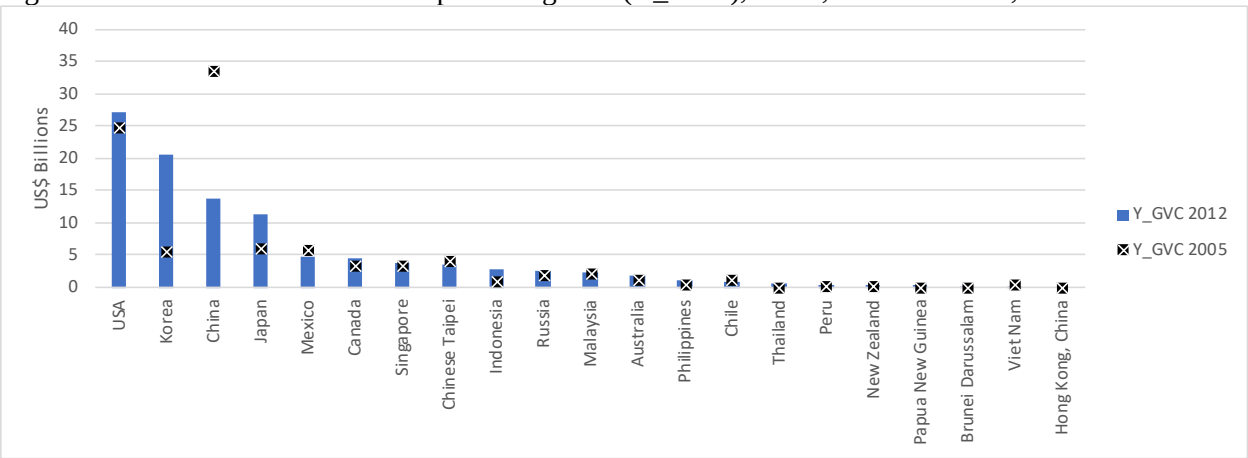
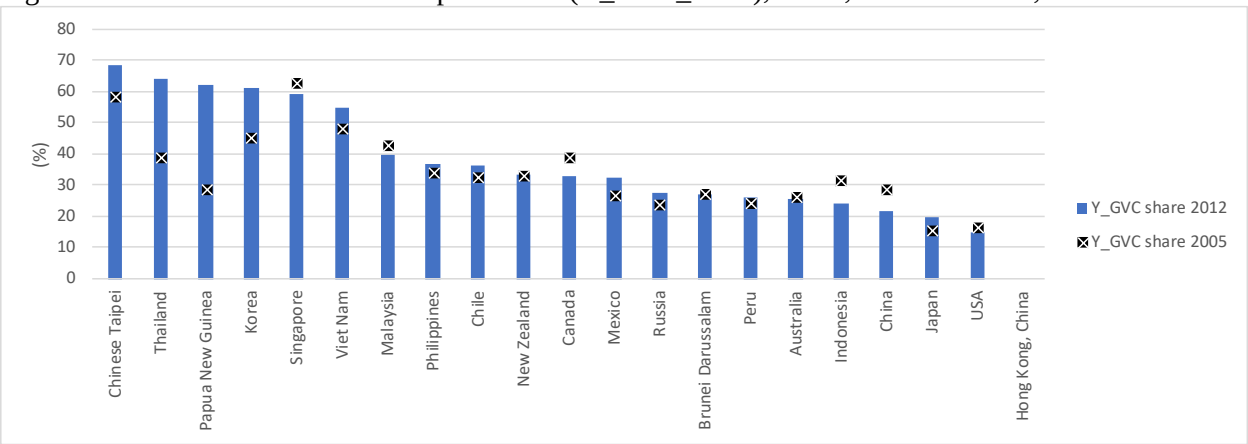


Figure 2.5.12 Backward GVC Participation rate (Y_GVC_share), CHM, 2005 and 2012, APEC



Motor Vehicles, trailers and semi-trailers (MTR)

GVC-related trade

In 2012, the motor vehicles industry (MTR) generated $438.9 billion of GVC-related trade in the APEC region. About 79.3 percent of gross exports in this industry was GVC-related, and over 60 percent of GVC-related trade within MTR was in the form of complex GVCs.

In 2012, Japan and the United States had the largest amount of GVC-related trade in the MRT industry at $101.9 billion and $99.5 billion, respective, together accounting for nearly a half of MTR GVC-related trade in the APEC region. They were followed by Mexico ($59.4 billion, 13.1 percent); China ($54.7 billion, 12.0 percent); Thailand ($41.9 billion, 9.8 percent); Canada ($30.6 billion, 8.4 percent); and Korea ($22.4 billion, 4.7 percent) (figure 2.5.13 and figure 2.5.14). The APEC MTR GVCs form two regional clusters—one in the North America region that consists of the United States; Canada; and Mexico, and the other in the Asia-pacific region that consists of Japan; China; Thailand; and Korea.

In 2005, the United States; Japan; Canada; and Mexico led APEC economies in GVC-related trade within MTR in the region. In 2012, the shares of these four economies all declined, while China and Thailand emerged as two major GVC participants with rising shares in the MRT industry (figure 2.5.14).

Figure 2.5.13 GVC-related trade (EXGR_GVC), MTR, 2005 and 2012, APEC

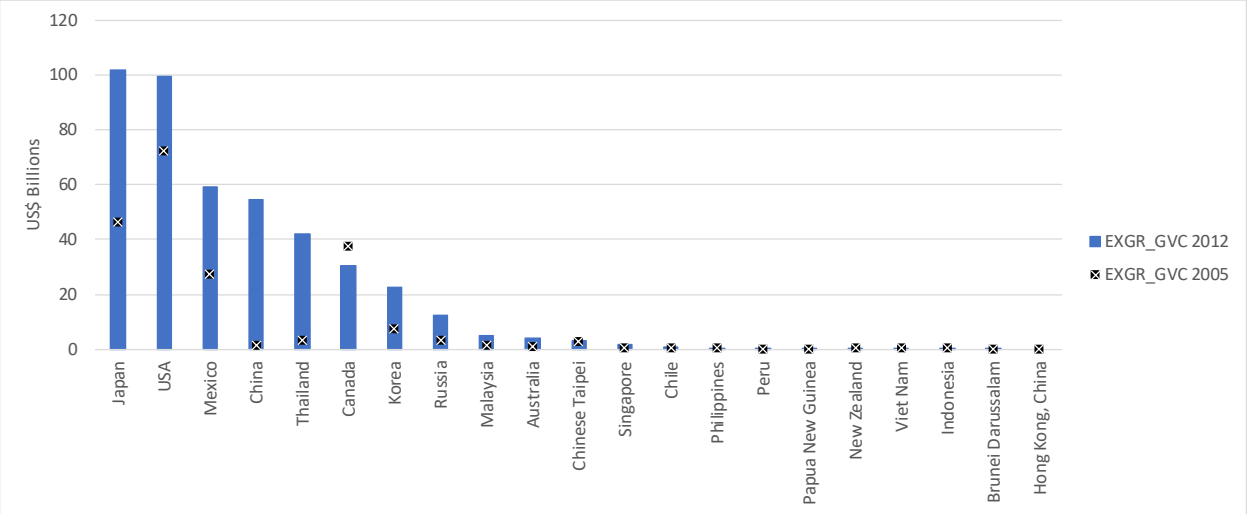
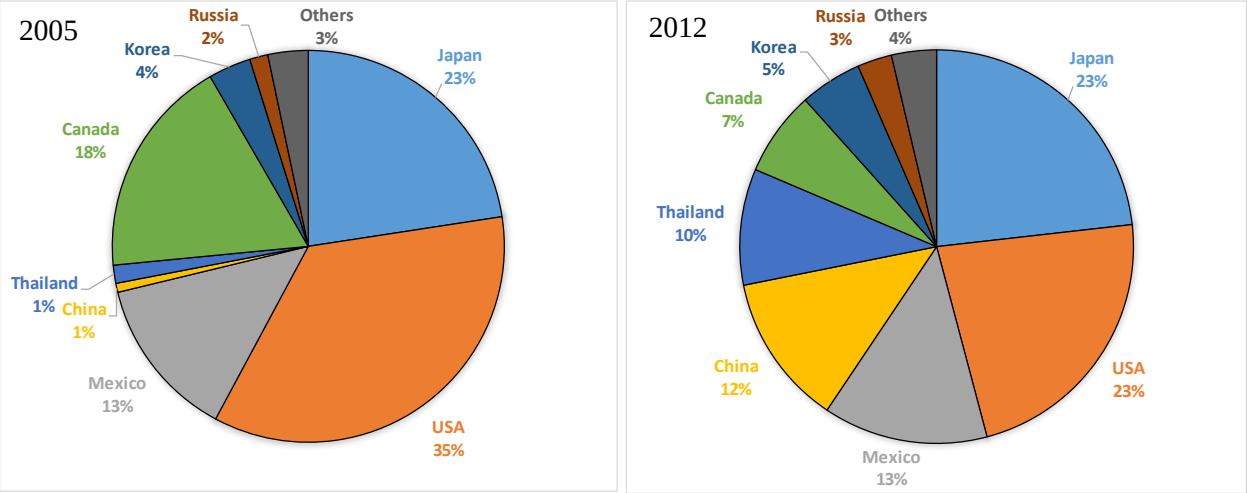


Figure 2.5.14 Share of APEC GVC-related trade, MTR, 2005 and 2012, APEC



Forward GVC Participation

In 2012, the forward GVC participation segment of the MTR industry—measured by domestic VA used in producing intermediate exports for the next stage of production in other economies—amounted to $141.9 billion in 2012, doubling from $69.6 billion in 2005. Japan generated the highest industry GDP from the forward GVC participation segment at $43.8 billion, followed by the United States with $27.4 billion (figure 2.5.15).

The average forward GVC participation rate of the MTR industry in the APEC region increased from 17.3 percent in 2005 to 23.7 percent in 2012, suggesting the growing forward GVC integration in this industry within the region. Thailand had the highest forward GVC participation rate in MTR at 85.3 percent, demonstrating its specialization in the upstream segment of the MTR GVCs. Most APEC economies experienced an increase in the forward GVC participation rate for the MTR industry. Among the exceptions were China; Canada; and Malaysia (figure 2.5.16).

Figure 2.5.15 Forward GVC Participation segment (V_GVC), MTR, 2005 and 2012, APEC

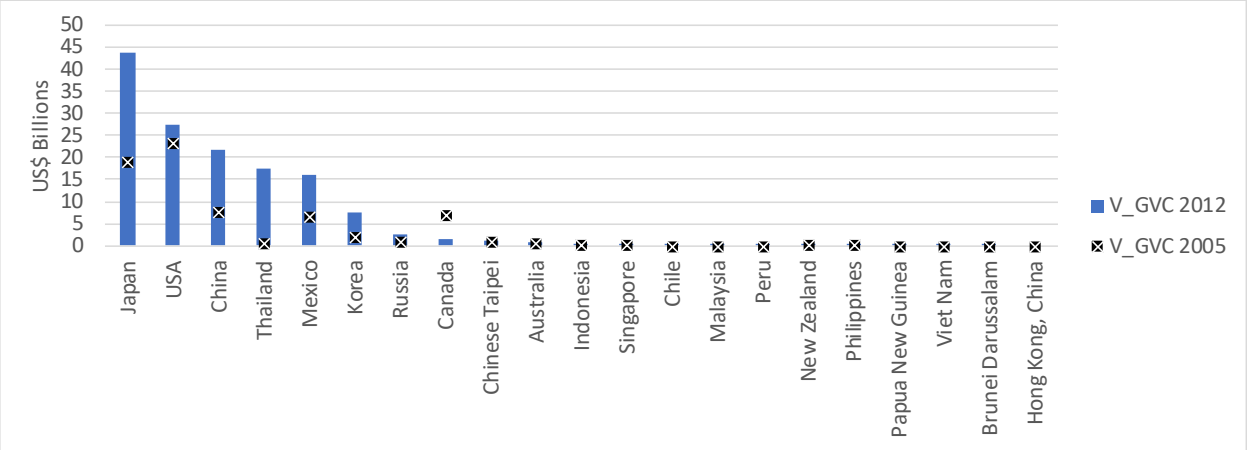
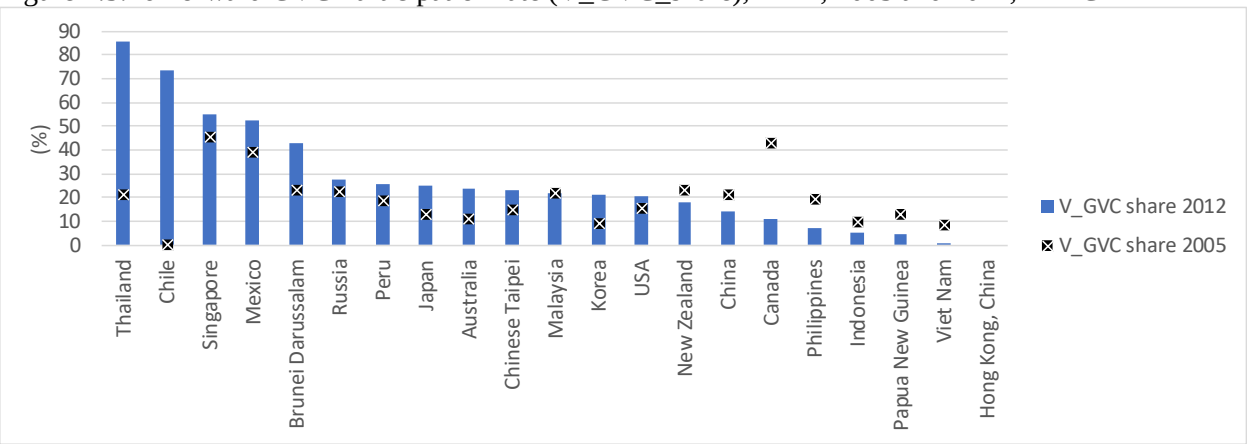


Figure 2.5.16 Forward GVC Participation rate (V_GVC_share), MTR, 2005 and 2012, APEC



Backward GVC Participation

In 2012, the backward GVC participation segment of the MTR industry—measured by imported intermediate inputs used in final production—amounted to $332.9 billion in 2012, increasing from $192.0 billion in 2005, indicating an increasing use of imported intermediate inputs in the final production of this industry. The United States and China had the highest value of the backward GVC participation segments at $82.0 billion and $80.9 billion, respectively (figure 2.5.17).

The average backward GVC participation rate of the MTR industry in the APEC region increased from 26.0 percent in 2005 to 28.3 percent in 2012. Canada had one of the highest backward GVC participation rate in MTR at 57.2 percent, demonstrating its specialization in the downstream segment of the MTR GVC. Most APEC economies experienced an increase in the backward GVC participation rates for the MTR industry. Among the exceptions were Malaysia; Singapore; the Philippines; Peru; and China (figure 2.5.18).

Figure 2.5.17 Backward GVC Participation segment (Y_GVC), MTR, 2005 and 2012, APEC

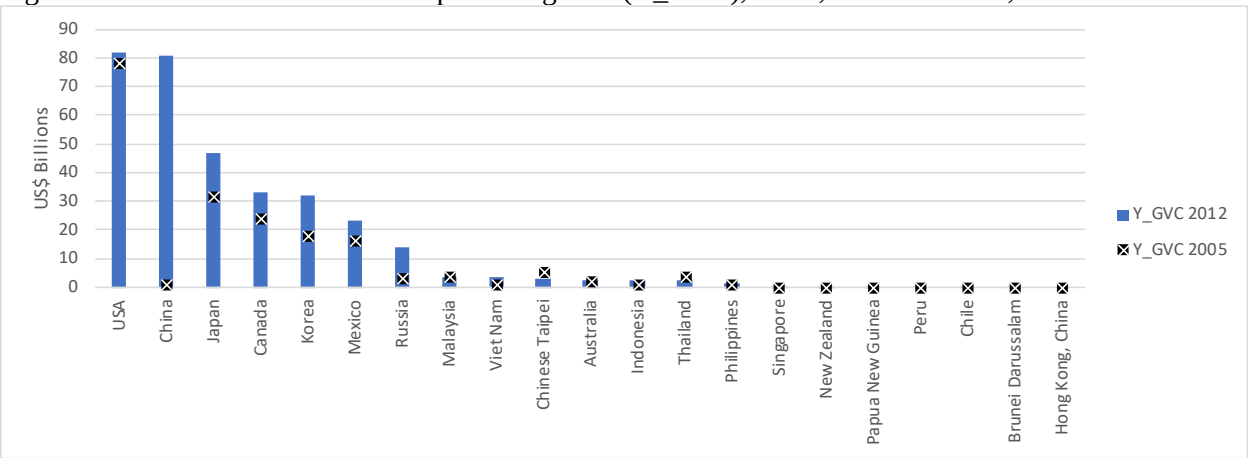
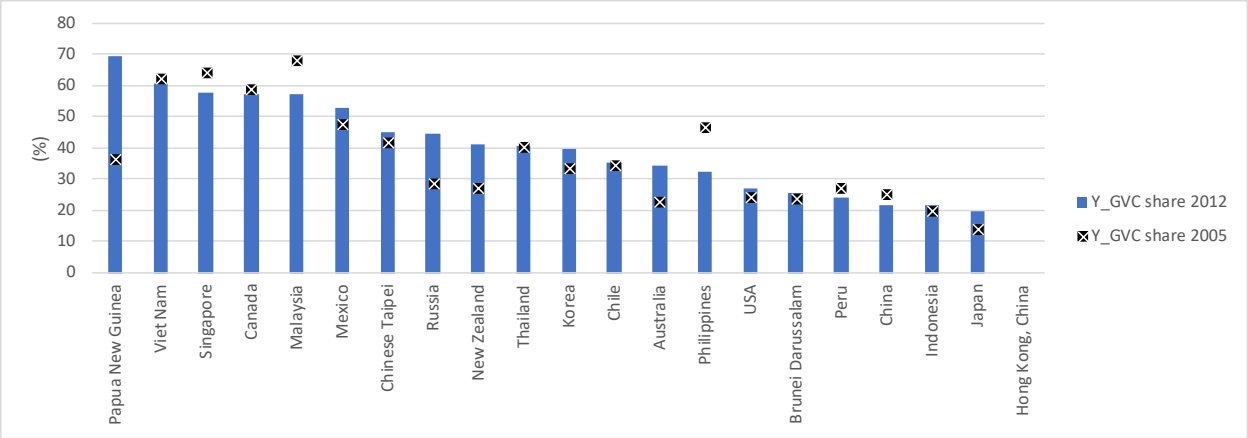


Figure 2.5.18 Backward GVC Participation rate (Y_GVC_share), MTR, 2005 and 2012, APEC



SECTION III

Economy Profiles[26]

Lin Jones, USITC[27]

Erika Bethmann, USITC

Grace Kenneally, former USITC

Zhi Wang, George Mason University

[26] Data source for this section is the APEC TiVA database. Since the APEC TiVA Initiative produced data for only two benchmark years (2005 and 2012), the analysis focuses on the trend between these two benchmark years.
[27] This article is the result of the ongoing professional research by US International Trade Commission (USITC) staff and is solely meant to represent the opinions and professional research of its author. It is not meant to represent in any way the views of the USITC, any of its individual Commissioners, or US Government.

Chapter 1: Australia

Industry Data Summary Based on SUTs

Gross Output[28]

In 2012, Australia's total gross output was $2.9 trillion, more than doubled from its 2005 level. Services sector accounted for 77.3 percent of Australia's gross output, followed by manufacturing sector with a share of 12.6 percent.[29]

Of the 34 industries, construction (CON) had the largest industry gross output at $501.2 billion, accounting for 13.6 percent of Australia's total gross output. Other top industries included R&D and other business activities (BZS, 9.0 percent), wholesale and retail trade (WRT, 8.6 percent), real estate activities (REA, 8.0 percent), and mining (MIN, 7.5 percent) (figure 3.1.1).

Value Added[30]

In 2012, Australia's total value added, or GDP, was $1.5 trillion, increasing from $677.8 billion in 2005, making it the sixth largest economy in the APEC region. The industries with the largest contribution to total GDP were real estate activities (REA, 11.3 percent of total GDP), BZS (9.3 percent), wholesale and retail trade (WRT, 9.2 percent), financial services (8.9 percent), and construction (CON, 8.4 percent).

The largest manufacturing industries in terms of value added were food products, beverages, and tobacco (FOD, 1.8 percent of total GDP), pulp, paper, paper products, printing and publishing (PAP, 1.0 percent), and fabricated metal products (FBM, 0.8 percent) (figure 3.1.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by Australian industries in 2012, about 11.4 percent came from the imported source, slightly below the average of 13.8 percent in the APEC region, but a small increase from 10.2 percent in 2005. The industries with the highest imported intermediate use intensity (IIUI) rates were coke, refined petroleum products and nuclear fuel (PET, 70.4 percent), computer, electronic and optical equipment (CEQ, 37.5 percent), machinery and equipment (MEQ, 32.5 percent), other transportation equipment (TRQ, 32.2 percent), and electrical machinery and apparatus (ELQ, 30.1 percent).

The average IIUI rate for manufacturing sector was 26.4 percent in 2012. Most manufacturing industries in Australia experienced an increase in IIUI during this period. The most notables were motor vehicles, trailer and semi-trailers (MTR), increasing by 97.1 percent; MEQ, increasing by 69.1 percent; and CEQ, increasing by 68.2 percent. Two exceptions were wood and wood products (WOD), decreasing by 36.7 percent; and basic metals (MET), decreasing by 13.6 percent.

Most services industries experienced small changes in IIUI during this period. The services industries experiencing a decrease in IIUI during this period included computer and related activities (ITS), and public administration and defense, compulsory social security (GOV) (figure 3.1.3).

[28] Based on the supply tables at basic price, which could differ from the official NA data.
[29] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[30] Based on the use tables at basic price, which could differ from the official NA data.

Figure 3.1.1. Gross output, by industry, 2005 and 2012, Australia

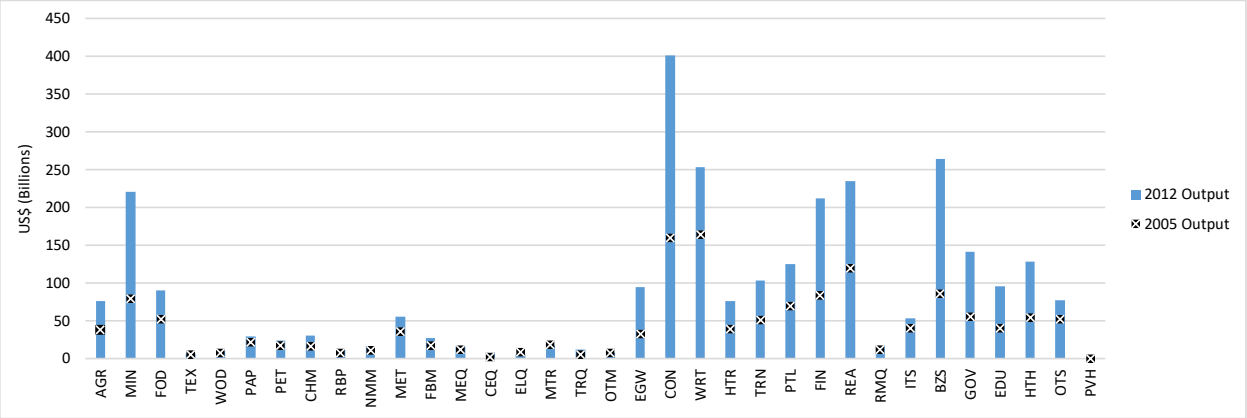


Figure 3.1.2 Value added (VA), by industry, 2005 and 2012, Australia

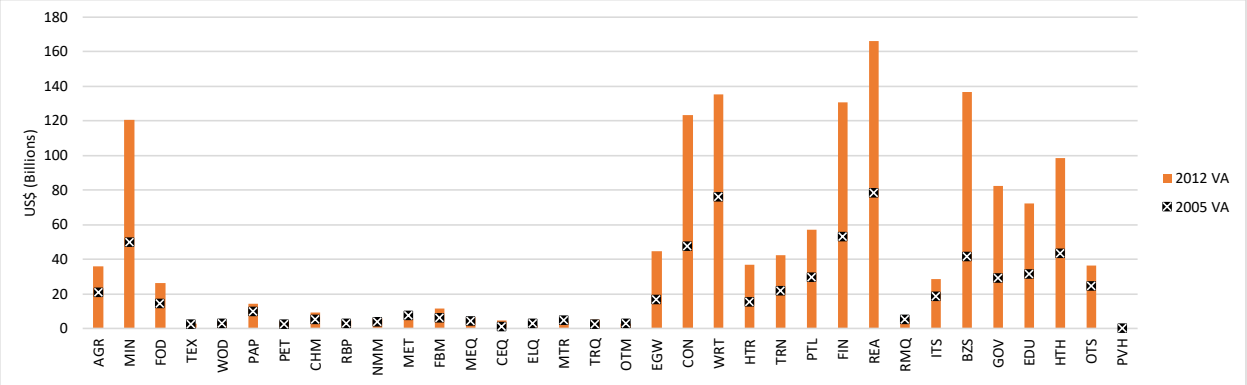
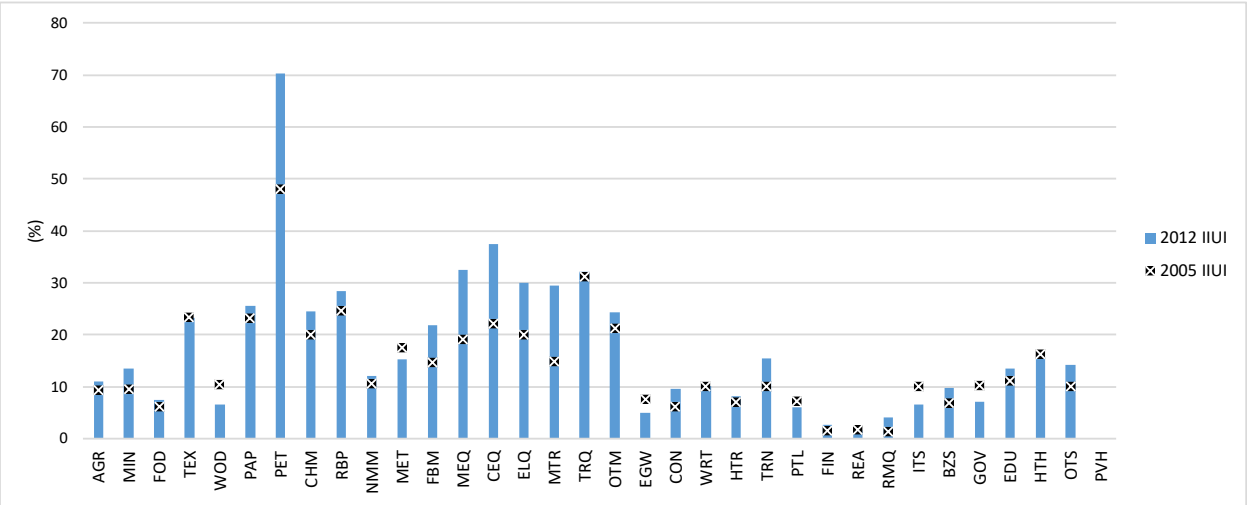


Figure 3.1.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, Australia



Selected APEC TiVA Measures[31]

GVC-Related Trade and GVC Participations

GVC-Related Trade[32]

In 2012, Australia's GVC-related trade amounted to $270.4 billion, more than doubled from $131.6 billion in 2005, and accounting for 91.8 percent of Australia's gross exports. About 45.4 percent of GVC-related trade was in the form of complex GVCs. Mining (MIN) topped all industries, accounting for 30.6 percent of Australia's GVC-related trade. It was followed by agriculture (AGR, 8.2 percent), food, beverage, and tobacco (FOD, 6.8 percent), basic metals (9.2 percent), and wholesale and retail trade (WRT, 7.5 percent) (figure 3.1.4).

Forward GVC Participation[33]

Australia's overall forward GVC participation rate decreased from 15.6 percent in 2005 to 14.7 percent in 2012, slightly above the APEC average of 13.8 percent. The complex forward GVC participation rate decreased from 5.3 percent to 4.8 percent during this period. The industries with the high forward GVC participation rate (over 50 percent) in 2012 were computer, electronic and optical equipment (CEQ, 70.8 percent), electrical machinery and apparatus (ELQ, 57.9 percent), basic metal (55.7 percent), machinery and equipment (55.4 percent), and mining (52.9 percent) (figure 3.1.5).

Backward GVC Participation[34]

Australia's overall backward GVC participation rate decreased from 11.6 percent in 2005 to 11.2 percent in 2012, below the APEC average of 12.7 percent. The complex backward GVC participation rate increased from 3.6 percent to 3.9 percent during this period. Among the industries with the highest (over 30 percent) backward GVC participation rate in 2012 were coke, refined petroleum products and

[31] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[32] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[33] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[34] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

nuclear fuel (PET, 61.2 percent), and motor vehicles, trailers and semi-trailers (MTR, 34.3 percent) (figure 3.1.6).

Figure 3.1.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, Australia

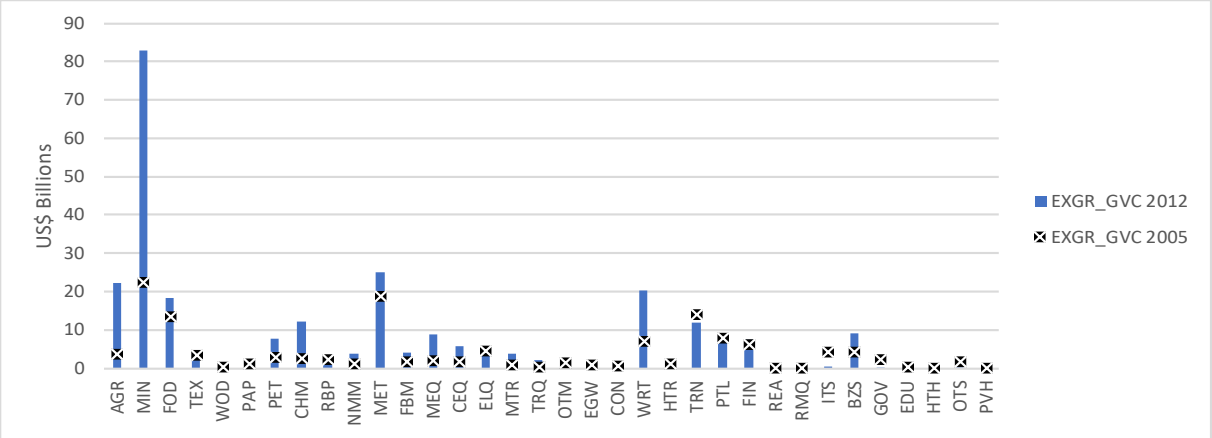


Figure 3.1.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, Australia

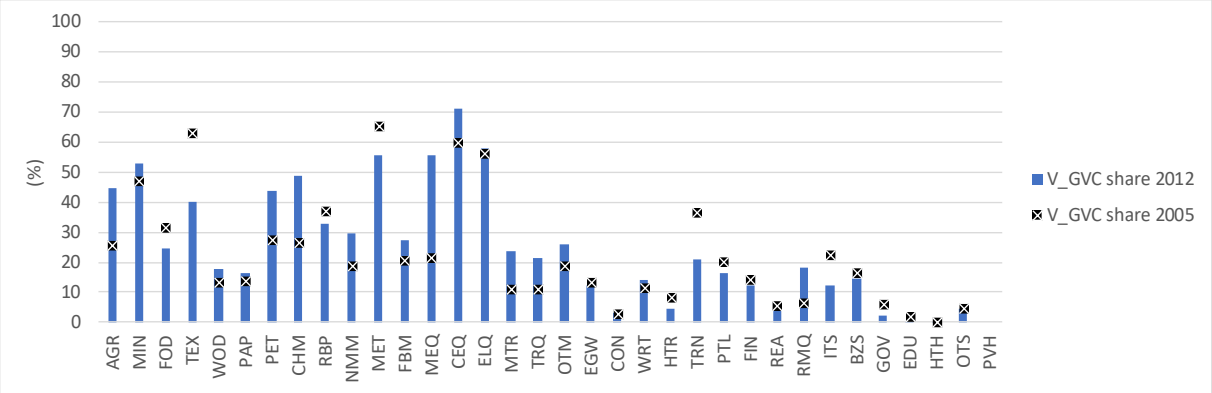
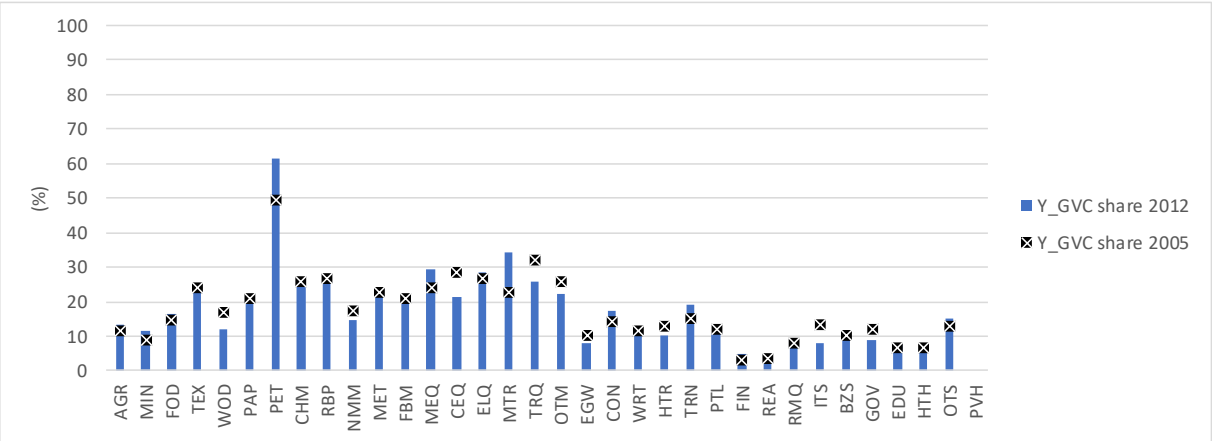


Figure 3.1.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, Australia



Value Added Trade and Top APEC Trading Partners

Value-added exports[35]

In 2012, Australia had value-added exports of $241.1 billion, almost doubled from $121.5 billion in 2005. Mining (MIN) topped all industries, accounting for 26.7 percent of Australia's value-added exports. It was followed by wholesale and retail trade (WRT, 9.7 percent), and R&D and other business activities (BZS, 8.9 percent). These three industries also experienced the largest increases in value-added exports during this period (figure 3.1.7).

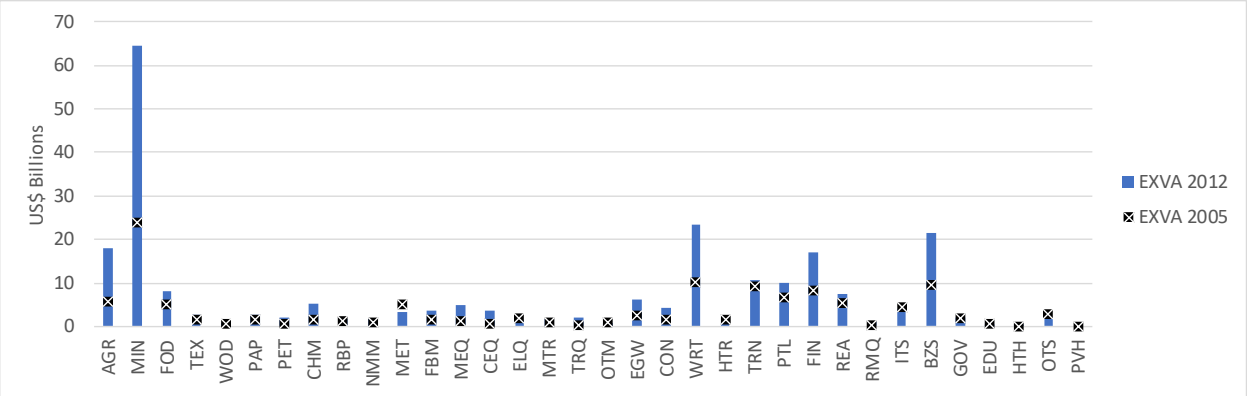
Value-added imports[36]

In 2012, Australia had value-added imports of $270.0 billion, nearly doubled from $138.3 billion in 2005. WRT topped all industries, accounting for 8.7 percent of Australia's value-added imports in 2012. It was followed by MIN (7.7 percent), and transport and storage (TRN, 5.9 percent). The industries that experienced the largest increases in value-added imports during this period were private households with employed persons & extra-territorial organizations & bodies (PVH, 526.9 percent), construction (CON, 411.8 percent), food products beverages and tobacco (FOD, 392.3percent), agriculture (AGR, 329.7 percent), and renting of machinery and equipment (RMQ, 312.2 percent) (figure 3.1.8).

Top APEC Trading Partners

In 2012, in the APEC region, China; Japan; the United States; and Korea; and Chinese Taipei were the top destinations for Australia's value-added exports (figure 3.1.9), and China; the United States; Japan; Korea; and Malaysia were the top sources for Australia's value-added imports (figure 3.1.10).

Figure 3.1.7 Value-added exports (EXVA), by industry, 2005 and 2012, Australia



[35] Value-added exports refer to domestic value added embodied in foreign final demand.
[36] Value-added imports refer to foreign value added embodied in domestic final demand.

Figure 3.1.8 Value-added imports (IMVA), by industry, 2005 and 2012, Australia

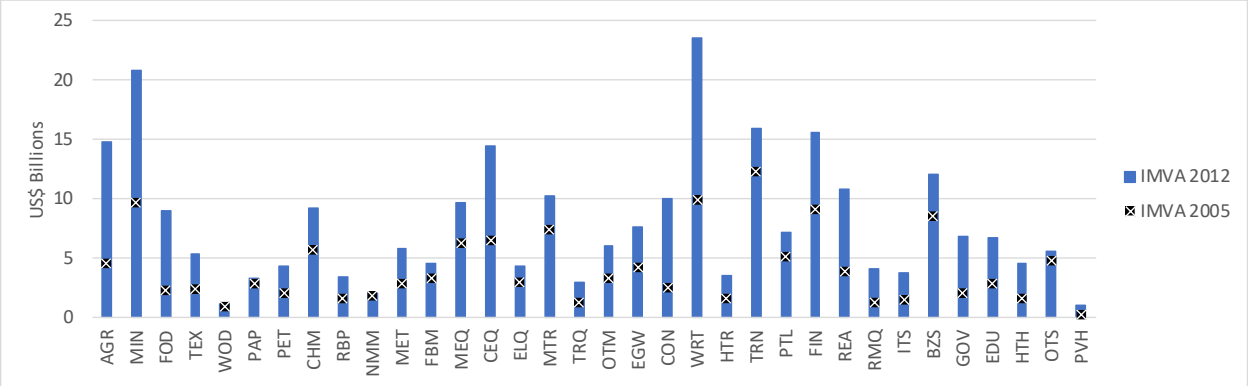


Figure 3.1.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, Australia

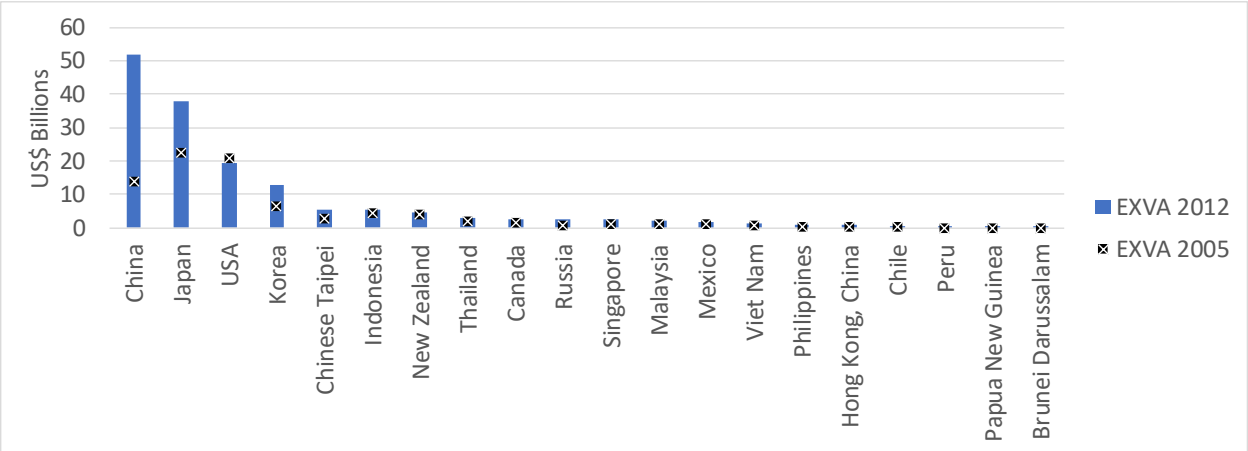
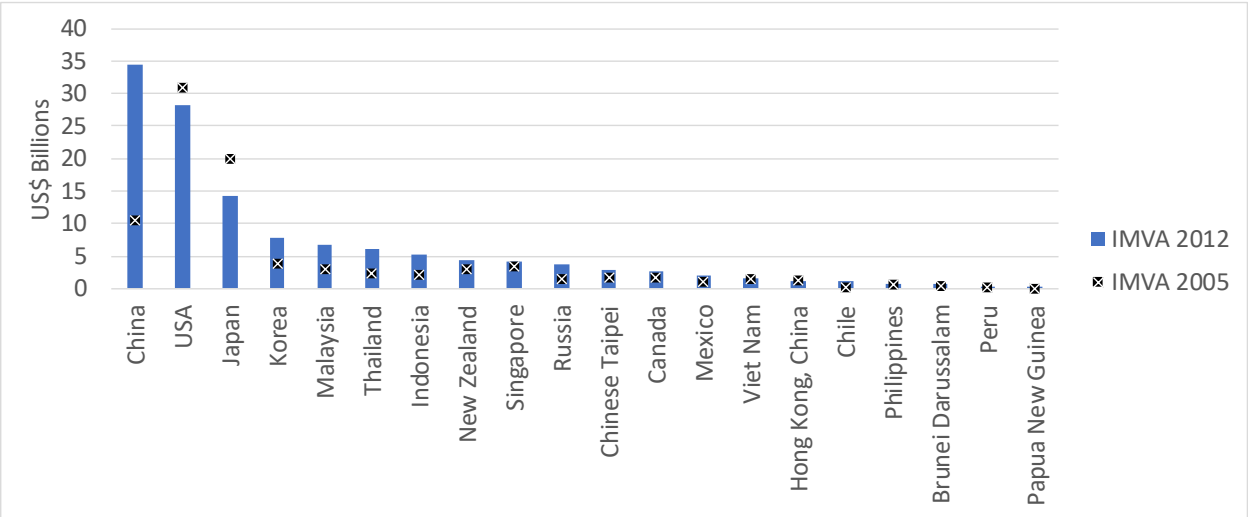


Figure 3.1.10 APEC sources of value-added imports (IMVA), 2005 and 2012, Australia



Chapter 2: Brunei Darussalam

Industry Data Summary Based on SUTs

Gross Output[37]

In 2012, total gross output in Brunei Darussalam (Brunei) was $32.7 billion, more than doubled from $16.0 billion in 2005. Mining (MIN), which included the petroleum and natural gas extraction industry, had the largest gross output of $13.2 billion, more than doubled from $6.3 billion in 2005. Mining accounted for 40.2 percent of Brunei's total gross output, while manufacturing and services sectors accounted for 22.5 percent and 36.6 percent of Brunei's total gross output, respectively.[38]

Other top industries included Coke, refined petroleum products, and nuclear fuels (PET, 20.4 percent), public administration and defense, compulsory social security (GOV, 8.7 percent), and construction (CON, 7.7 percent) (figure 3.2.1).

Value Added[39]

In 2012, Brunei's total value added, or GDP, was $19.3 billion, increasing from $9.6 billion in 2005. Mining was also the largest sector in terms of value added, contributing $10.1 billion, or 52.3 percent, to overall GDP. This reflects the economic importance of the petroleum and natural gas extraction industry in Brunei. Other than mining, the industries with the largest contribution to total GDP were PET (14.9 percent of total GDP), GOV (8.8 percent), and wholesale and retail trade (WRT, 3.6 percent) (figure 3.2.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by Brunei's industries in 2012, 28.0 percent were imported, an increase from 23.8 percent in 2005, and above the average of 13.8 percent in the APEC region.

As a small economy dominated by oil production, Brunei's most industries relied on imported inputs. The average imported intermediate use intensity (IIUI) rate for manufacturing sector was 40.3 percent, and the average IIUI rate for services sector was 41.7 percent, which were higher than most APEC economies. PET had the lowest IIUI, with imported source accounting for only 3.5 percent of all intermediates used in 2012. Several industries had more than 50 percent of the IIUI rates. These industries included food products, beverages and tobacco (FOD, IIUI rate of 62.5 percent), agriculture, hunting, forestry and fishing (AGR, 59.0 percent), textile, leather and footwear (TEX, 57.6 percent), computer and related activities (ITS, 58.1 percent), hotels and restaurants (HTR, 56.9 percent), education (EDU, 53.5 percent), and health and social work (HTH, 51.1 percent).[40]

All industries in Brunei experienced an increase in imported intermediate use intensity during this period, though at a varied degree (figure 3.2.3).

[37] Based on the supply tables at basic price, which could differ from the official NA data.
[38] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[39] Based on the use tables at basic price, which could differ from the official NA data.
[40] Nine manufacturing industries had a uniform IIUI rate of 38.5 percent, most likely due to the lack of industry production data. As a result, a uniform proportionality assumption was applied to these manufacturing industries for the compilation of the use tables for Brunei Darussalam.

Figure 3.2.1. Gross output, by industry, 2005 and 2012, Brunei Darussalam

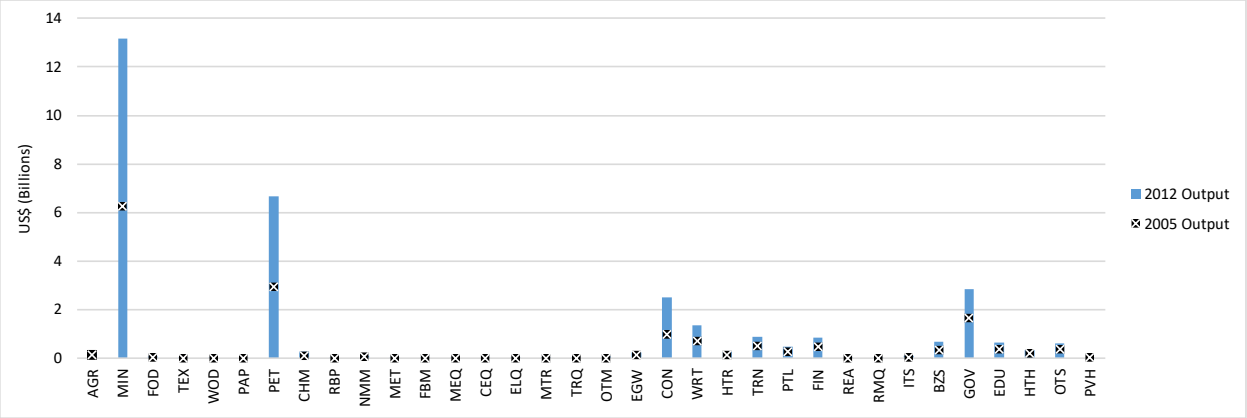


Figure 3.2.2 Value added (VA), by industry, 2005 and 2012, Brunei Darussalam

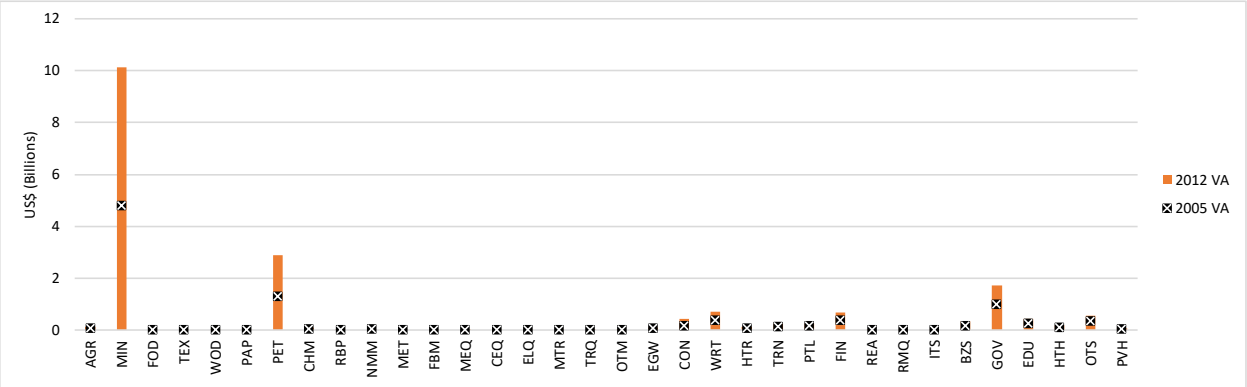
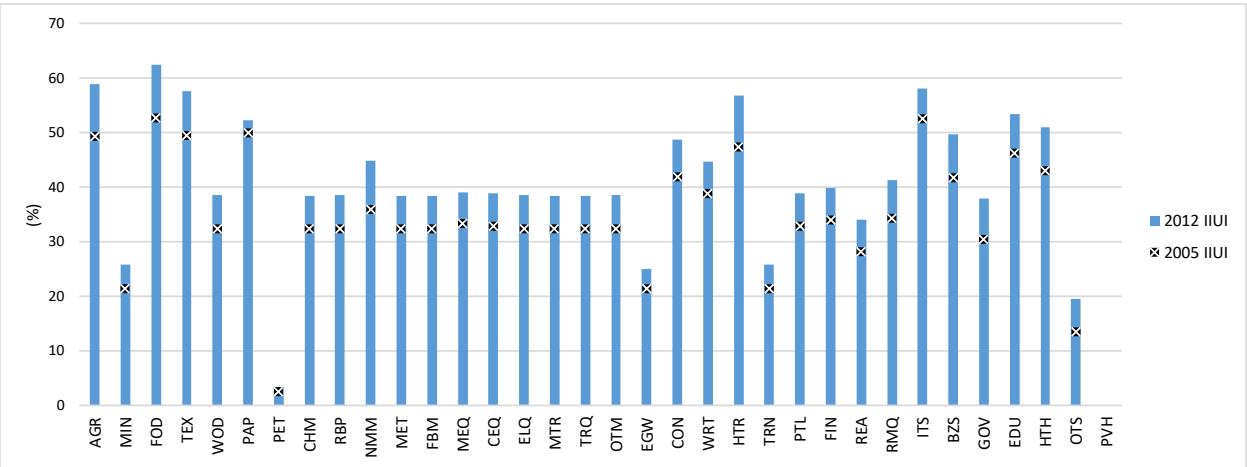


Figure 3.2.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, Brunei Darussalam



Selected APEC TiVA Measures[41]

GVC-Related Trade and GVC Participations

GVC-Related Trade[42]

In 2012, Brunei's GVC-related trade amounted to $11.7 billion, more than doubled from $5.3 billion in 2005, and accounting for 91.3 percent of Brunei's gross exports. About 38.0 percent of GVC-related trade was in the form of complex GVCs. Mining (MIN) topped all industries, accounting for 73.3 percent of Brunei's GVC-related trade. It was followed by coke, refined petroleum products and nuclear fuel (PET), accounting for 14.3 percent of Brunei's GVC-related trade (figure 3.2.4).

Forward GVC Participation[43]

Brunei's overall forward GVC participation rate increased from 47.5 percent in 2005 to 53.6 percent in 2012, far above the APEC average of 13.8 percent. The complex forward GVC participation rate increased from 13.4 percent to 16.0 percent during this period. Among the industries with the highest forward GVC participation rate in 2012 were MIN at 81.5 percent, food, beverages, and tobacco (FOD) and non-metallic mineral products (NMM) both at 58.6 percent, and textiles, and leather and footwear (TEX) at 51.4 percent (figure 3.2.5).

Backward GVC Participation[44]

Brunei's overall backward GVC participation rate increased from 17.5 percent in 2005 to 22.4 percent in 2012, above the APEC average of 12.7 percent. The complex backward GVC participation rate increased from 6.5 percent to 9.1 percent during this period. Among the industries with the highest backward GVC participation rate in 2012 were computer and related activities (ITS, 55.1 percent), food, beverages and tobacco (FOD, 49.1 percent), real estate activities (REA, 45.8 percent), and construction (CON, 45.7 percent) (figure 3.2.6).

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[41] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[42] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[43] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[44] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.2.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, Brunei Darussalam

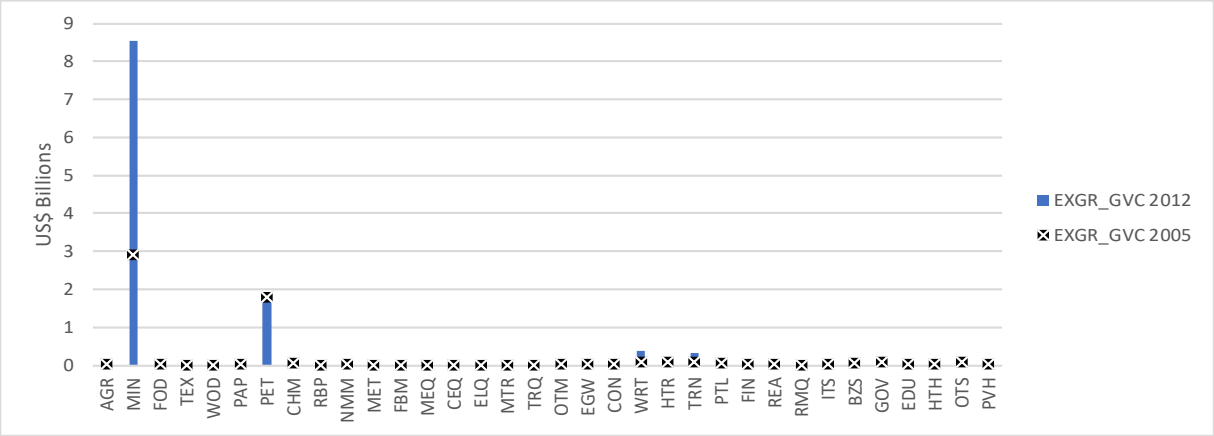


Figure 3.2.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, Brunei Darussalam

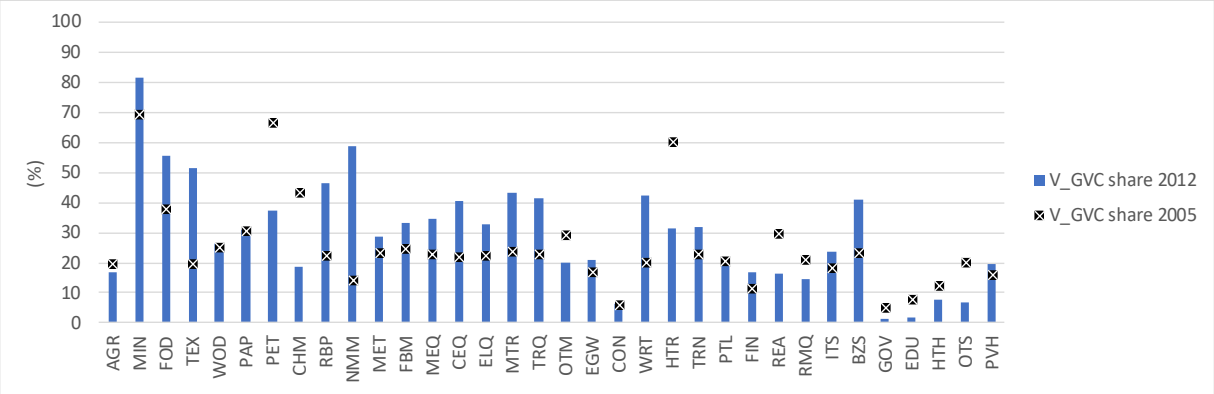
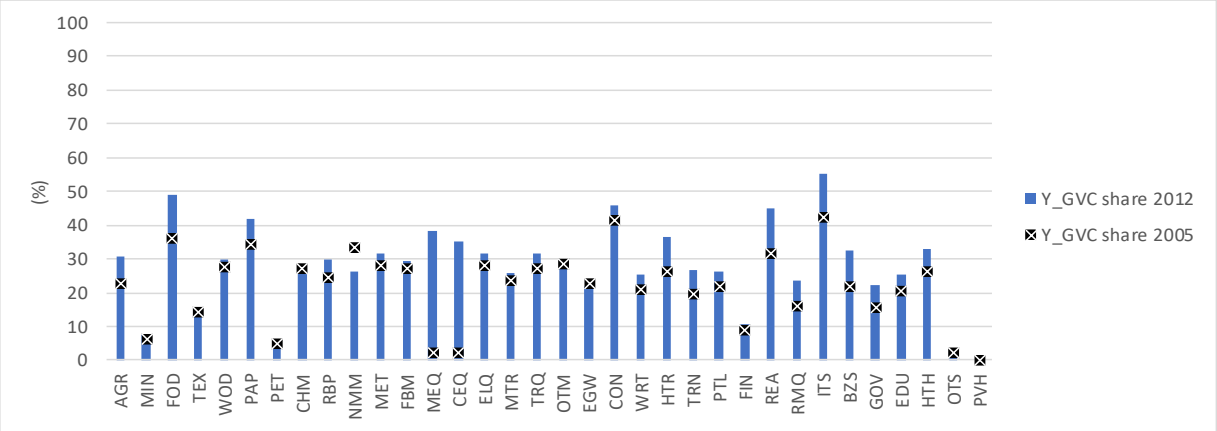


Figure 3.2.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, Brunei Darussalam



Value-Added Trade and Top APEC Trading Partners

Value-added exports[45]

In 2012, Brunei had value-added exports of $11.4 billion, more than doubled from $5.4 billion in 2005. Mining (MIN) dominated all industries, accounting for nearly 75.2 percent of Brunei's value-added exports. It was followed by coke, refined petroleum products and nuclear fuel (PET), accounting for over 11.7 percent of Brunei's value-added exports. Both industries experienced a substantial increase in value-added exports during this period (figure 3.2.7).

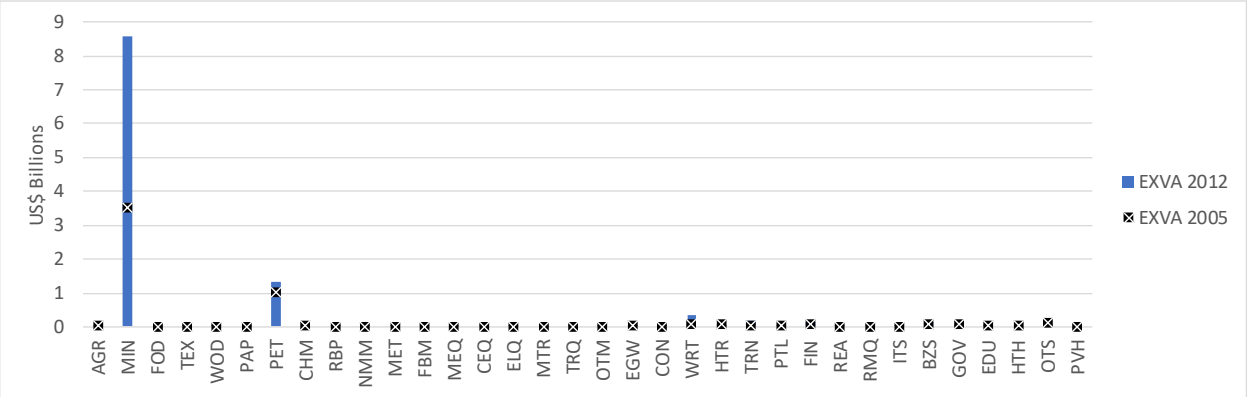
Value-added imports[46]

In 2012, Brunei had value-added imports of $4.0 billion, more than doubled from $1.6 billion in 2005. MIN topped all industries, accounting for 10.2 percent of Brunei's value-added imports. It was followed by chemicals (CHM, 9.5 percent), wholesale and retail trade (WRT, 8.8 percent), agriculture (AGR, 8.5 percent), and transport and storage (TRN, 6.0 percent). These five industries also experienced large increases in value-added imports during this period, but real estate activities (REA), renting of machinery and equipment (RMQ) and computer and related activities (ITS) also saw the large increases, though from a low base in 2005 (figure 3.2.8).

Top APEC Trading Partners

In 2012, in the APEC region, Japan; Korea; Australia; China; and the United States were the top destinations for Brunei's value-added exports (figure 3.2.9), and China; Singapore; Malaysia; the United States; and Japan were the top sources for Brunei's value-added imports (figure 3.2.10).

Figure 3.2.7 Value-added exports (EXVA), by industry, 2005 and 2012, Brunei Darussalam



[45] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.
[46] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.2.8 Value-added imports (IMVA), by industry, 2005 and 2012, Brunei Darussalam

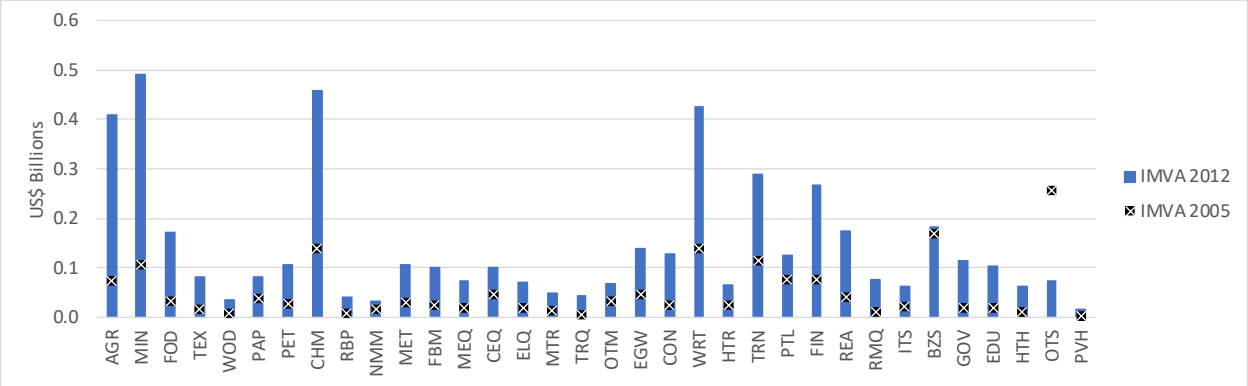


Figure 3.2.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, Brunei Darussalam

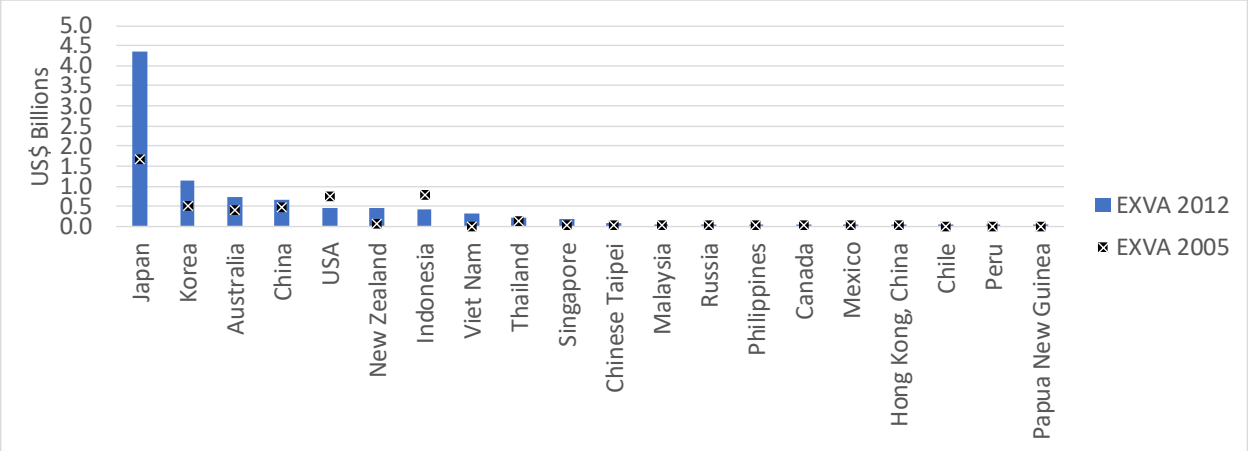
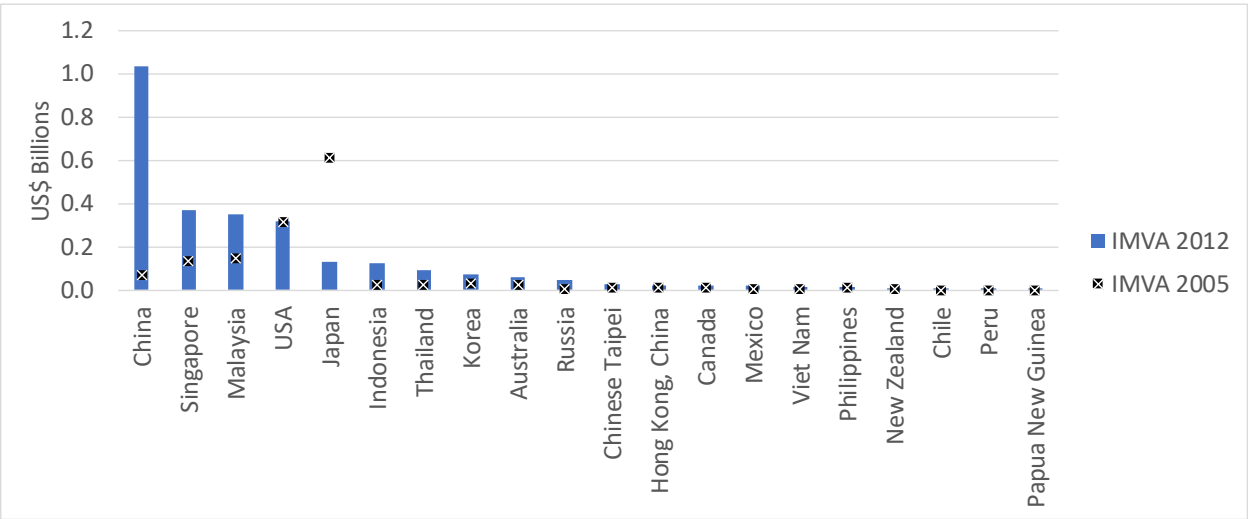


Figure 3.2.10 APEC sources of value-added imports (IMVA), 2005 and 2012, Brunei Darussalam



Chapter 3: Canada

Industry Data Summary Based on SUTs

Gross Output[47]

In 2012, Canada's total gross output was $3.2 trillion, increasing by less than 30 percent from $2.5 trillion in 2005. Manufacturing and services sectors accounted for 20.5 percent and 70.8 percent of Canada's total gross output, respectively.[48]

Of the 34 industries, construction (CON) had the largest industry gross output of $309.2 billion in 2012, almost doubled from its 2005 level, and accounting for 9.5 percent of Canada's total gross output. Other top industries included wholesale and retail trade (WRT, 9.1 percent), public administration and defense, compulsory social security (GOV, 8.6 percent), real estate activities (REA, 8.1 percent), and mining (MIN, 6.2 percent) (figure 3.3.1).

Value Added[49]

In 2012, Canada's total value added, or GDP, was $1.7 trillion, increasing from $1.1 trillion in 2005. Services sector accounted for 79.6 percent of Canada's total GDP, followed by manufacturing with a share of 11.4 percent.

The industries with the top contribution to total GDP were real estate activities (REA, 11.6 percent of total GDP), WRT (10.6 percent), GOV (8.8 percent), CON (7.9 percent), and MIN (7.3 percent).

The largest manufacturing industries in terms of value added were food products, beverages, and tobacco (FOD, 1.7 percent of total GDP), machinery and equipment (MEQ, 1.3 percent), and chemicals (CHM, 1.1 percent) (figure 3.3.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by Canadian industries in 2012, 21.6 percent were imported, a slight decrease from 22.5 percent in 2005, but above the average of 13.8 percent in the APEC region. The industries with the highest imported intermediate use intensity (IIUI) were motor vehicles manufacturing (MTR, 58.7 percent), computer, electronic and optical equipment (CEQ, 54.5 percent), and electrical machinery and apparatus (ELQ, 53.1 percent).

The average IIUI rate in Canadian manufacturing sector was 38.1 percent in 2012. Most manufacturing industries in Canada experienced an increase in IIUI during this period. Of them, the most notable were ELQ, increasing by 17.0 percent; rubber and plastics (RBP), increasing by 16.8 percent; and coke, refined petroleum products and nuclear fuel (PET), increasing by 15.2 percent. One notable exception was CEQ, whose IIUI rate decreased by 10.6 percent from 60.9 percent in 2005 to 54.5 percent in 2012.

Comparatively, services sector had a lower average IIUI rate of 15.4 percent. Most services industries experienced an increase in IIUI during this period. The most notables were post and telecommunication (PTL), increasing by 28.9 percent; and renting of Machinery and equipment (RMQ), increasing by 27.6 percent. A few exceptions included electricity, gas and water supply (ELQ), decreasing by 35.2 percent; and health and social work (HTH), decreasing by 10.5 percent (figure 3.3.3).

[47] Based on the supply tables at basic price, which could differ from the official NA data.
[48] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[49] Based on the use tables at basic price, which could differ from the official NA data.

Figure 3.3.1 Gross output, by industry, 2005 and 2012, Canada

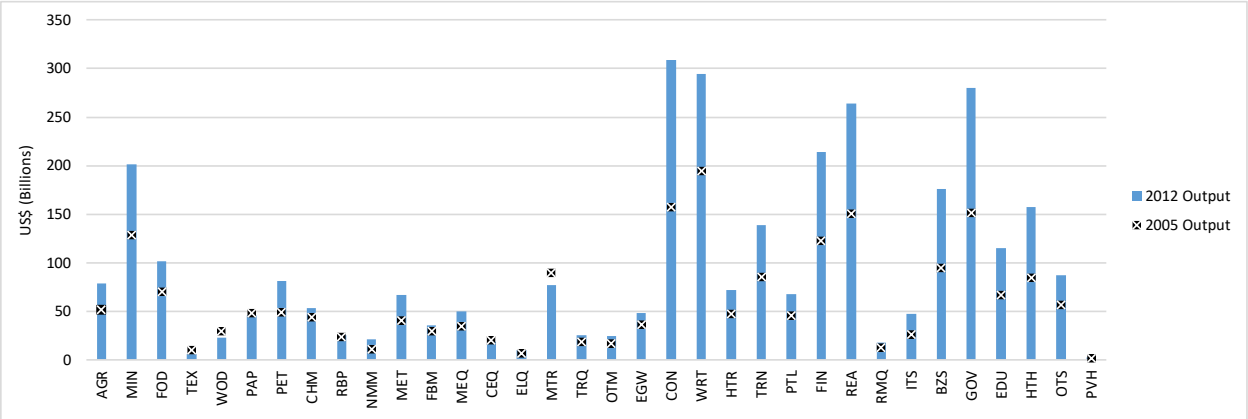


Figure 3.3.2 Value added (VA), by industry, 2005 and 2012, Canada

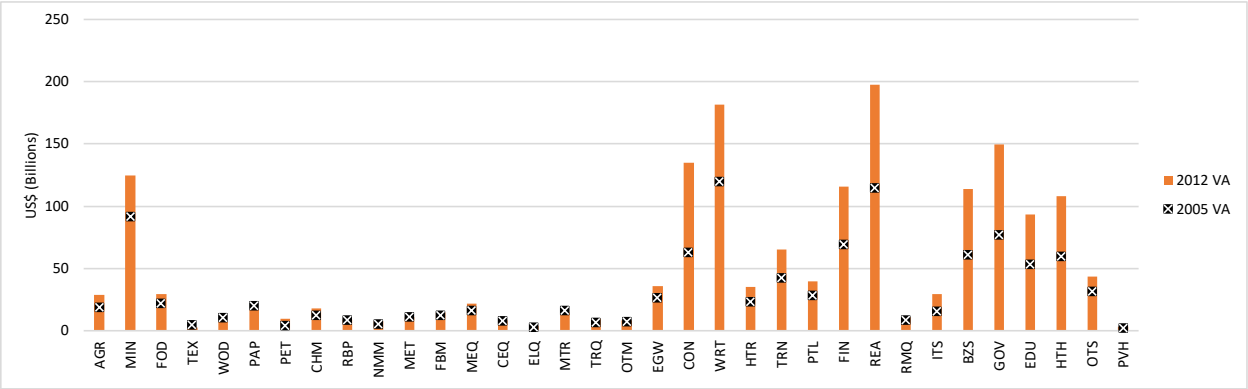
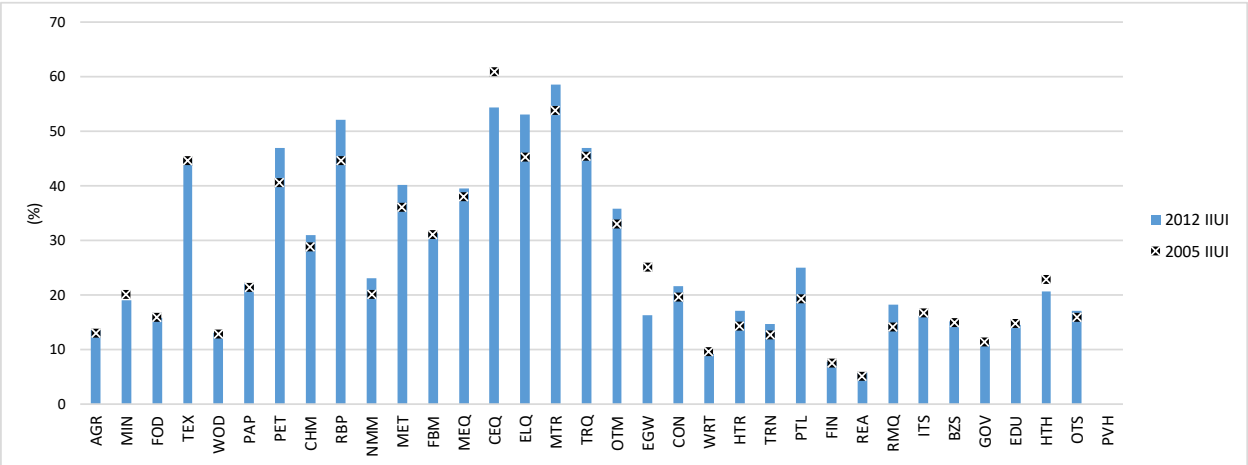


Figure 3.3.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, Canada



Selected APEC TiVA Measures[50]

GVC-Related Trade and GVC Participations

GVC-Related Trade[51]

In 2012, Canada's GVC-related trade amounted to $419.3 billion, increasing by 18.7 percent from $353.3 billion in 2005, and accounting for 82.9 percent of Canada's gross exports. About 51.3 percent of GVC-related trade was in the form of complex GVCs. Mining (MIN) topped all industries, accounting for 19.0 percent of Canada's GVC-related trade. It was followed by and agriculture (AGR, 9.2 percent), basic metals (MET, 8.1 percent), and motor vehicles, trailers and semi-trailers (MTR, 7.3 percent) (figure 3.3.4).

Forward GVC Participation[52]

Canada's overall forward GVC participation rate decreased from 17.6 percent in 2005 to 16.0 percent in 2012, above the APEC average of 13.8 percent. The complex forward GVC participation rate decreased from 4.2 percent to 4.0 percent during this period. Among the industries with the highest forward GVC participation rate in 2012 were textiles, leather and footwear (TEX) at 75.3 percent, basic metals (MET) at 67.9 percent, rubber and plastics products (RBP, 64.1 percent) and AGR at 60.6 percent (figure 3.3.5).

Backward GVC Participation[53]

Canada's overall backward GVC participation rate decreased from 19.1 percent in 2005 to 16.6 percent in 2012, though above the APEC average of 12.7 percent. The complex backward GVC participation rate increased from 5.1 to 6.1 percent during this period. Among the industries with the highest backward GVC participation rate in 2012 were MTR (57.2 percent), coke, refined petroleum products and nuclear fuel (PET, 48.8 percent), MET (47.3 percent), RBP (42.1 percent), and electrical machinery and apparatus (ELQ, 41.9 percent) (figure 3.3.6).

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[50] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[51] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[52] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[53] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.3.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, Canada

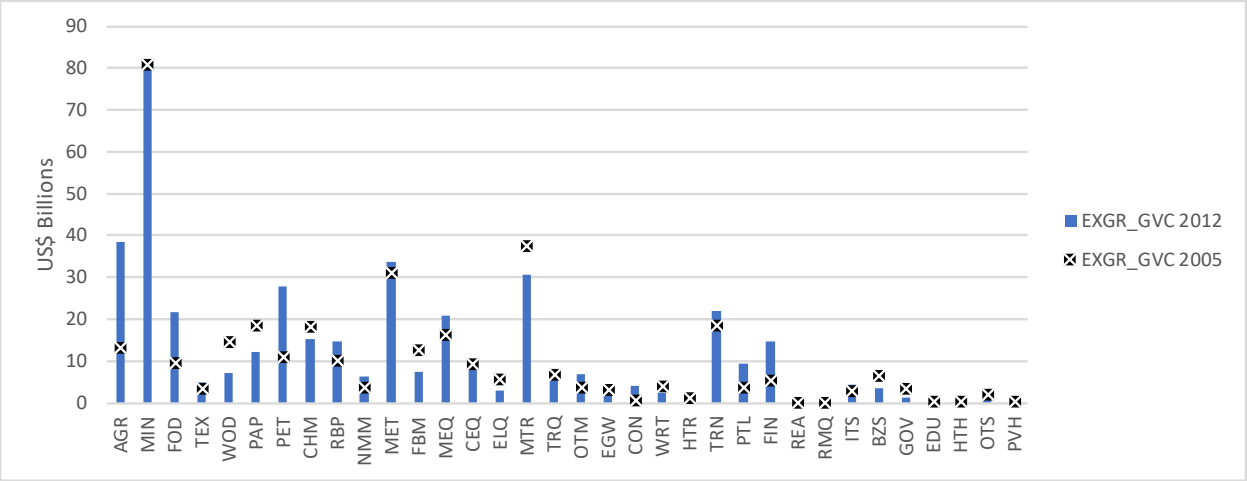


Figure 3.3.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, Canada

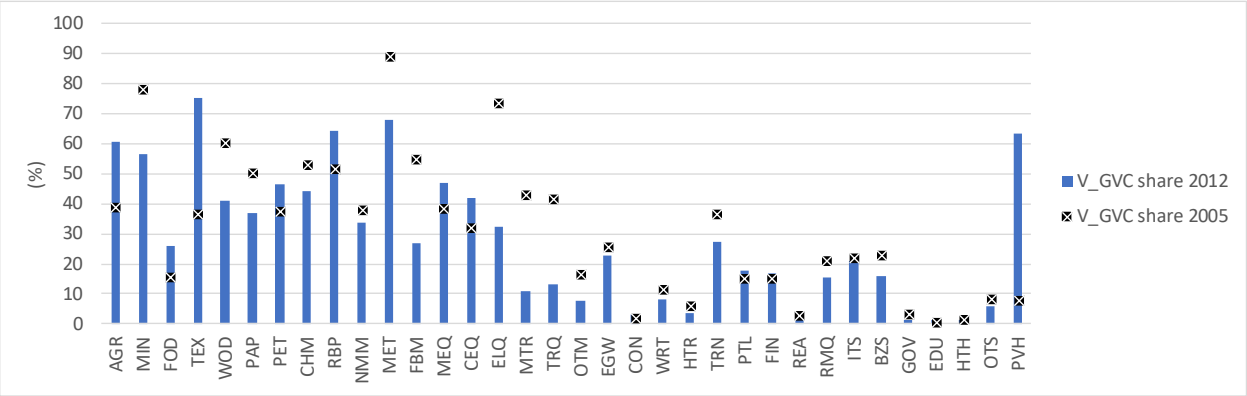
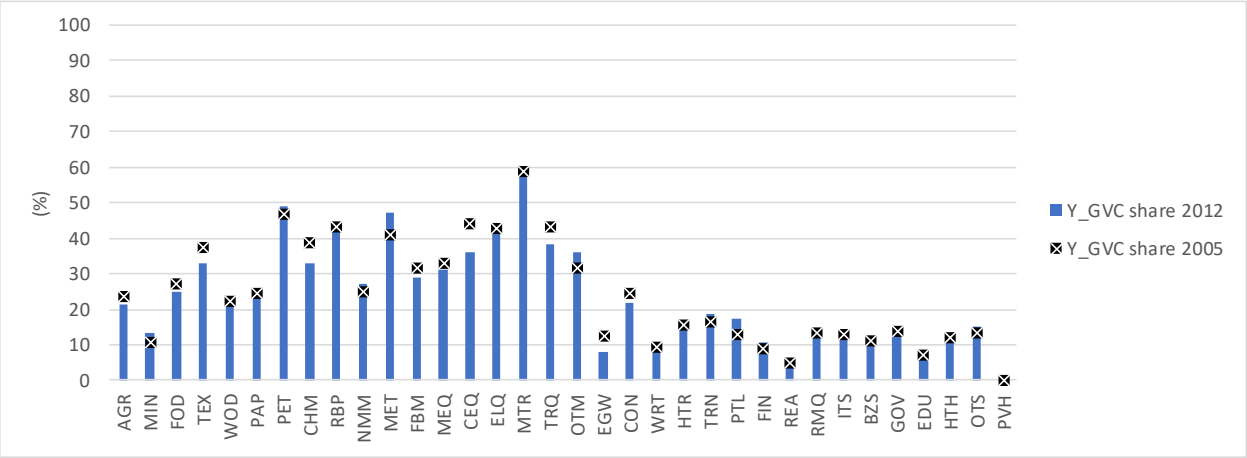


Figure 3.3.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, Canada



Value Added Trade and Top APEC Trading Partners

Value-added exports[54]

In 2012, Canada had value-added exports of $354.5 billion, increasing by 25.1 percent from $283.4 billion in 2005. Mining (MIN) topped all industries, accounted for 21 percent of Canada's value-added exports. It was followed by R&D and other business activities (BZS, 7.0 percent), finance and insurance (FIN, 6.7 percent), transport and storage (TRN, 6.2 percent), and wholesale and retail trade (WRT, 6.1 percent). The industries experiencing the largest increase in value-added exports were FIN and agriculture (AGR) (figure 3.3.7).

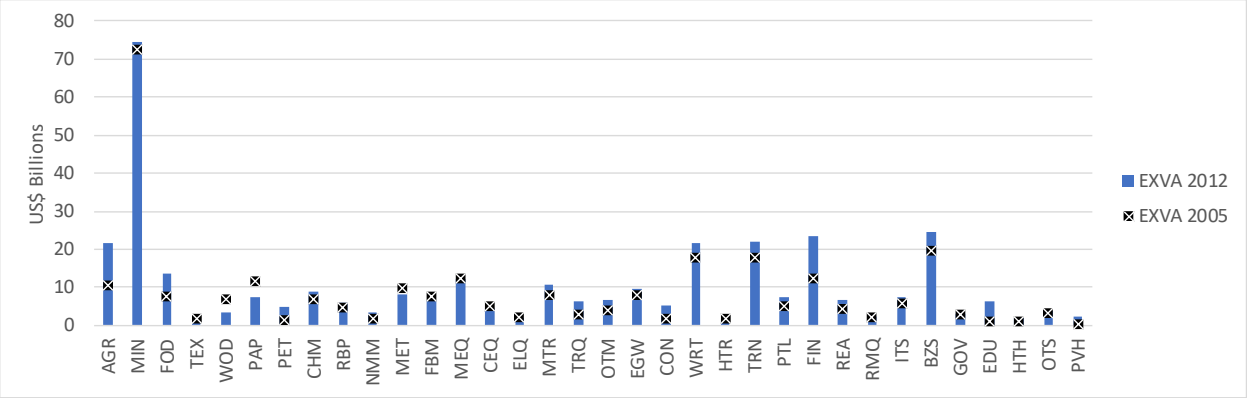
Value-added imports[55]

In 2012, Canada had value-added imports of $396.3 billion, a significant increase from $239.5 billion in 2005. Wholesale and retail trade (WRT) topped all industries, accounting for 8.3 percent of Canada's value- added imports. It was followed by mining (MIN, 8.1 percent), R&D and other business activities (BZS, 6.2 percent), and computer electronic and optical equipment (CEQ, 5.7 percent). The industries that experienced the largest increases in value-added imports during this period were education (EDU), and health and social work (HTH), although from a low base in 2005 (figure 3.3.8).

Top APEC Trading Partners

In 2012, in the APEC region, the United States; China; Japan; Mexico; and Korea were the top destinations for Canada's value-added exports, as well as the top sources for Canada's value-added imports (figure 3.3.9 and 3.3.10).

Figure 3.3.7 Value-added exports (EXVA), by industry, 2005 and 2012, Canada



[54] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.
[55] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.3.8 Value-added imports (IMVA), by industry, 2005 and 2012, Canada

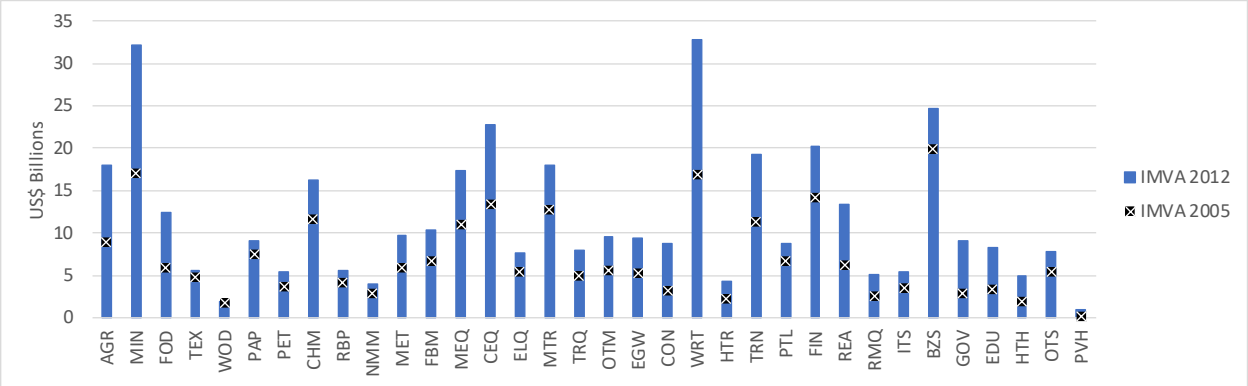


Figure 3.3.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, Canada

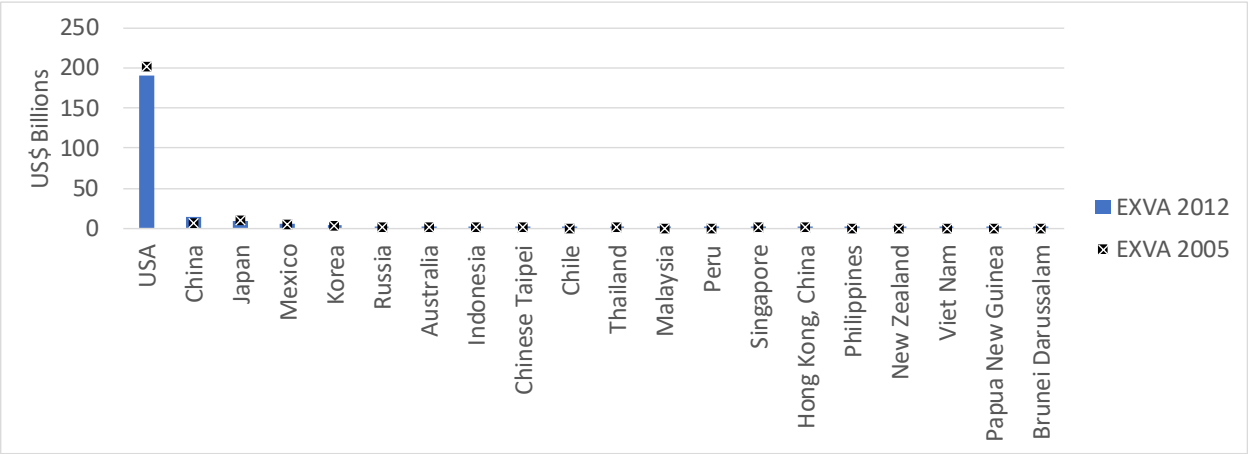
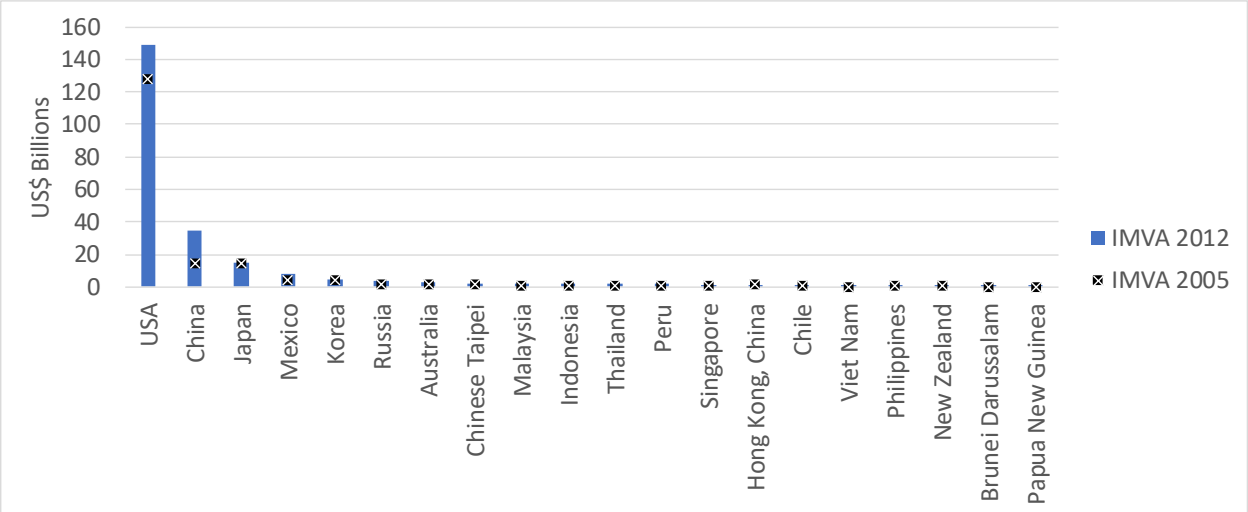


Figure 2.5.10 APEC sources of value-added imports (IMVA), 2005 and 2012, Canada



Chapter 4: Chile

Industry Data Summary Based on SUTs

Gross Output[56]

In 2012, Chile's total gross output was $523.5 billion, more than doubled from $255.4 billion in 2005. Manufacturing and services sectors accounted for 21.6 percent and 63.1 percent of Chile's total gross output, respectively.[57]

Of the 34 industries, mining (MIN) had the largest gross output of $56.3 billion in 2012, increasing by 86.4 percent from $30.2 billion in 2005. MIN accounted for 10.8 percent to Chile's gross output. Other top industries included wholesale and retail trade (WRT, 10.2 percent), food, beverages, and tobacco (FOD,8.1 percent), R&D and other business activities (BZS, 7.7 percent), and transport and storage (TRN, 7.3 percent) (figure 3.4.1).

Value Added[58]

In 2012, Chile's total value added, or GDP, was $244.4 billion, more than doubled from $112.5 billion in 2005. Overall, manufacturing and services sectors contributed 11.8 percent and 70.9 percent of Chile's total GDP, respectively.

Mining (MIN) was the largest industry, accounting for 13.7 percent of Chile's overall GDP. Other top industries by value added were all from the services sector: R&D and other business activities (BZS, 10.3 percent of GDP), wholesale and retail trade (WRT, 10.1 percent), and construction (CON, 7.1 percent). The largest manufacturing industries in terms of value added were FOD (4.6 percent), and chemicals (1.4 percent) (figure 3.4.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by Chile's industries in 2012, 18.9 percent were imported, above the APEC average of 13.8 percent, and a slight increase from 17.2 percent in 2005. The industries with the highest imported intermediate use intensity (IIUI) were coke, refined petroleum products and nuclear fuel (PET, 83.1 percent), rubber and plastics (RBP, 44.8 percent), and electrical machinery and apparatus (ELQ, 40.2 percent).

The average IIUI rate for manufacturing sector was 30.9 percent in 2012. Most manufacturing industries in Chile experienced an increase in IIUI during this period. Of them, the most notables were PET, RBP, and chemicals (CHM), with their IIUI rates all increasing by more than 35 percent. Three exceptions were machinery and equipment (MEQ), ELQ, and motor vehicles, trailers and semi-trailers (MTR), but their decreases in IIUI were relatively small by less than 8 percent.

The average IIUI rate for services sector was 11.0 percent. Most services industries experienced a small change in IIUI during this period, with the exceptions of TRN, whose IIUI increased by 39.1 percent; and electricity, gas and water supply (EGW), whose IIUI increased by 44.9 percent (figure 3.4.3).

[56] Based on the supply tables at basic price, which could differ from the official NA data.
[57] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[58] Based on the use tables at basic price, which could differ from the official NA data.

Figure 3.4.1 Gross output, by industry, 2005 and 2012, Chile

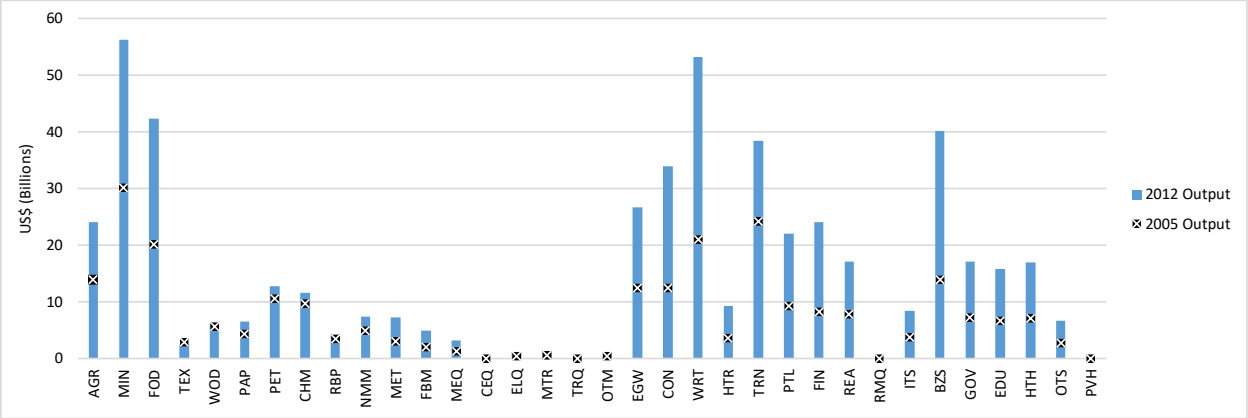


Figure 3.4.2 Value added (VA), by industry, 2005 and 2012, Chile

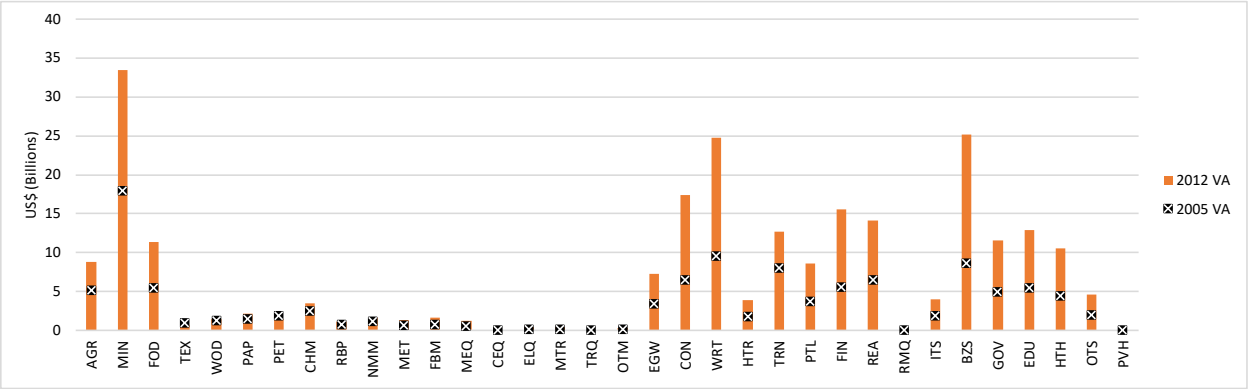
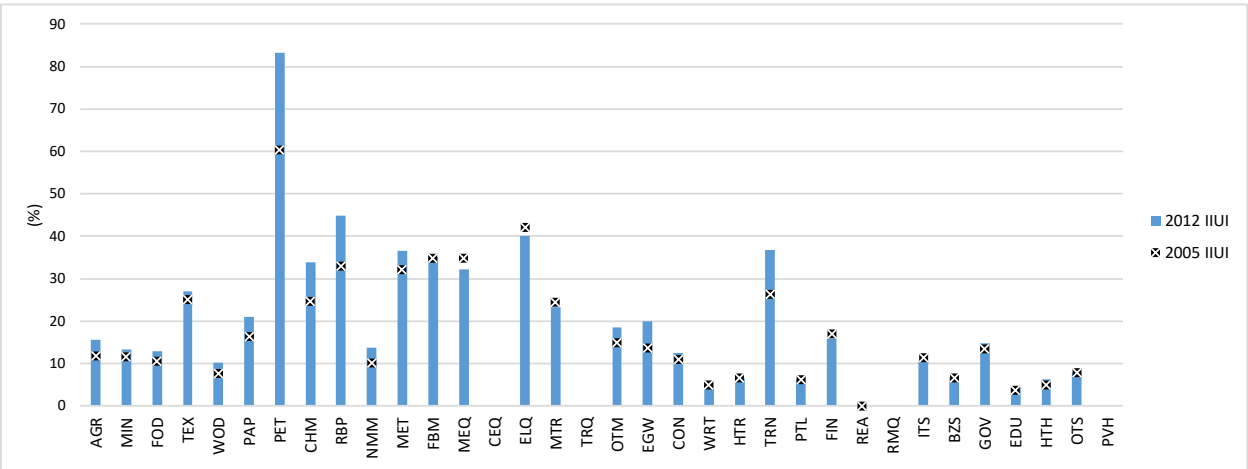


Figure 3.4.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, Chile



Selected APEC TiVA Measures[59]

GVC-Related Trade and GVC Participations

GVC-Related Trade[60]

In 2012, Chile's GVC-related trade amounted to $83.0 billion, increasing by 87.5 percent from $44.3 billion in 2005, and accounting for 91.9 percent of Chile's gross exports. About 51.6 percent of GVC-related trade was in the form of complex GVCs. Mining (MIN) topped all industries, accounting for 29.9 percent of Chile's GVC-related trade. It was followed by food, beverages, and tobacco (FOD, 10.1 percent), and agriculture (AGR, 9.2 percent) (figure 3.4.4).

Forward GVC Participation[61]

Chile's overall forward GVC participation rate decreased from 29.7 percent in 2005 to 24.3 percent in 2012, still well above the APEC average of 13.8 percent. The complex forward GVC participation rate decreased from 8.1 percent to 7.8 percent during this period. Among the industries with the highest forward GVC participation rate in 2012 were motor vehicles, trailers and semi-trailers (MTR) at 73.7 percent, basic metals (MET) at 60.3 percent, pulp, paper, paper products, printing and publishing (PAP, 57.4 percent), chemicals (CHM, 53.8 percent), and MIN(53.6 percent) (figure 3.4.5).

Backward GVC Participation[62]

Chile's overall backward GVC participation rate decreased from 19.1 percent in 2005 to 17.9 percent in 2012, above the APEC average of 12.7 percent. The complex backward GVC participation rate increased from 6.0 percent to 6.4 percent during this period. Among the industries with the highest backward GVC participation rate in 2012 were coke, refined petroleum products and nuclear fuel (PET, 76.6 percent), basic metals (MET, 44.9 percent), and rubber and plastics (RBP, 42.8 percent). The industries experiencing the largest increase in backward GVC participation rate were PET and wood products (WOD) (figure 3.4.6).

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[59] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[60] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[61] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[62] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.4.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, Chile

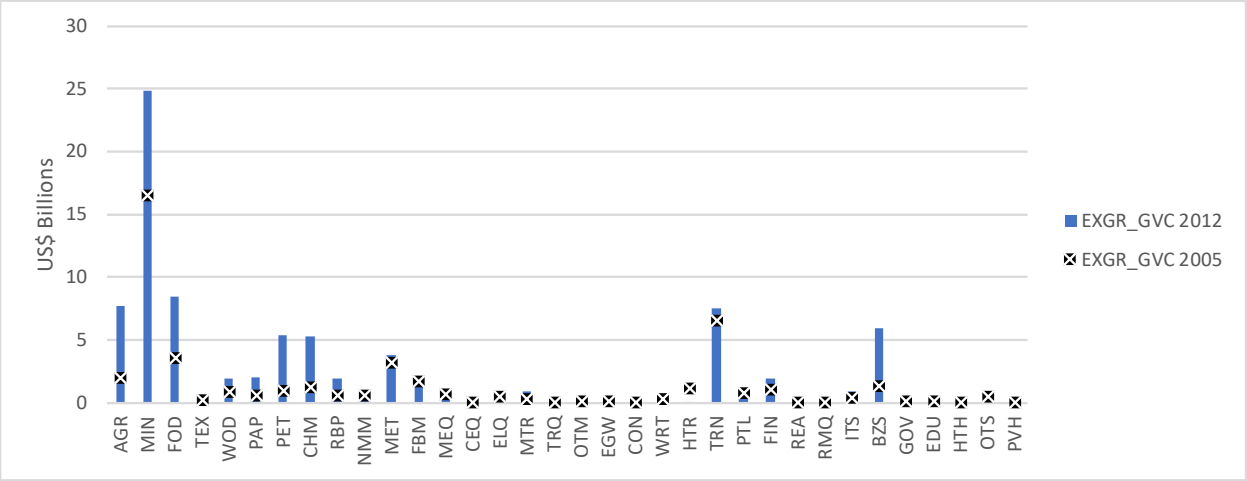


Figure 3.4.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, Chile

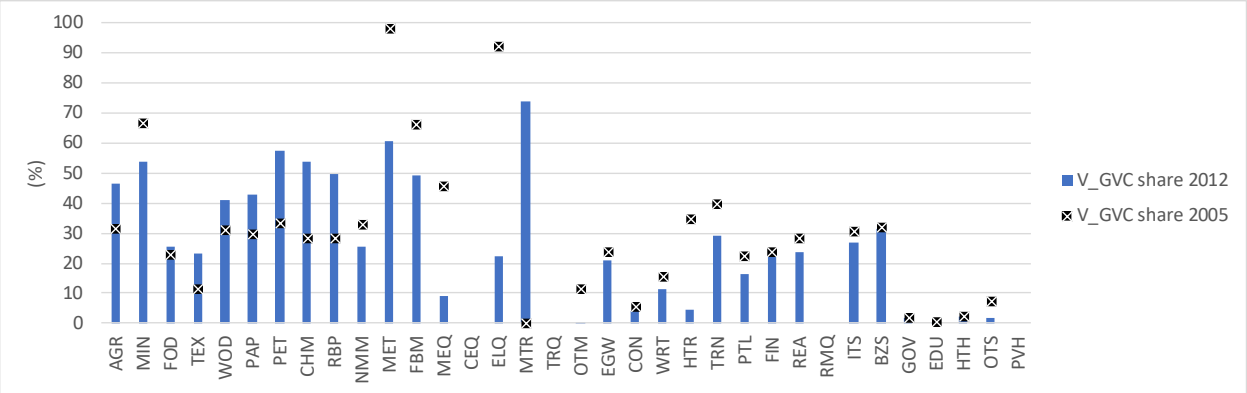
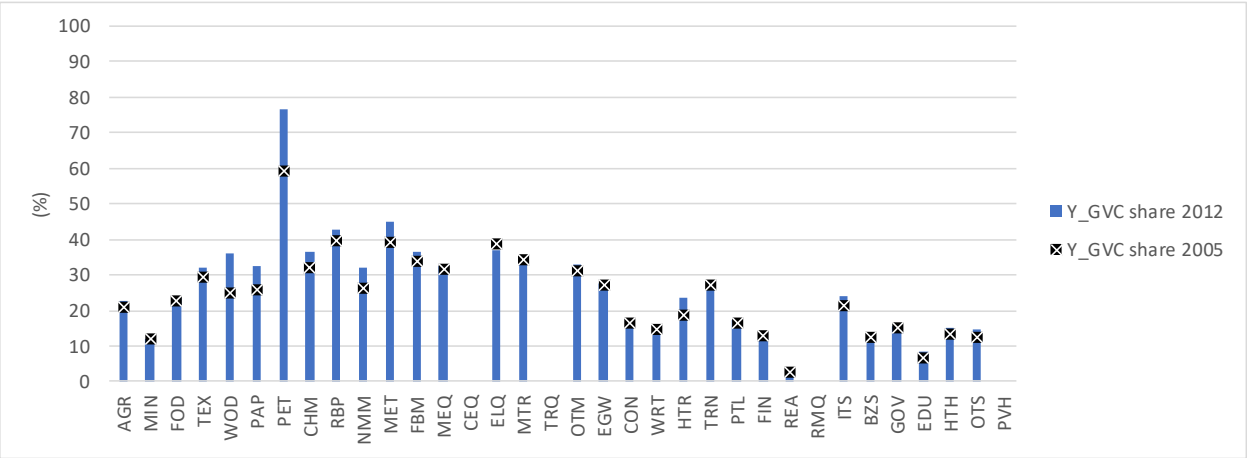


Figure 3.4.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, Chile



Value Added Trade and Top APEC Trading Partners

Value-added exports[63]

In 2012, Chile had value-added exports of $66.5 billion, increased 73.1 percent from $38.4 billion in 2005. Mining (MIN) topped 34 sectors in value-added exports, accounted for over 27.4 percent of Chile's value- added exports. It was followed by R&D and other business activities (BZS, 12.7 percent), transport and storage (TRN, 7.6 percent), agriculture (AGR, 6.7 percent), and finance and insurance (FIN, 6.0 percent). The industries experiencing the largest increase in value-added exports were BZS and AGR (figure 3.4.7).

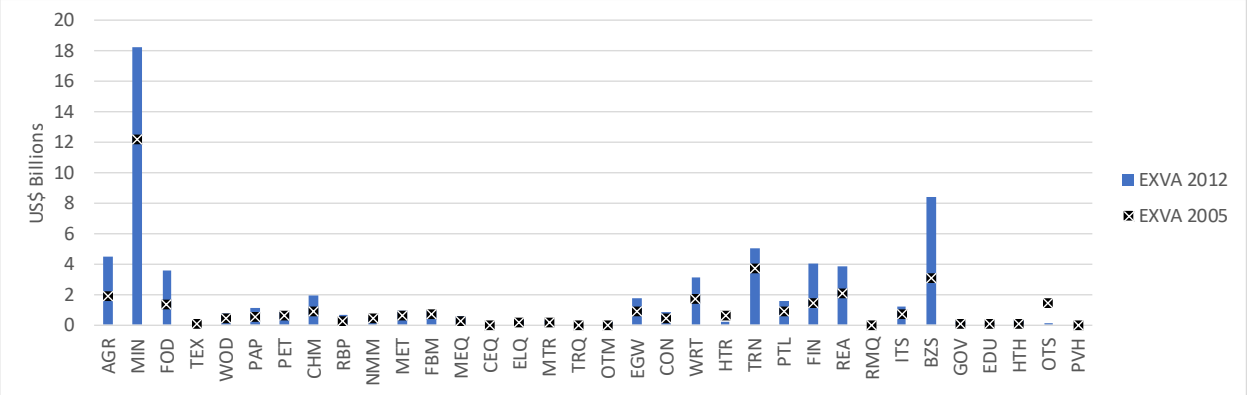
Value-added imports[64]

In 2012, Chile had value-added imports of $68.7 billion, more than doubled from $28.1 billion in 2005. MIN topped all industries, accounting for 11.6 percent of Chile's value-added imports in 2012. It was followed by wholesale and retail trade (WRT, 8.3 percent), and AGR (5.8 percent). These three industries experienced the large increases in value-added imports during this period, but motor vehicles (MTR) and most services industries saw the largest increases from a relatively lower base in 2005 (figure 3.4.8).

Top APEC Trading Partners

In 2012, in the APEC region, China; the United States; Japan; Korea; and Canada were the top destinations for Chile's value-added exports (figure 3.4.9), and the United States; China; Japan; Korea; and Mexico were the top sources for Chile's value-added imports (figure 3.4.10).

Figure 3.4.7 Value-added exports (EXVA), by industry, 2005 and 2012, Chile



[63] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.
[64] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.4.8 Value-added imports (IMVA), by industry, 2005 and 2012, Chile

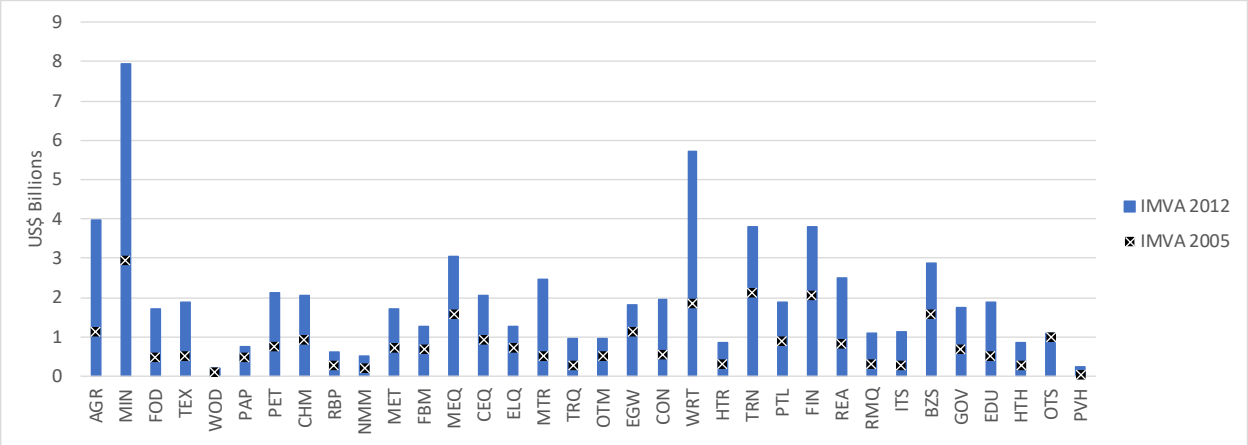


Figure 3.4.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, Chile

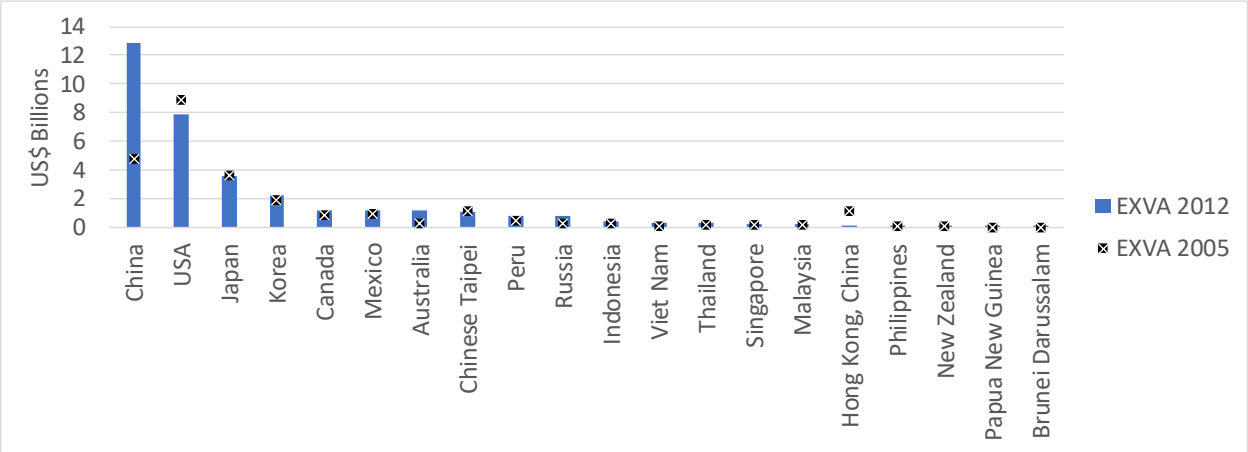
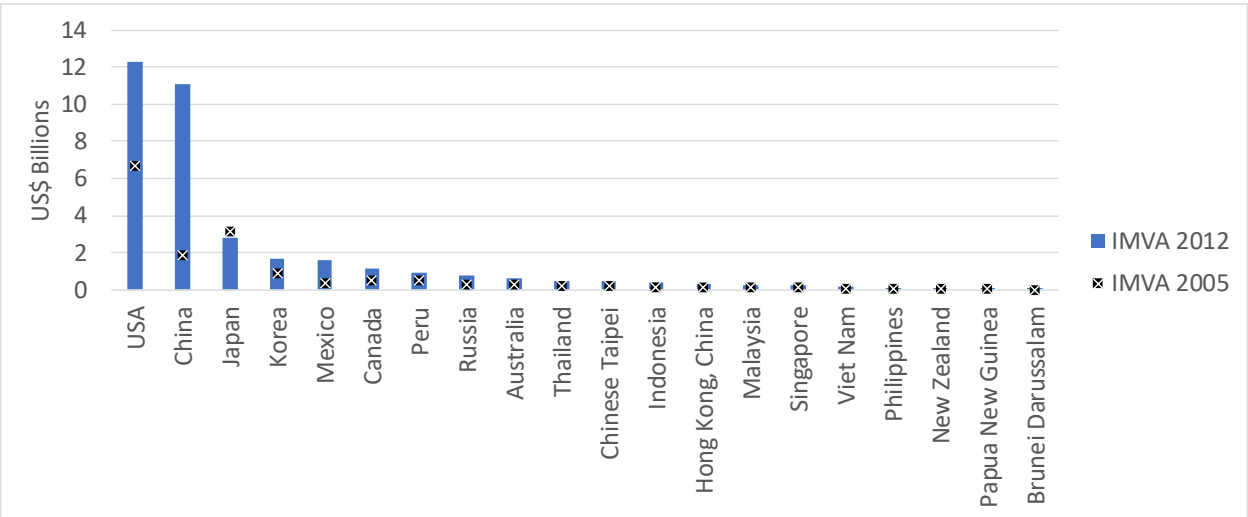


Figure 3.4.10 APEC sources of value-added imports (IMVA), 2005 and 2012, Chile



Chapter 5: China

Industry Data Summary Based on SUTs

Gross Output[65]

In 2012, China's total gross output was $24.8 trillion, increasing significantly from $6.7 trillion in 2005. Manufacturing and services sectors accounted for 51.2 percent and 39.8 percent of China's gross output in 2012.[66]

Of the 34 industries, construction (CON) had the largest gross industry output of $2.2 trillion, accounting for 8.8 percent of China's total gross output in 2012, and a nearly fourfold increase from $519.6 billion in 2005. Other top industries included basic metals (MET, 6.9 percent); agriculture, hunting, forestry and fishing (AGR, 5.7 percent); chemicals (CHM, 5.7 percent); and food products, beverages and tobacco (FOD, 5.5 percent) (figure 3.5.1).

Value Added[67]

In 2012, China's total value added, or GDP, was $8.0 trillion, increasing from $2.3 trillion in 2005, making it the second largest economy in the APEC region as well as in the world. Services sector accounted for 54.7 percent of China's total GDP, followed by manufacturing sector (30.4 percent) and AGR (10.4 percent).

Of 34 industries, AGR was the largest industry, followed by wholesale and retail trade (WRT, 7.4 percent), construction (CON, 7.2 percent), finance and insurance (FIN, 7.0 percent), and real estate activities (REA, 6.2 percent).

The largest manufacturing industries in terms of value added were basic metal (MET, 3.8 percent); food products, beverages and tobacco (FOD, 3.8 percent), and chemicals (CHM, 3.2 percent) (figure 3.5.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by Chinese industries in 2012, only 9.0 percent were imported, decreasing from 11.8 percent in 2005, and below the average of 13.8 percent in the APEC region. The industries with the highest imported intermediate use intensity (IIUI) were coke, refined petroleum products and nuclear fuel (PET, 43.1 percent), and computer, electronic and optical equipment (CEQ, 36.6 percent).

The average IIUI rate in Chinese manufacturing sector was 12.9 percent in 2012. Most manufacturing industries in China experienced a decrease in IIUI during this period. Of them, the most notable were chemicals (CHM), decreasing by 48.5 percent; CEQ, decreasing by 38.2 percent; and other manufacturing (OTM), decreasing by 37.0 percent.

The average IIUI rate in Chinese services sector was only 3.1 percent in 2012. Most services industries experienced a decrease in IIUI during this period as well. The most notables were construction (CON), decreasing by 83.7 percent; renting of Machinery and equipment (RMQ), increasing by 82.2 percent; and R&D and other business activities (BZS), decreasing by 69.2 percent. A few exceptions included wholesale and retail trade (WRT), increasing by over 600 percent; finance and insurance (FIN), increasing by 32.5 percent; and health and social work (HTH), increasing by 30.9 percent (figure 3.5.3).

[65] Based on the supply tables at basic price, which could differ from the official NA data.
[66] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[67] Based on the use tables at basic price, which could differ from the official NA data.

Figure 3.5.1 Gross output, by industry, 2005 and 2012, China

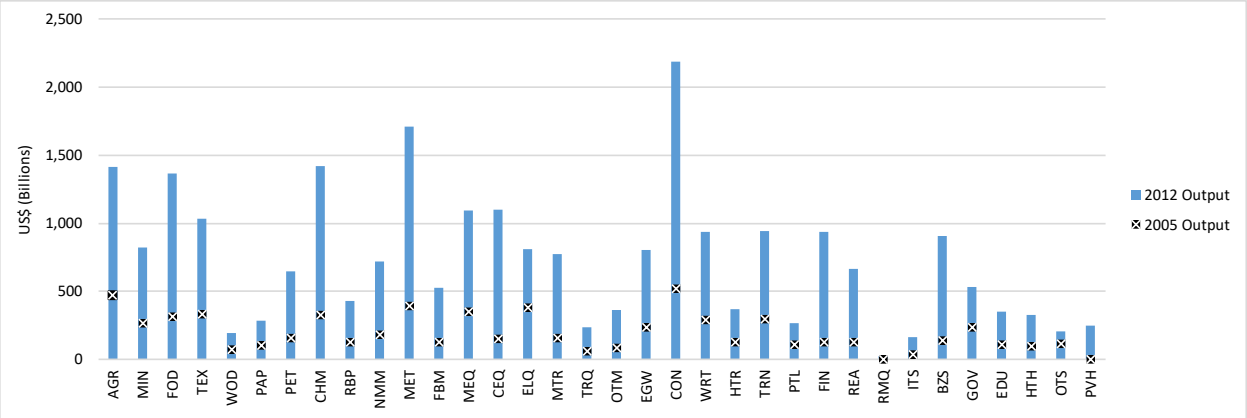


Figure 3.5.2 Value added, by industry, 2005 and 2012, China

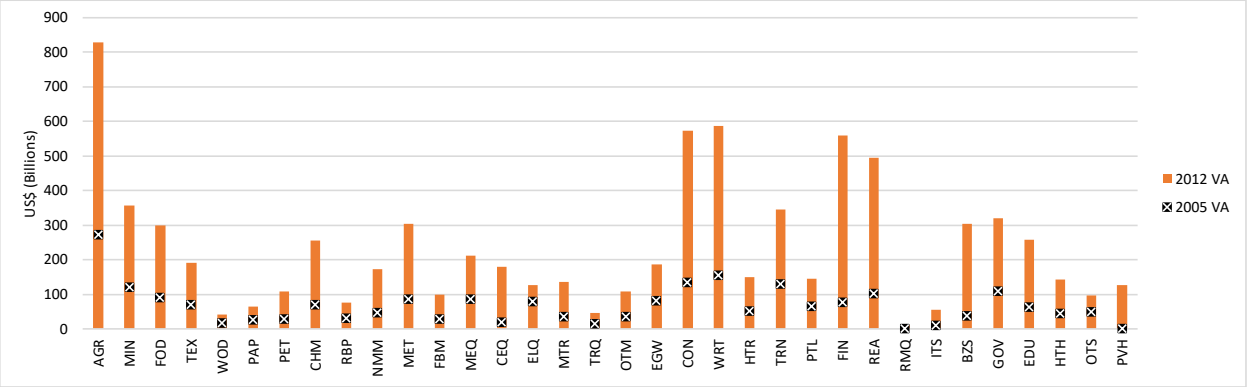
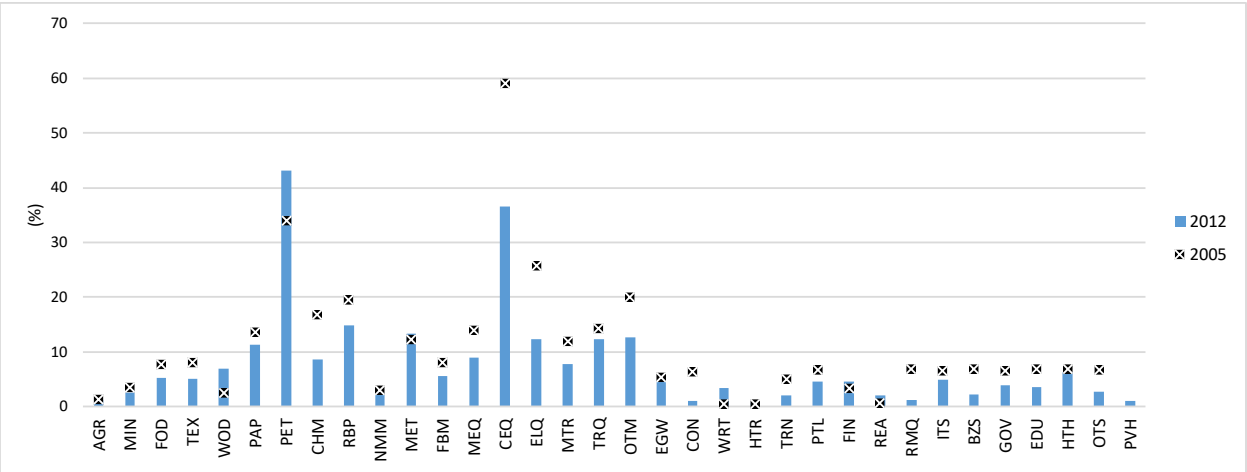


Figure 3.5.3 Imported intermediate use intensity, by industry, 2005 and 2012, China



Selected APEC TiVA Measures[68]

GVC-Related Trade and GVC Participations

GVC-Related Trade[69]

In 2012, China's GVC-related trade amounted to $1.8 trillion, nearly tripled from $605.2 billion in 2005, and accounting for 82.7 percent of China's gross exports. About 54.1 percent of GVC-related trade was in the form of complex GVCs. Computer, electronic and optical equipment (CEQ) topped all industries, accounting for 21.5 percent of China's GVC-related trade. It was followed by textile, leather, and footwear (TEX), and electrical machinery and apparatus (ELQ), both at 6.6 percent (figure 3.5.4).

Forward GVC Participation[70]

China's forward GVC participation rate decreased from 18.6 percent in 2005 to 15.3 percent in 2012, still above the APEC average of 13.8 percent. The complex forward GVC participation rate decreased slightly from 5.7 percent to 5.4 percent during this period. The industries with the highest forward GVC participation rates in 2012 were computer, electronic and optical equipment (CEQ) at 42.5 percent, other manufacturing (OTM) at 36.6 percent, and MIN at 33.0 percent (figure 3.5.5).

Backward GVC Participation[71]

China's backward GVC participation rate decreased from 19.0 percent in 2005 to 13.6 percent in 2012, still slightly above the APEC average of 12.7 percent. The complex backward GVC participation rate decreased from 6.9 percent to 5.6 percent during this period. The industries with the highest backward GVC participation rates in 2012 were CEQ at 44.5 percent, and coke, refined petroleum products and nuclear fuel (PET) at 43.2 percent. Almost all industries experienced a decrease in backward GVC participation rate during this period except PET (figure 3.5.6).

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[68] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[69] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[70] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[71] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.5.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, China

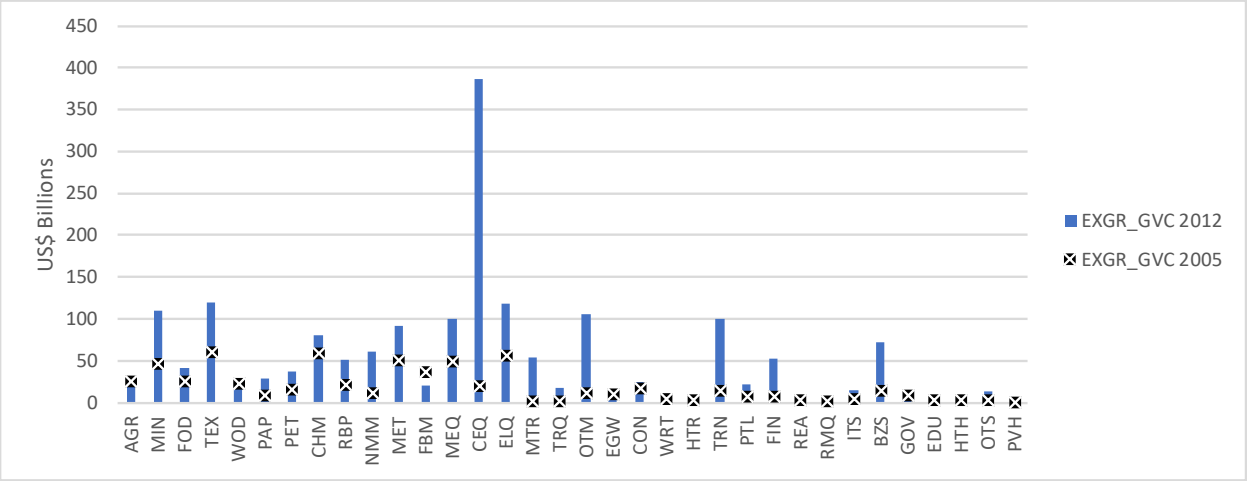


Figure 3.5.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, China

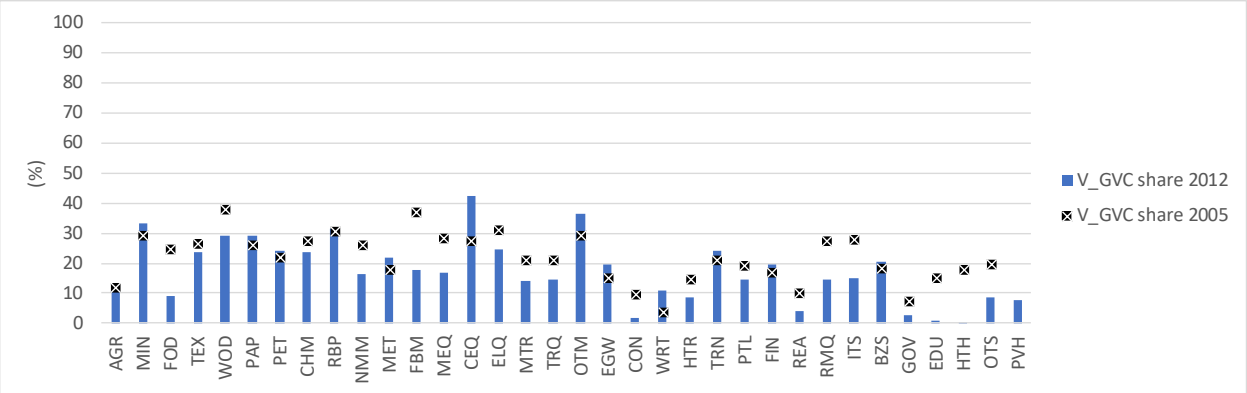
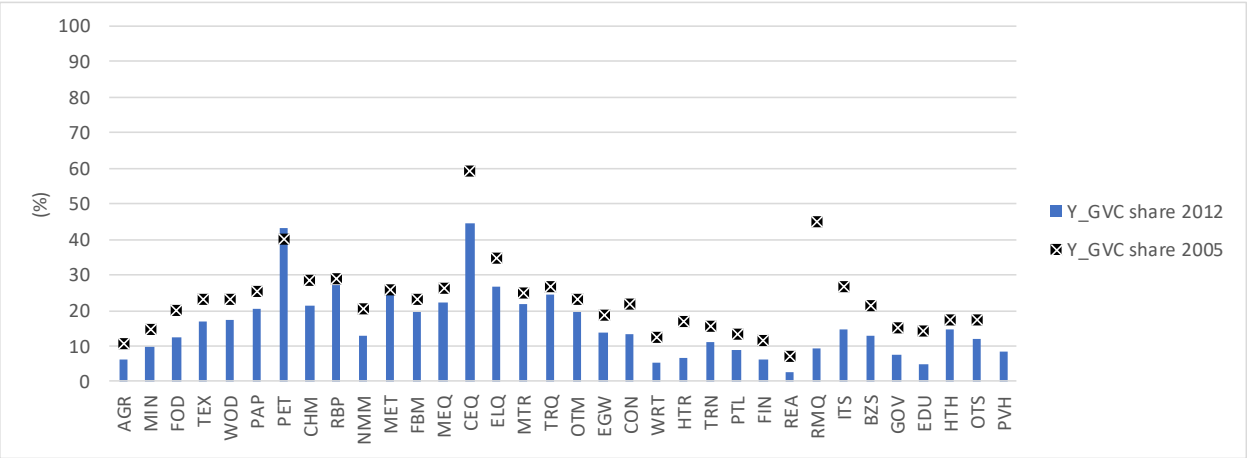


Figure 3.5.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, China



Value Added Trade and Top APEC Trading Partners

Value-added exports[72]

In 2012, China had value-added exports of $1.6 trillion, almost tripled from $532.4 billion in 2005. Mining (MIN) topped all industries, accounting for 8.3 percent of China's value -added exports. It was followed by agriculture (AGR, 7.7 percent), finance and insurance (FIN, 7.9 percent), and computer electronic and optical equipment (CEQ, 7.2 percent). Those industries also experienced the largest increases in value-added exports during this period (figure 3.5.7).

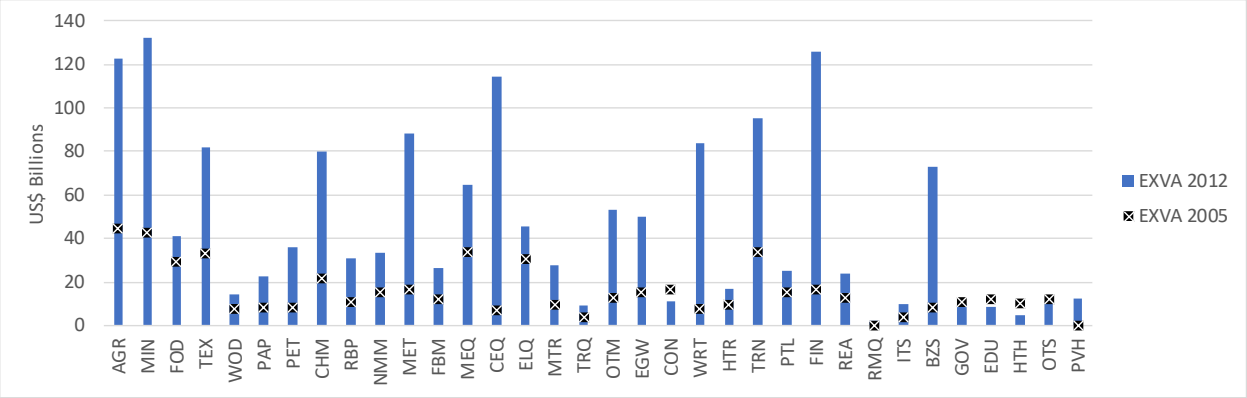
Value-added imports[73]

In 2012, China had value-added imports of nearly $1.1 trillion, more than doubled from $408.6 billion in 2005. MIN topped all industries, accounting for 13.5 percent of China's value-added imports in 2012. It was followed by wholesale and retail trade (WRT, 8.8 percent), CEQ at 6.7 percent, finance and insurance (FIN, 5.6 percent), and transport and storage (TRN, 5.5 percent). The industries that experienced the largest increases in value-added imports during this period were other transport equipment (TRQ), education (EDU), other community social and personal services (OTS), and health and social work (HTH) (figure 3.5.8).

Top APEC Trading Partners

In 2012, in the APEC region, the United States; Japan; Korea; Australia; and Russia were the top destinations for China's value-added exports (figure 3.5.9), and the United States; Japan; Australia; Korea; and Hong Kong, China were the top sources for China's value-added imports (figure 3.5.10).

Figure 3.5.7 Value-added exports (EXVA), by industry 2005 and 2012, China



[72] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.
[73] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.5.8 Value-added imports (IMVA), by industry 2005 and 2012, China

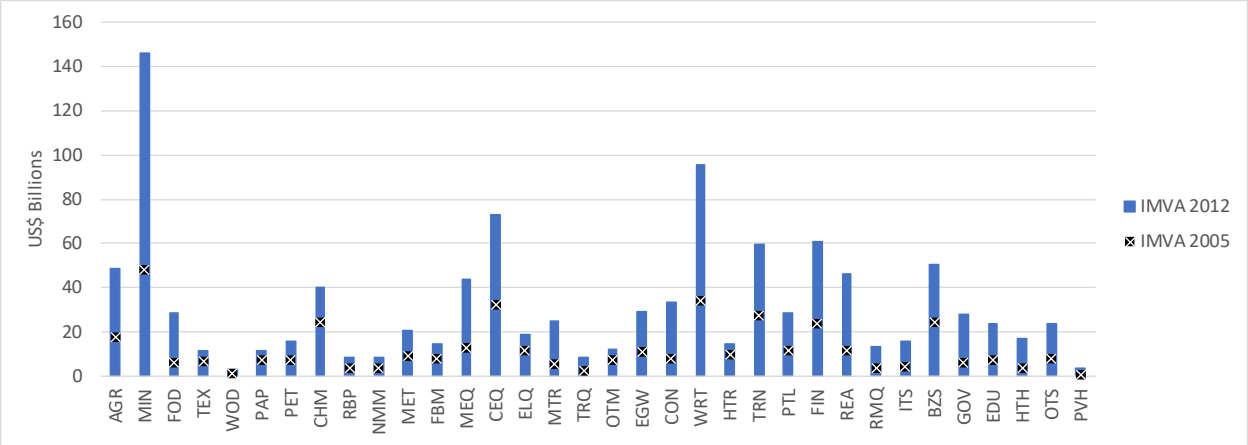


Figure 3.5.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, China

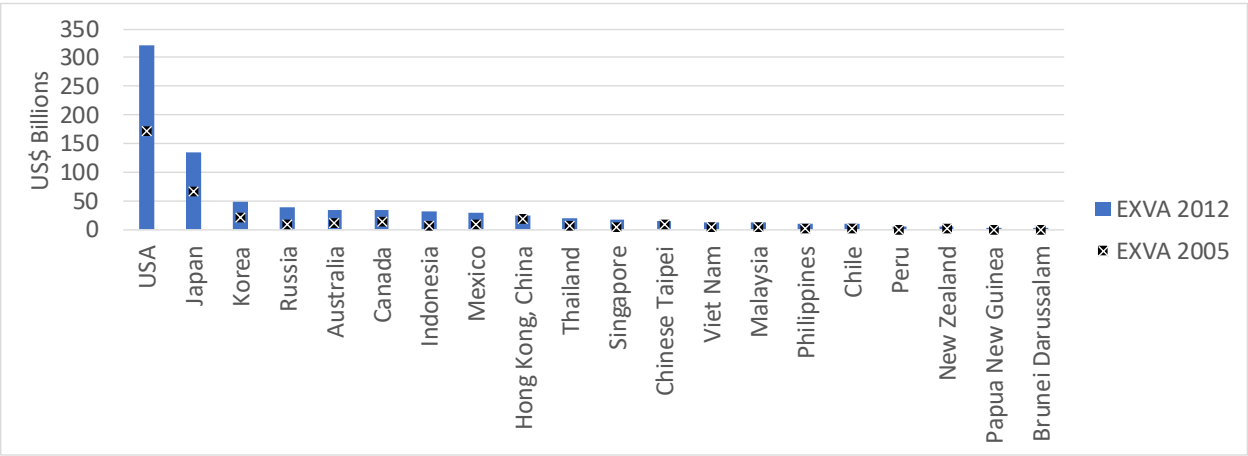
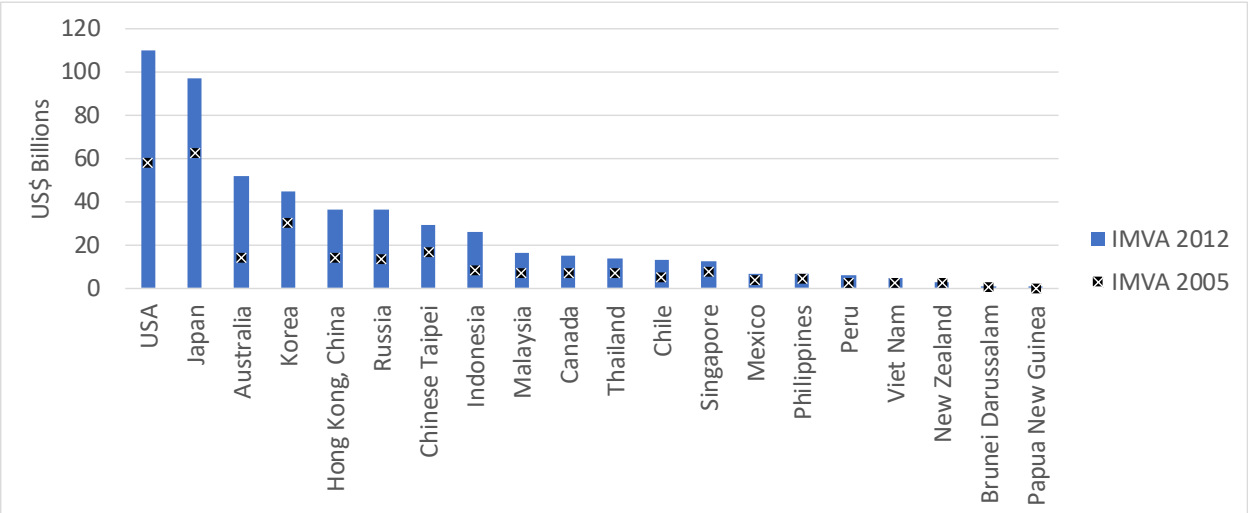


Figure 3.5.10 APEC sources of value-added imports (IMVA), 2005 and 2012, China



Chapter 6: Hong Kong, China

Industry Data Summary Based on SUTs

Gross Output[74]

In 2012, Hong Kong, China's total gross output was $481.9 billion, increasing by more than 50 percent from $311.1 billion in 2005. Services dominated the economy of Hong Kong, China, accounting for 94.6 percent of Hong Kong, China's total gross output, followed by manufacturing with a share of 5.3 percent.[75]

Of the 34 industries, wholesale and retail trade (WRT) had the largest industry gross output of $115.9 billion, a nearly 50 percent increase from its 2005 level, and accounting for 24.1 percent of total gross output of Hong Kong, China. Other top industries included finance and insurance (FIN, 14.0 percent of total gross output), real estate activities (REA, 11.3 percent), and transport and storage (TRN, 9.9 percent) (figure 3.6.1).

Value Added[76]

In 2012, Hong Kong, China's total value added, or GDP, was $254.2 billion, increasing from $174.1 billion in 2005. Services sectors[77] accounted for 98.5 percent of Hong Kong, China's total GDP, followed by manufacturing with a share of 1.5 percent.

The top industries measured by value added were WRT (25.1 percent of total GDP), REA (16.3 percent), FIN (15.9 percent), R&D and other business activities (BZS, 5.7 percent), and transport and storage (TRN, 5.7 percent).

The largest manufacturing industries in terms of value added were food products, beverages, and tobacco (FOD, 0.9 percent of total GDP) [78], pulp, paper, paper products, printing and publishing (PAP, 0.2 percent) [79], and basic metals (MET, 0.2 percent)[80] (figure 3.6.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by Hong Kong, China's industries in 2012, 39.0 percent were imported, an increase from 32.1 percent in 2005, and much higher than the average of 13.8 percent in the APEC region. The industries with the highest imported intermediate use intensity (IIUI) were MET (84.6 percent), FOD (70.0 percent), and AGR (69.7 percent).

All of Hong Kong, China's manufacturing industries experienced increases in IIUI during this period. The most notables were MET, increasing by 49.5 percent; and PAP, increasing by 28.4 percent. Most services industries in Hong Kong, China also experienced an increase in IIUI during this period. Of the most notables were renting of machinery and equipment (RMQ), increasing by nearly 100 percent; BZS, increasing by 56.8 percent; education (EDU), increasing by 52.8 percent; FIN, increasing by 51.9 percent; and construction (CON), increasing by 39.9 percent. One exception was hotels and restaurants

[74] Based on the supply tables at basic price, which could differ from the official NA data.
[75] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[76] Based on the use tables at basic price, which could differ from the official NA data.
[77] Services sectors here also include electricity, gas and water supply; sewerage, waste management and remediation activities; and construction.
[78] Refers to manufacturing of food products, beverage, and tobacco and other manufacturing industries not elsewhere included.
[79] Refers to manufacturing of paper products, printing and reproduction of recorded media.
[80] Refers to manufacturing of metal, computer, electronic and optical products, machinery and equipment.

(HTR), whose IIUI rate decreased from 45.2 percent in 2005 to 38.7 percent in 2012 (figure 3.6.3).Figure 3.6.1 Gross output, by industry, 2005 and 2012, Hong Kong, China

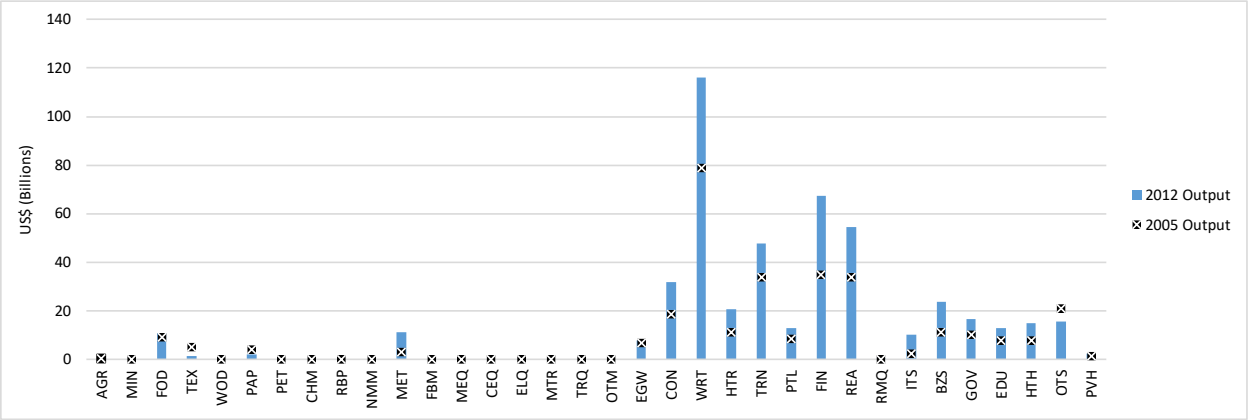


Figure 3.6.2 Value added (VA), by industry, 2005 and 2012, Hong Kong, China

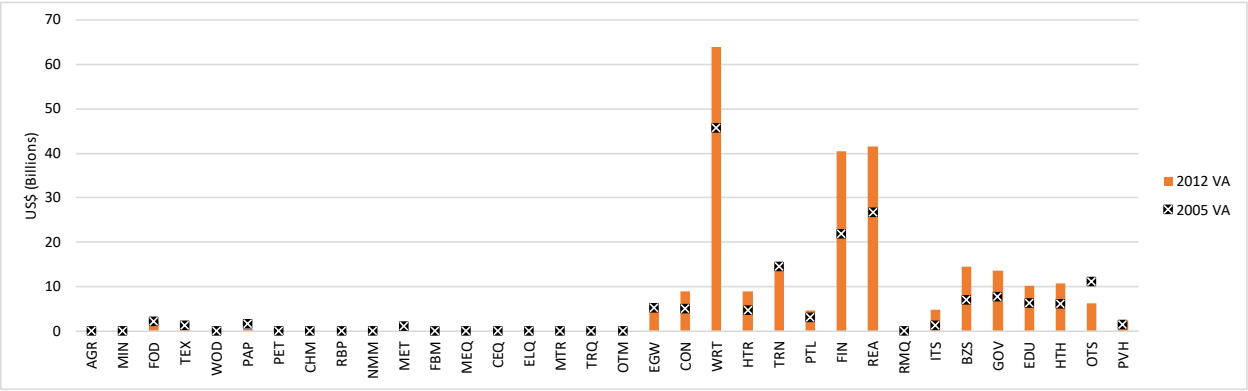
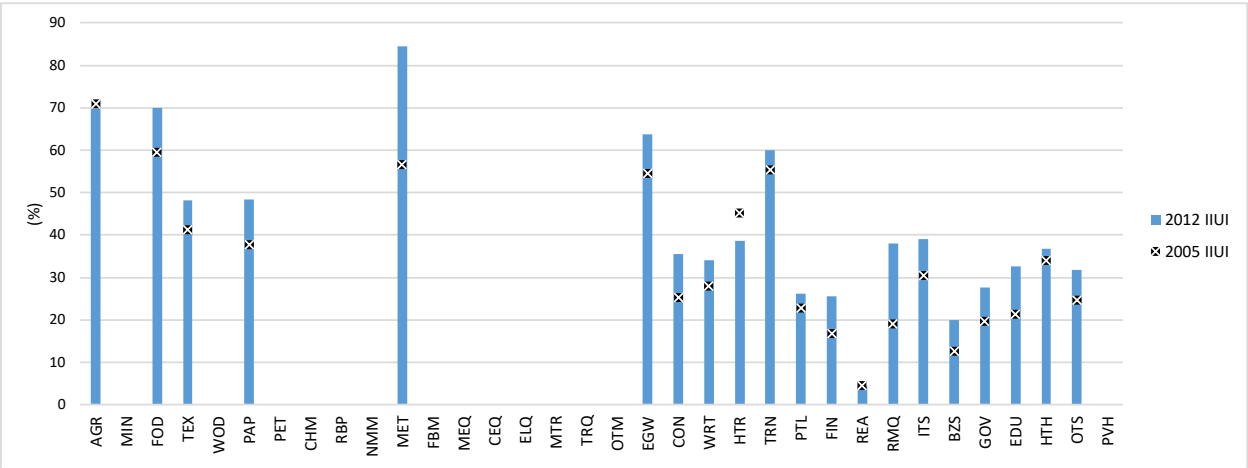


Figure 3.6.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, Hong Kong, China



Selected APEC TiVA Measures[81]

GVC-Related Trade and GVC Participations

GVC-Related Trade[82]

In 2012, Hong Kong, China's GVC-related trade amounted to $112.8 billion, increasing by 71.0 percent from $66.0 billion in 2005, and accounting for 96.0 percent of Hong Kong, China's gross exports.[83] About 64.0 percent of GVC-related trade was in the form of complex GVCs. Services industries constituted 73.1 percent Hong Kong, China's GVC-related trade. Among merchandise trade, Basic metals (MET) topped all goods industries at 11.6 percent, followed by food products, beverages and tobacco (FOD) at 10.5 percent. However, 96 and 75 percent of their gross exports were foreign contents (figure 3.6.4).

Forward GVC Participation[84]

Hong Kong, China's forward GVC participation rate increased from 23.7 percent in 2005 to 26.9 percent in 2012, though far above the APEC average of 13.8 percent. The complex forward GVC participation rate increased from 6.1 percent to 9.1 percent during this period. The industries with the highest forward GVC participation rates in 2012 were paper products printing, and publishing (PAP) at 94.8 percent, followed by MET at 93.3 percent, FOD at 87.6 percent, and agriculture (AGR) at 80.5 percent (figure 3.6.5).

Backward GVC Participation[85]

Hong Kong, China's backward GVC participation rate increased from 24.2 percent in 2005 to 25.3 percent in 2012, above the APEC average of 12.7 percent. The complex backward GVC participation rate decreased from 8.9 percent to 7.1 percent during this period. The industries with the highest backward GVC participation rates in 2012 were MET at 96.4 percent, followed by FOD at 74.9 percent, textile, leather and footwear (TEX) at 64.9 percent, and AGR at 62.2 percent (figure 3.6.6).

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[81] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[82] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[83] Hong Kong, China's gross exports excluded re-exports.

[84] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[85] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.6.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, Hong Kong, China

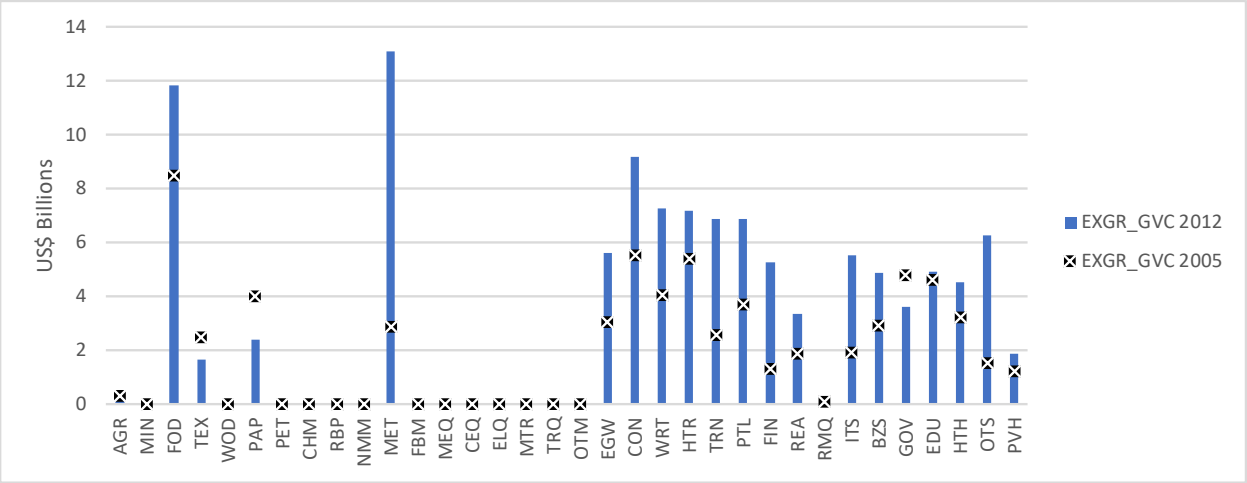


Figure 3.6.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, Hong Kong, China

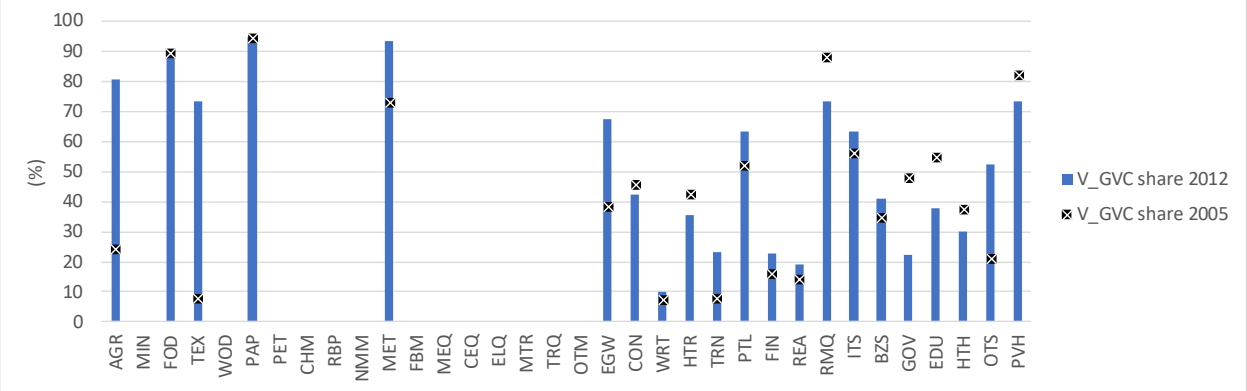
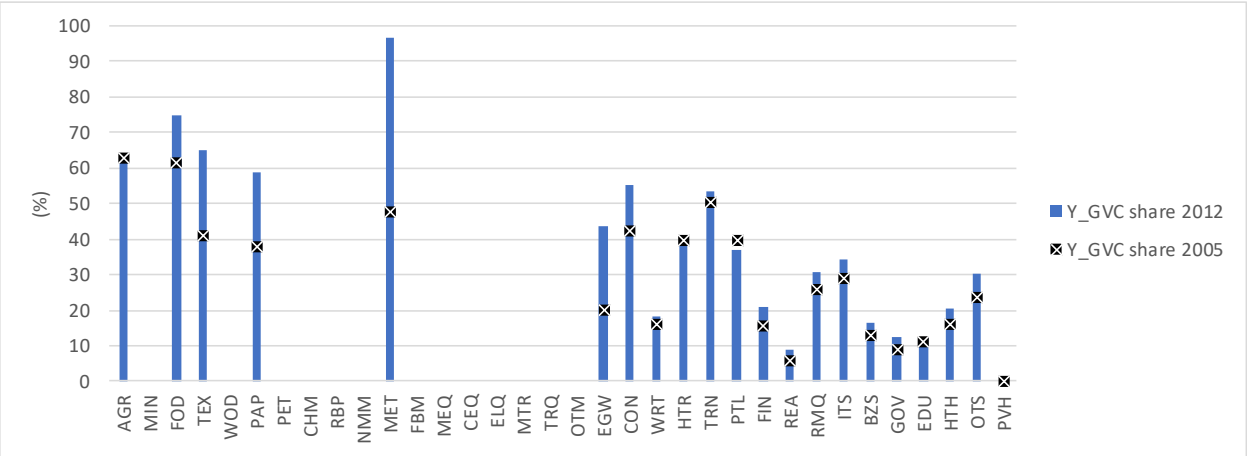


Figure 3.6.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, Hong Kong, China



Value Added Trade and Top APEC Trading Partners

Value-added exports[86]

In 2012, Hong Kong, China had value-added exports of $65.7 billion, increasing by 10.2 percent from $59.8 billion in 2005. Finance and insurance (FIN) topped all industries, accounting for 12.9 percent of Hong Kong, China's value-added exports. It was followed by real estate activities (REA, 12.0 percent), wholesale and retail trade (WRT, 8.8 percent), and R&D and other business activities (BZS,8.5 percent). These top industries also experienced the largest increases in value-added exports during this period. Meanwhile, value-added exports of textiles and textile products, leather and footwear (TXT), PAP, and basic Metals (MET) were significantly declined (figure 3.6.7).

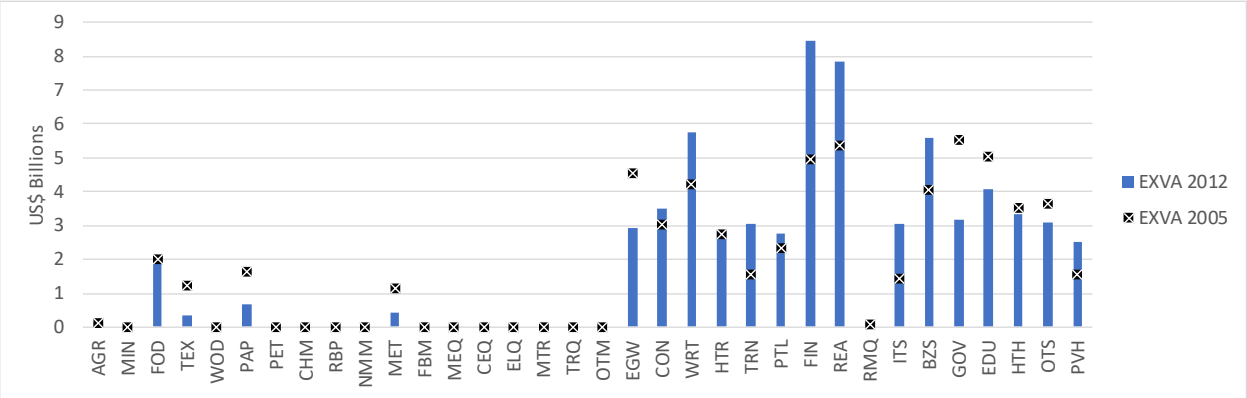
Value-added imports[87]

In 2012, Hong Kong, China had value-added imports of $60.7 billion, increasing from $49.6 billion in 2005. Mining (MIN) topped all industries, accounting for 15.3 percent of Hong Kang, China's value-added imports in 2012. It was followed by agriculture (AGR, 10.1 percent), finance and insurance (FIN, 8.1 percent) and transport and storage (TRN, 7.9 percent). The industries that experienced the largest increases in value-added imports during this period were MIN, FIN and Electricity gas and water supply (EGW) (figure 3.6.8).

Top APEC Trading Partners

In 2012, in the APEC region, China; the United States; Japan; Canada; and Viet Nam were the top destinations for Hong Kong, China's value-added exports (figure 3.6.9), and China; the United States; Japan; Indonesia; and Australia were the top sources for Hong Kong, China's value-added imports (figure 3.6.10).

Figure 3.6.7 Value-added exports (EXVA), by industry 2005 and 2012, Hong Kong, China



[86] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.
[87] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.6.8 Value-added imports (IMVA), by industry 2005 and 2012, Hong Kong, China

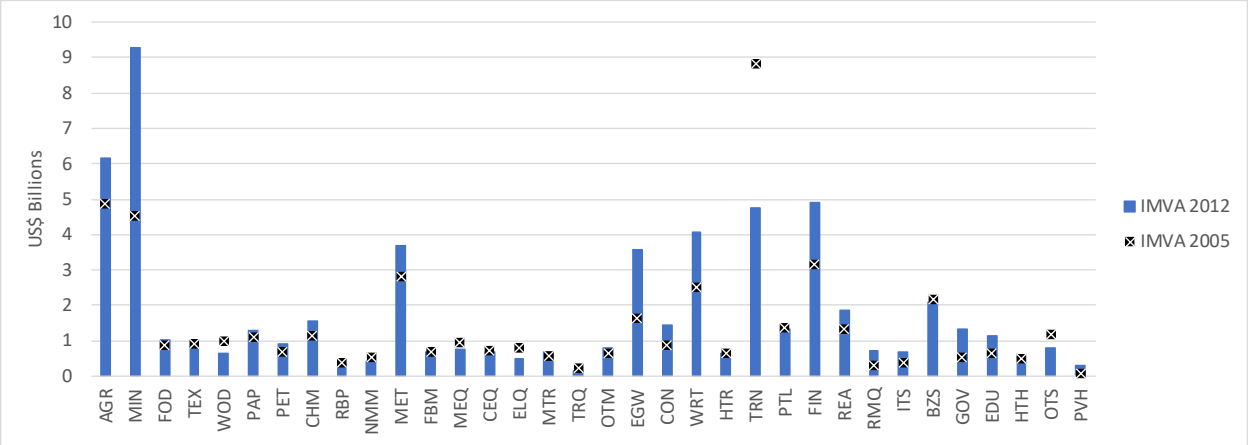


Figure 3.6.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, Hong Kong, China

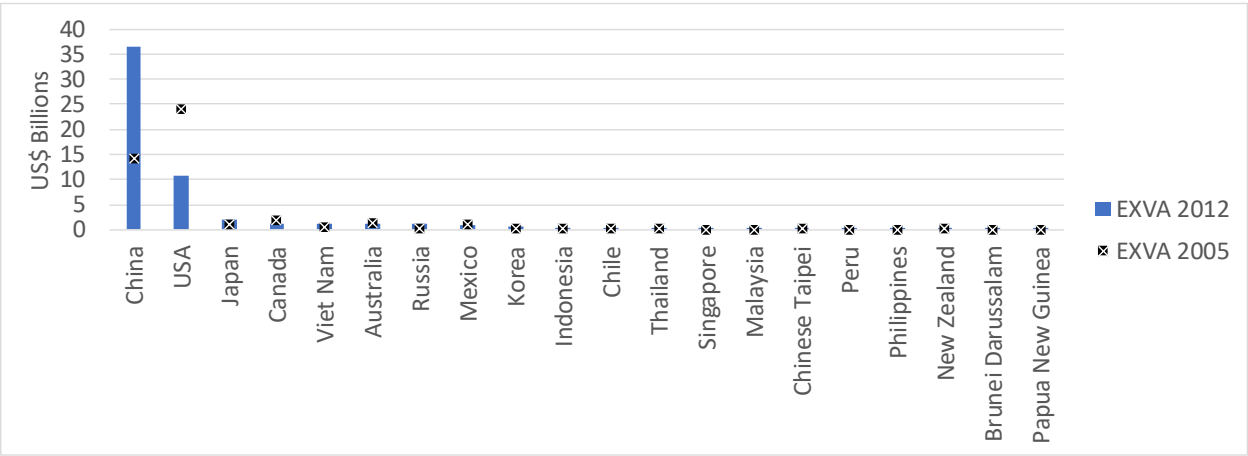
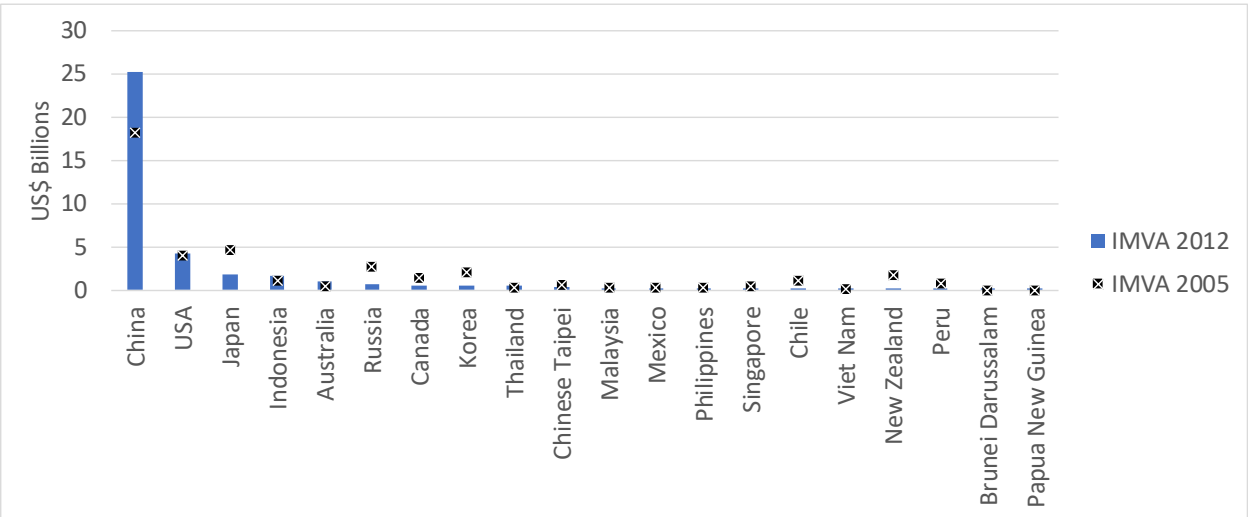


Figure 3.6.10 APEC sources of value-added imports (IMVA), 2005 and 2012, Hong Kong, China



Chapter 7: Indonesia

Industry Data Summary Based on SUTs

Gross Output[88]

In 2012, Indonesia's total gross output was $1.7 trillion, more than doubling from $696.8 billion in 2005. Manufacturing and services sectors accounted for 31.9 percent and 51.6 percent of Indonesia's total gross output, respectively.[89]

Of the 34 industries, construction (CON) had the largest industry gross output of $228.0 billion in 2012, increasing almost three times from its 2005 level. CON accounted for 13.2 percent of Indonesia's total gross output, followed by wholesale and retail trade (WRT, 10.4 percent), food, beverages, and tobacco (FOD, 10.0 percent), and agriculture (AGR, 8.7 percent) (figure 3.7.1).

Value Added[90]

In 2012, Indonesia's total value added, or GDP, was $899.4 billion, increasing from $348.9 billion in 2005. Services sector accounted for 52.5 percent of Indonesia's total GDP, followed by manufacturing with a share of 21.9 percent.

Agriculture, hunting, forestry and fishing (AGR) was the largest industry, contributing 13.7 percent of total GDP. Other top industries in terms of value added were wholesale and retail trade (WRT, 13.5 percent of total GDP), mining (MIN, 11.9 percent), and construction (CON, 9.6 percent).

The largest manufacturing industries in terms of value added were food products, beverages, and tobacco (FOD, 6.4 percent of total GDP), coke, petroleum products, and nuclear fuel (PET, 3.5 percent), and chemicals (CHM, 1.7 percent) (figure 3.7.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by Indonesian industries in 2012, 16.7 percent were imported, a slight increase from 15.4 percent in 2005, and above the APEC average of 13.8 percent. The industries with the highest imported intermediate use intensity (IIUI) were machinery and equipment (MEQ, 48.8 percent), computer, electronic and optical equipment (CEQ, 40.8 percent), and electrical machinery and apparatus (ELQ, 37.9 percent).

The average IIUI rate in manufacturing sector was 23.9 percent in 2012. Most manufacturing industries in Indonesia experienced an increase in IIUI during this period. Of them, the most notable were pulp, paper, paper products, printing and publishing (PAP), increasing by 53.2 percent; wood products (WOD), increasing by 40.3 percent; and textiles (TEX), increasing by 35.1 percent. Two notable exceptions were PET, with its IIUI rate decreasing by 22.1 percent; and basic metals (MET), with its IIUI rate decreasing by 9.3 percent.

The average IIUI rate in services sector was 14.6 percent in 2012. All services industries experienced an increase in IIUI during this period. Of them, the most notable were transport and storage (TRN), increasing by 42.5 percent; CON, increasing by 34.6 percent; education (EDU), increasing by 30.4 percent; and WRT, increasing by 29.9 percent (figure 3.7.3).

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[88] Based on the supply tables at basic price, which could differ from the official NA data.
[89] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[90] Based on the use tables at basic price, which could differ from the official NA data.

Figure 3.7.1 Gross output, by industry, 2005 and 2012, Indonesia

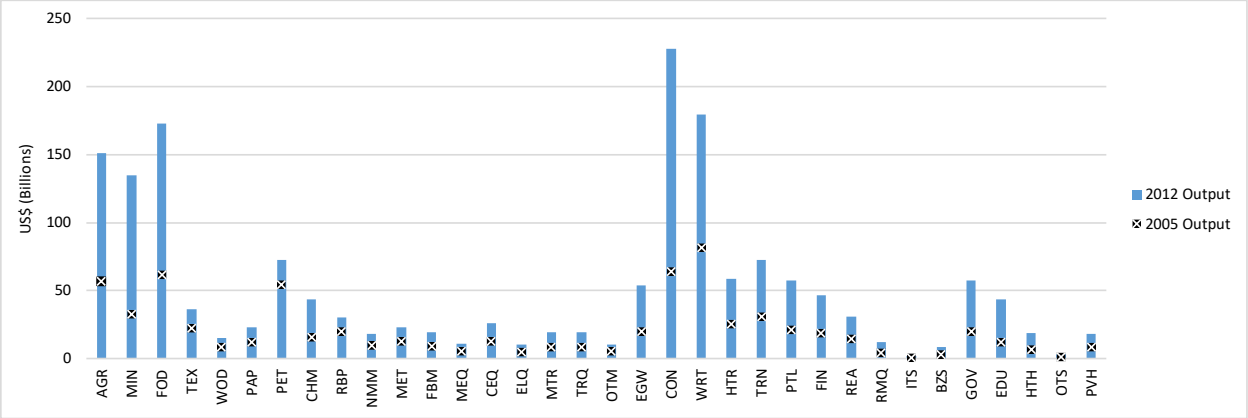


Figure 3.7.2 Value added (VA), by industry, 2005 and 2012, Indonesia

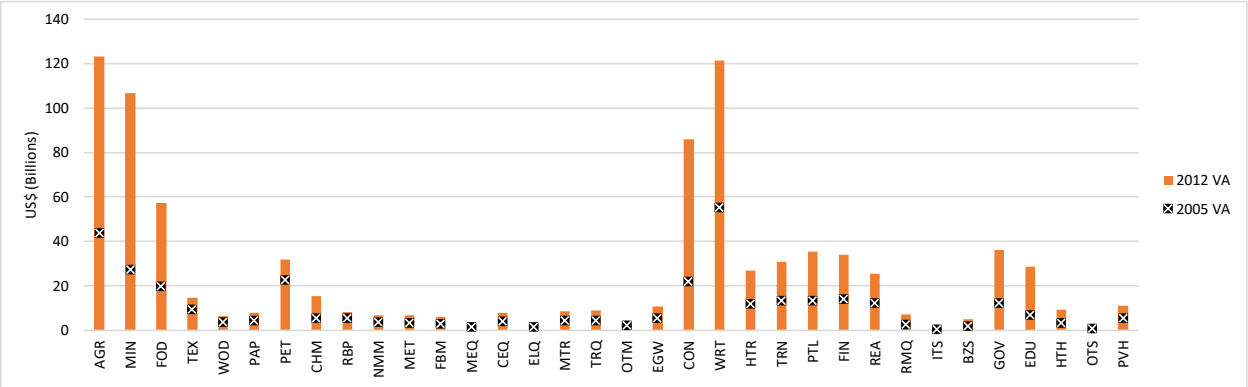
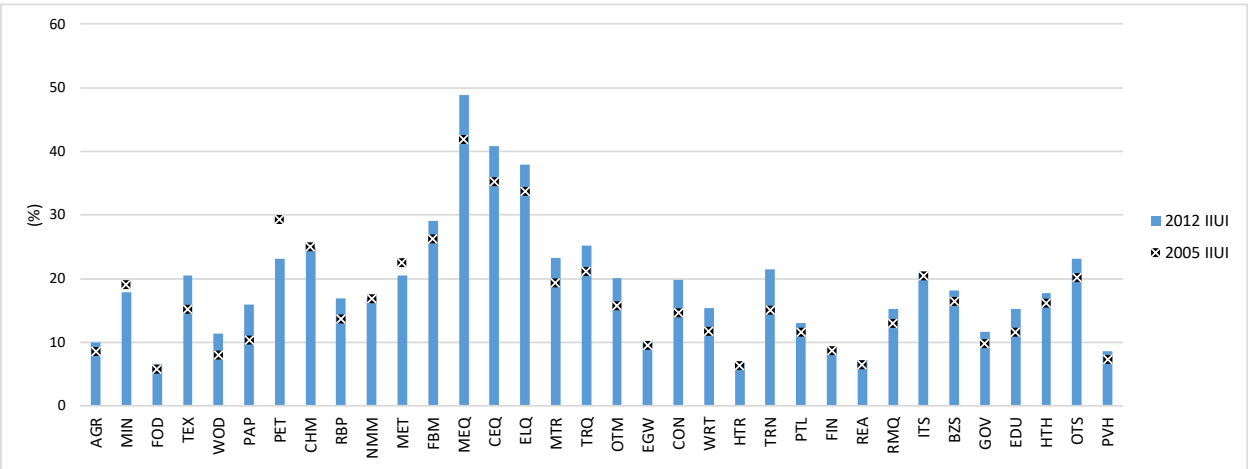


Figure 3.7.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, Indonesia



Selected APEC TiVA Measures[91]

GVC-Related Trade and GVC Participations

GVC-Related Trade[92]

In 2012, Indonesia's GVC-related trade amounted to $186.9 billion, more than doubled from $79.6 billion in 2005, and accounting for 80.0 percent of Indonesia's gross exports. About half GVC-related trade was in the form of complex GVCs. Mining (MIN) topped all industries, accounting for 18.9 percent of Indonesia's GVC-related trade. It was followed by agriculture (AGR, 15.1 percent), transport and storage (TRN, 13.0 percent) and food, beverages and tobacco (FOD, 10.5 percent) (figure 3.7.4).

Forward GVC Participation[93]

Indonesia's forward GVC participation rate decreased from 18.6 percent in 2005 to 16.7 percent in 2012, though above the APEC average of 13.8 percent. The complex forward GVC participation rate decreased from 6.6 percent to 6.4 percent during this period. The industries with the highest forward GVC participation rates in 2012 were wood and wood products (WOD) at 52.4 percent, pulp, paper, paper products, printing and publishing (PAP) at 51.9 percent, and TRN at 36.5 percent (figure 3.7.5).

Backward GVC Participation[94]

Indonesia's backward GVC participation rate decreased from 17.5 percent in 2005 to 15.2 percent in 2012, above the APEC average of 12.7 percent. The complex backward GVC participation rate decreased from 7.0 to 6.4 percent during this period. The industries with the highest backward GVC participation rates in 2012 were machinery and equipment (MEQ) at 49.7 percent, computer, electronic and optical equipment (CEQ) at 39.8 percent, and electrical machinery and apparatus (ELQ) at 38.2 percent (figure 3.7.6).

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[91] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[92] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[93] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[94] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.7.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, Indonesia

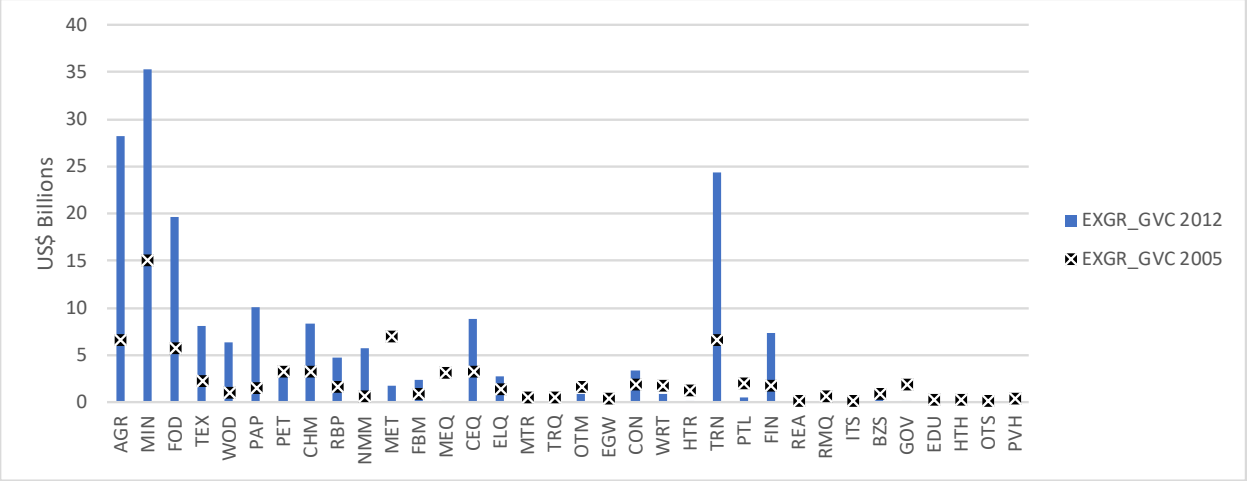


Figure 3.7.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, Indonesia

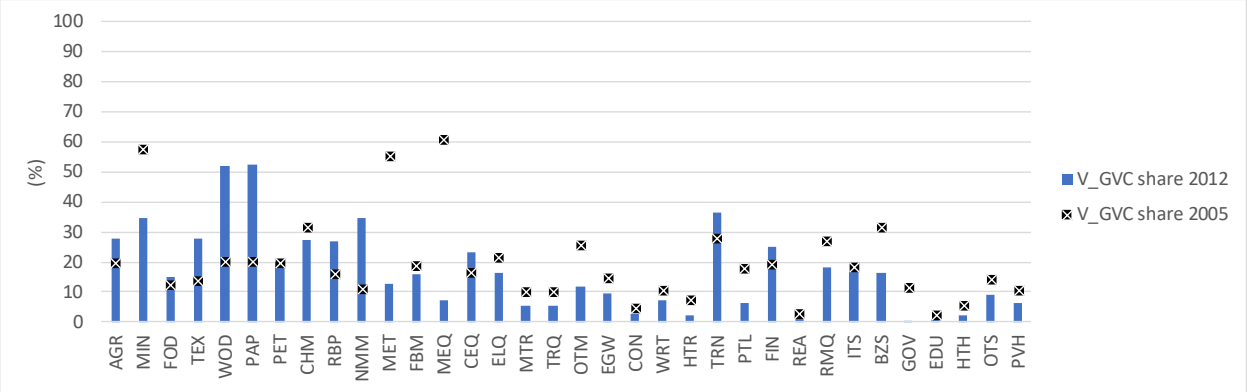
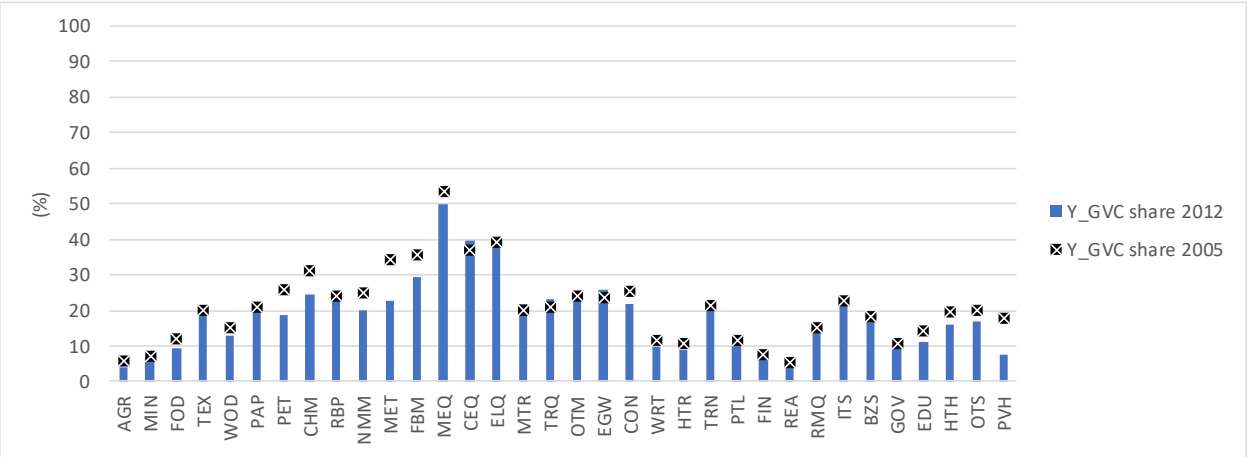


Figure 3.7.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, Indonesia



Value Added Trade and Top APEC Trading Partners

Value-added exports[95]

In 2012, Indonesia had value-added exports of $195.3 billion, more than doubled from $84.2 billion in 2005. Mining (MIN) and agriculture (AGR) topped all industries, accounting for 23.8 percent and 20.4 percent of Indonesia's value-added exports, respectively. They also experienced the largest increases in value-added exports during this period (figure 3.7.7).

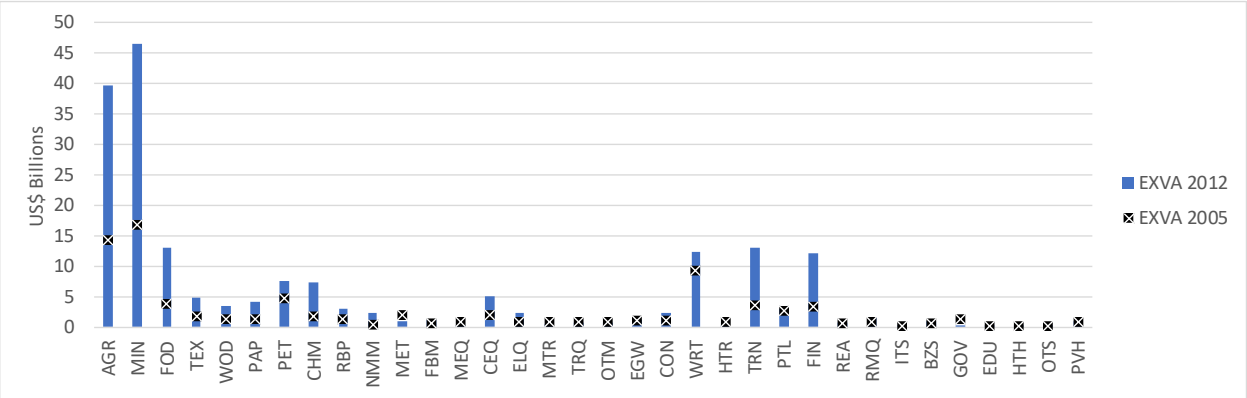
Value-added imports[96]

In 2012, Indonesia had value-added imports of $200.8 billion, nearly tripled from $71.0 billion in 2005. Wholesale and retail trade (WRT) topped all industries, accounting for 9.3 percent of Indonesia's value -added imports in 2012. It was followed by MIN at 7.8 percent, AGR at 6.1 percent, transport and storage (TRN) at 5.9 percent. The industries that experienced the largest increases in value-added imports during this period were private households with employed persons & extra-territorial organizations & bodies (PVH), renting of machinery and equipment (RMQ), and construction (CON), though from a low base in 2005 (figure 3.7.8).

Top APEC Trading Partners

In 2012, in the APEC region, China; Japan; the United States; Singapore; and Korea were the top destinations and sources for Indonesia's value-added exports (figure 3.7.9) and value-added imports (figure 3.7.10).

Figure 3.7.7 Value-added exports (EXVA), by industry, 2005 and 2012, Indonesia



[95] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.
[96] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.7.8 Value-added imports (IMVA), by industry, 2005 and 2012, Indonesia

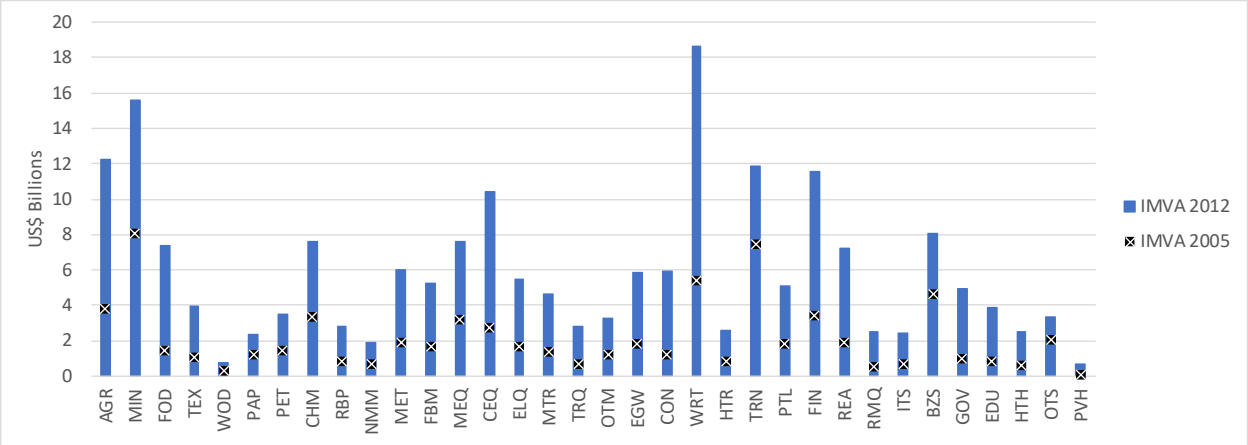


Figure 3.7.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, Indonesia

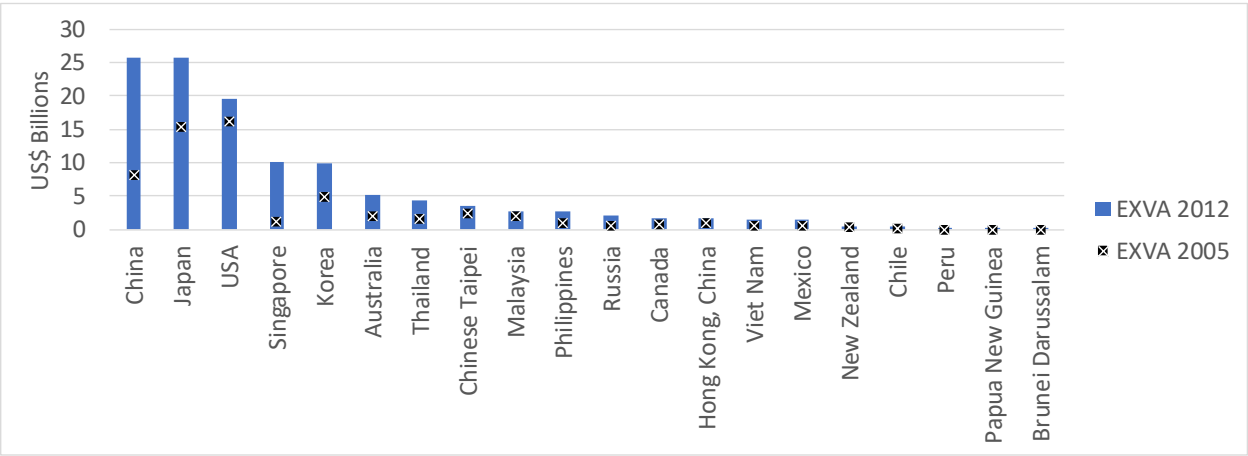
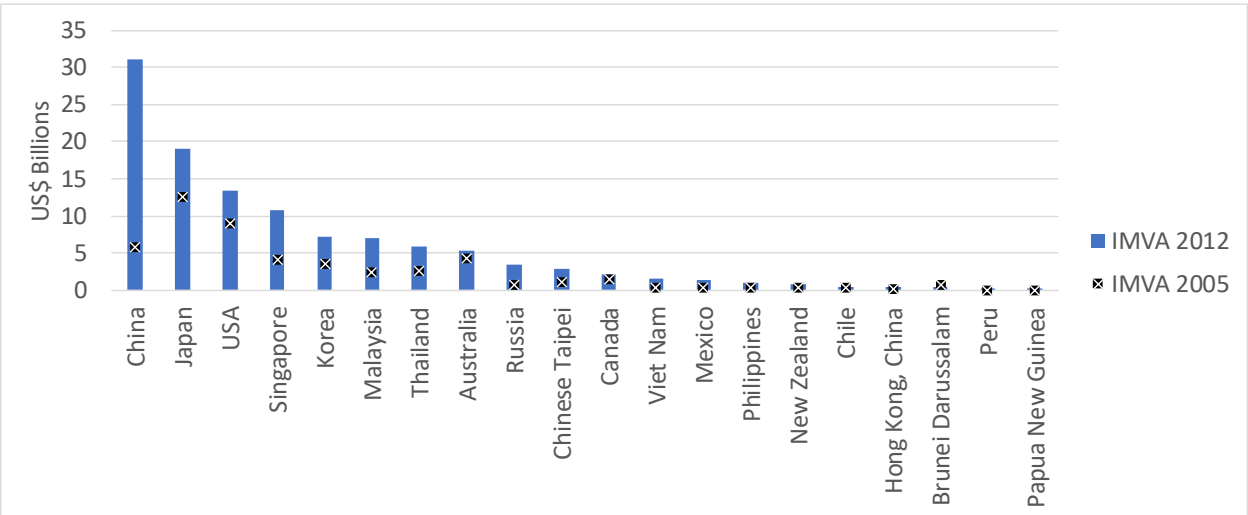


Figure 3.7.10 APEC sources of value-added imports (IMVA), 2005 and 2012, Indonesia



Chapter 8: Japan

Industry Data Summary Based on SUTs

Gross Output[97]

In 2012, Japan's total gross output was $11.6 trillion, increasing by 34.3 percent from $8.6 trillion in 2005. Manufacturing and services sectors accounted for 31.5 percent and 67.2 percent of Japan's gross output, respectively.[98]

Of 34 industries, wholesale and retail trade (WRT) had the largest industry gross output of $1.4 trillion in 2012, increasing by 35.6 percent from its 2005 level, and accounting for 11.9 percent of Japan's total gross output. Other top industries included real estate activities (REA, 7.9 percent), health and social work (HTH, 6.0 percent), construction (CON, 5.7 percent), and R&D and other business activities (BZS, 5.6 percent) (figure 3.8.1).

Value Added[99]

In 2012, Japan's total value added, or GDP, was $5.8 trillion, increasing from $4.5 trillion in 2005, making it the third largest economy in the APEC region. As a services-oriented economy, services sectors together accounted for 79.7 percent of Japan's total GDP, followed by manufacturing with a share of 19.1 percent. The industries with the largest contribution to total GDP were WRT (15.0 percent of total GDP), REA (12.3 percent), BZS (7.3 percent), and HTH (7.0 percent).

The largest manufacturing industries in terms of value added were machinery and equipment (MEQ, 2.9 percent of total GDP), motor vehicles, trailers and semi-trailers (MTR, 2.8 percent of total GDP), and food products, beverages and tobacco (FOD, 2.4 percent) (figure 3.8.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by Japanese industries in 2012, 13.5 percent were imported, a slight increase from 10.1 percent in 2005, and almost on par with the APEC average of 13.8 percent. The industries with the highest imported intermediate use intensity (IIUI) were coke, refined petroleum products and nuclear fuel (PET, 75.3 percent), electricity, gas and water supply (EGW, 38.2 percent), and computer, electronic and optical equipment (CEQ, 20.7 percent).

The average IIUI rate in manufacturing sector was 18.7 percent in 2012. Most manufacturing industries in Japan experienced an increase in IIUI during this period. Of them, the most notable were electrical machinery and apparatus (ELQ), increasing by 69.9 percent; and CEQ, increasing by 55.6 percent.

Comparatively, the average IIUI rate in services sector was much lower at 8.8 percent in 2012. Most services industries also experienced an increase in IIUI. Of them, the most notable was EGW, increasing by 43.4 percent. Two exceptions were education (EDU), decreasing by 36.3 percent; and BZS, decreasing by 35.9 percent (figure 3.8.3).

[97] Based on the supply tables at basic price, which could differ from the official NA data.
[98] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[99] Based on the use tables at basic price, which could differ from the official NA data.

Figure 3.8.1 Gross output, by industry, 2005 and 2012, Japan

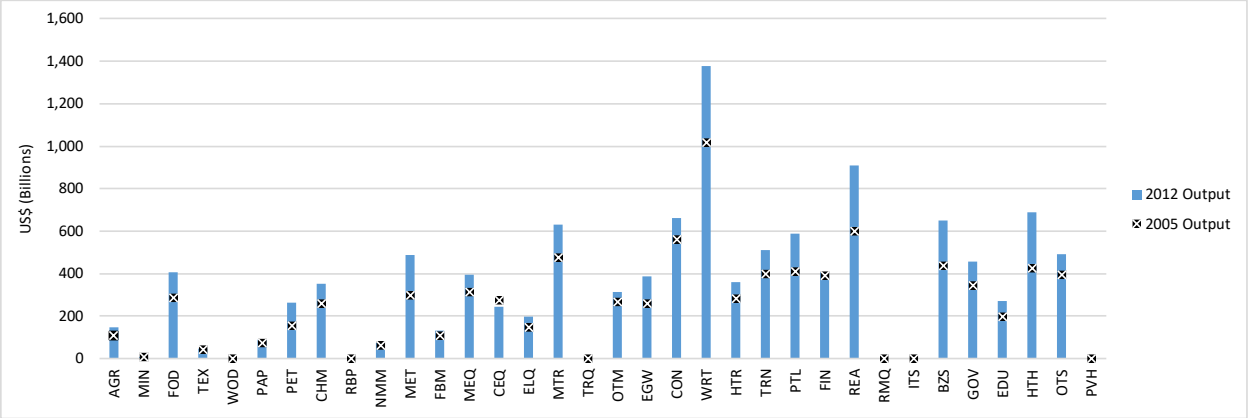


Figure 3.8.2 Value added (VA), by industry, 2005 and 2012, Japan

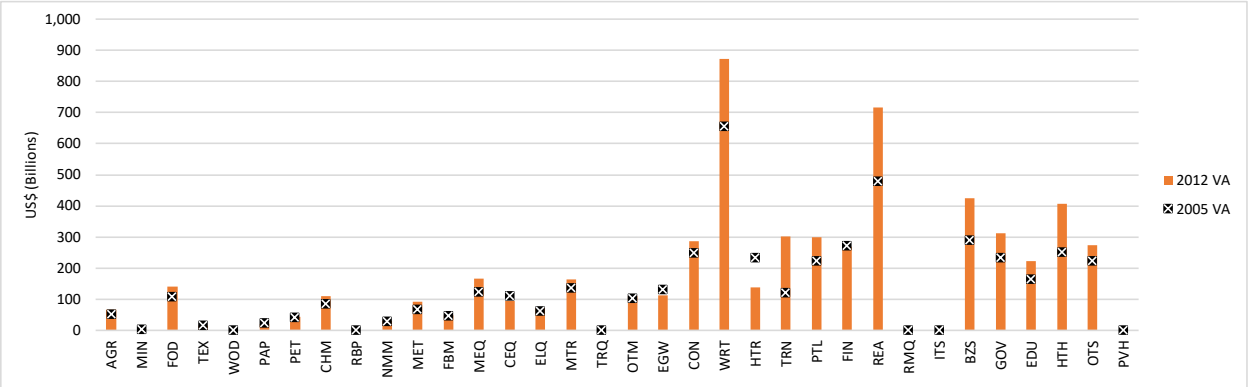
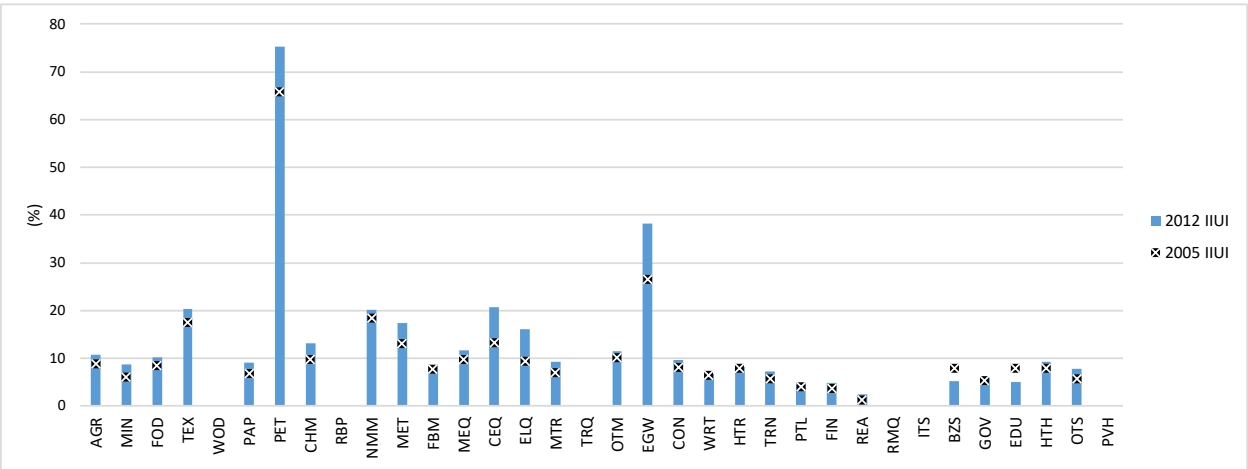


Figure 3.8.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, Japan



Selected APEC TiVA Measures[100]

GVC-Related Trade and GVC Participations

GVC-Related Trade[101]

In 2012, Japan's GVC-related trade amounted to $746.1 billion, increasing 46.8 percent from $508.1 billion in 2005, and accounting for 84.4 percent of Japan's gross exports. About 48.8 percent of GVC-related trade was in the form of complex GVCs. Motor vehicles, trailers and semi-trailers (MTR) topped all industries, accounting for 13.7 percent of Japan's GVC-related trade. It was followed by computer, electronic and optical equipment (CEQ, 10.8 percent), finance and insurance (FIN, 10.5 percent), and post and telecommunications (PLT, 10.3 percent) (figure 3.8.4).

Forward GVC Participation[102]

Japan's forward GVC participation rate increased from 9.0 percent in 2005 to 9.8 percent in 2012, still below the APEC average of 13.8 percent. The complex forward GVC participation rate barely increased from 3.36 percent to 3.38 percent during this period. The industries with the high forward GVC participation rates in 2012 were computer, electronic and optical equipment (CEQ) at 39.7 percent, textile, leather, and footwear (TEX) at 38.0 percent, basic Metals (MET) at 35.6 percent, other non-metallic mineral products (NMM) at 32.9 percent, and electrical machinery and apparatus (ELQ) at 30.3 percent (figure 3.8.5).

Backward GVC Participation[103]

Japan's backward GVC participation rate increased from 8.4 percent in 2005 to 10.8 percent in 2012, still below the APEC average of 12.7 percent. The complex backward GVC participation rate increased from 2.5 percent to 3.6 percent during this period. The industries with the highest backward GVC participation rates in 2012 were coke, refined petroleum products and nuclear fuel (PET) at 67.5 percent,

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[100] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[101] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[102] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[103] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

followed at distance by electricity gas and water supply (EGW, 35.9 percent) and MET at 31.5 percent (figure 3.8.6).

Figure 3.8.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, Japan

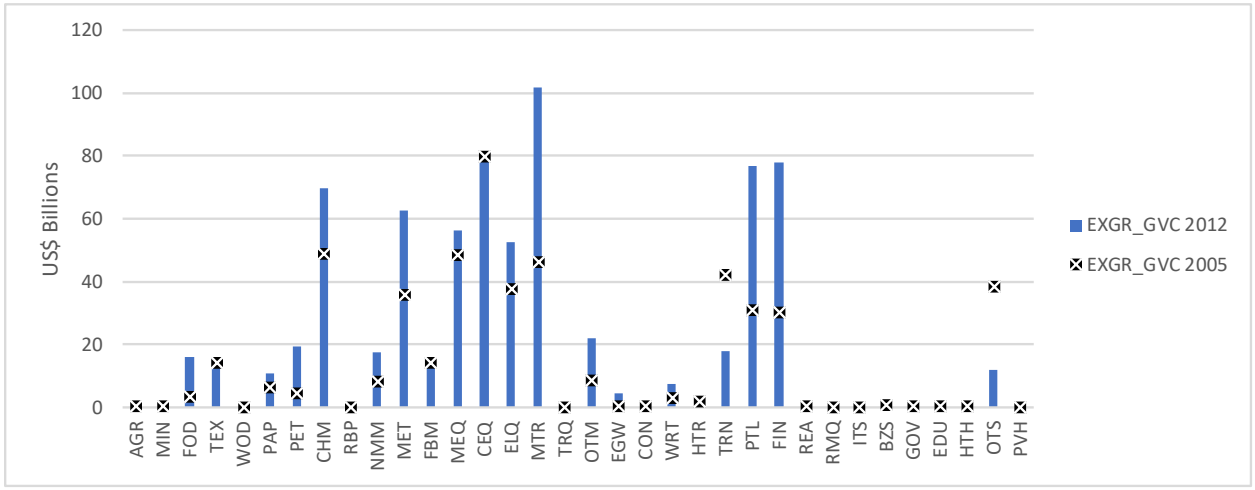


Figure 3.8.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, Japan

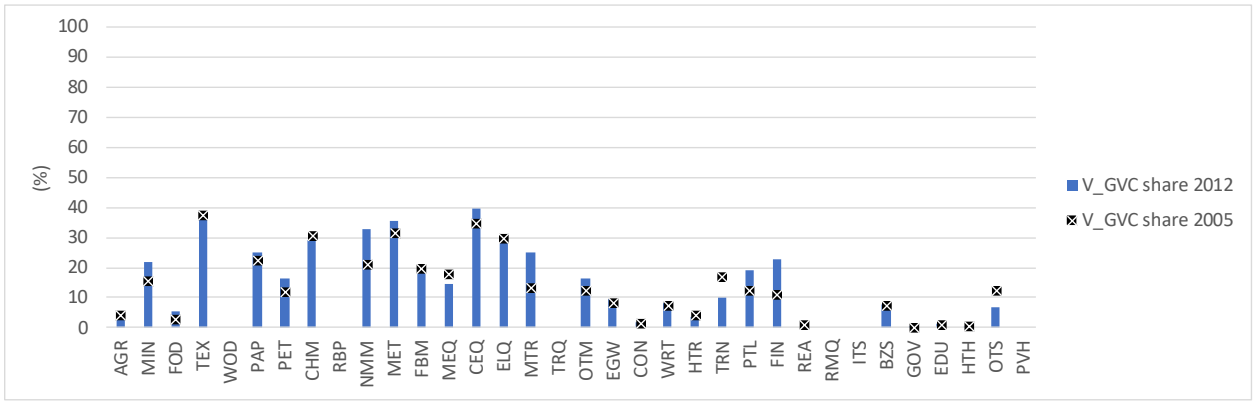
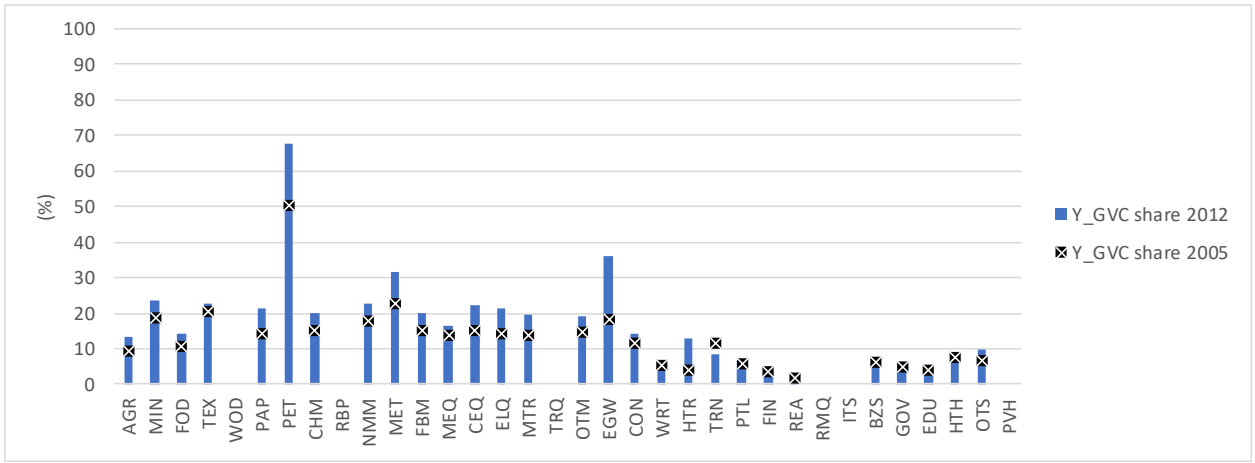


Figure 3.8.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, Japan



Value Added Trade and Top APEC Trading Partners

Value-added exports[104]

In 2012, Japan had value-added exports of $705.8 billion, increasing by 26 percent from $562.2 billion in 2005. Wholesale and retail trade (WRT) topped all industries, accounting for 12.2 percent of value-added exports in 2012. It was followed by finance and insurance (FIN, 9.5 percent), machinery and equipment (MEQ, 8.9 percent), post and telecommunications (PTL, 8.7 percent), and motor vehicles, trailers and semi-trailers (MTR, 8.2 percent). The industries experiencing the largest increase in value-added exports during this period were FIN, PTL, MEQ, and WRT (figure 3.8.7).

Value-added imports[105]

In 2012, Japan had value-added imports of $818.5 billion, increasing from $497.0 billion in 2005. Mining (MIN) topped all industries, accounting for 16.1 percent of Japan's value-added imports in 2012. It was followed by WRT (7.6 percent), and agriculture (AGR, 7.2 percent). These three industries experienced the largest increases in value-added imports during this period (figure 3.8.8).

Top APEC Trading Partners

In 2012, in the APEC region, the United States; China; Korea; Thailand; and Indonesia were the top destinations for Japan's value-added exports (figure 3.8.9), and China; the United States; Australia; Korea; and Indonesia were the top sources for Japan's value-added imports (figure 3.8.10).

Figure 3.8.7 Value-added exports (EXVA), by industry 2005 and 2012, Japan

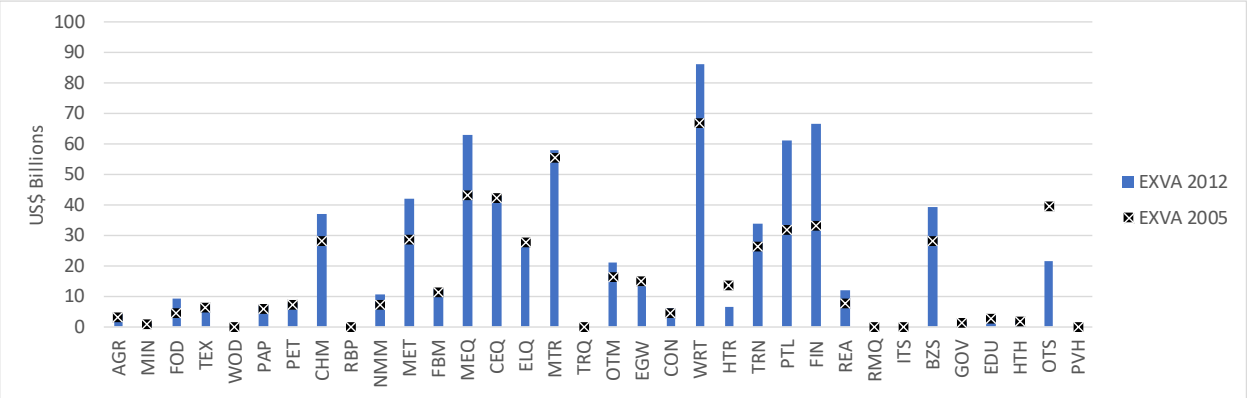
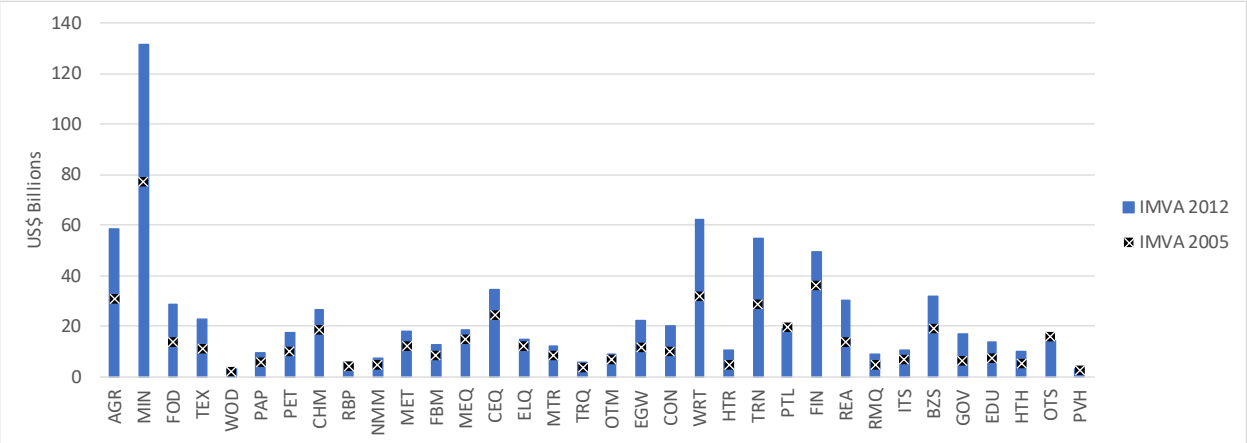


Figure 3.8.8 Value-added imports (IMVA), by industry 2005 and 2012, Japan



[104] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.
[105] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.8.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, Japan

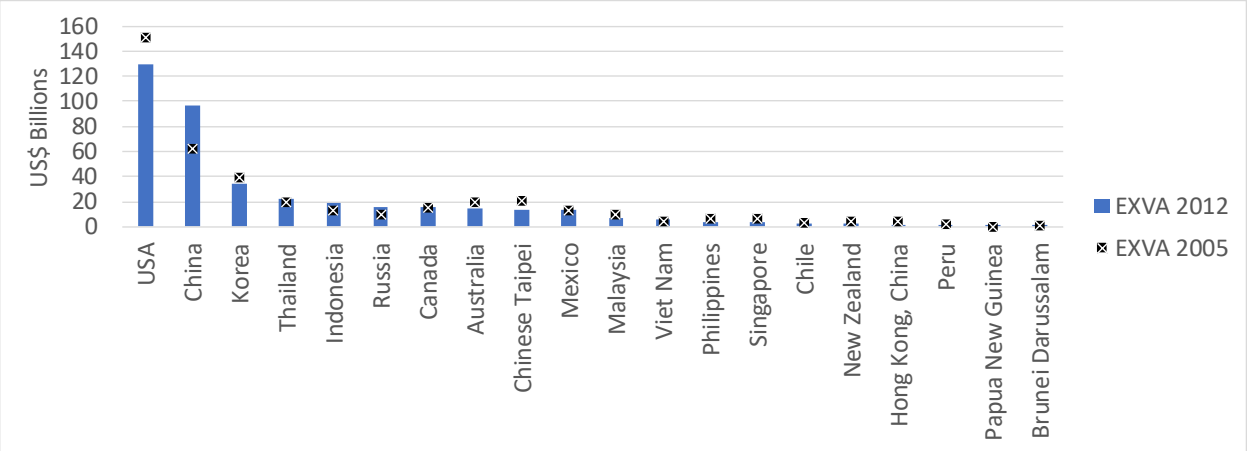
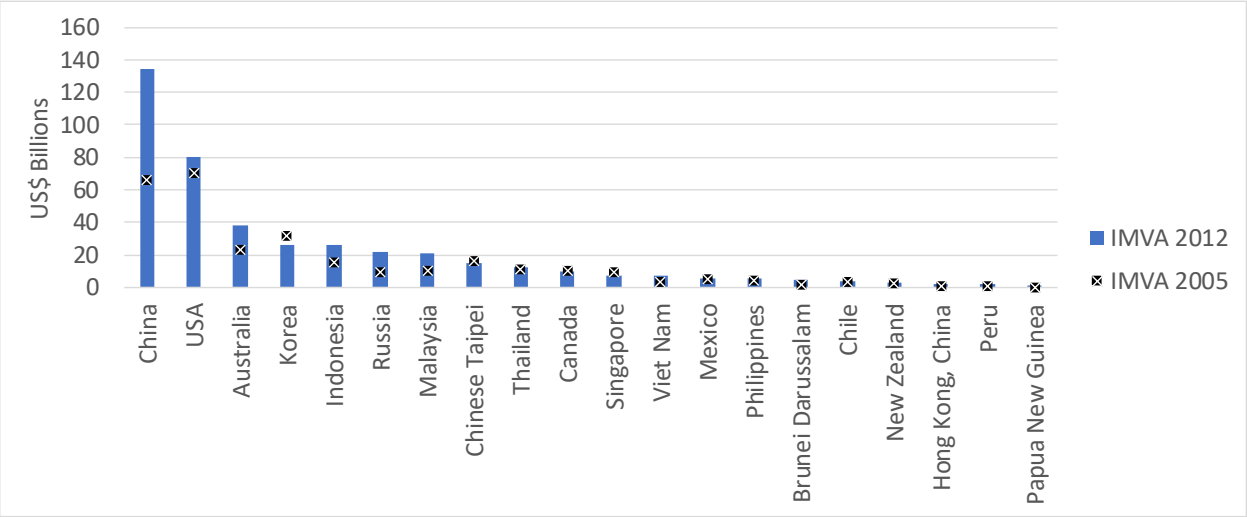


Figure 3.8.10 APEC sources of value-added imports (IMVA), 2005 and 2012, Japan



Chapter 9: Korea

Industry Data Summary Based on SUTs

Gross Output[106]

In 2012, Korea's total gross output was $3.1 trillion, increasing by more than 50 percent from $1.9 trillion in 2005. Manufacturing and services sectors accounted for 50.4 and 47.9 percent of Korea's gross output in 2012, respectively.[107]

Of 34 industries, computer, electronic and optical equipment (CEQ) had the largest gross output of $283.2 billion, increasing more than 50 percent from its 2005 level and accounting for 9.2 percent of Korea's total gross output. Other top industries included wholesale and retail trade (WRT, 6.4 percent of total gross output), construction (CON, 5.2 percent), and chemicals (CHM, 5.1 percent) (figure 3.9.1).

Value Added[108]

In 2012, Korea's total value added, or GDP, was $1.1 trillion, increasing by 37.0 percent from $810.4 billion in 2005. Services sectors together accounted for 66.4 percent of Korea's total GDP, followed by manufacturing with a share of 31.0 percent.

The industries with the largest contributions to total GDP were WRT (9.1 percent of total GDP), real estate activities (REA, 7.7 percent), R&D and other business activities (BZS, 7.1 percent), and public administration and defense, compulsory social security (GOV, 7.1 percent).

The largest manufacturing industries in terms of value added were CEQ (6.8 percent of total GDP), motor vehicles, trailers and semi-trailers (MTR, 3.1 percent), and chemicals (CHM, 2.7 percent) (figure 3.9.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by Korean industries in 2012, 27.9 percent were imported, an increase from 21.9 percent in 2005, and well above the APEC average of 13.8 percent. The industries with the highest imported intermediate use intensity (IIUI) were coke, refined petroleum products and nuclear fuel (PET, 83.1 percent), electricity, gas and water supply (EGW, 52.2 percent), and basic metals (MET, 45.6 percent).

The average IIUI rate in Korean manufacturing sector was 29.1 percent in 2012, increasing from 24.2 percent in 2005. Most manufacturing industries in Korea experienced an increase in IIUI during this period. Of them, the most notables were basic metals (MET), increasing by 78.1 percent; and chemicals (CHM), increasing by 76.9 percent. Five manufacturing industries were the exceptions. Among them were machinery and equipment (MEQ), decreasing by 23.8 percent; non-metallic mineral products (NMM), decreasing by 19.6 percent; and other manufacturing (OTM), decreasing by 12.6 percent.

The average IIUI rate in Korean services sector was 14.5 percent in 2012, increasing slightly from 14.2 percent in 2005. Services industries displayed a similar divergent trend during this period. Seven services industries experienced a decrease in IIUI, including CON, decreasing by 45.5 percent; real estate activities (REA), decreasing by 48.1 percent; and GOV, decreasing by 36.7 percent. Eight services industries experienced an increase in IIUI, including BZS, increasing by 51.5 percent; finance

[106] Based on the supply tables at basic price, which could differ from the official NA data.
[107] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[108] Based on the use tables at basic price, which could differ from the official NA data.

and insurance (FIN), increasing by 50.4 percent; and transport and storage (TRN), increasing by 30.1 percent (figure 3.9.3).

Figure 3.9.1 Gross output, by industry, 2005 and 2012, Korea

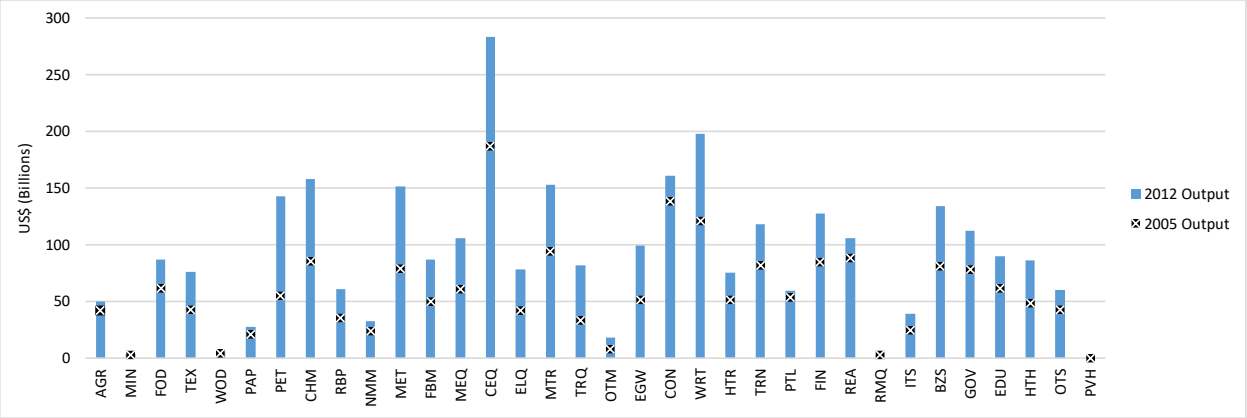


Figure 3.9.2 Value added (VA), by industry, 2005 and 2012, Korea

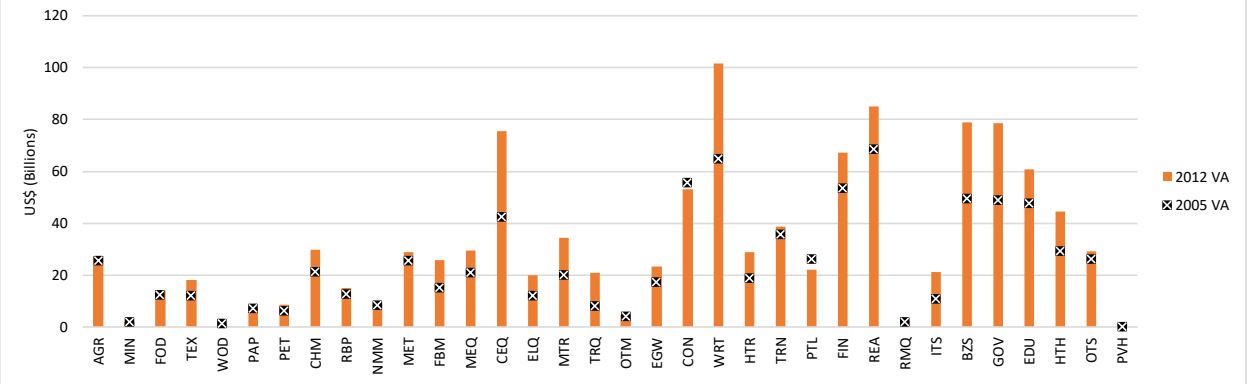
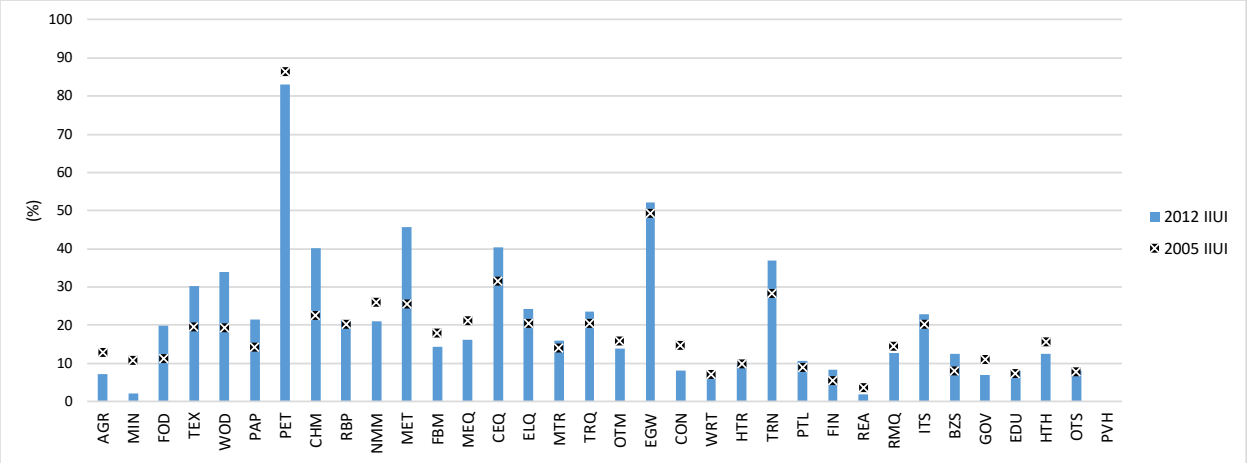


Figure 3.9.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, Korea



Selected APEC TiVA Measures[109]

GVC-Related Trade and GVC Participations

GVC-Related Trade[110]

In 2012, Korea's GVC-related trade amounted to $612.3 billion, more than doubled from $282.6 billion in 2005, and accounting for 87.2 percent of Korea's gross exports. About two third of GVC-related trade was in the form of complex GVCs. Computer, electronic and optical equipment (CEQ) topped all industries, accounting for 20.7 percent of Korea's GVC-related trade. It was followed by transport and storage (TRN, 11.8 percent), and R&D and other business activities (BZS, 9.3 percent) (figure 3.9.4).

Forward GVC Participation[111]

Korea's forward GVC participation rate increased from 20.4 percent in 2005 to 27.2 percent in 2012, above the APEC average of 13.8 percent. The complex forward GVC participation rate increased from 6.9 percent to 9.4 percent during this period. The industries with the highest forward GVC participation rates in 2012 were mining (MIN) at 75.2 percent, TRN at 69.4 percent, CEQ at 55.4 percent, and BZS at 53.3 percent (figure 3.9.5).

Backward GVC Participation[112]

Korea's backward GVC participation rate increased from 21.9 percent in 2005 to 30.6 percent in 2012, well above the APEC average of 12.7 percent. The complex backward GVC participation rate increased from 7.5 percent to 12.3 percent during this period. The industries with the highest backward GVC participation rates in 2012 were coke, refined petroleum products and nuclear fuel (PET) at 86.0 percent, chemicals (CHM) at 60.9 percent, basic metals (MET) at 59.0 percent, electricity, gas and water supply (EGW) at 56.9 percent, and CEQ at 50.5 percent (figure 3.9.6).

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[109] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[110] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

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Figure 3.9.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, Korea

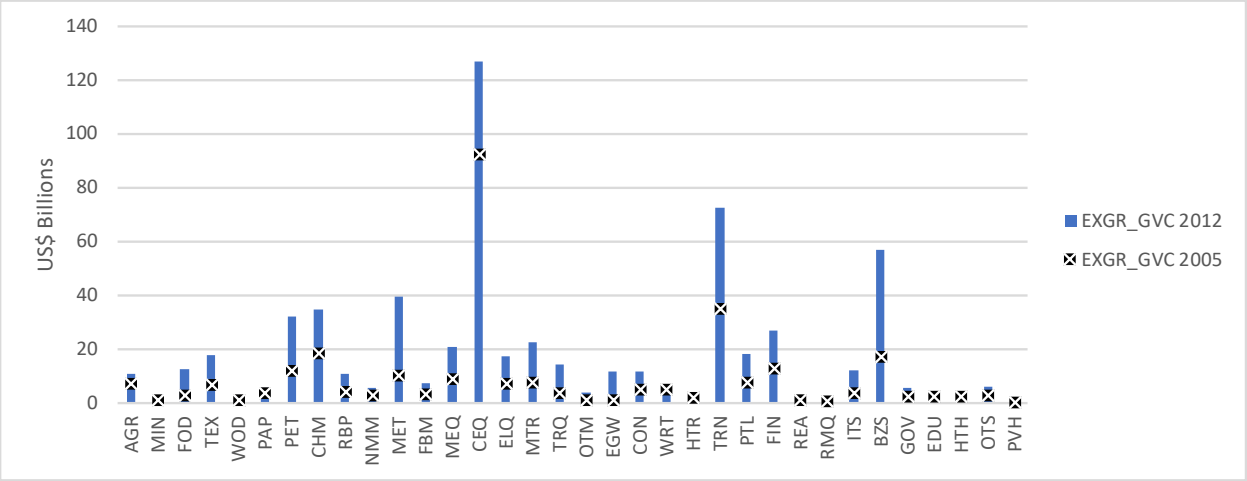


Figure 3.9.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, Korea

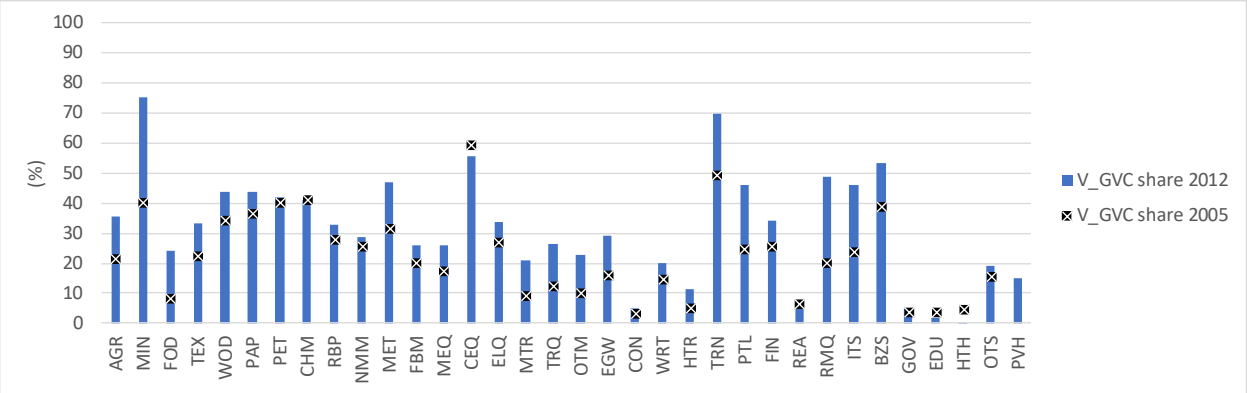
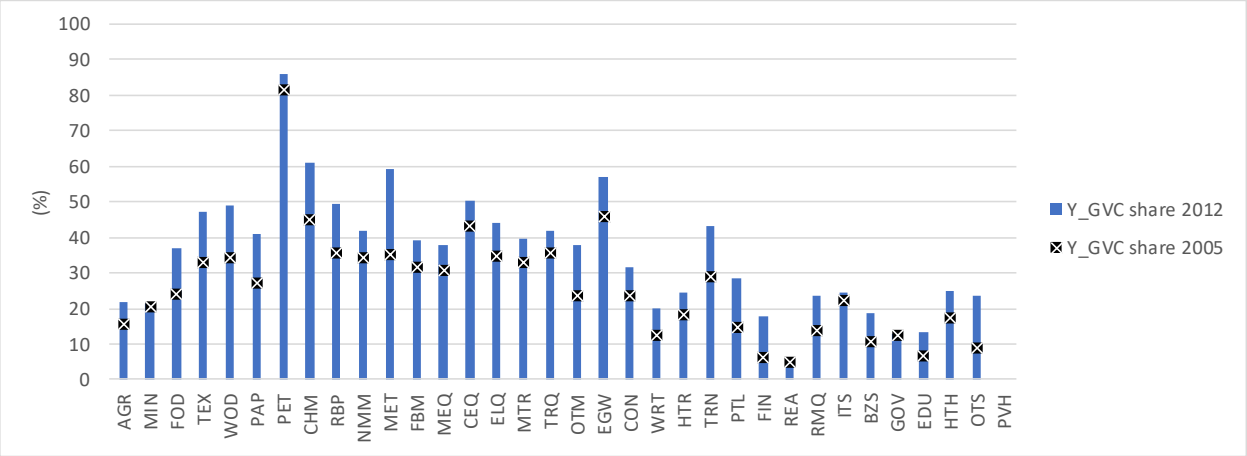


Figure 3.9.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, Korea



Value Added Trade and Top APEC Trading Partners

Value-added exports[113]

In 2012, Korea had value-added exports of $400.1 billion, increasing by 77.8 percent from $224.8 billion in 2005. Computer, electronic and optical equipment (CEQ) topped all industries, accounting for 12.9 percent of Korea's value-added exports in 2012. It was followed by R&D and other business activities (BZS, 11.5 percent), finance and insurance (FIN, 8.9 percent), and transport and storage (TRN, 8.1 percent). The industries experiencing the largest increase in value-added exports during this period were BZS, CEQ, and FIN (figure 3.9.7).

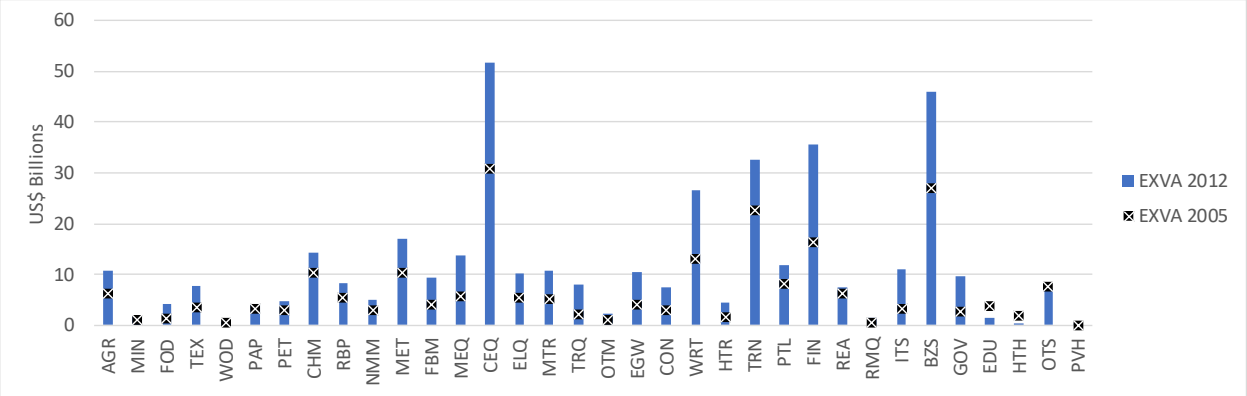
Value-added imports[114]

In 2012, Korea had value-added imports of $377.6 billion, increased by 85.4 percent from $203.7 billion in 2005. Mining (MIN) topped all industries, accounting for 12.7 percent of Korea's value-added imports in 2012. It was followed by wholesale and retail trade (WRT, 8.5 percent), FIN and TRN (both at 6.2 percent). The industries that experienced the largest increases in value-added imports during this period were services industries, though some industries such as computer and related activities (ITS) and health and social work (HTH) were from a low based in 2005 (figure 3.9.8).

Top APEC Trading Partners

In 2012, in the APEC region, China; the United States; Japan; Australia; and Russia were the top destinations and sources for Korea's value-added exports and imports (figure 3.9.9 and 3.9.10).

Figure 3.9.7 Value-added exports (EXVA), by industry 2005 and 2012, Korea



[113] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.
[114] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.9.8 Value-added imports (IMVA), by industry 2005 and 2012, Korea

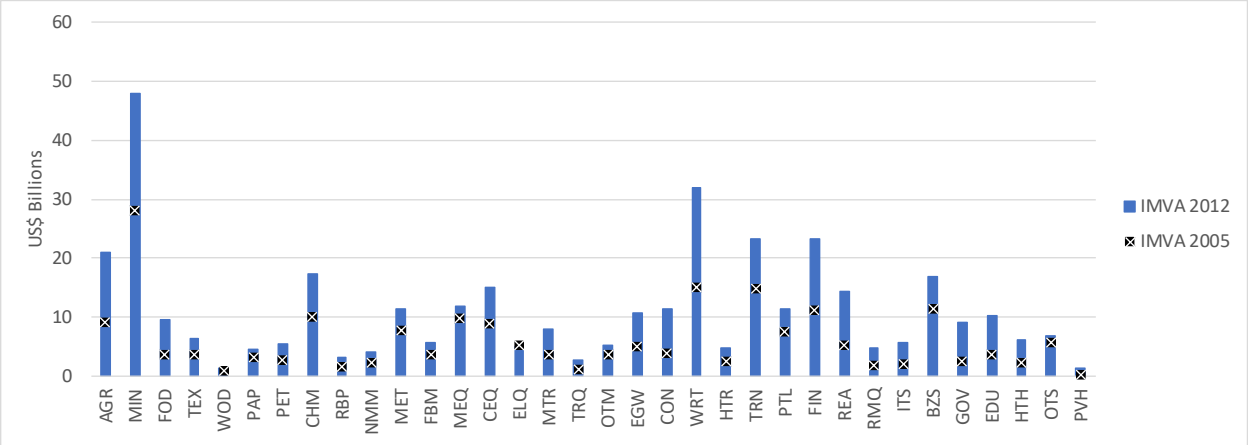


Figure 3.9.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, Korea

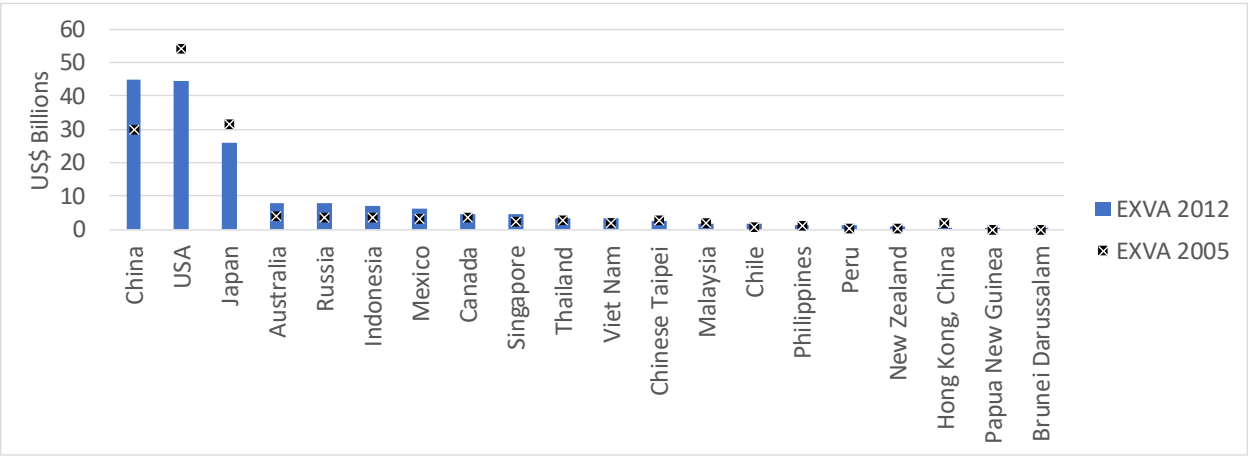
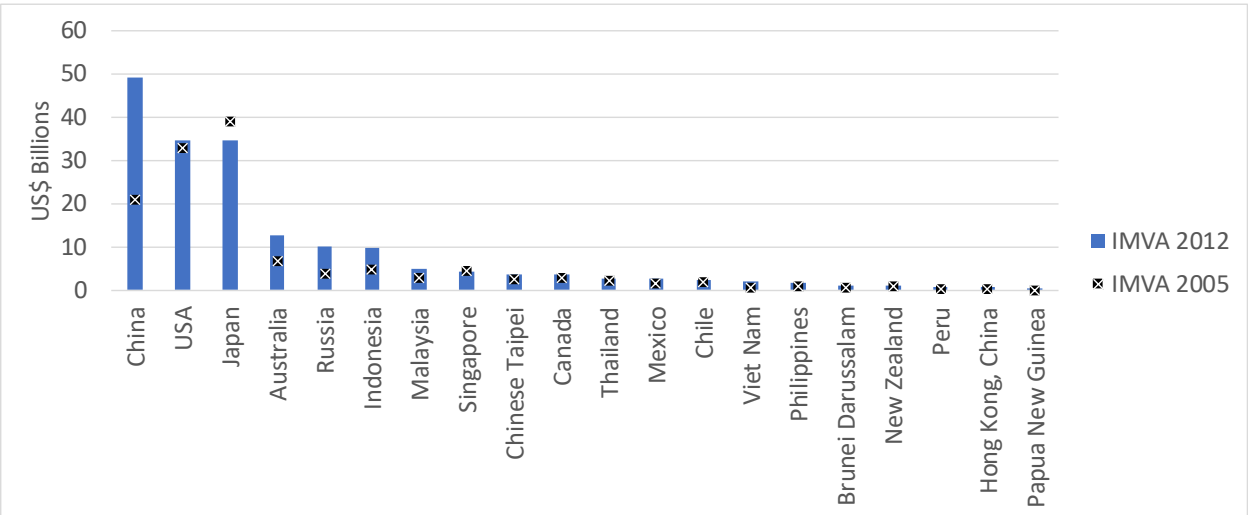


Figure 3.9.10 APEC sources of value-added imports (IMVA), 2005 and 2012, Korea



Chapter 10: Malaysia

Industry Data Summary Based on SUTs

Gross Output[115]

In 2012, Malaysia's total gross output was $792.3 billion, increasing by 87.1 percent from $423.5 billion in 2005. Manufacturing and services sectors accounted for 44.0 percent and 45.3 percent of Malaysia's total gross output, respectively.[116]

Of 34 industries, wholesale and retail trade (WRT) had the largest industry gross output of $77.2 billion, an almost threefold increase from its 2005 level, accounting for 9.7 percent of Malaysia's total gross output. Other top industries included food products, beverages and tobacco (FOD, 9.2 percent), coke, refined petroleum products and nuclear fuel (PET, 6.6 percent), finance and insurance (FIN, 6.4 percent), and agriculture, hunting, forestry and fishing (AGR, 5.7 percent) (figure 3.10.1).

Value Added[117]

In 2012, Malaysia's total value added, or GDP, was $310.4 billion, more than doubled from $134.5 billion in 2005. Services sectors together accounted for 56.6 percent of Malaysia's total GDP, followed by manufacturing with a share of 23.2 percent.

The industries with the top contribution to total GDP were WRT (14.2 percent of total GDP), mining (MIN, 10.6 percent), AGR (9.6 percent), FIN (8.4 percent), and public administration and defense, compulsory social security (GOV, 5.3 percent).

The largest manufacturing industries in terms of value added were PET (4.1 percent of total GDP), transport and storage (TRN, 3.6 percent), and computer, electronic and optical equipment (CEQ, 3.6 percent) (figure 3.10.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by Malaysian industries in 2012, 20.1 percent were imported, a significant decrease from 32.2 percent in 2005, but still well above the APEC average of 13.8 percent. The industries with the highest imported intermediate use intensity (IIUI) were basic metals (MET, 39.3 percent), fabricated metal products (FBM, 36.0 percent), and motor vehicles manufacturing (MTR, 34.7 percent).

The average IIUI rate of Malaysian manufacturing sector was 25.6 percent in 2012, declining from 31.7 percent in 2005. Most manufacturing industries experienced a decrease in IIUI during this period. Of them, the most notables were CEQ, decreasing by 49.5 percent; pulp, paper, paper products, printing and publishing (PAP), decreasing by 49.2 percent; and wood and products of word and cork (WOD), decreasing by 40.7 percent. The one notable exception was other transport equipment (TRQ), increasing by 61.9 percent.

The average IIUI rate of Malaysian services sector was 15.4 percent in 2012, a slight decrease from 18.0 percent in 2005. Several services industries experienced an increase in IIUI during this period, notably other community, social and personal services (OTS), increasing by 323.6 percent; and FIN, increasing by 141.8 percent. On the other hand, some services industries experienced a decrease in IIUI during this period, notably R&D and other business activities (BZS), decreasing by 70.8 percent;

[115] Based on the supply tables at basic price, which could differ from the official NA data.
[116] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[117] Based on the use tables at basic price, which could differ from the official NA data.

computer and related activities (ITS), decreasing by 57.9 percent; and REA, decreasing by 28.5 percent (figure 3.10.3).

Figure 3.10.1 Gross output, by industry, 2005 and 2012, Malaysia

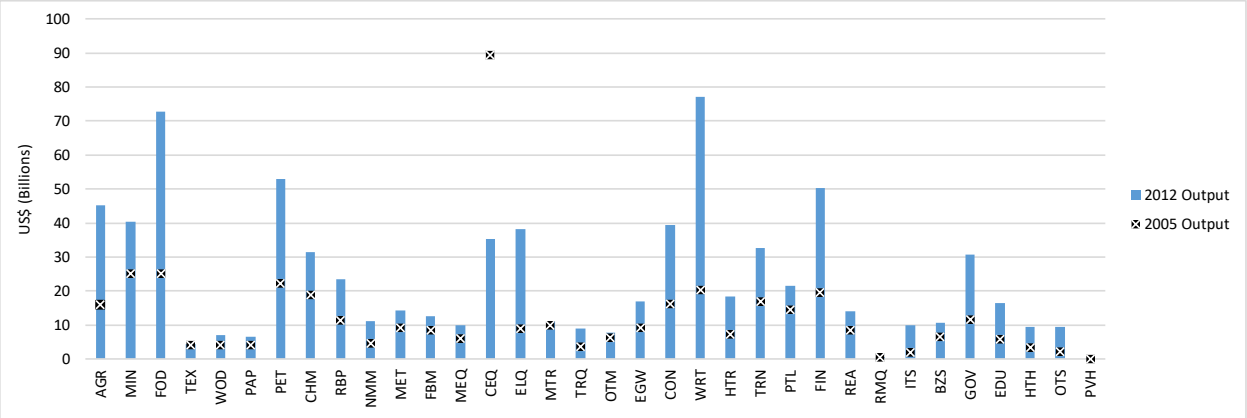


Figure 3.10.2 Value added (VA), by industry, 2005 and 2012, Malaysia

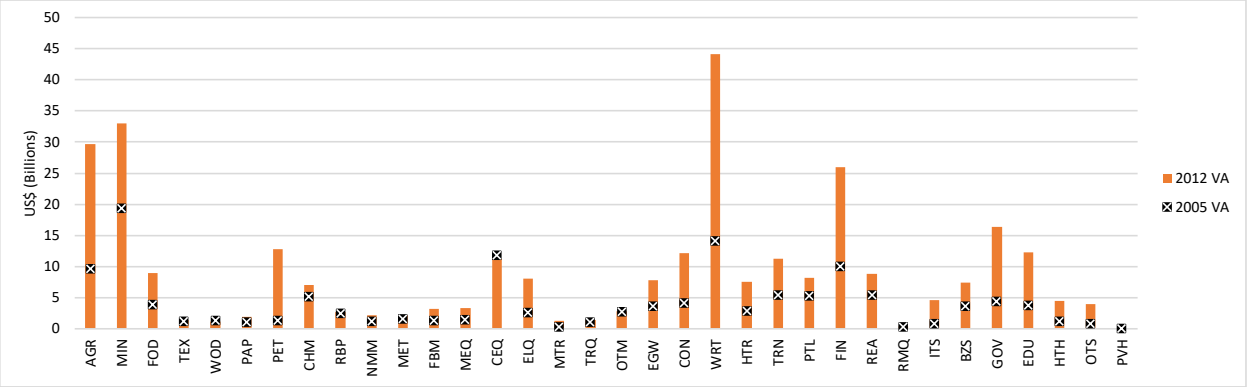
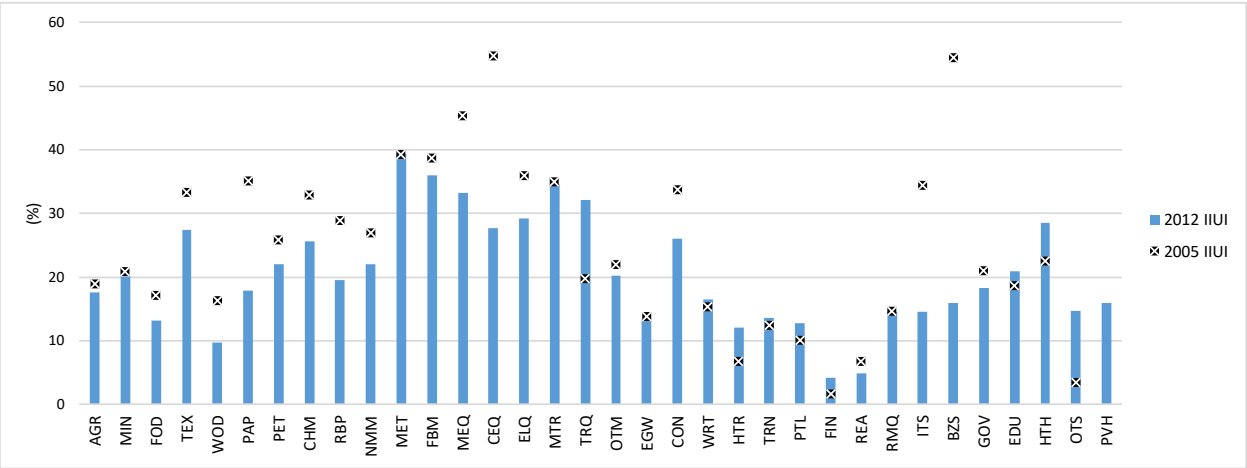


Figure 3.10.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, Malaysia



Selected APEC TiVA Measures[118]

GVC-Related Trade and GVC Participations

GVC-Related Trade[119]

In 2012, Malaysia's GVC-related trade amounted to $190.7 billion, increasing 37.2 percent from $139.0 billion in 2005, accounting for 84.6 percent of Malaysia's gross exports. About 63.1 percent of GVC-related trade was in the form of complex GVCs. Electrical machinery and apparatus (ELQ) topped all industries, accounting for 13.1 percent of Malaysia's GVC-related trade. It was followed by coke refined petroleum products (PET, 11.2 percent), food, beverages, and tobacco (FOD, 11.1 percent), and computer, electronic and optical equipment (CEQ, 10.5 percent) (figure 3.10.4).

Forward GVC Participation[120]

Malaysia's forward GVC participation rate decreased from 47.8 percent in 2005 to 37.2 percent in 2012, though far above the APEC average of 13.8 percent. The complex forward GVC participation rate decreased from 17.4 percent to 14.7 percent during this period. The industries with the highest forward GVC participation rates in 2012 were ELQ at 75.1 percent, mining (MIN) at 72.3 percent, basic metals (MET) at 72.0 percent, agriculture(AGR) at 63.8 percent, TRN at 79.5 percent, PET at 59.3 percent, and CEQ at 59.0 percent (figure 3.10.5).

Backward GVC Participation[121]

Malaysia's backward GVC participation rate decreased from 43.2 percent in 2005 to 26.0 percent in 2012, still above the APEC average of 12.7 percent. The complex backward GVC participation rate decreased from 24.6 percent to 14.3 percent during this period. The industries with the highest backward GVC participation rates in 2012 were motor vehicles, trailers and semi-trailers (MTR) at 57.0 percent, MET at 54.2 percent, Other transport equipment (TRQ) at 52.2 percent (figure 3.10.6).

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[118] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[119] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[120] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[121] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.10.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, Malaysia

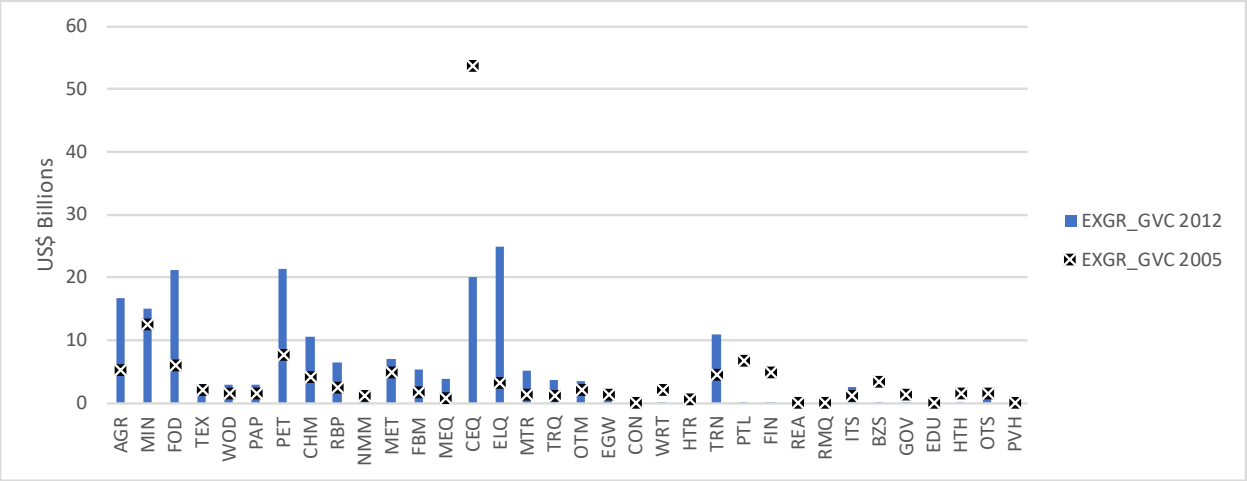


Figure 3.10.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, Malaysia

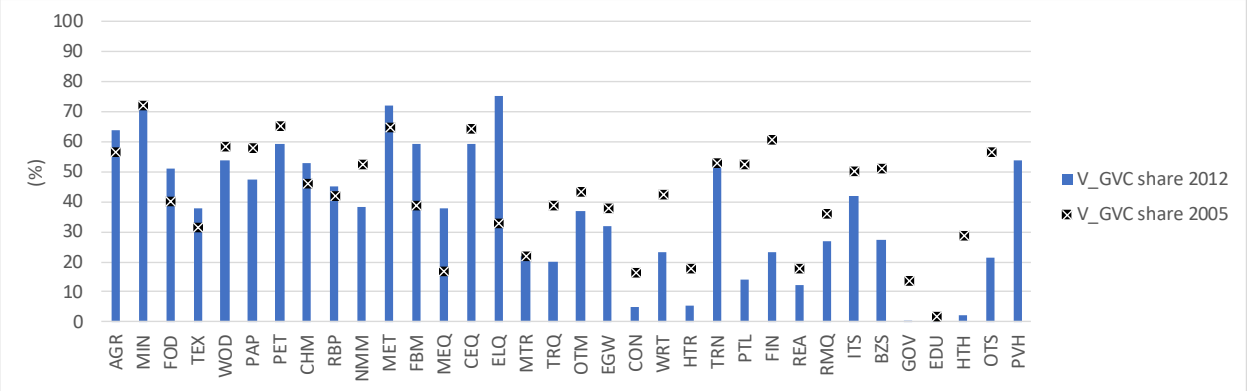
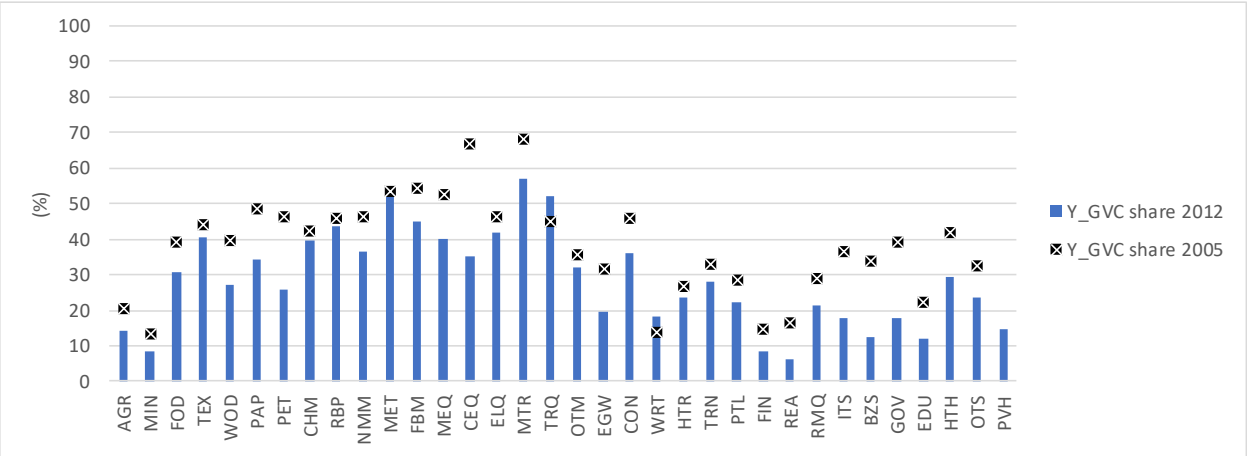


Figure 3.10.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, Malaysia



Value Added Trade and Top APEC Trading Partners

Value-added exports[122]

In 2012, Malaysia had value-added exports of $150.9 billion, increased by 75 percent from $86.0 billion in 2005. Mining (MIN) topped all industries, accounting for 16.6 percent of Malaysia's value-added exports in 2012. It was followed by agriculture (AGR, 15.2 percent), and wholesale and retail trade (WRT, 9.8 percent). The industries experiencing the largest increase in value-added exports during this period were AGR, and coke, refined petroleum products and nuclear fuel (PET) (figure 3.10.7).

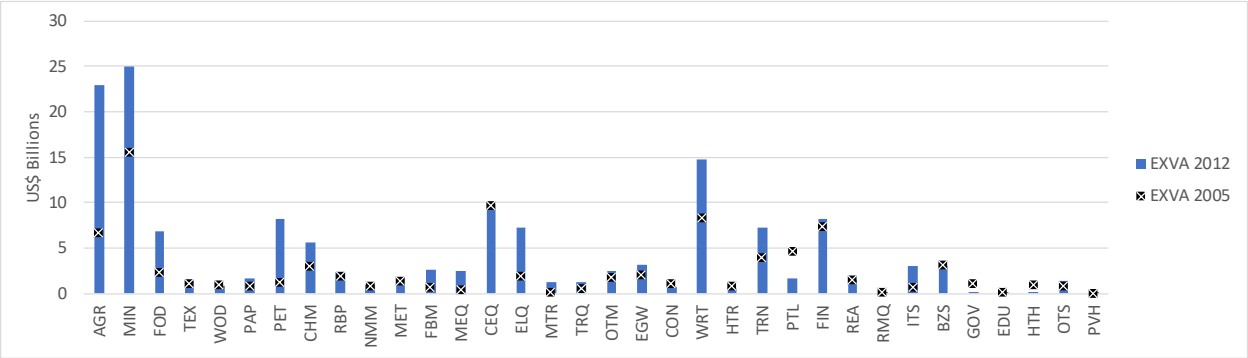
Value-added imports[123]

In 2012, Malaysia had value-added imports of $78.8 billion, increased by 46.9 percent from $53.6 billion in 2005. WRT topped all industries, accounting for 8.8 percent of Malaysia's value-added imports in 2012. It was followed by MIN (8.7 percent), and AGR (8.2 percent). Value-added imports of motor vehicles (MTR), construction (CON), finance and insurance (FIN), renting of machinery and equipment (RMQ) also experienced dramatic increase, though from a relative lower based in 2005 (figure 3.10.8).

Top APEC Trading Partners

In 2012, in the APEC region, Japan; the United States; China; Indonesia; and Australia were the top destinations for Malaysia's value-added exports (figure 3.10.9), and China; Japan; the United States; Indonesia; and Thailand were the top sources for Malaysia's value-added imports (figure 3.10.10).

Figure 3.10.7 Value-added exports (EXVA), by industry, 2005 and 2012, Malaysia



[122] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.
[123] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.10.8 Value-added imports (IMVA), by industry, 2005 and 2012, Malaysia

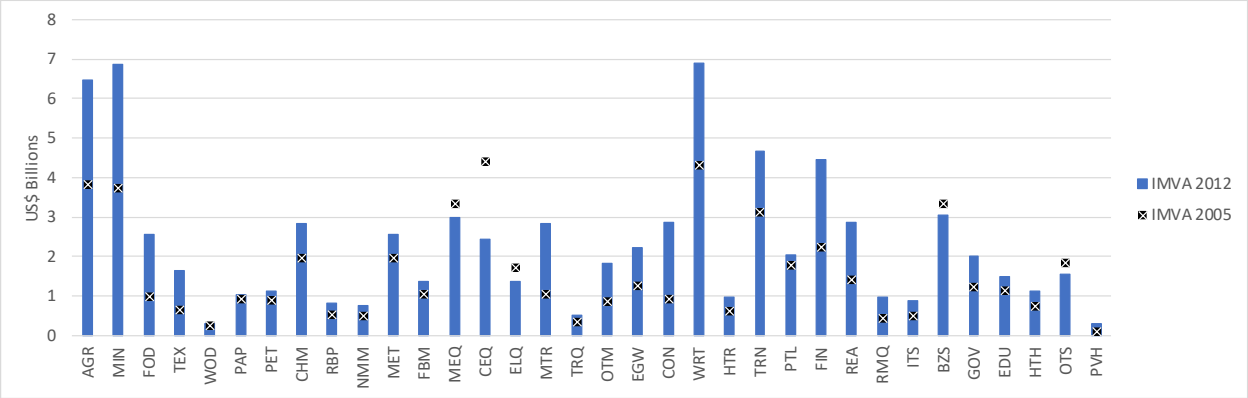


Figure 3.10.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, Malaysia

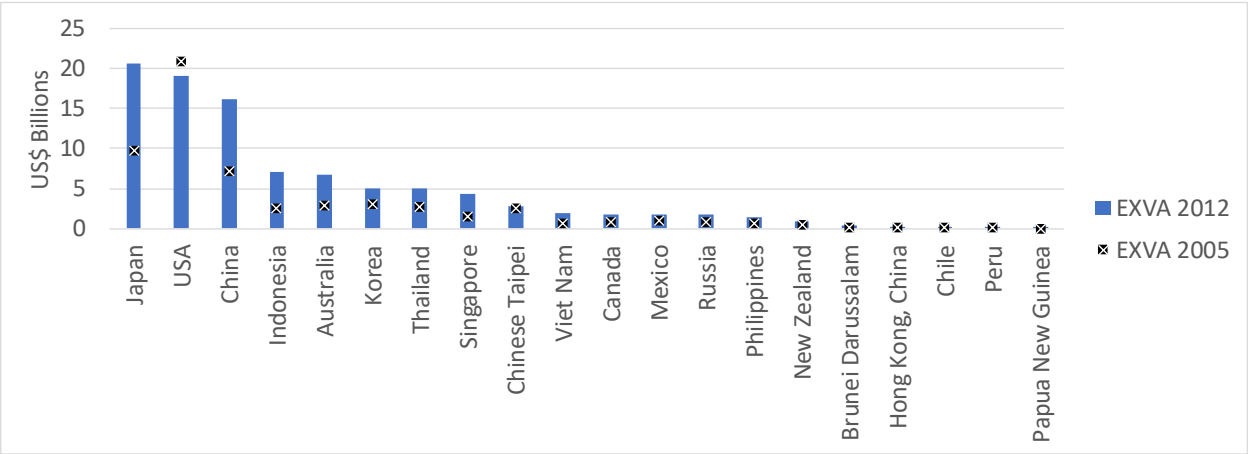
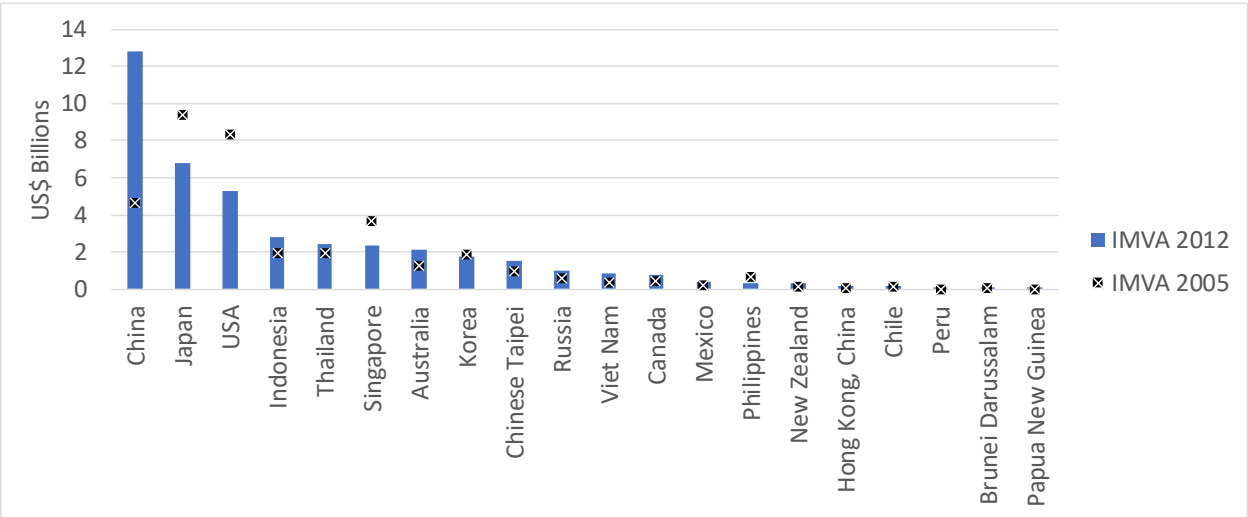


Figure 3.10.10 APEC sources of value-added imports (IMVA), 2005 and 2012, Malaysia



Chapter 11: Mexico

Industry Data Summary Based on SUTs

Gross Output[124]

In 2012, Mexico's total gross output was $2.0 trillion, increasing by nearly 40 percent from $1.4 trillion in 2005. Manufacturing and services sectors accounted for 34.7 percent and 56.3 percent of Mexico's total gross output, respectively.[125]

Of 34 industries, wholesale and retail trade (WRT) had the largest industry gross output of $240.7 billion, accounting for 12.0 percent of Mexico's total gross output. Other top industries included construction (CON, 8.5 percent), food products, beverages, and tobacco (FOD, 7.5 percent), real estate activities (REA, 7.0 percent), and mining (MIN, 6.0 percent) (figure 3.11.1).

Value Added[126]

In 2012, Mexico's total value added, or GDP, was $1.5 trillion, increasing from $828.3 billion in 2005. Services sectors together accounted for 69.9 percent of Mexico's total GDP, followed by manufacturing with a share of 18.0 percent.

The industries with the top contribution to total GDP were WRT (16.1 percent of total GDP), REA (11.3 percent), MIN (8.7 percent), and CON (8.2 percent).

The largest manufacturing industries in terms of value added were FOD (5.0 percent of total GDP), motor vehicles, trailers and semi-trailers (MTR, 2.6 percent), and chemicals (CHM, 2.1 percent) (figure 3.11.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by Mexican industries in 2012, about 32.9 percent came from the imported source, increasing from 27.7 percent in 2005, and well above the average of 13.8 percent in the APEC region. The industries with the highest imported intermediate use intensity (IIUI) rates were computer, electronic and optical equipment (CEQ, 88.3 percent), MTR (63.0 percent), other transport equipment (TRQ, 61.4 percent), electrical machinery and apparatus (ELQ, 60.3 percent), machinery and equipment (MEQ, 58.5 percent), other manufacturing (OTM, 57.6 percent), and rubber and plastics products (RBP, 56.6 percent).

The average IIUI rate of Mexican manufacturing sector was 42.1 percent in 2012, increasing from 36.0 percent in 2005. Most manufacturing industries in Mexico experienced an increase in IIUI during this period. Of them, the most notable were coke, refined petroleum products and nuclear fuel (PET), increasing by 63.4 percent; CHM, increasing by 47.3 percent; other non-metallic mineral products (NMM), increasing by 33.7 percent; and FOD, increasing by 25.4 percent. Basic metals (MET) was the only exception, decreasing by 9.3 percent.

The average IIUI rate of Mexican services sector was 18.1 percent in 2012, increasing from 13.6 percent in 2005. All services industries in Mexico experienced an increase in IIUI during this period. The most notable being post and telecommunications (PTL), increasing by 48.1 percent; and REA, increasing by 46.2 percent (figure 3.11.3).

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[124] Based on the supply tables at basic price, which could differ from the official NA data.
[125] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[126] Based on the use tables at basic price, which could differ from the official NA data.

Figure 3.11.1 Gross output, by industry, 2005 and 2012, Mexico

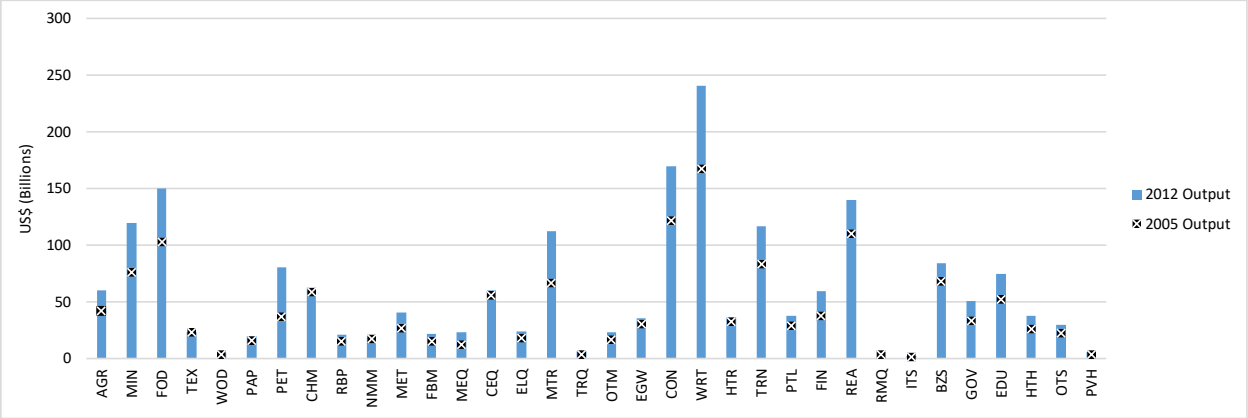


Figure 3.11.2 Value added (VA), by industry, 2005 and 2012, Mexico

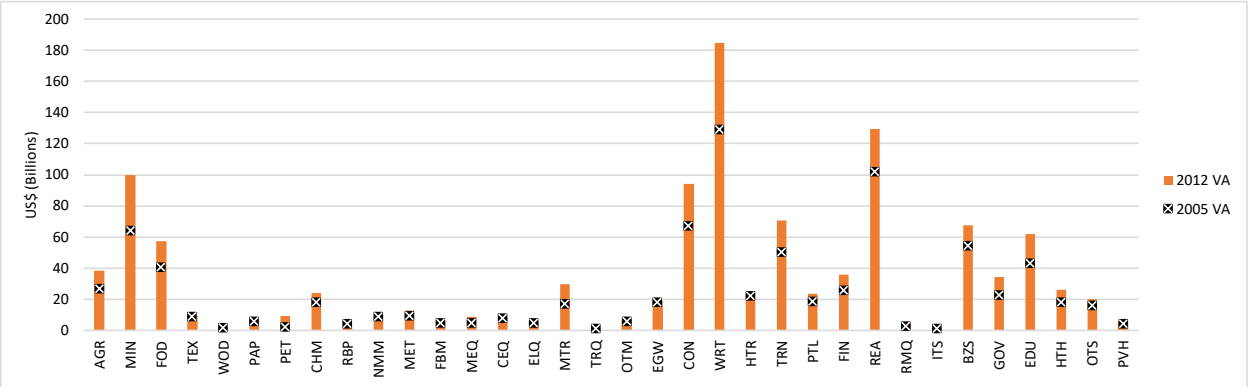
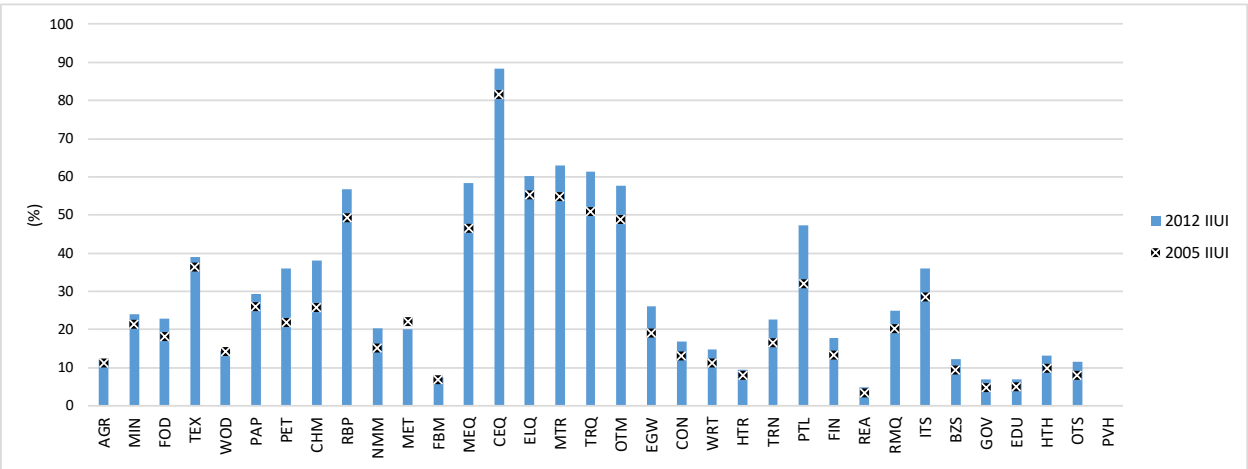


Figure 3.11.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, Mexico



Selected APEC TiVA Measures[127]

GVC-Related Trade and GVC Participations

GVC-Related Trade[128]

In 2012, Mexico's GVC-related trade amounted to $363.9 billion, increasing 80.6 percent from $201.5 billion in 2005, and accounting for 91.1 percent of Mexico's gross exports. About 59.2 percent of GVC-related trade was in the form of complex GVCs. Motor vehicles, trailers and semi-trailers (MTR) topped all industries, accounting for 16.3 percent of Mexico's GVC-related trade. It was followed by computer, electronic and optical equipment (CEQ, 13.2 percent), and food, beverage, and tobacco (FOD, 11.3 percent) (figure 3.11.4).

Forward GVC Participation[129]

Mexico's forward GVC participation rate increased from 13.6 percent in 2005 to 18.2 percent in 2012, above the APEC average of 13.8 percent. The complex forward GVC participation rate increased from 3.4 percent to 5.2 percent during this period. The industries with the highest forward GVC participation rates in 2012 were computer, electronic and optical equipment (CEQ) at 68.2 percent, textile, leather, and footwear (TEX) at 66.9 percent, rubber and plastics products (RBP) at 62.5 percent, basic metals (MET) at 61.8 percent, and paper products (PAP) at 60.4 percent (figure 3.11.5).

Backward GVC Participation[130]

Mexico's backward GVC participation rate increased from 17.6 percent in 2005 to 18.4 percent in 2012, above the APEC average of 12.7 percent. The complex backward GVC participation rate decreased from 7.7 percent to 7.0 percent during this period. The industries with the highest backward GVC participation rates in 2012 were CEQ at 80.0 percent, ELQ at 55.5 percent, MTR at 52.6 percent, and rubber and plastics (RBP) at 51.8 percent (figure 3.11.6).

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[127] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[128] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[129] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[130] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.11.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, Mexico

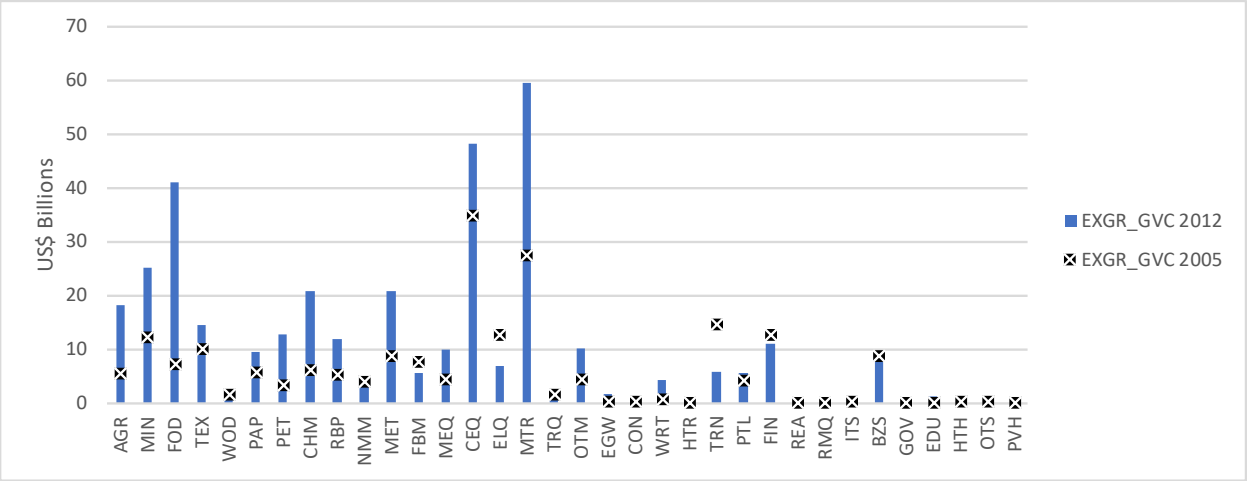


Figure 3.11.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, Mexico

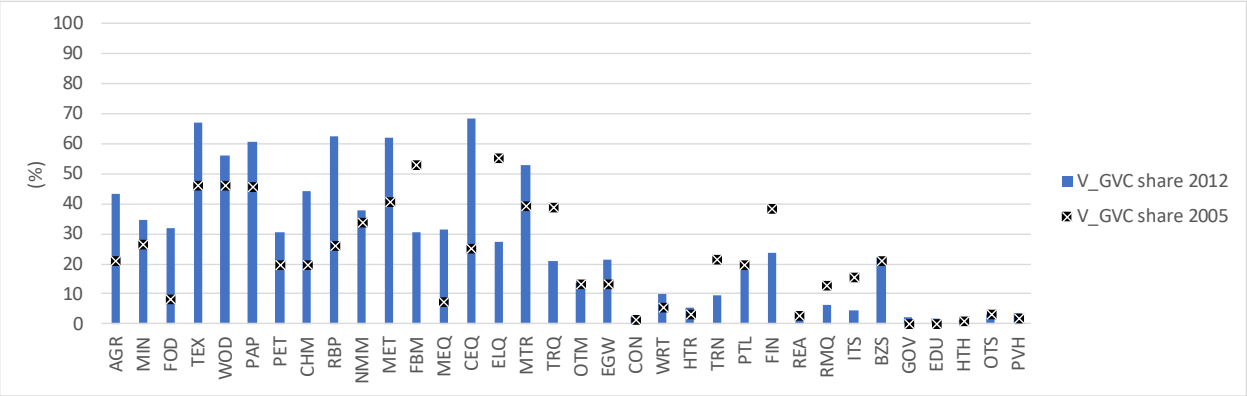
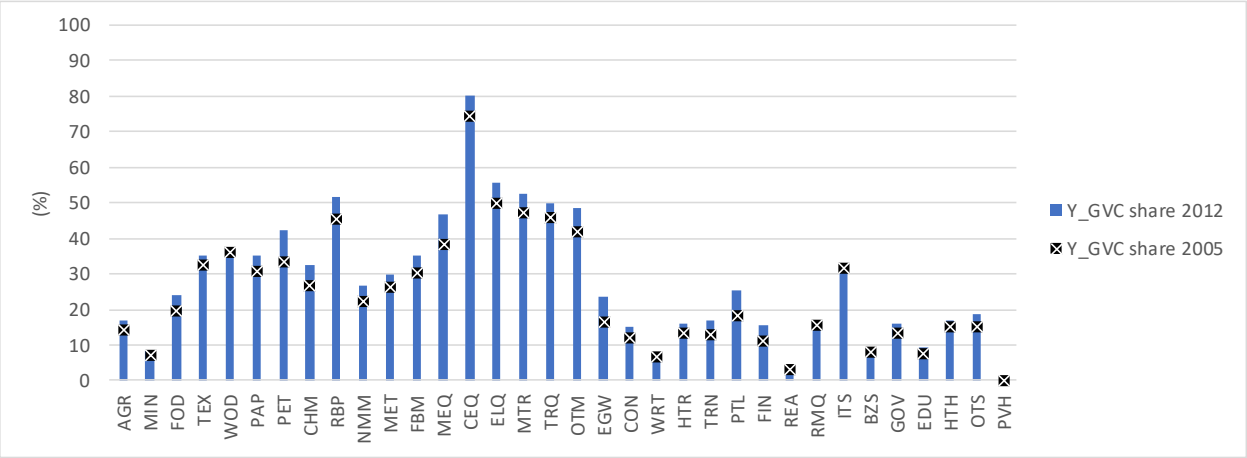


Figure 3.11.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, Mexico



Value Added Trade and Top APEC Trading Partners

Value-added exports[131]

In 2012, Mexico had value-added exports of $241.1 billion, increasing by 60 percent from $150.6 billion in 2005. Mining (MIN) topped all industries, accounting for over 14.9 percent of Mexico's value-added exports in 2012. It was followed by food, beverages and tobacco (FOD, 9.8 percent), wholesale and retail trade (WRT, 8.7percent), agriculture (AGR, 7.7 percent), and motor vehicles, trailers and semi-trailers (MTR, 7.3 percent). These industries also experienced the largest increase in value-added exports during this period (figure 3.11.7).

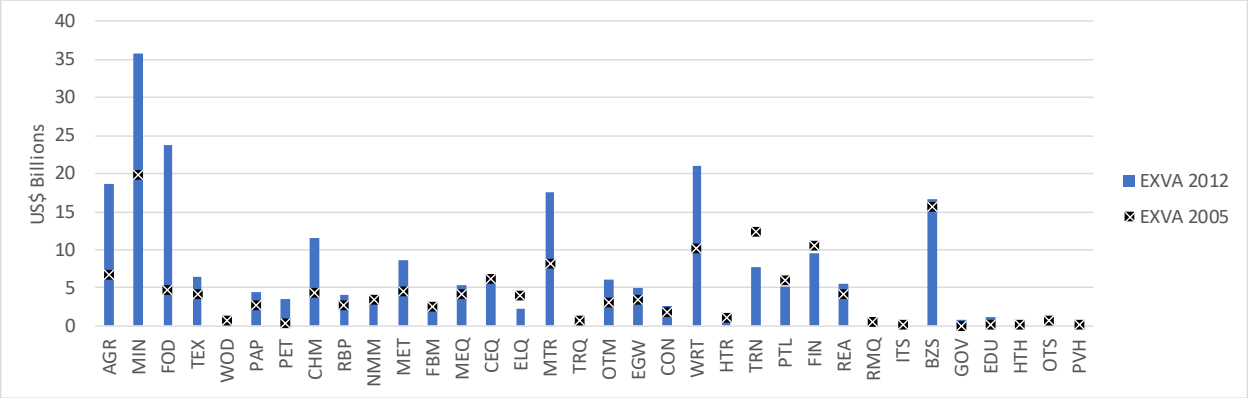
Value-added imports[132]

In 2012, Mexico had value-added imports of $263.8 billion, increasing from $163.7 billion in 2005. Computer, electronic and optical equipment (CEQ) topped all industries, accounting for 8.4 percent of Mexico's value-added imports in 2012. It was followed by WRT at 8.0 percent, MIN at 6.7 percent, finance and insurance (FIN) and transport and storage (TRN), both at 5.5 percent. The industries that experienced the largest increases in value-added imports during this period were private households with employed persons & extra-territorial organizations & bodies (PVH), health and social work (HTH), and agriculture (AGR) (figure 3.11.8).

Top APEC Trading Partners

In 2012, in the APEC region, the United States; Canada; China; Japan; and Korea were the top destinations for Mexico's value-added exports (figure 3.11.9), and the United States; China; Japan; Korea; and Canada were the top sources for Mexico's value-added imports (figure 3.11.10).

Figure 3.11.7 Value-added exports (EXVA), by industry 2005 and 2012, Mexico



[131] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.
[132] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.11.8 Value-added imports (IMVA), by industry 2005 and 2012, Mexico

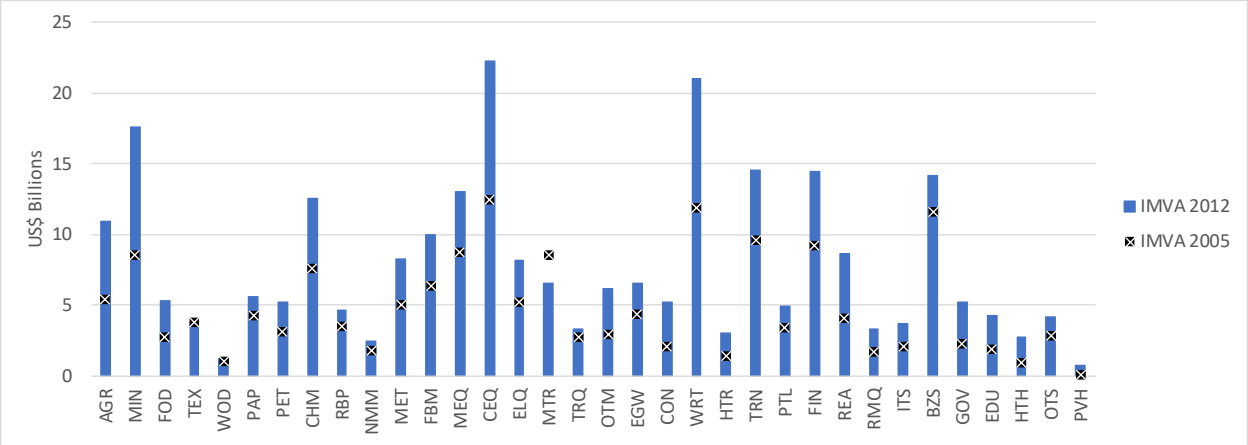


Figure 3.11.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, Mexico

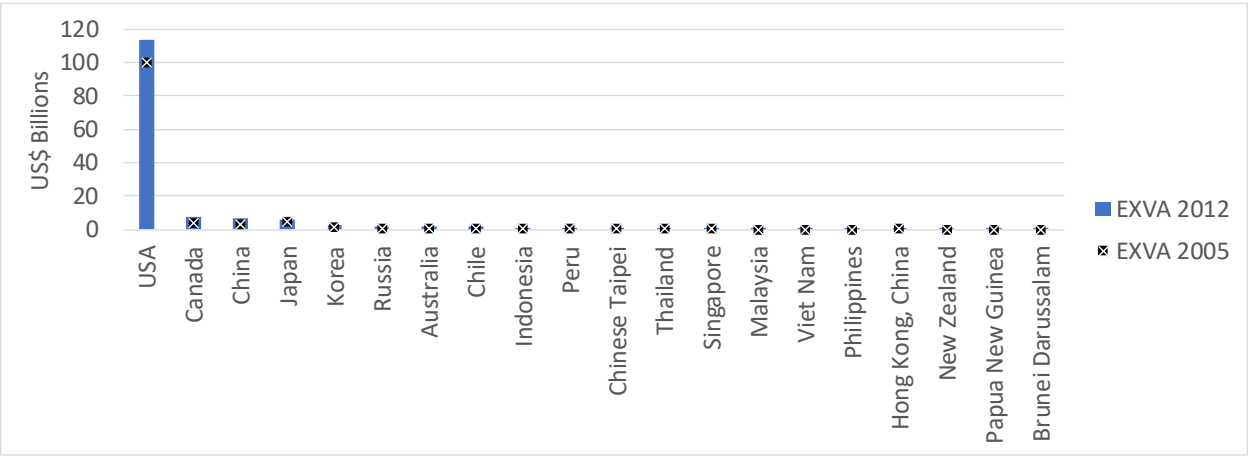
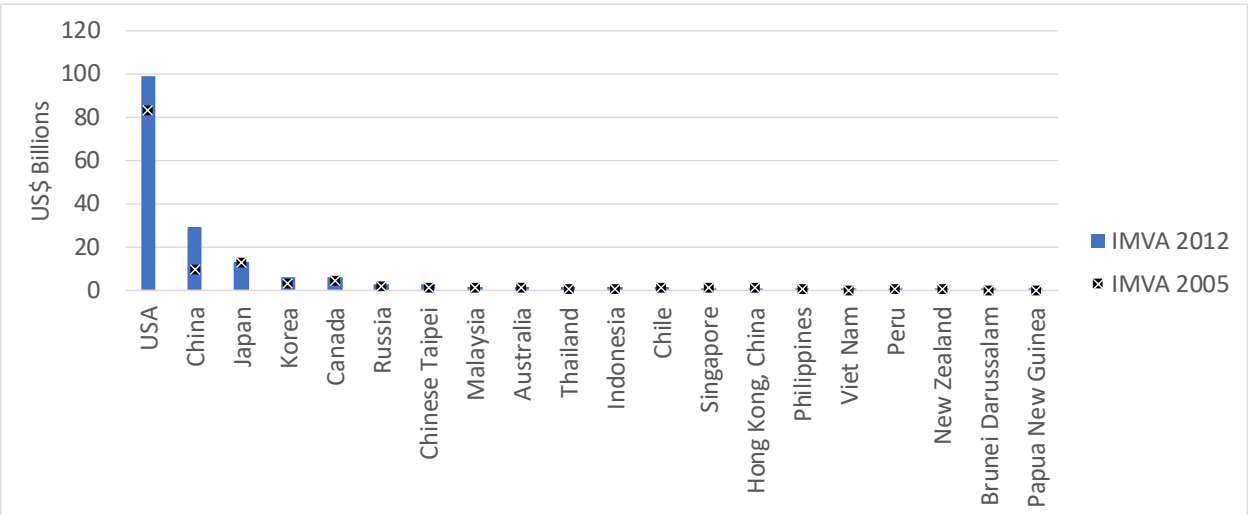


Figure 3.11.10 APEC sources of value-added imports (IMVA), 2005 and 2012, Mexico



Chapter 12: New Zealand

Industry Data Summary Based on SUTs

Gross Output[133]

In 2012, New Zealand's total gross output was $344.6 billion, increasing by 48.1 percent from $232.7 billion in 2005. Manufacturing and services sectors accounted for 20.7 percent and 70.6 percent of New Zealand's total gross output, respectively.[134]

Of 34 industries, real estate services (REA) had the largest industry gross output of $37.2 billion, a 60.9 percent increase from its 2005 level, accounting for 10.8 percent of New Zealand's total gross output. Other top industries included food beverages and tobacco (FOD, 9.1 percent), construction (CON, 9.0 percent), and wholesale and retail trade (WRT, 8.6 percent) (figure 3.12.1).

Value Added[135]

In 2012, New Zealand's total value added, or GDP, was $159.3 billion, increasing from $103.6 billion in 2005. Services sectors accounted for 80.5 percent of New Zealand's total GDP, followed by manufacturing with a share of 11.4 percent.

The industries with the top contribution to total GDP were REA (15.2 percent of total GDP), WRT (10.1 percent), R&D and other business activities (BZS, 8.8 percent), health and social work (HTH, 6.7 percent), and agriculture, hunting, forestry and fishing (AGR, 6.2 percent).

The largest manufacturing industries in terms of value added were FOD (4.0 percent of total GDP), fabricated metal products, except machinery and equipment (FBM, 1.0 percent), and machinery and equipment (MEQ, 1.0 percent) (figure 3.12.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by New Zealand industries in 2012, 14.5 percent were imported, slightly above the average of 13.8 percent in the APEC region, and a small increase from 13.5 percent in 2005. The industries with the highest imported intermediate use intensity (IIUI) were coke, petroleum products, and nuclear fuel (PET, 87.2 percent), other transport equipment (TRQ, 55.7 percent), motor vehicles, trailers and semi-trailers (MTR, 55.7 percent), electricity gas and water supply (ELQ, 39.7 percent), and computer, electronic and optical equipment (CEQ, 39.7 percent).

The average IIUI rate of New Zealand manufacturing sector was 31.0 percent in 2012, increasing from 23.9 percent in 2005. Most manufacturing industries in New Zealand experienced an increase in IIUI during this period. Of them, the most notable were PET, increasing by 128.8 percent; TRQ, increasing by 87.4 percent; and MTR, increasing by 86.7 percent. Among a few notable exceptions were FBM, decreasing by 31.8 percent; and other manufacturing (OTM), decreasing by 23.0 percent.

The average IIUI rate of New Zealand services sector was 11.7 percent in 2012, decreasing from 13.1 percent in 2005. Most services industries experienced a decrease in IIUI during this period, but the changes were smaller. The services industries with the largest declines were electricity, gas, and water supply (EGW), decreasing by 77.7 percent; renting of machinery and equipment (RMQ), decreasing by 37.8 percent; and transport and storage (TRN), decreasing by 22.9 percent (figure 3.12.3).

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[133] Based on the supply tables at basic price, which could differ from the official NA data.

[134] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.

[135] Based on the use tables at basic price, which could differ from the official NA data.

Figure 3.12.1 Gross output, by industry, 2005 and 2012, New Zealand

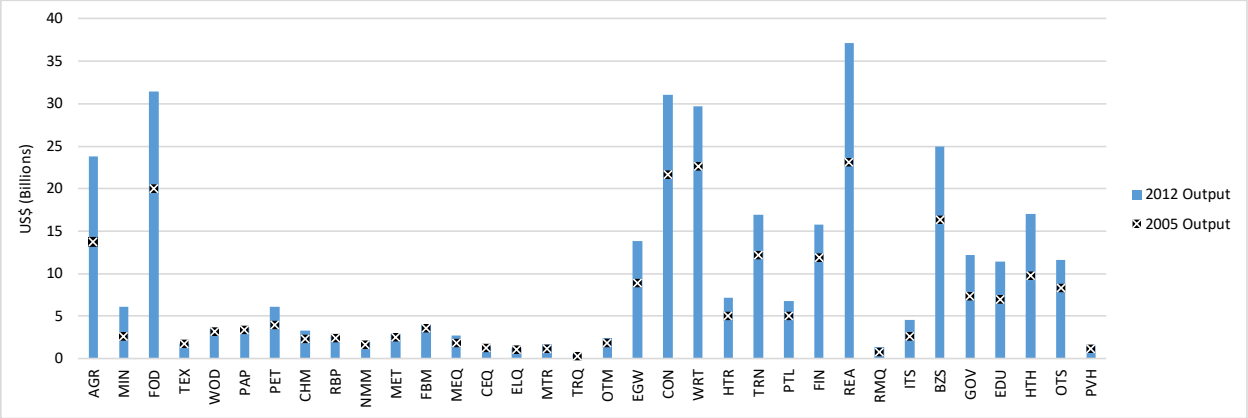


Figure 3.12.2 Value added (VA), by industry, 2005 and 2012, New Zealand

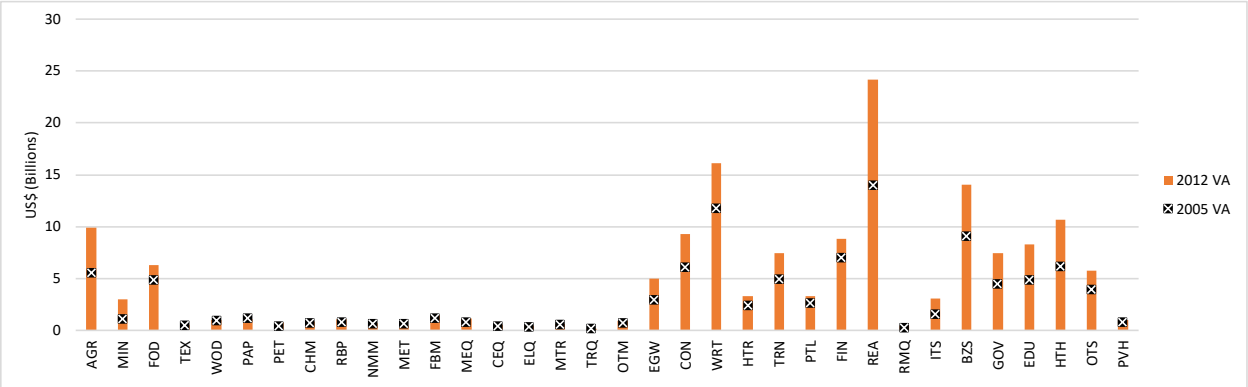
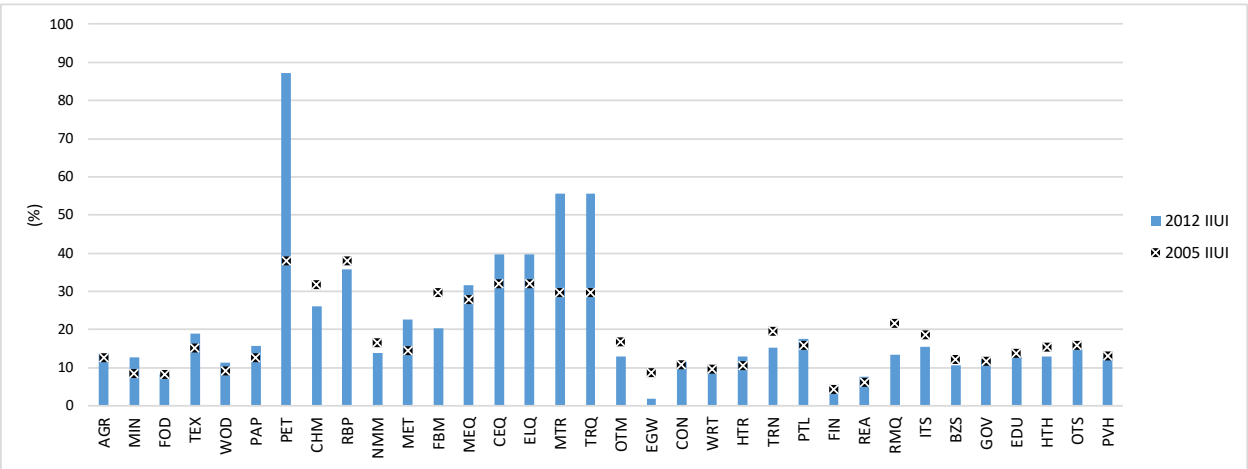


Figure 3.12.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, New Zealand



Selected APEC TiVA Measures[136]

GVC-Related Trade and GVC Participations

GVC-Related Trade[137]

In 2012, New Zealand's GVC-related trade amounted to $40.5 billion, increasing by 48.6 percent from $27.3 billion in 2005, and accounting for 82.7 percent of New Zealand's gross exports. About 52.3 percent of GVC-related trade was in the form of complex GVCs. Food, beverages, and tobacco (FOD) topped all industries, accounting for 16.8 percent of New Zealand's GVC-related trade. It was followed by agriculture (AGR, 12.6 percent), and mining (MIN, 11.2 percent) (figure 3.12.4).

Forward GVC Participation[138]

New Zealand's forward GVC participation rate decreased slightly from 19.7 percent in 2005 to 19.5 percent in 2012, above the APEC average of 13.8 percent. The complex forward GVC participation rate increased from 5.5 percent to 6.4 percent during this period. The industries with the highest forward GVC participation rates in 2012 were basic metals (MET) at 92.8 percent, followed by MIN at 85.3 percent, and computer and related activities (ITS) as a distance third at 56.9 percent (figure 3.12.5).

Backward GVC Participation[139]

New Zealand's backward GVC participation rate decreased slightly from 16.0 percent in 2005 to 15.1 percent in 2012, above the APEC average of 12.7 percent. The complex backward GVC participation rate barely increased from 4.9 percent to 5.0 percent during this period. The industries with the highest backward GVC participation rates in 2012 were coke, refined petroleum products and nuclear fuel (PET) at 78.9 percent, motor vehicles, trailers and semi-trailers (MTR) at 41.1 percent, and other transport equipment (TRQ) at 38.3 percent (figure 3.12.6).

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[136] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[137] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[138] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[139] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.12.5 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, New Zealand

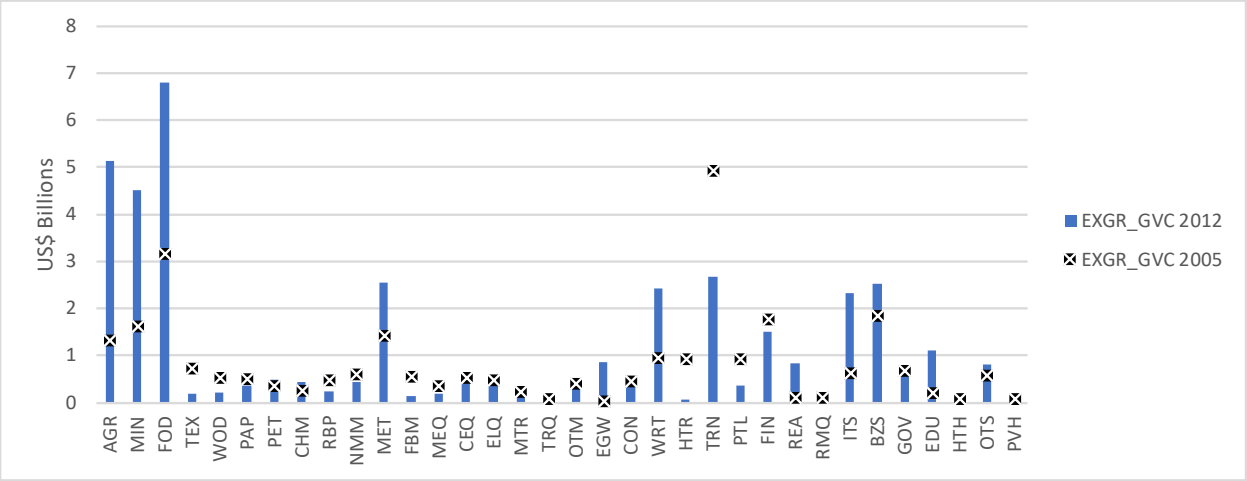


Figure 3.12.6 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, New Zealand

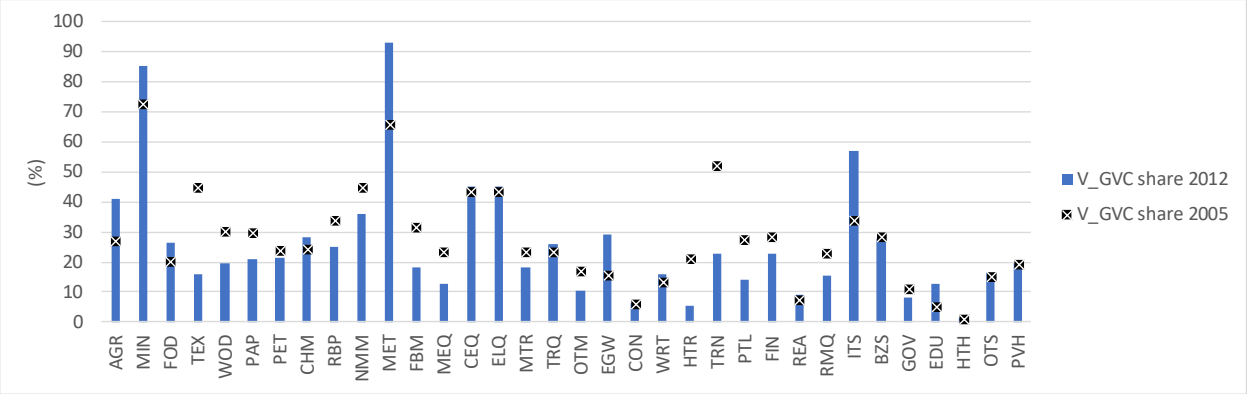
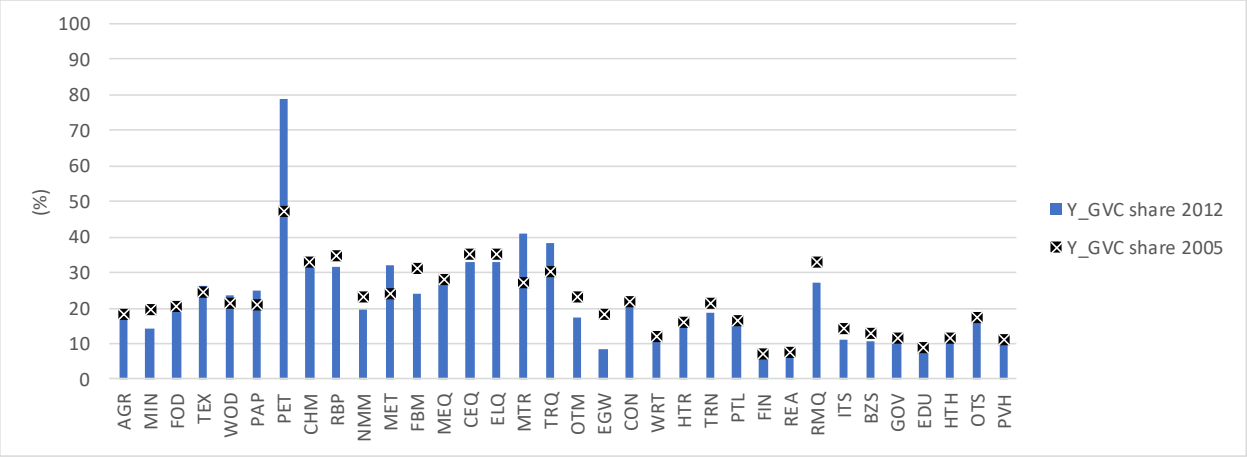


Figure 3.12.7 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, New Zealand



Value Added Trade and Top APEC Trading Partners

Value-added exports[140]

In 2012, New Zealand had value-added exports of $40 billion, increasing by 59.8 percent from $25.1 billion in 2005. Agriculture topped all industries, accounting for 12 percent of New Zealand's value-added exports in 2012. It was followed by R&D and other business activities (BZS, 11.5 percent), and transport and storage (TRN, 10.9 percent). The industries experiencing the largest increase in value-added exports during this period were agriculture (AGR), and some services industries such as education (EDU), and real estate activities (REA) (figure 3.12.7).

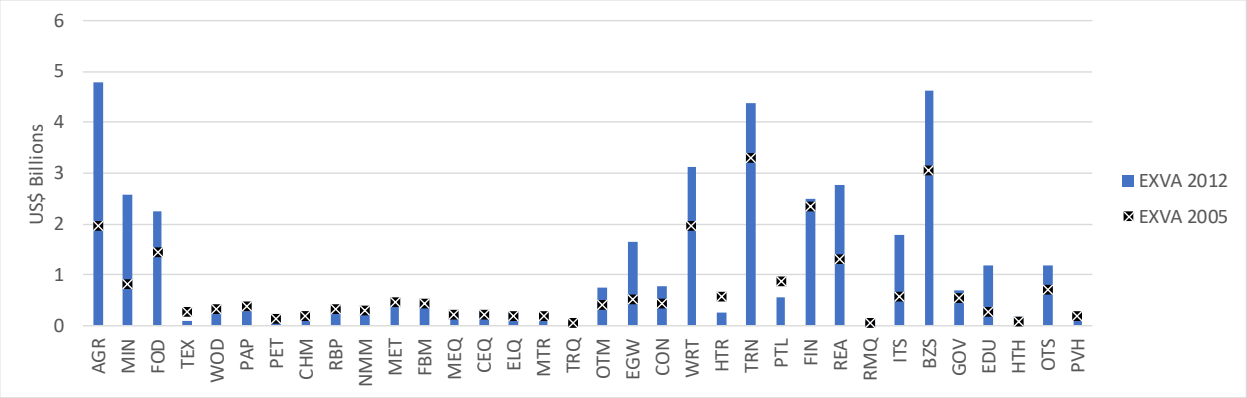
Value-added imports[141]

In 2012, New Zealand had value-added imports of $39.4 billion, increasing from $27.0 billion in 2005. Wholesale and retail trade (WRT) topped all industries, accounting for 9.4 percent of New Zealand's value -added imports in 2012. It was followed by MIN (9.1 percent), AGR (5.8 percent) and ffinance and insurance (FIN, 5.7 percent). The industries that experienced the largest increases in value-added imports during this period were AGR, and some service sectors such as renting of machinery and equipment (RMQ) from a low base in 2005 (figure 3.12.8).

Top APEC Trading Partners

In 2012, in the APEC region, Australia; the United States; China; Japan; and Korea were the top destinations for New Zealand's value-added exports (figure 3.12.9), and China; Australia; the United States; Japan; and Malaysia were the top sources for New Zealand's value-added imports (figure 3.12.10).

Figure 3.12.7 Value-added exports (EXVA), by industry, 2005 and 2012, New Zealand



[140] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.
[141] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.12.8 Value-added imports (IMVA), by industry, 2005 and 2012, New Zealand

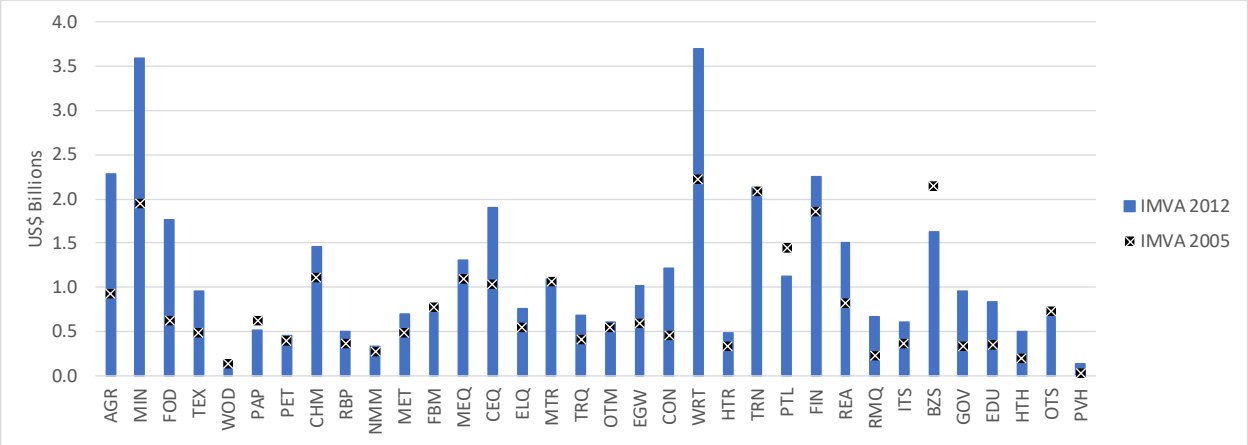


Figure 3.12.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, New Zealand

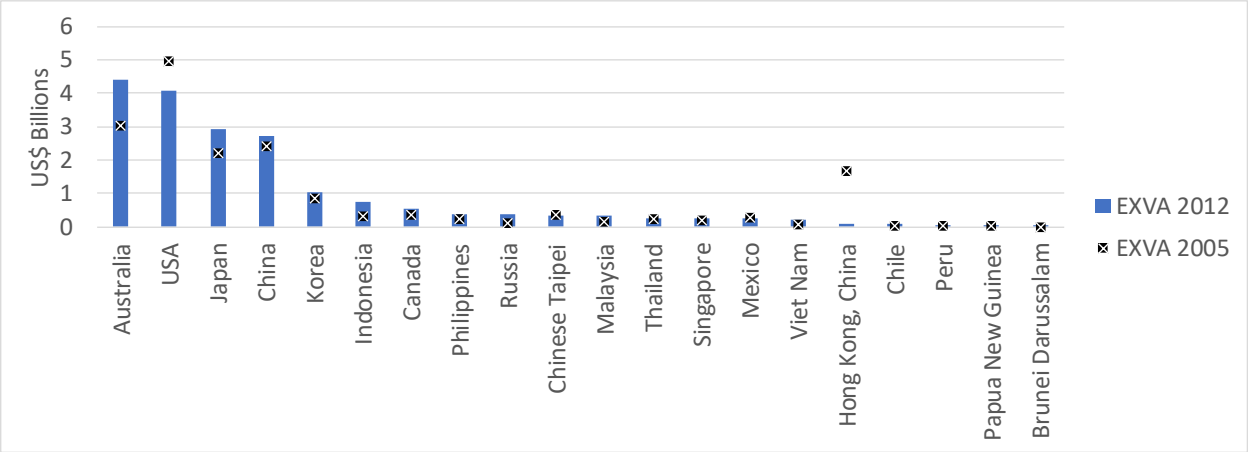
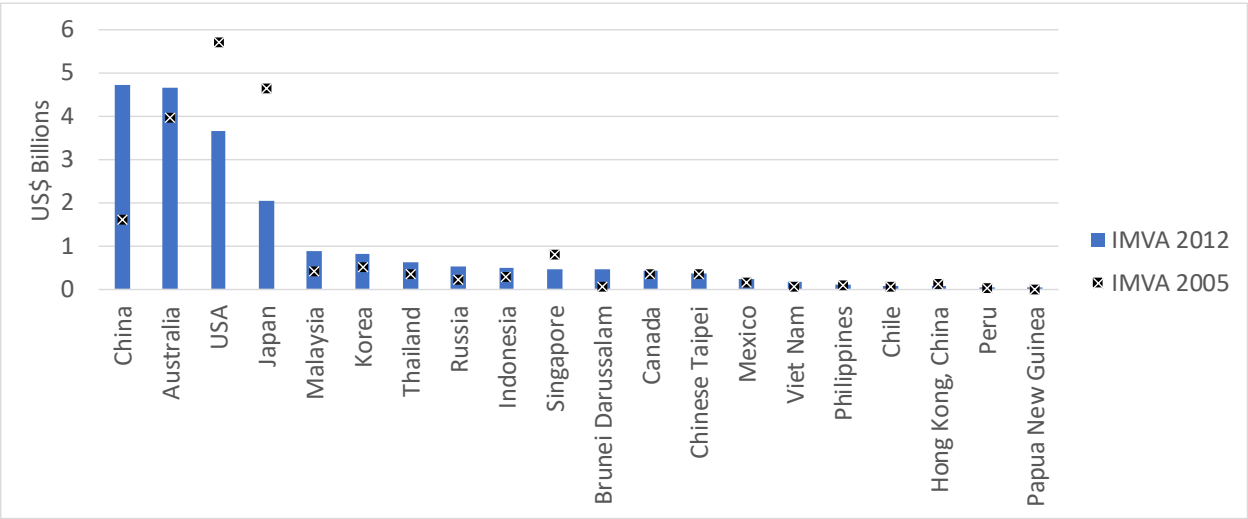


Figure 3.12.10 APEC sources of value-added imports (IMVA), 2005 and 2012, New Zealand



Chapter 13: Papua New Guinea

Industry Data Summary Based on SUTs

Gross Output[142]

In 2012, Papua New Guinea (PNG)'s total gross output was $31.3 billion, increasing by 213.1 percent from $10.0 billion in 2005. Manufacturing and services sectors as a whole accounted for 20.7 percent and 72.1 percent of Papua New Guinea's total gross output, respectively.[143]

Of the 34 industries, finance and insurance (FIN) had the largest industry gross output of $8.6 billion, increasing by 215.4 percent from its 2005 level, and accounting for 27.5 percent of Papua New Guinea's total gross output. Other top industries included wholesale and retail trade (WRT, 8.4 percent), construction (CON, 5.9 percent), public administration and defense, compulsory social security (GOV, 5.8 percent), and agriculture (AGR, 5.4 percent) (figure 3.13.1).

Value Added[144]

In 2012, Papua New Guinea's total value added, or GDP, was $14.9 billion, increasing from $5.0 billion in 2005. Services sectors together accounted for 78.2 percent of Papua New Guinea's total GDP, followed by manufacturing with a share of 13.1 percent.

The industries with the top contribution to total GDP were FIN (36.9 percent of total GDP), WRT (9.1 percent), AGR (6.4 percent), and CON (5.8 percent).

The largest manufacturing industries in terms of value added were electrical and machinery apparatus (ELQ, 3.1 percent of total GDP), food products, beverages, and tobacco (FOD, 2.4 percent), and wood and products of wood and cork (WOD, 1.4 percent) (figure 3.13.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by industries in Papua New Guinea in 2012, 20.1 percent were imported, an increase from 17.5 percent in 2005, and above the average of 13.8 percent in the APEC region. The industries with the highest imported intermediate use intensity (IIUI) were private households with employed persons and extra-territorial organizations and bodies (PVH, 61.2 percent), ELQ (38.0 percent), and other manufacturing (OTM, 36.6 percent).

The average IIUI rate of Papua New Guinea manufacturing sector was 29.8 percent in 2012, increasing from 28.9 percent in 2005. Almost all manufacturing industries in Papua New Guinea experienced an increase in IIUI during this period. The most notables were other transport equipment (TRQ) and motor vehicles, trailers and semi-trailers (MTR), both increasing by 9.8 percent; and ELQ, increasing by 9.5 percent. FOD was the only exception whose IIUI rate decreased from 16.8 percent in 2005 to 16.2 percent in 2012.

The average IIUI rate of Papua New Guinea services sector was 21.8 percent in 2012, increasing from 21.1 percent in 2005. Most services industries experienced an increase in IIUI during this period, including FIN, increasing by 48.8 percent, and GOV, increasing by 16.4 percent. Several services industries, on the other hand, experienced a decrease in IIUI during this period, including rental of machinery and equipment (RMQ), R&D and other business activities (BZS), and computer and related activities (ITS) (figure 3.13.3).

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[142] Based on the supply tables at basic price, which could differ from the official NA data.
[143] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[144] Based on the use tables at basic price, which could differ from the official NA data.

Figure 3.13.1 Gross output, by industry, 2005 and 2012, Papua New Guinea

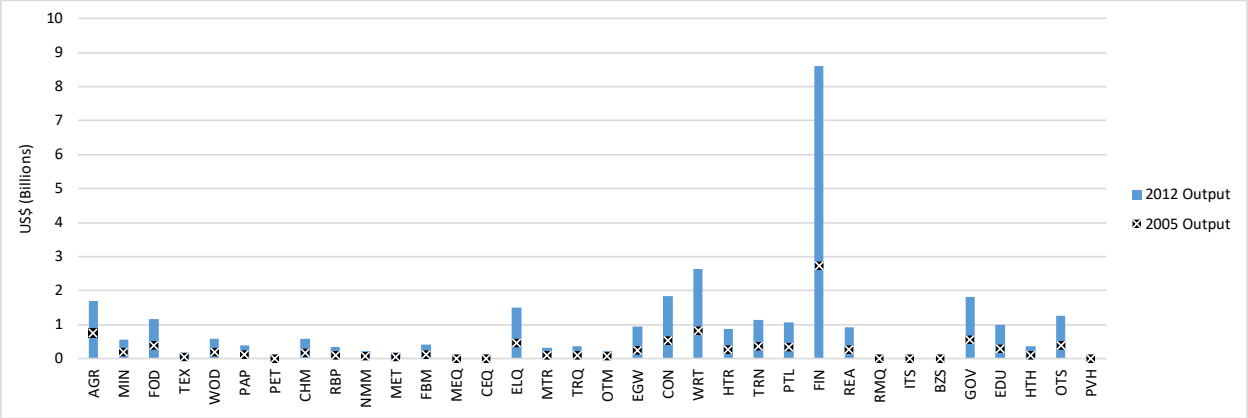


Figure 3.13.2 Value added, by industry, 2005 and 2012, Papua New Guinea

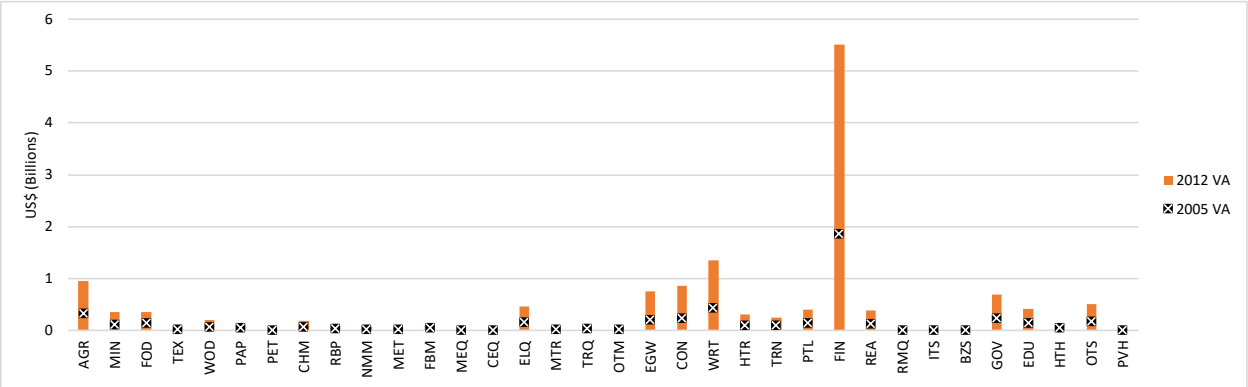
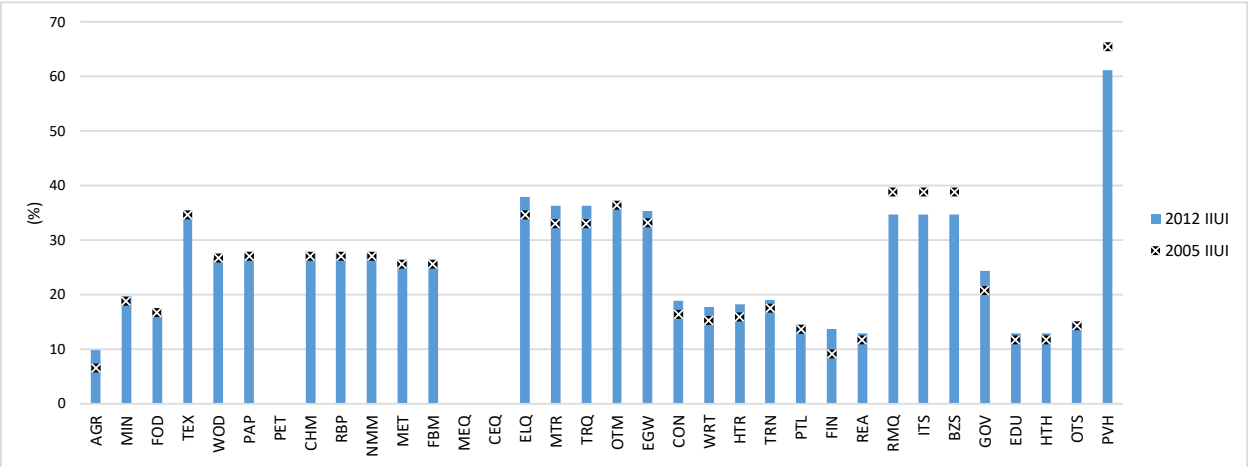


Figure 3.13.3 Imported intermediate use intensity, by industry, 2005 and 2012, Papua New Guinea



Selected APEC TiVA Measures[145]

GVC-Related Trade and GVC Participations

GVC-Related Trade[146]

In 2012, PNG's GVC-related trade amounted to $11.2 billion, increasing from $2.4 billion in 2005, and accounting for 62.3 percent of PNG's gross exports. About 81.1 percent of GVC-related trade was in the form of complex GVCs. Agriculture (AGR) topped all industries, accounting for 13.4 percent of PNG's GVC-related trade. It was followed by mining (MIN, 7.1 percent), wholesale and retail trade (WRT) at 6.9 percent, transport and storage (TRN, 6.6 percent), and food, beverage, and tobacco (FOD, 6.3 percent) (figure 3.13.4).

Forward GVC Participation[147]

PNG's forward GVC participation rate decreased from 33.8 percent in 2005 to 21.3 percent in 2012, above the APEC average of 13.8 percent. The complex forward GVC participation rate decreased from 8.9 percent to 7.1 percent during this period. The industries with the highest forward GVC participation rates in 2012 were AGR at 60.1 percent, mining (MIN) at 45.9 percent and TRN at 40.6. All industries experienced a decrease in forward GVC participation rate during this period (figure 3.13.5).

Backward GVC Participation[148]

PNG's backward GVC participation rate increased from 15.9 percent in 2005 to 41.8 percent in 2012, significantly above the APEC average of 12.7 percent. The complex backward GVC participation rate increased from 11.2 percent to 31.5 percent during this period. The industries with the highest backward GVC participation rates in 2012 were renting of Machinery and equipment(RMQ) at 91.3 percent, basic metals (MET) at 79.2 percent, and textile, leather, and footwear (TEX) at 79.1 percent (figure 3.13.6).

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[145] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[146] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[147] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[148] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.13.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, Papua New Guinea

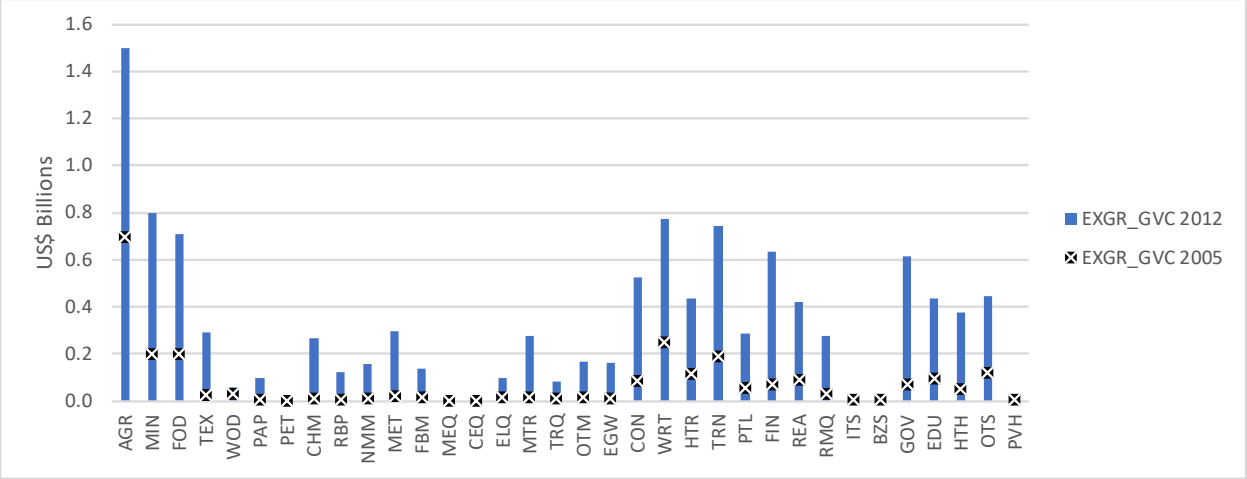


Figure 3.13.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, Papua New Guinea

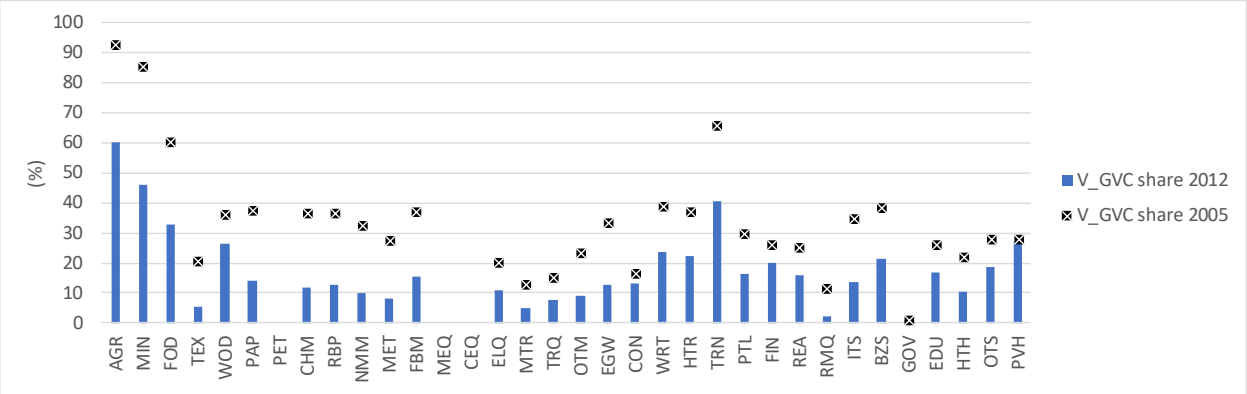
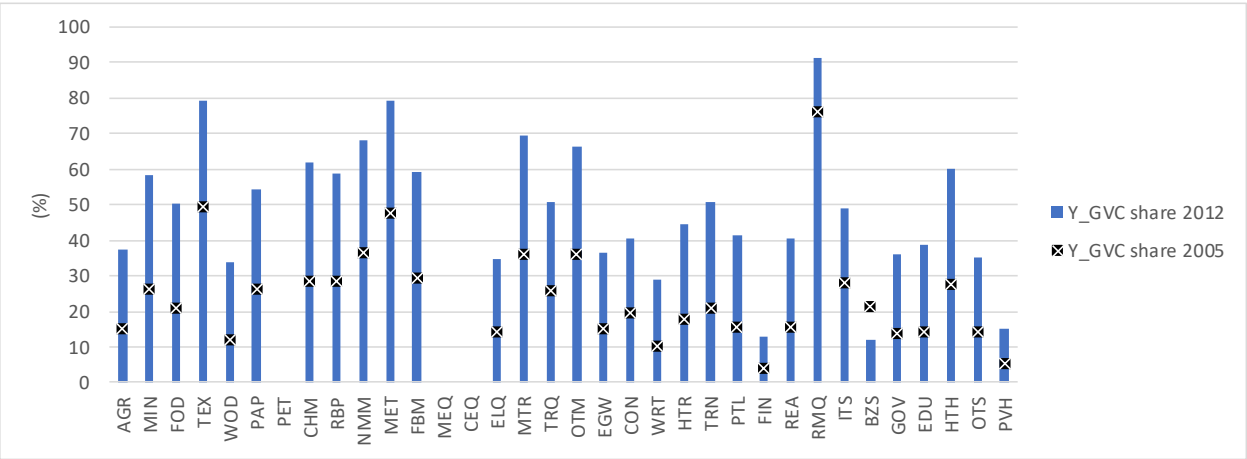


Figure 3.13.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, Papua New Guinea



Value Added Trade and Top APEC Trading Partners

Value-added exports[149]

In 2012, Papua New Guinea (PNG) had value-added exports almost $10 billion, nearly tripled from $3.4 billion in 2005. Finance and insurance (FIN) topped all industries in value-added exports (31.7

[149] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.

percent) in 2012, followed by agriculture (AGR, 9.3 percent), and wholesale and retail trade (WRT, 8.1 percent). These industries also experienced the largest increase in value-added exports during this period (figure 3.13.7).

Value-added imports[150]

In 2012, PNG had value-added imports of $28.5 billion, increasing significantly from $6.5 billion in 2005. Mining (MIN)) topped all industries, accounting for 9.7 percent of PNG's value-added imports in 2012. It was followed by WRT (9.3 percent) and TRN (6.9 percent). All industries experienced significant increases in value-added imports during this period, especially for services industries such as R&D and other business activities (BZS), computer and related activities (ITS), and hotels and restaurants (HTR) (figure 3.13.8).

Top APEC Trading Partners

In 2012, in the APEC region, the United States; China; Japan; Chile; and Korea were the top destinations for PNG's value-added exports (figure 3.13.9), and the United States; China; Korea; Russia; and Japan were the top sources for PNG's value-added imports (figure 3.13.10).

Figure 3.13.7 Value-added exports (EXVA), by industry 2005 and 2012, Papua New Guinea

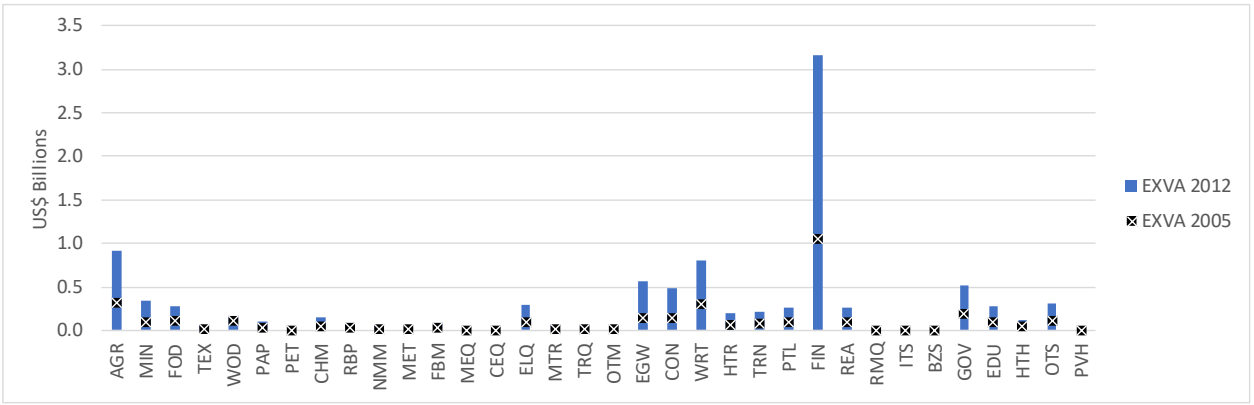
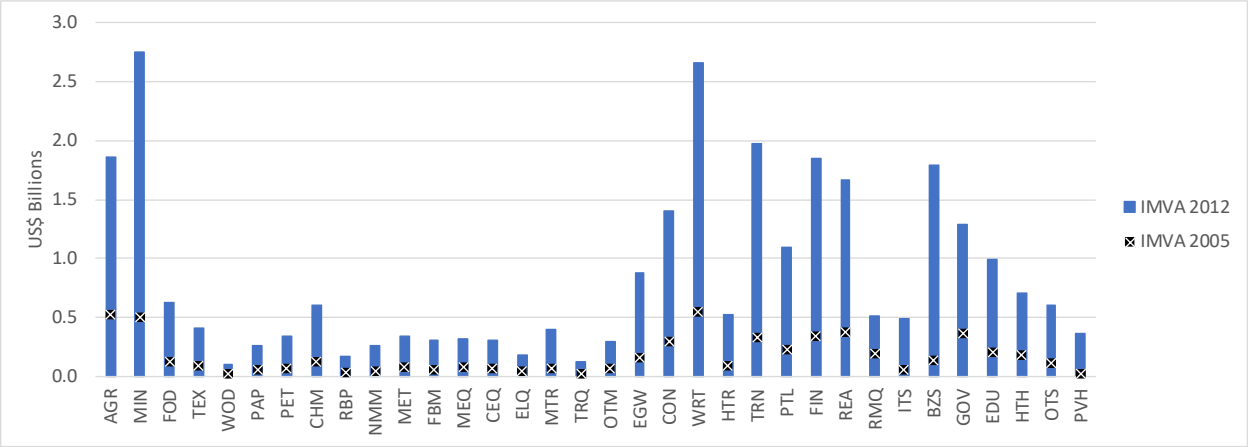


Figure 3.13.8 Value-added imports (IMVA), by industry 2005 and 2012, Papua New Guinea



[150] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.13.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, Papua New Guinea

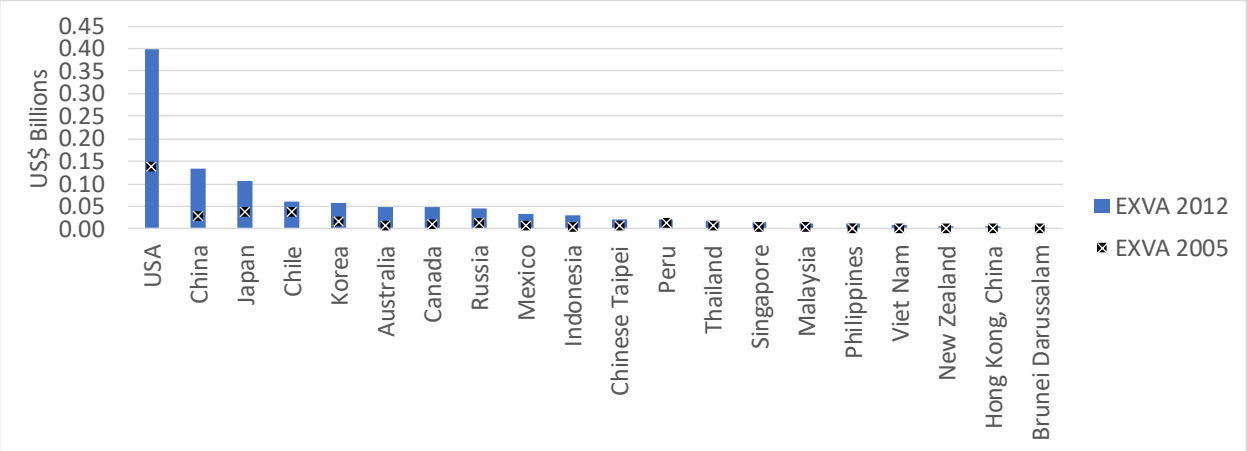
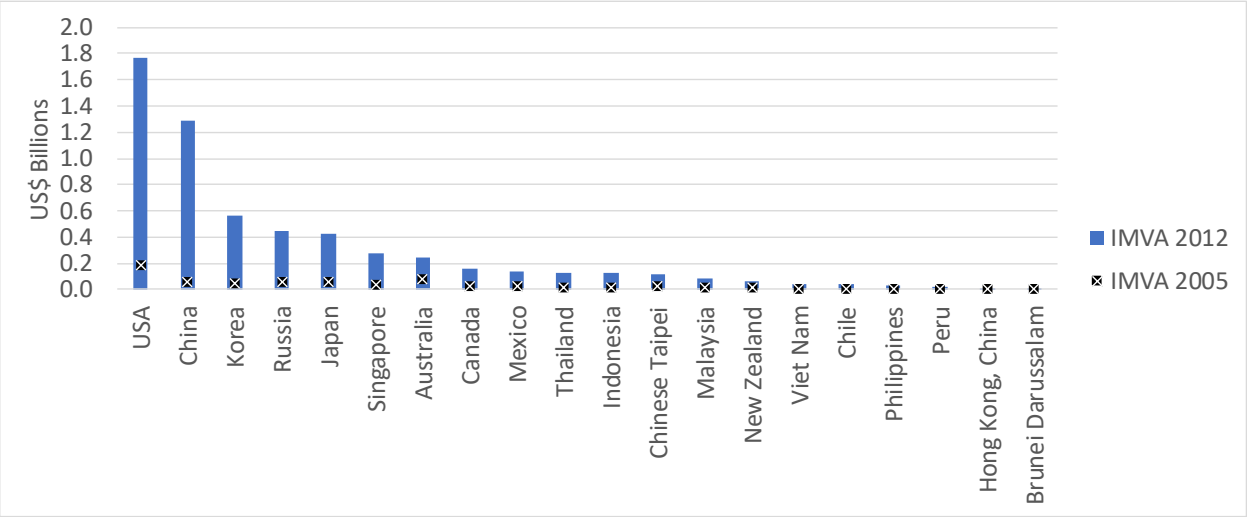


Figure 3.13.10 APEC sources of value-added imports (IMVA), 2005 and 2012, Papua New Guinea



Chapter 14: Peru

Industry Data Summary Based on SUTs

Gross Output[151]

In 2012, Peru's total gross output was $337.5 billion, increasing from $134.0 billion in 2005. Manufacturing and services sectors accounted for 26.6 percent and 57.4 percent of Peru's total gross output, respectively.[152]

Of the 34 industries, mining (MIN) had the largest industry gross output of $35.3 billion, an increase of 184.1 percent from its 2005 level, and accounting for 10.5 percent of Peru's total gross output. Other top industries included wholesale and retail trade (WRT, 9.7 percent), food production, beverages, and tobacco (FOD, 8.2 percent), construction (CON, 8.0 percent), and transport and storage services (TRN, 7.6 percent) (figure 3.14.1).

Value Added[153]

In 2012, Peru's total value added, or GDP, was $176.0 billion, increasing from $69.3 billion in 2005. Services sectors together accounted for 62.7 percent of Peru's total GDP, followed by manufacturing with a share of 16.6 percent.

The industries with the top contribution to total GDP were MIN (13.3 percent of total GDP), WRT (12.1 percent), agriculture, hunting, forestry and fishing (AGR, 7.4 percent), CON (7.1 percent), and TRN (5.9 percent).

The largest manufacturing industries in terms of value added were food products, beverages, and tobacco (FOD, 4.2 percent of total GDP), textiles and textile products, leather and footwear (TEX, 1.8 percent), and other manufacturing (OTM, 1.6 percent) (figure 3.14.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by Peruvian industries in 2012, 16.9 percent were imported, an increase from 14.2 percent in 2005, and above the average of 13.8 percent in the APEC region. The industries with the highest imported intermediate use intensity (IIUI) were coke, petroleum products, and nuclear fuel (PET, 56.1 percent); rubber and plastic products (RBP, 51.9 percent); and computer, electronic and optical equipment (CEQ, 46.0 percent).

The average IIUI rate of manufacturing sector in Peru was 26.6 percent in 2012, increasing from 23.8 percent in 2005. Most manufacturing industries experienced an increase in IIUI during this period. Of them, the most notable were basic metals (MET), increasing by 106.0 percent; textile, leather, and footwear (TEX), increasing by 50.0 percent; and other non-metallic mineral products (NMM), increasing by 44.6 percent. Four manufacturing industries experienced a decrease in IIUI during this period, including electrical machinery and apparatus (ELQ), decreasing by 26.4 percent; wood products and cork (WOD), decreasing by 19.3 percent; and CEQ, decreasing by 10.3 percent.

The average IIUI rate of services sector in Peru was 10.0 percent in 2012, increasing from 7.4 percent in 2005. Most services industries experienced an increase in IIUI during this period. Of them, the most notable were real estate activities (REA), increasing by 390.5 percent; and renting of machinery and equipment (RMQ), increasing by 98.2 percent (figure 3.14.3).

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[151] Based on the supply tables at basic price, which could differ from the official NA data.
[152] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[153] Based on the use tables at basic price, which could differ from the official NA data.

Figure 3.14.1 Gross output, by industry, 2005 and 2012, Peru

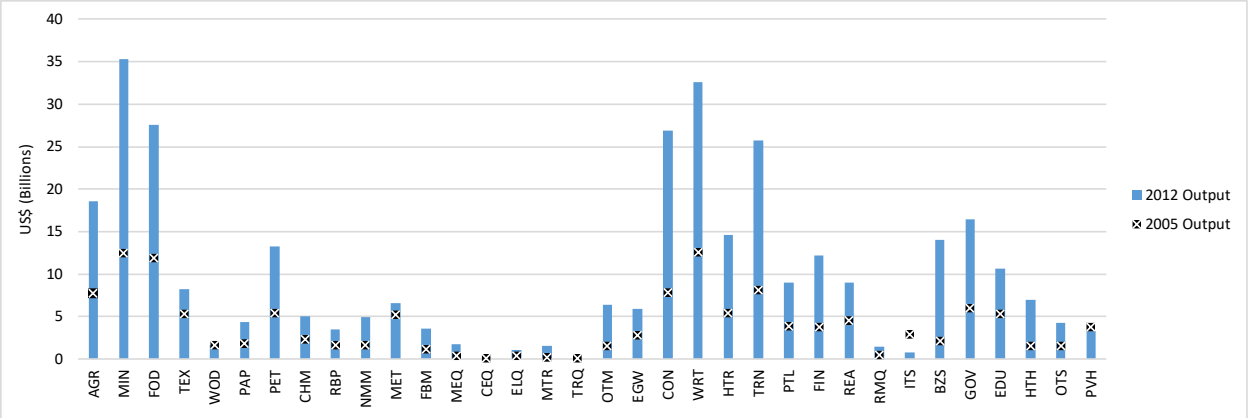


Figure 3.14.2 Value added (VA), by industry, 2005 and 2012, Peru

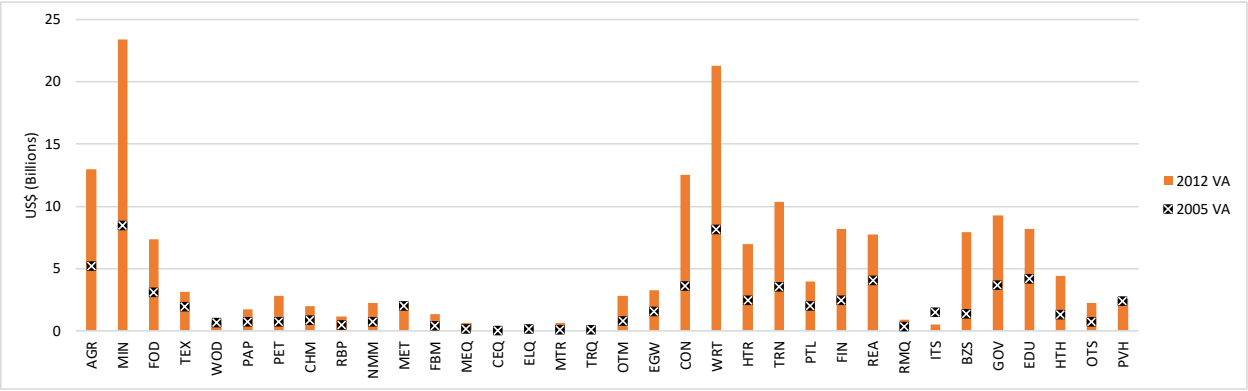
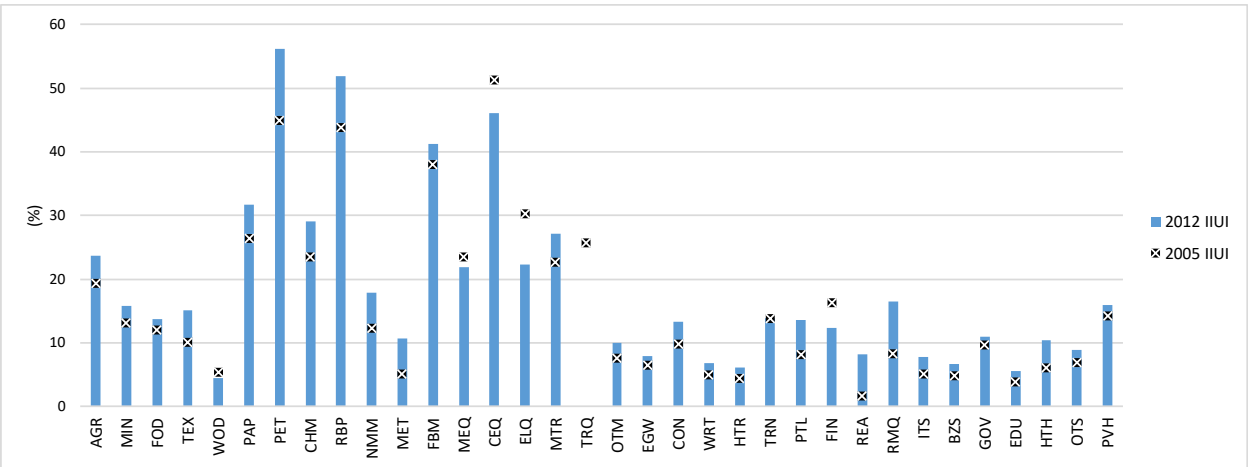


Figure 3.14.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, Peru



Selected APEC TiVA Measures[154]

GVC-Related Trade and GVC Participations

GVC-Related Trade[155]

In 2012, Peru's GVC-related trade amounted to $42.8 billion, more than tripled from $13.7 billion in 2005, and accounting for 92.4 percent of Peru's gross exports. About 45.8 percent of GVC-related trade was in the form of complex GVCs. Mining (MIN) topped all industries, accounting for 38.8 percent of Peru's GVC-related trade. It was followed by agriculture (AGR, 17.9 percent), and coke, refined petroleum products and nuclear fuel (PET, 12.3 percent) (figure 3.14.4).

Forward GVC Participation[156]

Peru's forward GVC participation rate increased from 16.0 percent in 2005 to 19.2 percent in 2012, above the APEC average of 13.8 percent. The complex forward GVC participation rate increased from 4.7 percent to 6.0 percent during this period. The industries with the highest forward GVC participation rates in 2012 were computer, electronic and optical equipment (CEQ) at 97.5 percent, followed by MIN at 53.6 percent, coke, refined petroleum products and nuclear fuel (PET) at 50.4 percent, and AGR at 50.2 percent (figure 3.14.5).

Backward GVC Participation[157]

Peru's backward GVC participation rate increased from 13.7 percent in 2005 to 14.4 percent in 2012, slightly above the APEC average of 12.7 percent. The complex backward GVC participation rate increased from 3.6 percent to 4.4 percent during this period. The industries with the highest backward GVC participation rates in 2012 were PET at 53.6 percent, followed in distance by rubber and plastics (RBP) at 37.0 percent, and CEQ at 30.7 percent, both declined from 2005 (figure 3.14.6).

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[154] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[155] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[156] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[157] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.14.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, Peru

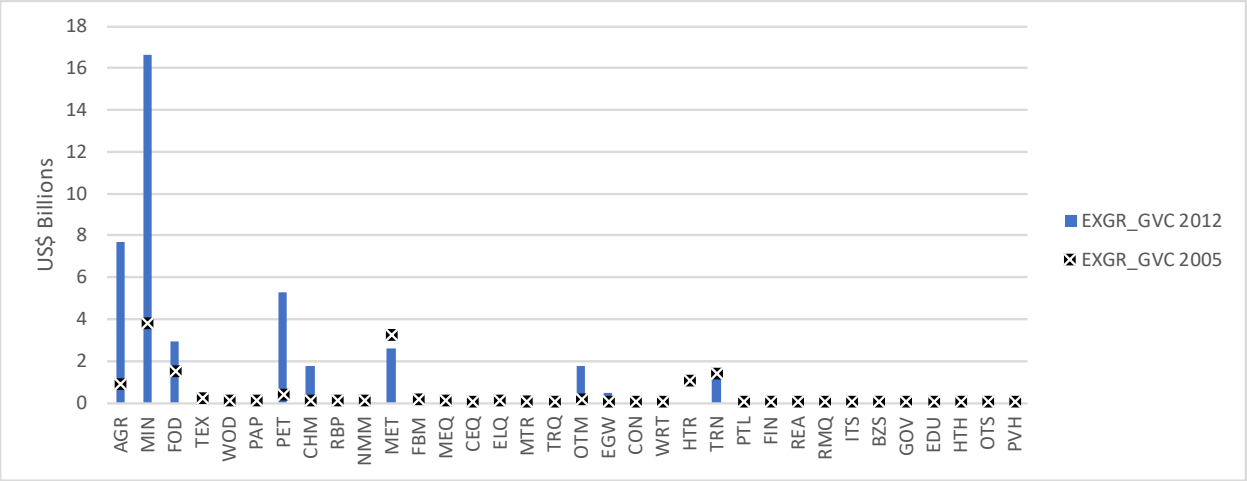


Figure 3.14.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, Peru

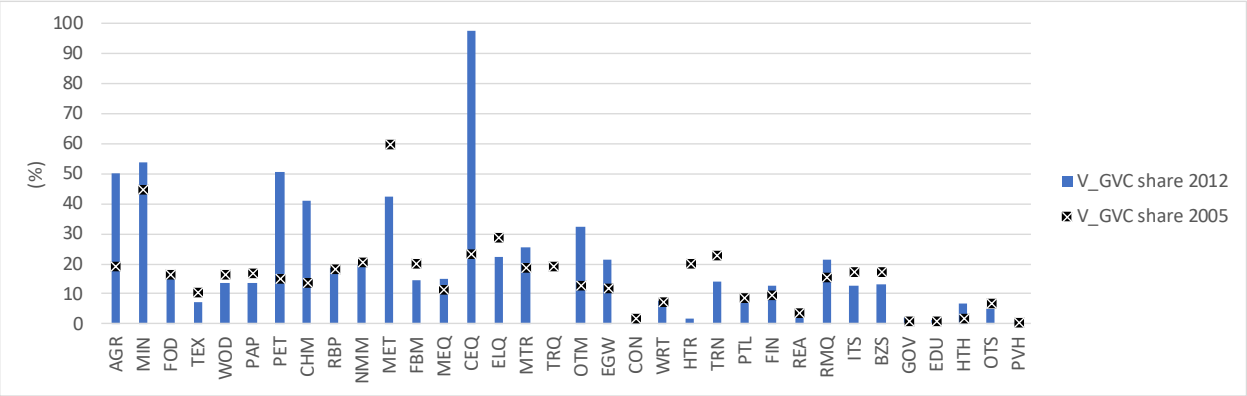
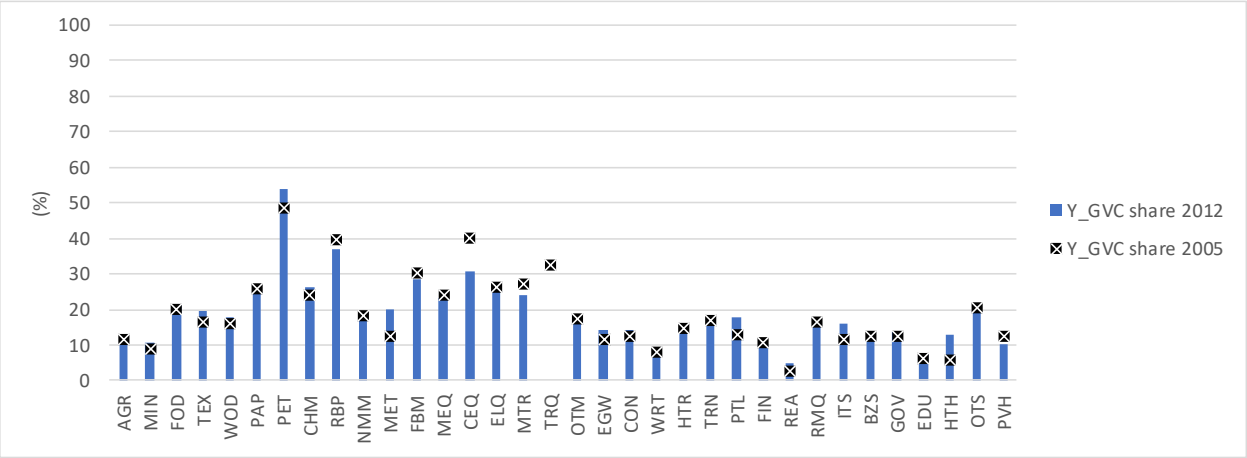


Figure 3.14.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, Peru



Value Added Trade and Top APEC Trading Partners

Value-added exports[158]

In 2012, Peru had value-added exports of $46.4 billion, more than doubled from $17.4 billion in 2005. Mining (MIN) topped all industries, accounting for 34.9 percent of Peru's value-added exports in 2012. It was followed by agriculture (AGR, 17.9 percent). These two industries also experienced the largest increase in value-added exports during this period (figure 3.14.7).

Value-added imports[159]

In 2012, Peru had value-added imports of $39.7 billion, tripled from $13.0 billion in 2005. Wholesale and retail trade (WRT) topped all industries, accounting for 8.2 percent of Peru's value-added imports in 2012. It was followed by MIN (8.2 percent), and AGR (6.6 percent). Most industries experienced significant increases in value-added imports during this period, though some of them were from a relatively low based in 2005 (figure 3.14.8).

Top APEC Trading Partners

In 2012, in the APEC region, the United States; China; Japan; Canada; and Chile were the top destinations for Peru's value-added exports (figure 3.14.9), and the United States; China; Japan; Korea; and Mexico were the top sources for Peru's value-added imports (figure 3.14.10).

Figure 3.14.7 Value-added exports (EXVA), by industry 2005 and 2012, Peru

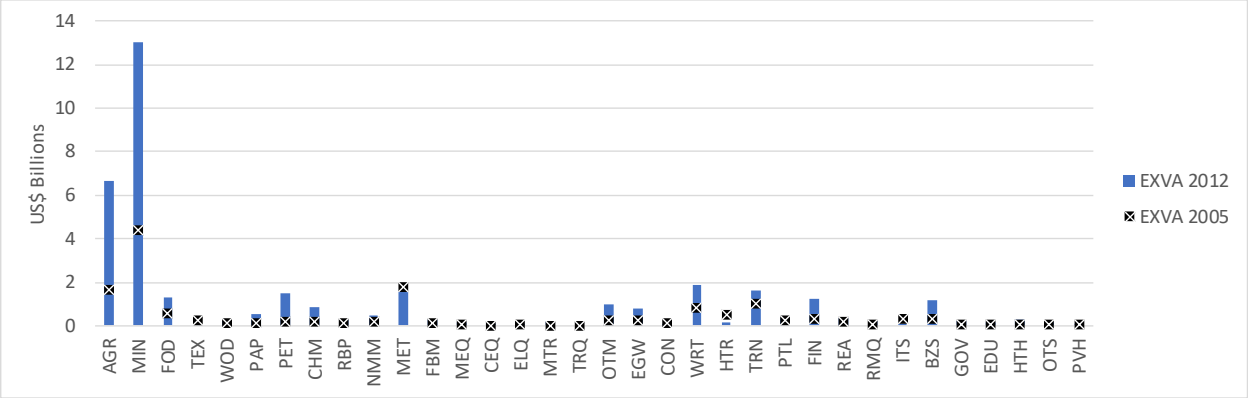
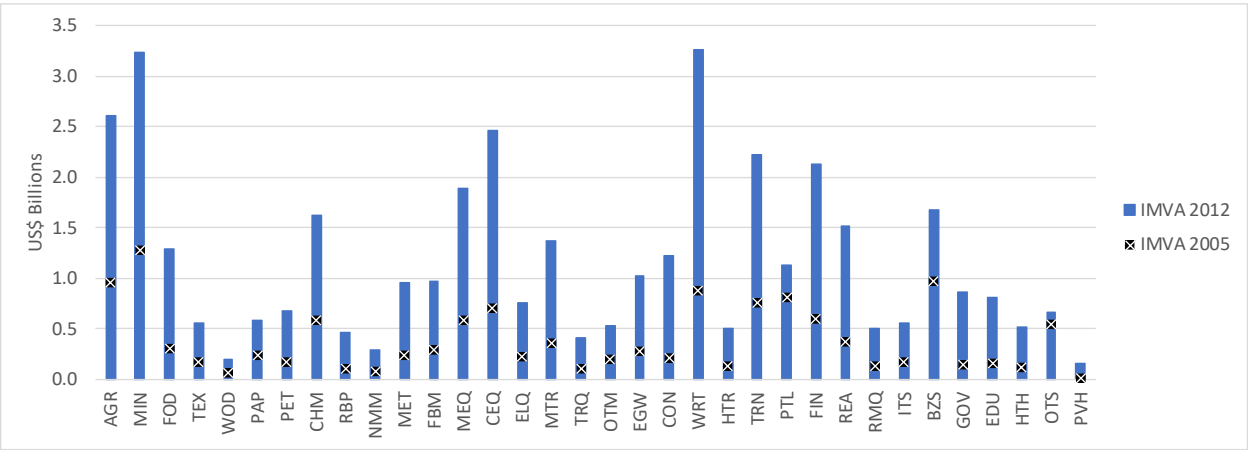


Figure 3.14.8 Value-added imports (IMVA), by industry 2005 and 2012, Peru



[158] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.
[159] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.14.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, Peru

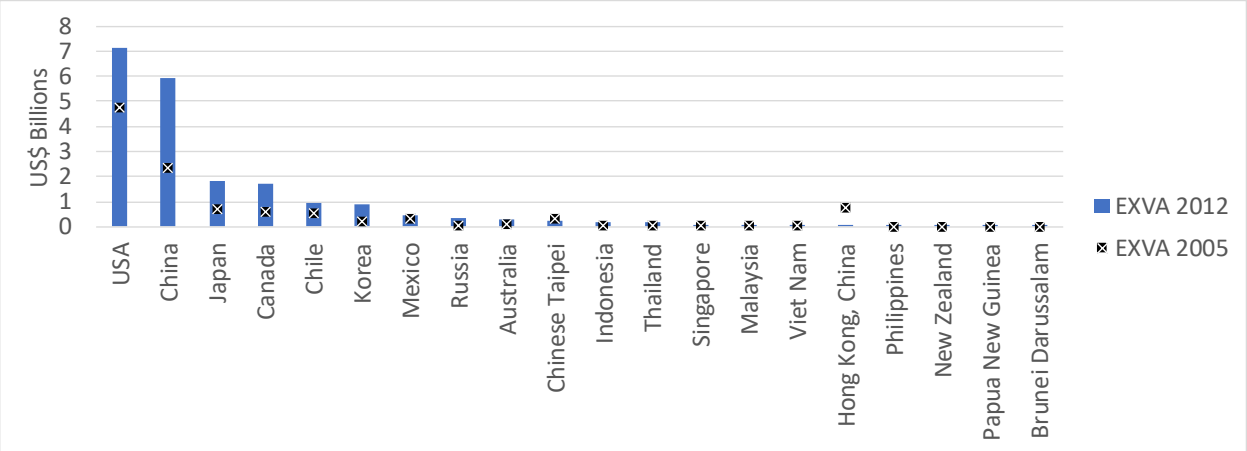
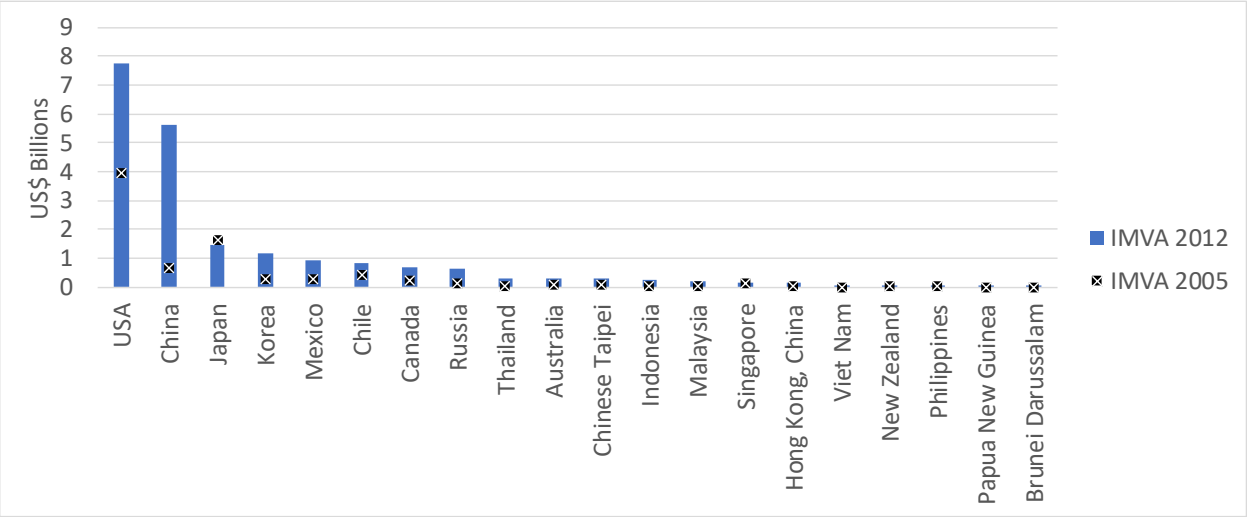


Figure 3.14.10 APEC sources of value-added imports (IMVA), 2005 and 2012, Peru



Chapter 15: The Philippines

Industry Data Summary Based on SUTs

Gross Output[160]

In 2012, The Philippines' total gross output was $513.3 billion, increasing from $200.7 billion in 2005. Manufacturing and services sectors accounted for 29.4 percent and 59.9 percent of The Philippines's total gross output, respectively.[161]

Of the 34 industries, wholesale and retail trade (WRT) has the largest industry gross output of $75.0 billion, an increase of 289.1 percent from its 2005 level, and accounting for 14.6 percent of The Philippines' total gross output. Other top industries included food, beverages, and tobacco (FOD, 13.7 percent), agriculture, hunting, forestry and fishing (AGR, 9.9 percent), financial services (FIN, 6.7 percent), and public administration and defense, compulsory social security (GOV, 5.6 percent) (figure 3.15.1).

Value Added[162]

In 2012, The Philippines' total value added, or GDP, was $252.8 billion, increasing from $97.7 billion in 2005. Services sectors together accounted for 64.9 percent of The Philippines's total GDP, followed by manufacturing with a share of 19.7 percent.

The industries with the top contribution to total GDP were WRT (15.3 percent of total GDP), AGR (14.0 percent), FOD (10.2 percent), FIN (8.0 percent), and GOV (7.1 percent).

The largest manufacturing industries in terms of value added after FOD were computer, electronic and optical equipment (CEQ, 3.0 percent of total GDP), and coke, petroleum products, and nuclear fuel (PET, 1.3 percent) (figure 3.15.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by The Philippines industries in 2012, 14.3 percent were imported, a decrease from 25.0 percent in 2005, but still above the average of 13.8 percent in the APEC region. The industries with the highest imported intermediate use intensity (IIUI) were PET (33.5 percent), chemicals (CHM, 33.5 percent), and basic metals (MET, 31.4 percent).

The average IIUI rate of manufacturing sector in The Philippines was 20.1 percent in 2012, decreasing from 27.1 percent in 2005. Most manufacturing industries in The Philippines experienced a decrease in IIUI during this period. Of them, the most notable were other non-metallic mineral products (NMM), decreasing by 72.7 percent; and PET, decreasing by 47.1 percent. Three manufacturing industries were the exceptions, including wood products and corks (WOD), increasing by 49.0 percent; and CHM, increasing by 43.7 percent.

The average IIUI rate of services sector in The Philippines was 12.0 percent in 2012, decreasing from 17.4 percent in 2005. All services industries experienced a decrease in IIUI during this period. Of them, the most notable were computer and related activities (ITS), decreasing by 71.7 percent; and FIN, decreasing by 62.5 percent (figure 3.15.3).

[160] Based on the supply tables at basic price, which could differ from the official NA data.
[161] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[162] Based on the use tables at basic price, which could differ from the official NA data.

Figure 3.15.1 Gross output, by industry, 2005 and 2012, The Philippines

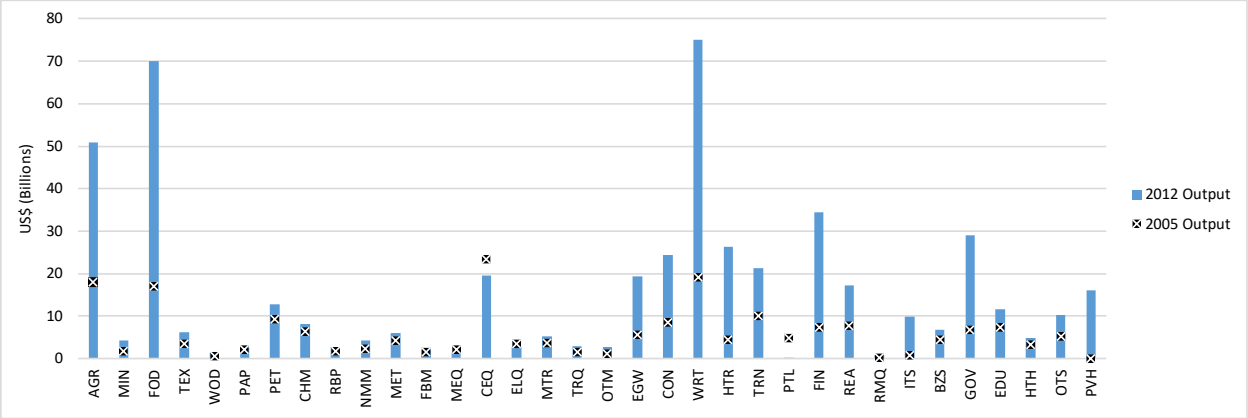


Figure 3.15.2 Value added (VA), by industry, 2005 and 2012, The Philippines

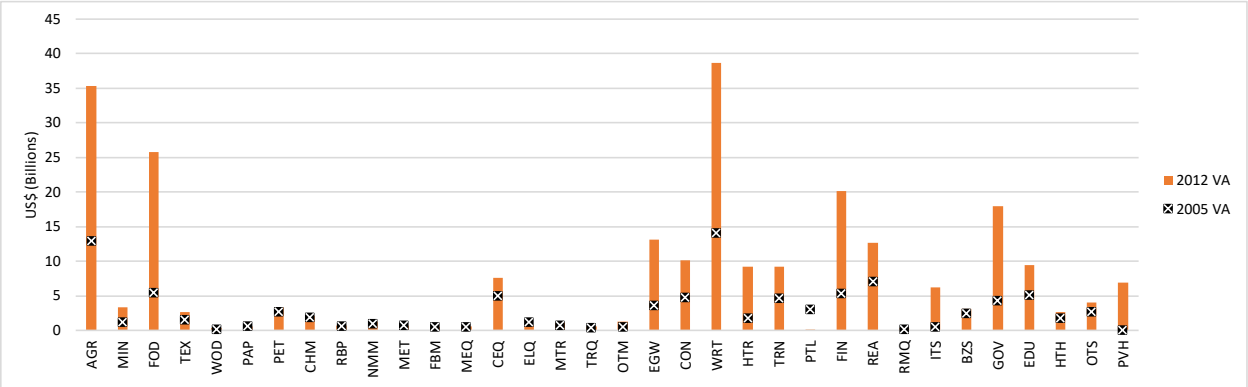
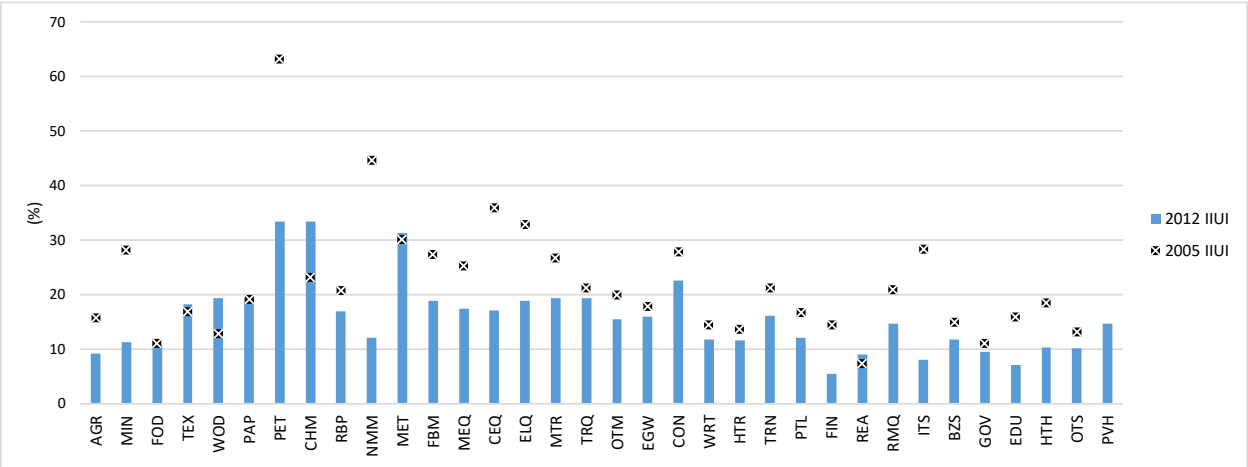


Figure 3.15.3 Imported intermediate use intensity IIUI), by industry, 2005 and 2012, The Philippines



Selected APEC TiVA Measures[163]

GVC-Related Trade and GVC Participations

GVC-Related Trade[164]

In 2012, The Philippines' GVC-related trade amounted to $54.1 billion, increasing by 39.1 percent from $38.9 billion in 2005, and accounting for 88.1 percent of The Philippines's gross exports. About 49.6 percent of GVC-related trade was in the form of complex GVCs. Computer, electronic and optical equipment (CEQ) topped all industries, accounting for 20.7 percent of The Philippines's GVC-related trade. It was followed by food, beverage, and tobacco (FOD, 17.5 percent), R&D and other business activities (BZS, 12.0 percent), and transport and storage (TRN, 9.0 percent) (figure 3.15.4).

Forward GVC Participation[165]

The Philippines' forward GVC participation rate decreased from 25 percent in 2005 to 17 percent in 2012, above the APEC average of 13.8 percent. The complex forward GVC participation rate decreased from 8.9 percent to 5.7 percent during this period. The industries with the highest forward GVC participation rates in 2012 were BZS at 98.3 percent, mining (MIN) at 79.3 percent, CEQ at 59.0 percent, other manufacturing (OTM) at 56.9 percent, and machinery and equipment (MEQ) at 53.7 percent (figure 3.15.5).

Backward GVC Participation[166]

The Philippines' backward GVC participation rate decreased from 19.2 percent in 2005 to 14.5 percent in 2012, above the APEC average of 12.7 percent. The complex backward GVC participation rate decreased from 6.6 percent to 5.4 percent during this period. The industries with the highest backward GVC participation rates in 2012 were basic metals (MET) at 43.3 percent, Chemical products (CHM) at 36.7 percent, and Coke refined petroleum products and nuclear fuel (PET) at 35.7 percent (figure 3.15.6).

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[163] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[164] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[165] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[166] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.15.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, The Philippines

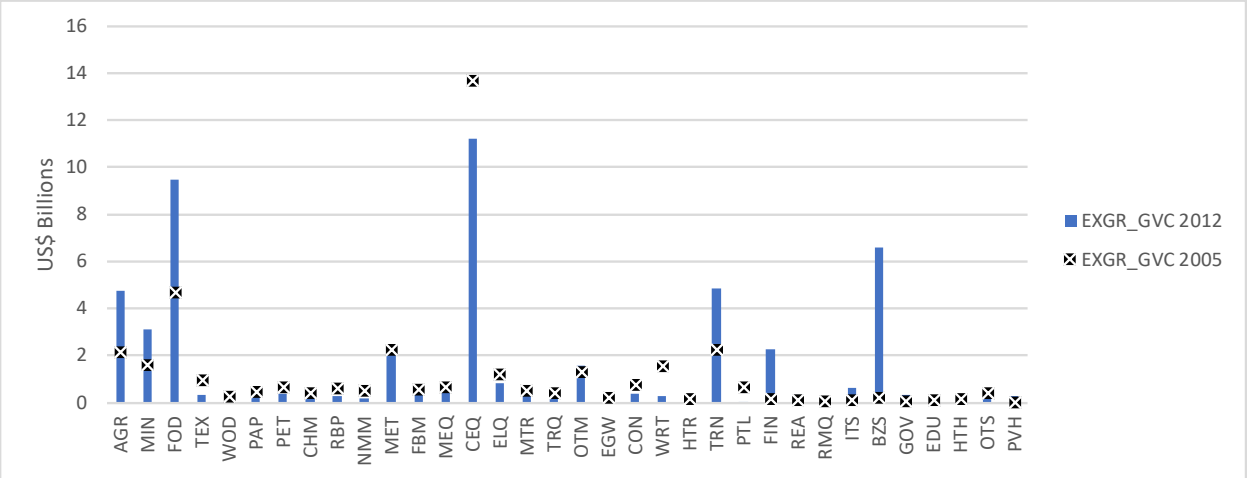


Figure 3.15.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, The Philippines

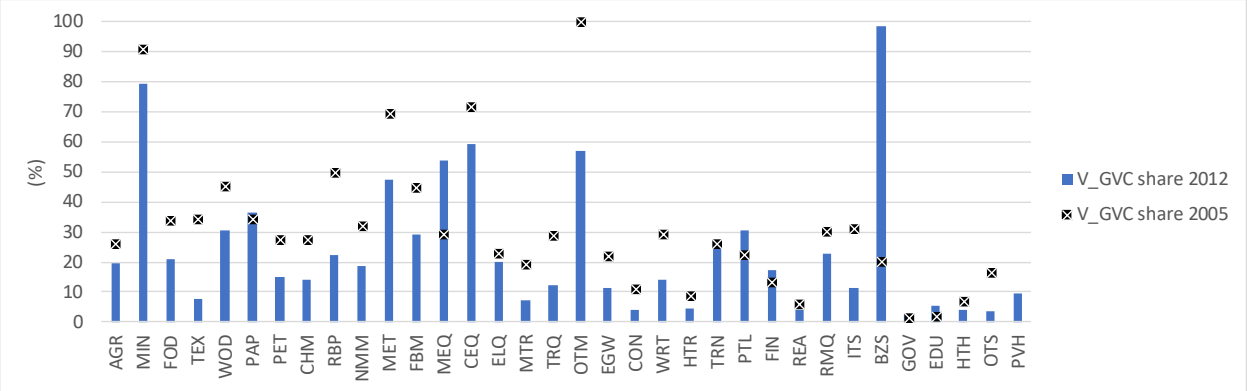
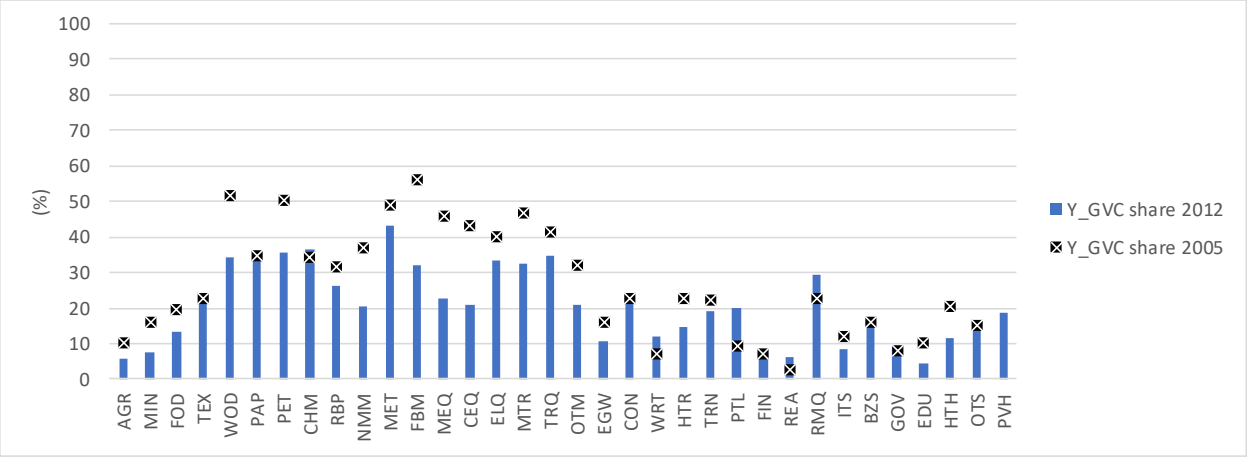


Figure 3.15.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, The Philippines



Value Added Trade and Top APEC Trading Partners

Value-added exports[167]

In 2012, the Philippines had value-added exports of $52.3 billion, nearly doubled from $28.5 billion in 2005. Agriculture (AGR) topped all industries, accounting for 15.6 percent of The Philippines' value-added exports in 2012. It was followed by wholesale and retail trade (WRT, 12.9. percent),) food, beverage and tobacco (FOD, 12.2 percent), computer electronic and optical equipment (CEQ, 10.7 percent), transport and storage (TRN, 8.5. percent), and finance and insurance (FIN, 7.4 percent). The industries experiencing the largest increase in value-added exports during this period were FIN, AGR, and FOD (figure 3.15.7).

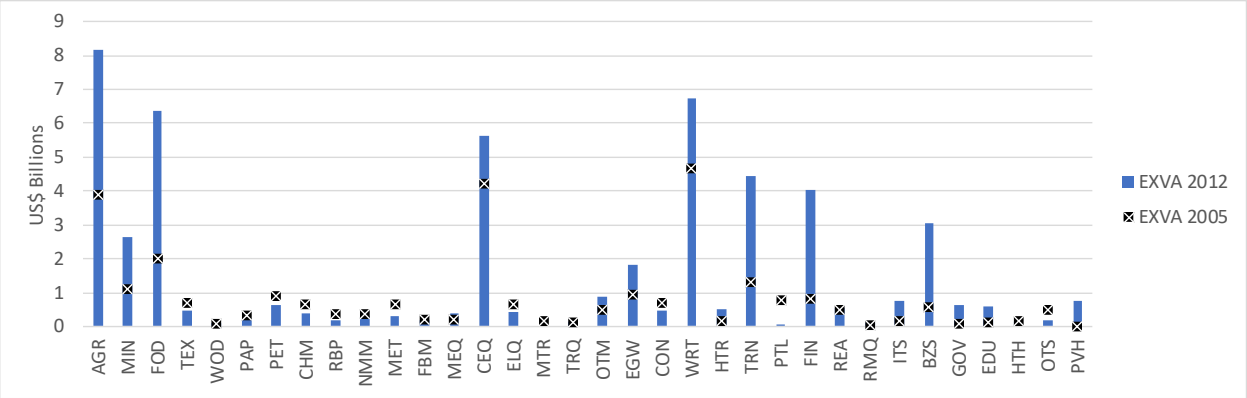
Value-added imports[168]

In 2012, the Philippines had value-added imports of $60.8 billion, more than doubled from $27.5 billion in 2005. Agriculture (AGR) topped all industries, accounting for 9.7 percent of The Philippines' value-added imports in 2012. It was followed by wholesale and retail trade (WRT, 8.9 percent), and mining (MIN, 8.7 percent). The industries that experienced the largest increases in value-added imports during this period were computer and related activities (ITS), renting of machinery and equipment (RMQ), and education (EDU) (figure 3.15.8).

Top APEC Trading Partners

In 2012, in the APEC region, the United States; China; Japan; Korea; and Thailand were the top destinations for the Philippines' value-added exports (figure 3.15.9), and China; the United States; Japan; Indonesia; and Thailand were the top sources for the Philippines' value-added imports (figure 3.15.10).

Figure 3.15.7 Value-added exports (EXVA), by industry 2005 and 2012, The Philippines



[167] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.
[168] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.15.8 Value-added imports (IMVA), by industry 2005 and 2012, The Philippines

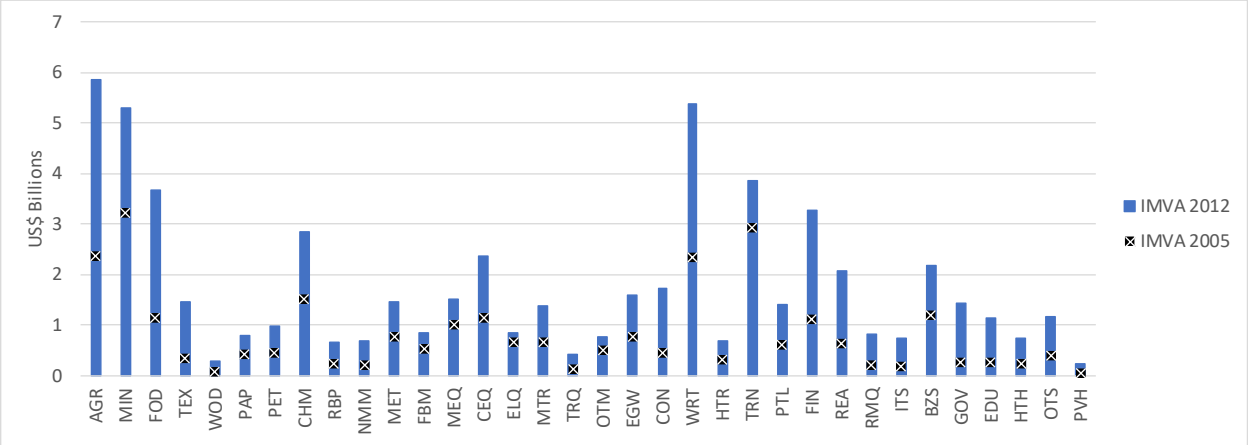


Figure 3.15.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, The Philippines

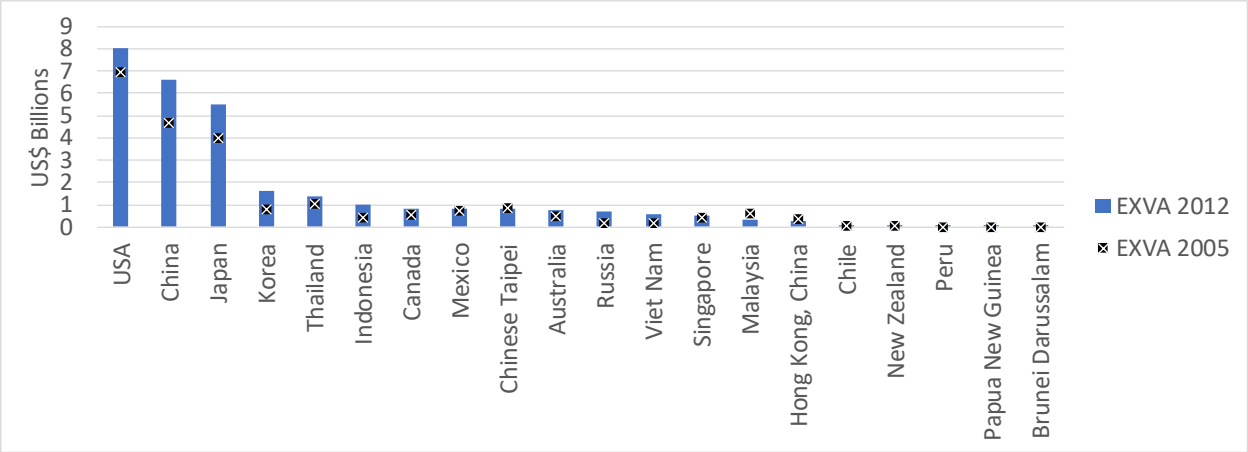
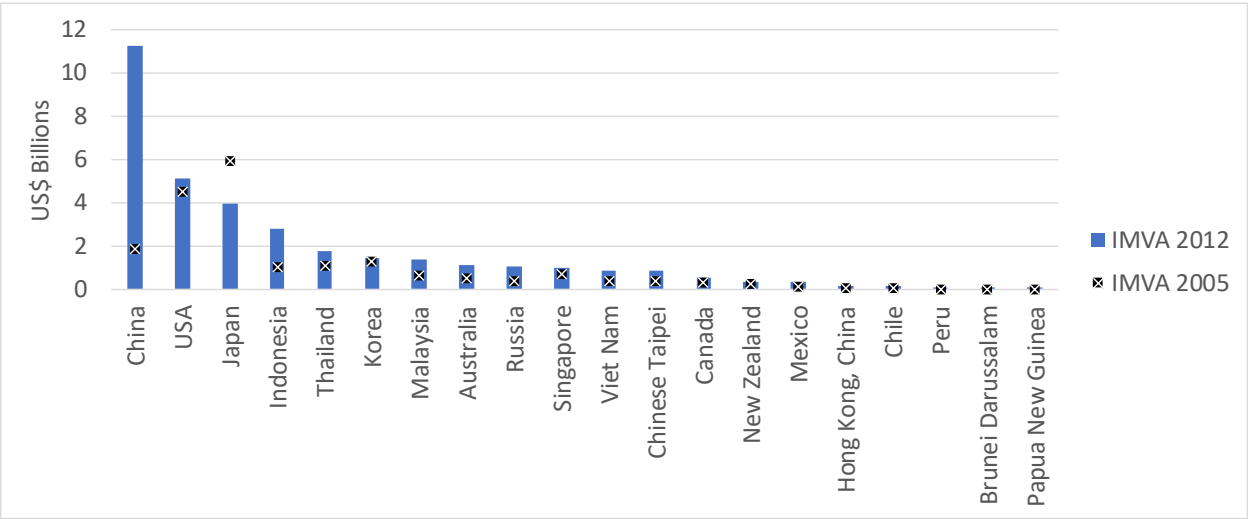


Figure 3.15.10 APEC sources of value-added imports (IMVA), 2005 and 2012, The Philippines



Chapter 16: Russia

Industry Data Summary Based on SUTs

Gross Output[169]

In 2012, Russia's total gross output was $3.7 trillion, increasing by 179.6 percent from $1.3 trillion in 2005. Manufacturing and services sectors accounted for 24.6 percent and 64.3 percent of Russia's total gross output, respectively.[170]

Of the 34 industries, wholesale and retail trade (WRT) had the largest industry gross output of $508.7 billion, an increase of 154.4 percent from its 2005 level, accounting for 13.9 percent of Russia's total gross output. Other top industries included construction (CON, 7.8 percent), mining (MIN, 7.4 percent), real estate activities (REA, 7.0 percent), and transport and storage services (TRN, 6.9 percent) (figure 3.16.1).

Value Added[171]

In 2012, Russia's total value added, or GDP, was $1.9 trillion, increasing from $654.7 billion in 2005. Services sectors together accounted for 73.2 percent of Russia's total GDP, followed by manufacturing with a share of 13.6 percent.

The industries with the top contribution to total GDP were WRT (16.8 percent of total GDP), REA (11.0 percent), MIN (9.4 percent), public administration and defense, compulsory social security (GOV, 7.7 percent), and construction (CON, 7.7 percent).

The largest manufacturing industries in terms of value added were coke, petroleum products, and nuclear fuel (PET, 3.1 percent of total GDP); food, beverages, and tobacco (FOD, 2.1 percent); and basic metals (MET, 1.8 percent) (figure 3.16.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by Russian industries in 2012, 11.8 percent were imported, an increase from 8.6 percent in 2005, but still below the average of 13.8 percent in the APEC region. The industries with the highest imported intermediate use intensity (IIUI) were motor vehicles, trailers and semi-trailers (MTR, 41.2 percent), textiles, leather and footwear (TEX, 37.8 percent), and computer, electronic and optical equipment (CEQ, 32.5 percent).

The average IIUI rate of manufacturing sector in Russia was 20.3 percent in 2012, increasing from 14.2 percent in 2005. Most manufacturing industries in Russia experienced an increase in IIUI during this period. Of them, the most notable were other transport equipment (TRQ), increasing by 147.0 percent; and MTR, increasing by 117.9 percent. The exceptions included pulp, paper, paper products, printing and publishing (PAP) and MET, but their IIUI rates decreased by very small amounts.

The average IIUI rate of services sector in Russia was 12.0 percent in 2012, increasing from 8.9 percent in 2005. Most services industries experienced an increase in IIUI during this period. Of them, the most notable were R&D and other business activities (BZS), increasing by 108.5 percent. The exception was electricity, gas, and water supply (EGW), decreasing by 22.2 percent (figure 3.16.3).

[169] Based on the supply tables at basic price, which could differ from the official NA data.
[170] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[171] Based on the use tables at basic price, which could differ from the official NA data.

Figure 3.16.1 Gross output, by industry, 2005 and 2012, Russia

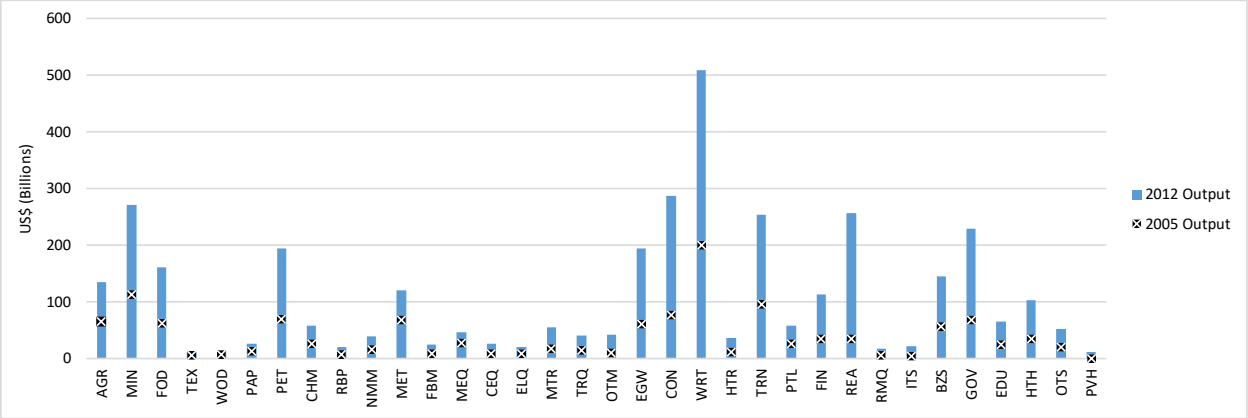


Figure 3.16.2 Value added (VA), by industry, 2005 and 2012, Russia

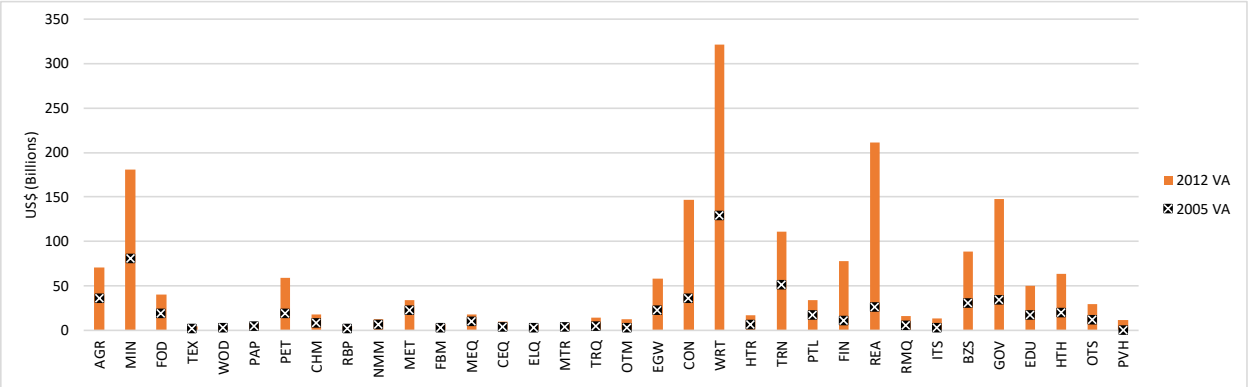
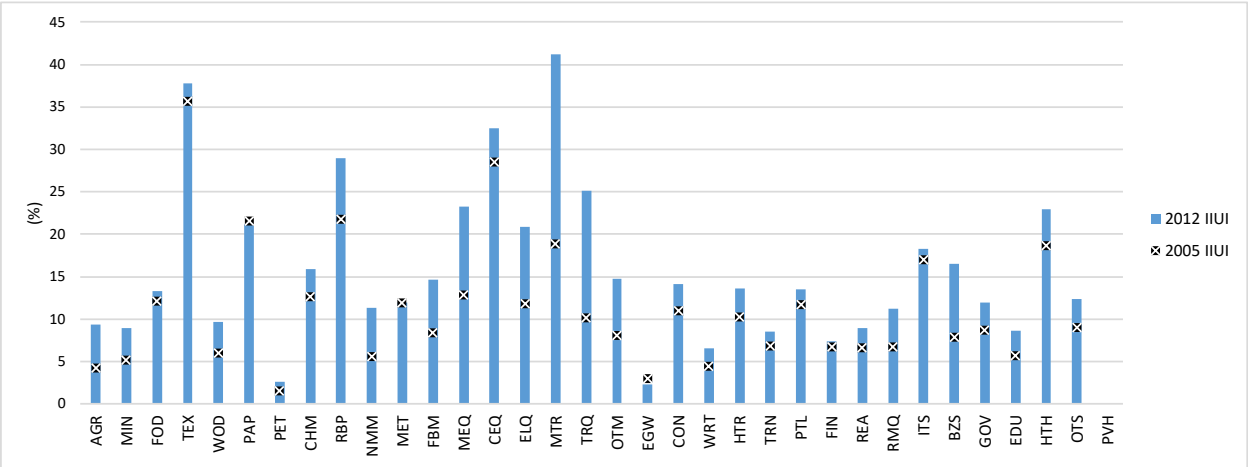


Figure 3.16.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, Russia



Selected APEC TiVA Measures[172]

GVC-Related Trade and GVC Participations

GVC-Related Trade[173]

In 2012, Russia's GVC-related trade amounted to $552.3 billion, more than doubled from $255.6 billion in 2005, and accounting for 93.9 percent of Russia's gross exports. About 43.1 percent of GVC-related trade was in the form of complex GVCs. Mining (MIN) topped all industries, accounting for 21.5 percent of Russia's GVC-related trade. It was followed by electricity gas and water supply (EGW, 16.6 percent), coke, refined petroleum products (PET, 12.5 percent), and basic metals (MET, 7.8 percent) (figure 3.16.4).

Forward GVC Participation[174]

Russia's forward GVC participation rate decreased from 23.0 percent in 2005 to 16.6 percent in 2012, above the APEC average of 13.8 percent. The complex forward GVC participation rate decreased from 8.2 percent to 7.1 percent during this period. The industries with the highest forward GVC participation rates in 2012 were EGW at 62.1 percent, followed by mining (MIN) at 59.9 percent, chemicals (CHM) at 56.0 percent, basic metals (MET) at 51.9 percent, and PET at 50.2 percent (figure 3.16.5).

Backward GVC Participation[175]

Russia's backward GVC participation rate decreased slightly from 14.1 percent in 2005 to 14.0 percent in 2012, above the APEC average of 12.7 percent. The complex backward GVC participation rate increased from 4.0 percent to 4.6 percent during this period. The industries with the highest backward GVC participation rates in 2012 were motor vehicles, trailers and semi-trailers (MTR) at 44.5 percent, and rubber and plastics (RBP) at 37.3 percent. MTR also experienced the largest increase in backward GVC participation during this period (figure 3.16.6).

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[172] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[173] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[174] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[175] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.16.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, Russia

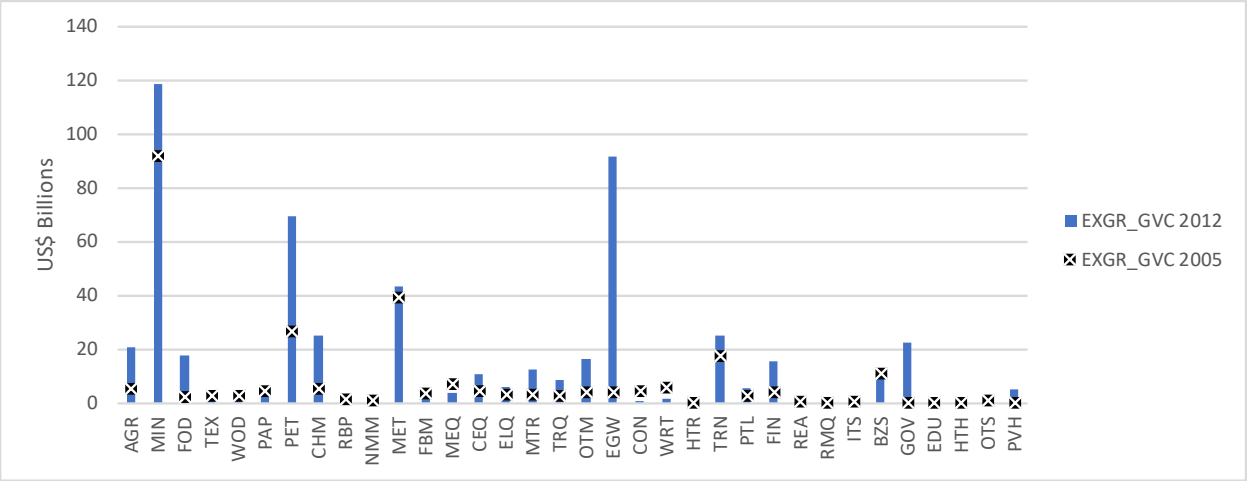


Figure 3.16.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, Russia

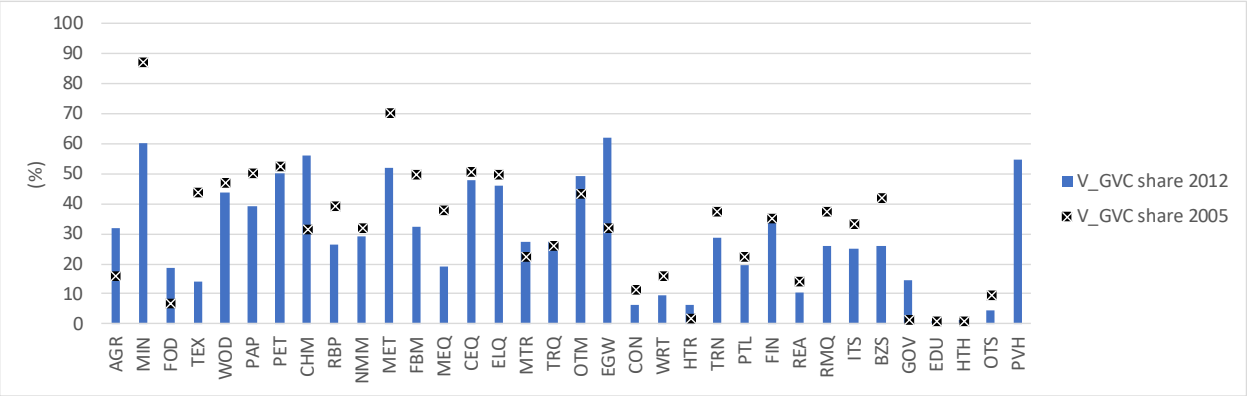
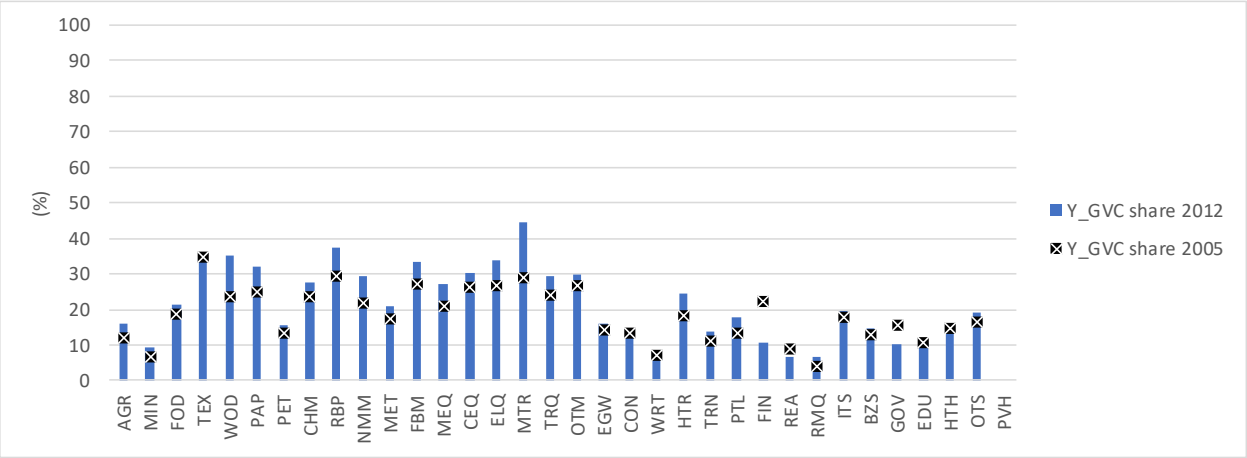


Figure 3.16.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, Russia



Value Added Trade and Top APEC Trading Partners

Value-added exports[176]

In 2012, Russia had value-added exports of $479.7 billion, more than doubled from $231.1 billion in 2005. Mining (MIN) topped all industries, accounting for 22.6 percent of Russia's value-added exports.

[176] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.

It was followed by EGW at 7.8 percent, and transport and storage (TRN) at 6.9 percent. MIN, EGW and PET also had the largest increases in value-added exports during this period (figure 3.16.7).

Value-added imports[177]

In 2012, Russia had value-added imports of $338.4 billion, more than double from $127.9 billion in 2005. Wholesale and retail trade (WRT) topped all industries, accounting for 8.6 percent of Russia's value-added imports in 2012. It was followed by TRN (7.4 percent), and finance and insurance (FIN, 6.4 percent). The industries that experienced the largest increases in value-added imports during this period were agriculture (AGR), mining (MIN), and most service industries (figure 3.16.8).

Top APEC Trading Partners

In 2012, in the APEC region, the United States; China; Japan; Korea; and Canada were the top destinations for Russia's value-added exports (figure 3.16.9), and the top sources for Russia's value-added imports (figure 3.16.10).

Figure 3.16.7 Value-added exports (EXVA), by industry, 2005 and 2012, Russia

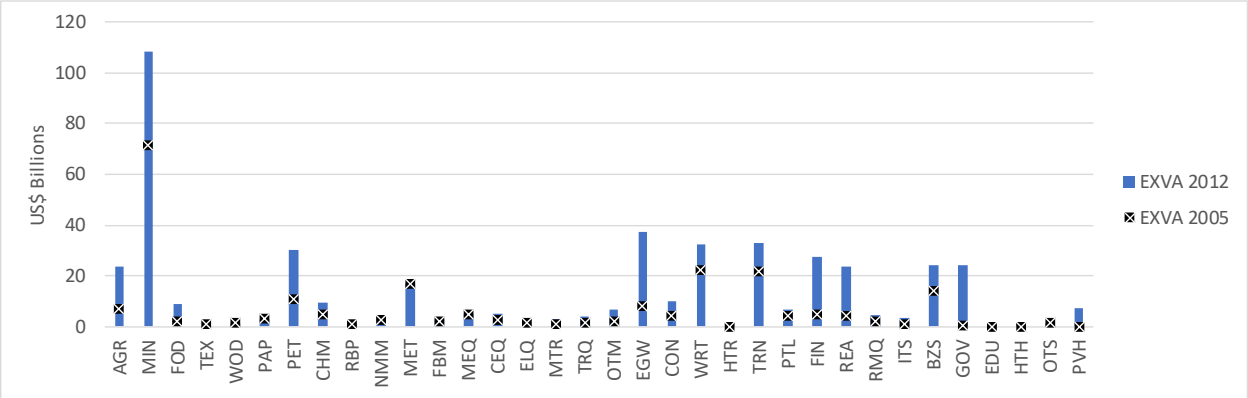
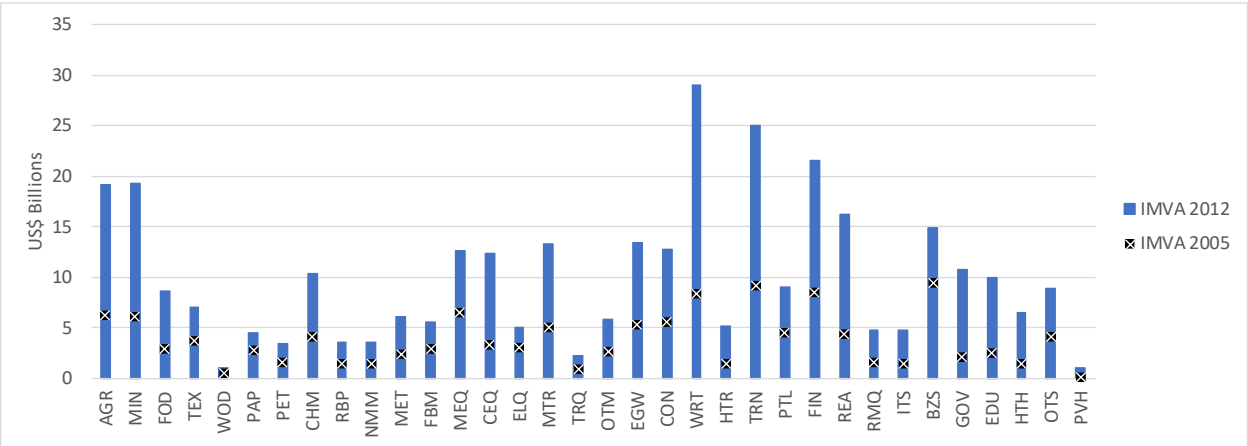


Figure 3.16.8 Value-added exports (IMVA), by industry, 2005 and 2012, Russia



[177] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.16.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, Russia

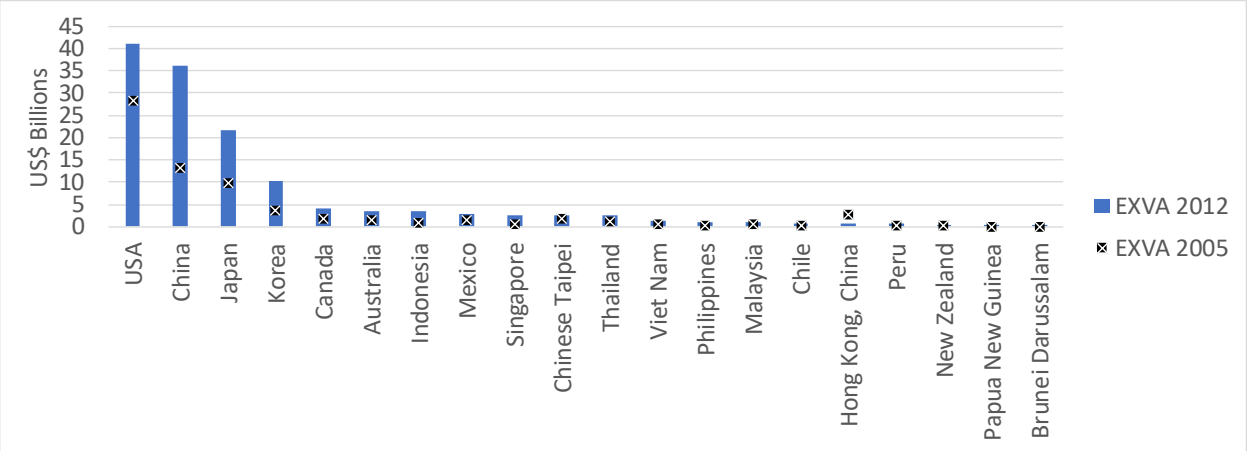
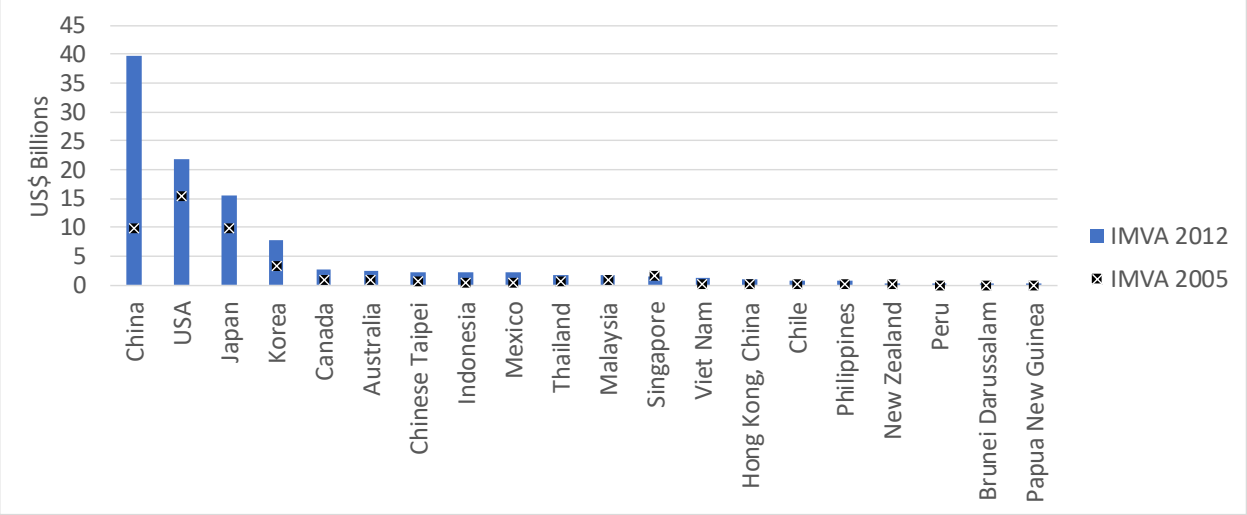


Figure 3.16.10 APEC sources of value-added imports (IMVA), 2005 and 2012, Russia



Chapter 17: Singapore

Industry Data Summary Based on SUTs

Gross Output[178]

In 2012, Singapore's total gross output was $764.3 billion, more than double its 2005 level of $338.5 billion. Manufacturing and services sectors as a whole accounted for 33.8 percent and 66.2 percent of Singapore's total gross output, respectively.[179]

Of the 34 industries, wholesale and retail trade (WRT) has the largest industry gross output of $106.6 billion, more than double its 2005 level, and accounting for 13.9 percent of Singapore's total gross output. Other top industries included computer, electronic and optical equipment (CEQ, 10.5 percent), transport and storage (TRN, 10.3 percent), finance and insurance (FIN, 7.7 percent), and chemicals (CHM, 7.2 percent) (figure 3.17.1).

Value Added[180]

In 2012, Singapore's total value added, or GDP, was $272.3 billion, increasing from $119.7 billion in 2005. As a services-oriented economy, services sectors together accounted for 79.8 percent of Singapore's total GDP, followed by manufacturing with a share of 20.2 percent.

The industries with the top contribution to total GDP were WRT (19.4 percent of total GDP), FIN (11.0 percent), real estate activities (REA, 9.4 percent), and R&D and other business activities (BZS, 7.9 percent), and TRN (6.7 percent).

The largest manufacturing industries in terms of value added were TRN (6.7 percent of total GDP), CEQ (6.1 percent), and chemicals (CHM, 5.4 percent) (figure 3.17.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by Singaporean industries in 2012, 51.5 percent were imported, a slight decrease from 55.6 percent in 2005, but well above the average of 13.8 percent in the APEC region. The industries with the highest imported intermediate use intensity (IIUI) were coke, refined petroleum products and nuclear fuel (PET, 93.2 percent), CEQ (75.2 percent), basic metals (MET, 73.2 percent), and computer and related activities (ITS, 70.2 percent).

The average IIUI rate of manufacturing sector in Singapore was 59.2 percent in 2012, decreasing from 65.9 percent in 2005. Most manufacturing industries experienced a decrease in IIUI during this period. Of them, the most notable were rubber and plastics products (RBP), decreasing by 49.1 percent; and machinery and equipment (MEQ), decreasing by 41.1 percent. Two notable exceptions were other manufacturing (OTM), increasing by 37.0 percent; and other transport equipment (TRQ), increasing by 19.1 percent.

The average IIUI rate of services sector in Singapore was 34.5 percent in 2012, increasing from 32.6 percent in 2005. Six services industries experienced an increase in IIUI during this period, such as renting of machinery and equipment (RMQ), increasing by 150.1 percent; FIN, increasing by 116.5 percent; and WRT, increasing by 94.3 percent. Eight services industries experienced a decrease in IIUI, including health and social work (HTH), decreasing by 71.5 percent; and REA, decreasing by 51.1 percent (figure 3.17.3).

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[178] Based on the supply tables at basic price, which could differ from the official NA data.
[179] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[180] Based on the use tables at basic price, which could differ from the official NA data.

Figure 3.17.1 Gross output, by industry, 2005 and 2012, Singapore

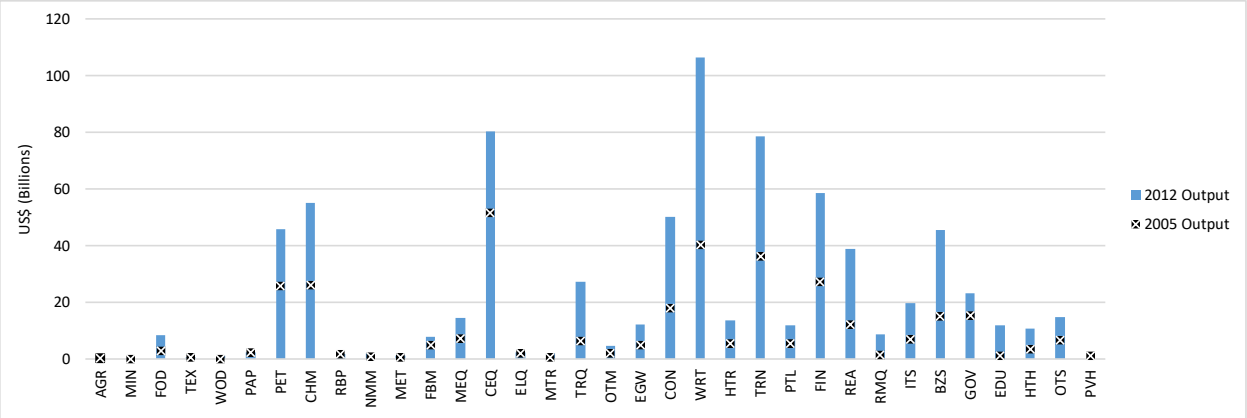


Figure 3.17.2 Value added (VA), by industry, 2005 and 2012, Singapore

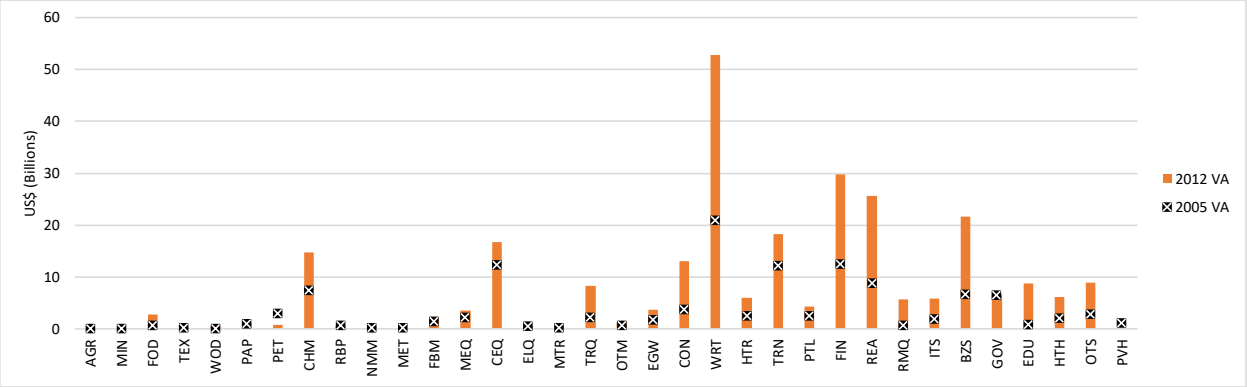
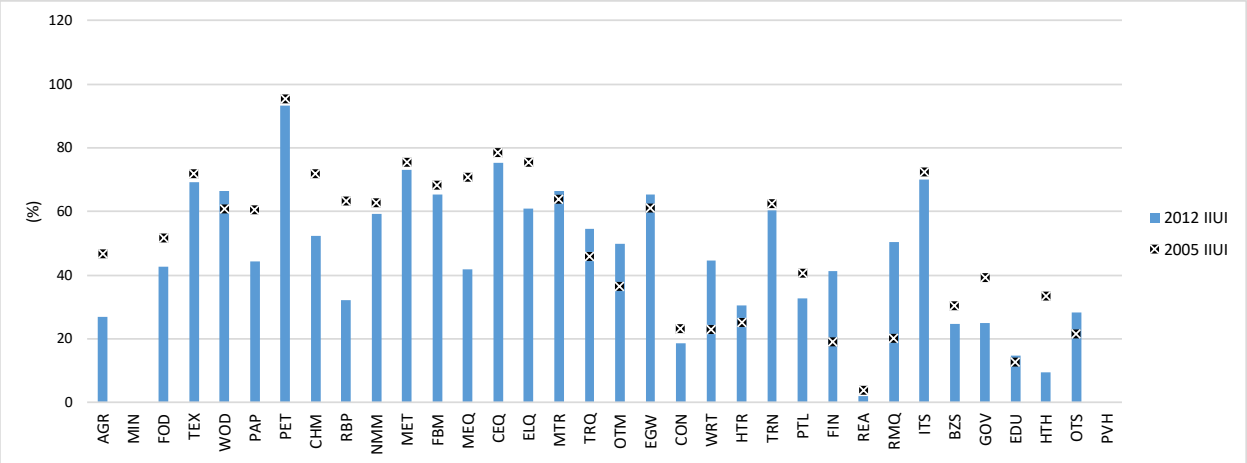


Figure 3.17.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, Singapore



Selected APEC TiVA Measures[181]

GVC-Related Trade and GVC Participations

GVC-Related Trade[182]

In 2012, Singapore's GVC-related trade amounted to $376.4 billion, increasing by 96.7 percent from $191.3 billion in 2005, and accounting for 86.7 percent of Singapore's gross exports. About 75.5 percent of GVC-related trade was in the form of complex GVCs. Computer, electronic and optical equipment (CEQ) topped all industries, accounting for 20 percent of Singapore's GVC-related trade. It was followed by chemicals (CHM, 13.3 percent), transport and storage (TRN, 8.6 percent), and finance and insurance (FIN, 8.1 percent) (figure 3.17.4).

Forward GVC Participation[183]

Singapore's forward GVC participation rate decreased from 53.3 percent in 2005 to 50 percent in 2012, far above the APEC average of 13.8 percent. The complex forward GVC participation rate decreased from 18.1 percent to 16.2 percent during this period. Four industries with over 99 percent forward GVC participation rates in 2012. They were agriculture (AGR), wood and wood products (WOD), paper and paper products (PAP), and other non-metallic mineral products (NMM) (figure 3.17.5).

Backward GVC Participation[184]

Singapore's backward GVC participation rate decreased slightly from 51.5 percent in 2005 to 50.6 percent in 2012, far above the APEC average of 12.7 percent. The complex backward GVC participation rate increased slightly from 29.6 percent to 30.9 percent during this period. The industries with the highest backward GVC participation rates in 2012 were Coke, refined petroleum products and nuclear fuel (PET) at 94.8 percent, basic metals (MET) at 66 percent, and CEQ at 64.8 percent (figure 3.17.6).

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[181] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[182] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[183] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[184] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.17.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, Singapore

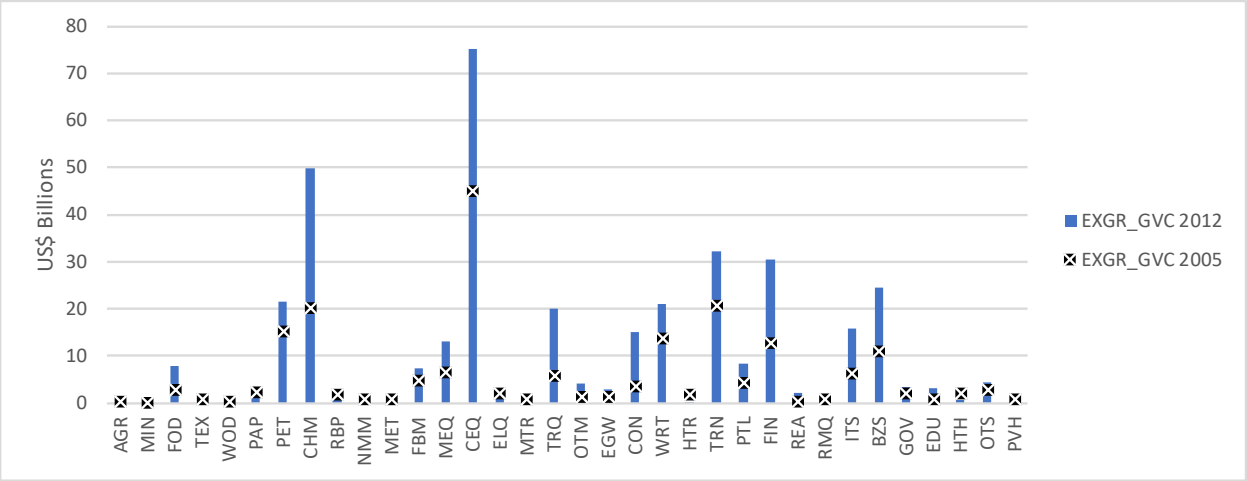


Figure 3.17.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, Singapore

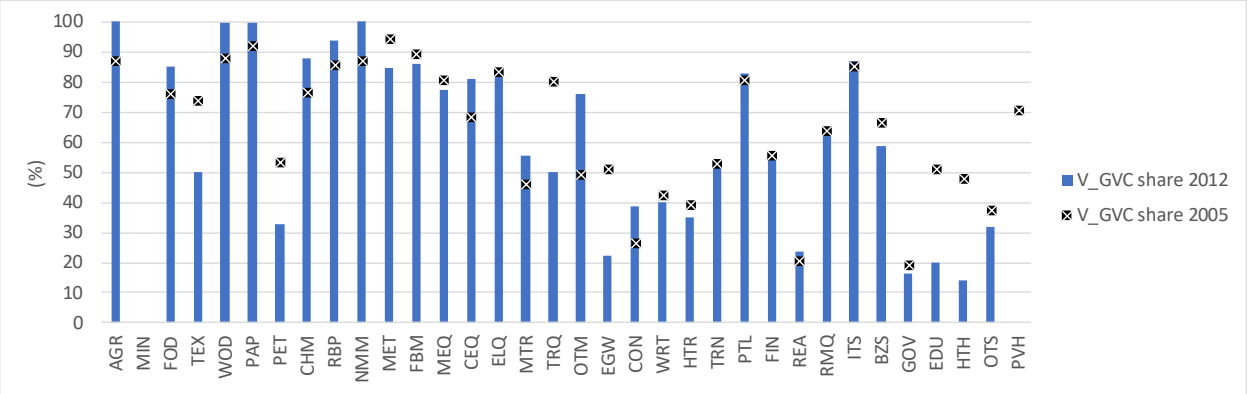
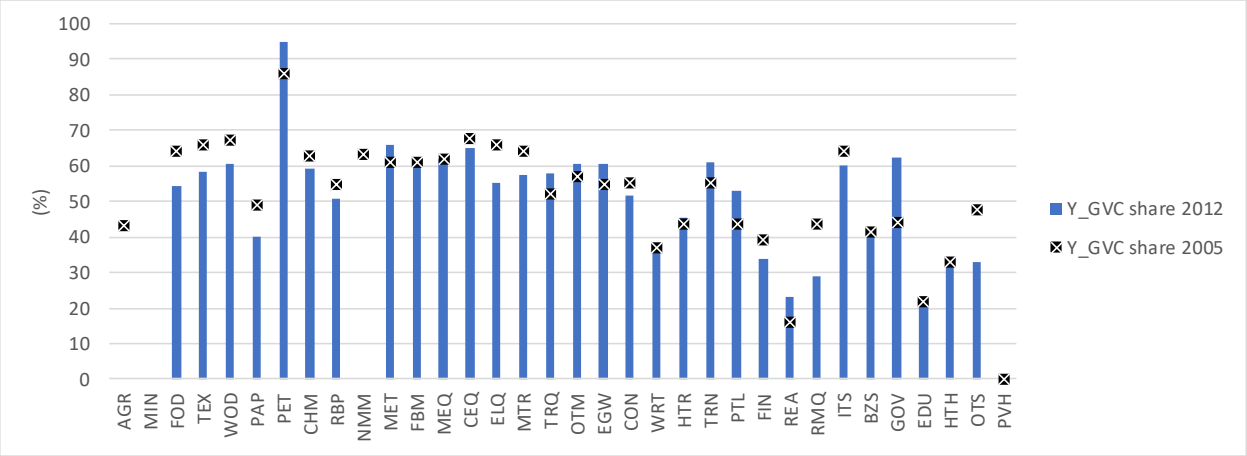


Figure 3.17.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, Singapore



Value Added Trade and Top APEC Trading Partners

Value-added exports[185]

In 2012, Singapore had value-added exports of $195.7 billion, more than doubled from $91.6 billion in 2005. Wholesale and retail trade (WRT) topped all industries, accounting for 14.9 percent of Singapore's value-added exports in 2012. It was followed by finance and insurance (FIN, 13.6 percent), R&D and other business activities (BZS, 10.4 percent), transport and storage (TRN, 8.3 percent), and computer, electronic and optical equipment (CEQ, 8.6 percent). The industries experiencing the largest increase in value-added exports during this period were WRT, FIN, BZS, and construction (CON). Value-added exports of most other services industries also increased dramatically during the same period, also from a relatively lower based in 2005 (figure 3.17.7).

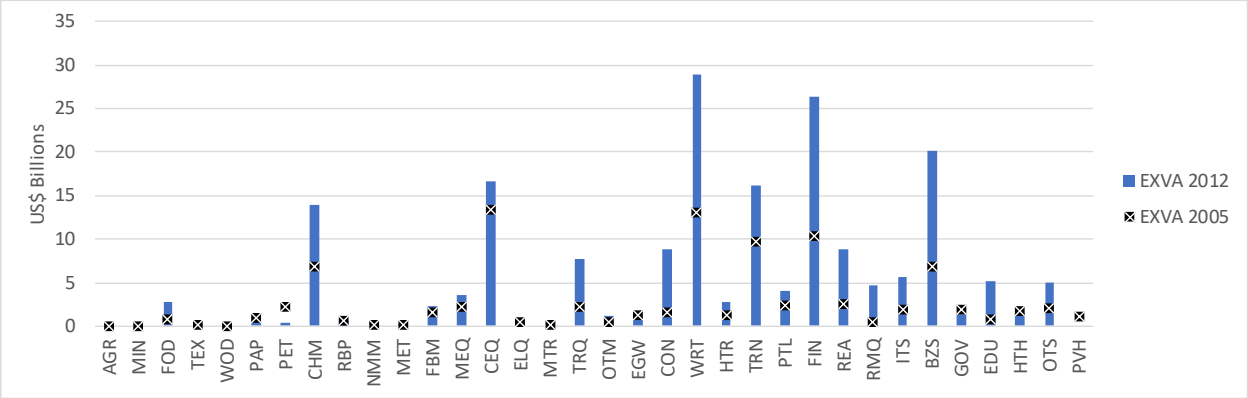
Value-added imports[186]

In 2012, Singapore had value-added imports of $125.8 billion, more than doubled from $53.4 billion in 2005. Mining (MIN) topped all industries, accounting for 17.3 percent of Singapore's value-added imports in 2012. It was followed by WRT (8.0 percent), TRN (6.4 percent) and FIN (6.3 percent). The industries that experienced the largest increases in value-added imports during this period were agriculture (AGR), MIN, and other Manufactures (OTM). Value-added imports of some services industries such as renting of machinery and equipment (RMQ), computer and related activities (ITS), and health and social work (HTH) also experience dramatic growth, though from a low based in 2005 (figure 3.17.8).

Top APEC Trading Partners

In 2012, in the APEC region, China; the United States; Indonesia; Japan; and Korea were the top destinations for Singapore's value-added exports (figure 3.17.9), and China; the United States; Indonesia; Korea; and Malaysia were the top sources for Singapore's value-added imports (figure 3.17.10).

Figure 3.17.7 Value-added exports (EXVA), by industry, 2005 and 2012, Singapore



[185] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.
[186] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.17.8 Value-added imports (IMVA), by industry, 2005 and 2012, Singapore

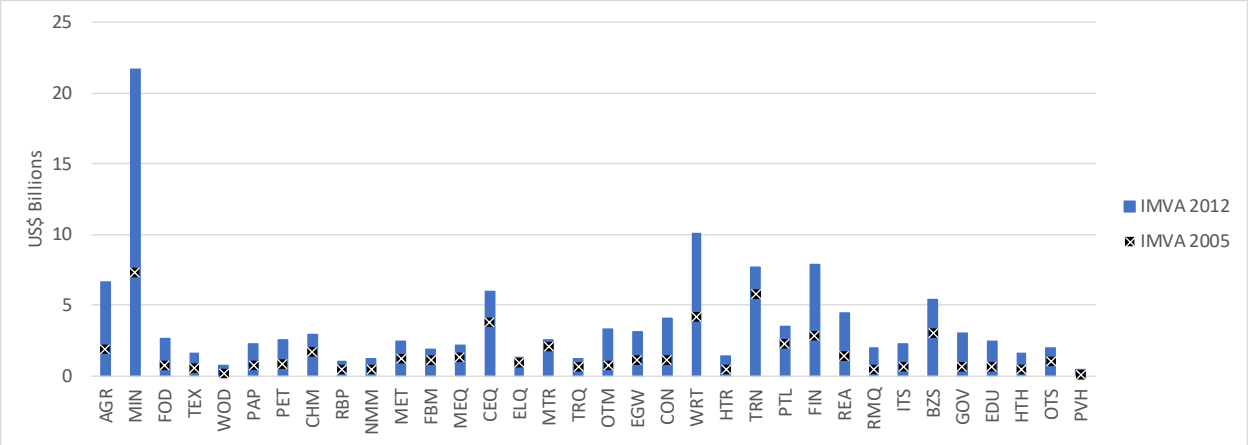


Figure 3.17.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, Singapore

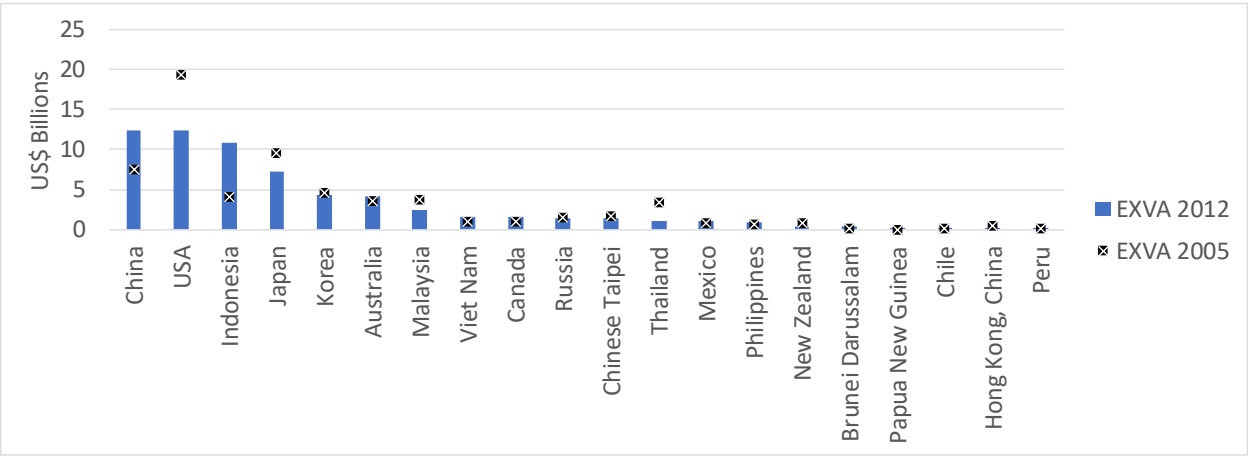
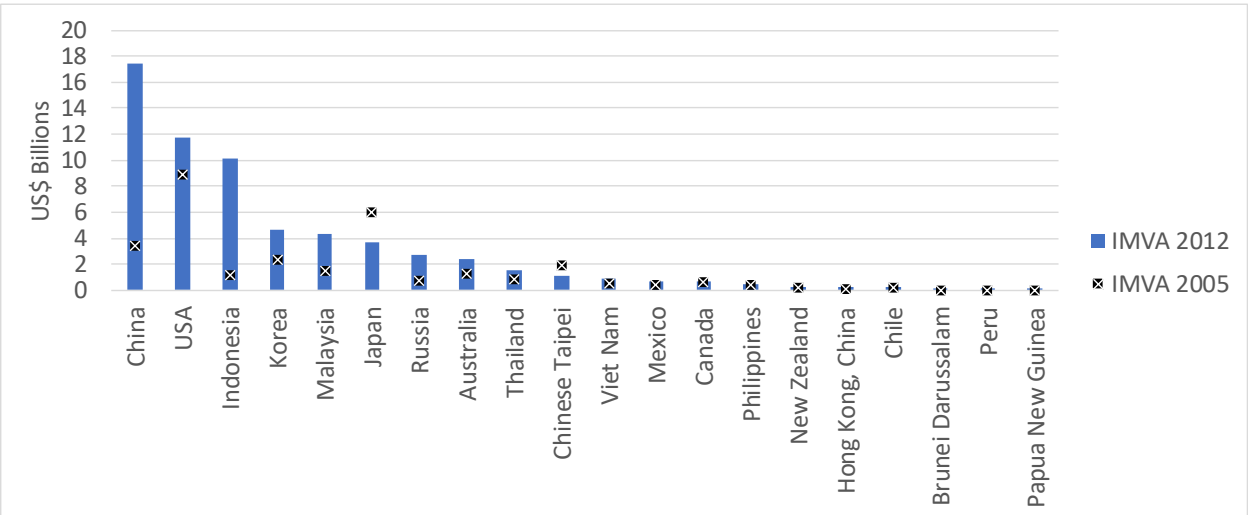


Figure 3.17.10 APEC sources of value-added imports (IMVA), 2005 and 2012, Singapore



Chapter 18: Chinese Taipei

Industry Data Summary Based on SUTs

Gross Output[187]

In 2012, Chinese Taipei's total gross output was $1.2 trillion, increasing by 42.4 percent from $829.7 billion in 2005. Manufacturing and services sectors accounted for 53.9 percent and 38.3 percent of Chinese Taipei's total gross output, respectively.[188]

Of the 34 industries, computer, electronic and optical equipment (CEQ) has the largest industry gross output of $195.7 billion, a 55.6 percent increase from its 2005 level, and accounting for 16.6 percent of Chinese Taipei's total gross output. Other top industries included wholesale and retail trade (WRT, 10.0 percent), coke, petroleum products, and nuclear fuel (PET, 8.5 percent), and basic metals (MET, 5.6 percent) (figure 3.18.1).

Value Added[189]

In 2012, Chinese Taipei's total value added, or GDP, was $476.6 billion, increasing from $360.3 billion in 2005. As a services-oriented economy, services sectors together accounted for 68.4 percent of Chinese Taipei's total GDP, followed by manufacturing with a share of 29.8 percent.

The industries with the largest contributions to total GDP were WRT (17.4 percent of total GDP), CEQ (13.6 percent), real estate activities (REA, 8.8 percent), and public administration and defense, compulsory social security (GOV, 7.6 percent) (figure 3.18.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by Chinese Taipei's industries in 2012, 28.5 percent were imported, a slight increase from 26.8 percent in 2005, and well above the average of 13.8 percent in the APEC region. The industries with the highest imported intermediate use intensity (IIUI) were electricity, gas, and water supply (EGW, 71.2 percent), PET (57.0 percent), and agriculture, hunting, forestry and fishing (AGR, 36.7 percent).

The average IIUI rate in Chinese Taipei's manufacturing sector was 25.5 percent in 2012. Most manufacturing industries in Chinese Taipei had a small change in IIUI during this period. The most notable exception was PET, decreasing by 39.5 percent; electrical machinery and apparatus (ELQ), decreasing by 20.6 percent; fabricated metal products (FBM), decreasing by 16.9 percent; and CEQ, decreasing by 14.3 percent. On the other spectrum, other manufacturing (OTM) and other non-metallic mineral products (NMM) experienced notable increases in IIUI.

Compare to manufacturing sector, the average IIUI rates in services sector was lower at 16.8 percent. Similarly, most services industries in Chinese Taipei did not experience large changes in IIUI during this period. The notable exceptions were transport and storage (TRN), increasing by 131.5 percent; computer and related activities (ITS}, increasing by 50.3 percent; and electricity, gas, and water supply (EGW), increasing by 46.8 percent (figure 3.18.3).

[187] Based on the supply tables at basic price, which could differ from the official NA data.
[188] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[189] Based on the use tables at basic price, which could differ from the official NA data.

Figure 3.18.1 Gross output, by industry, 2005 and 2012, Chinese Taipei

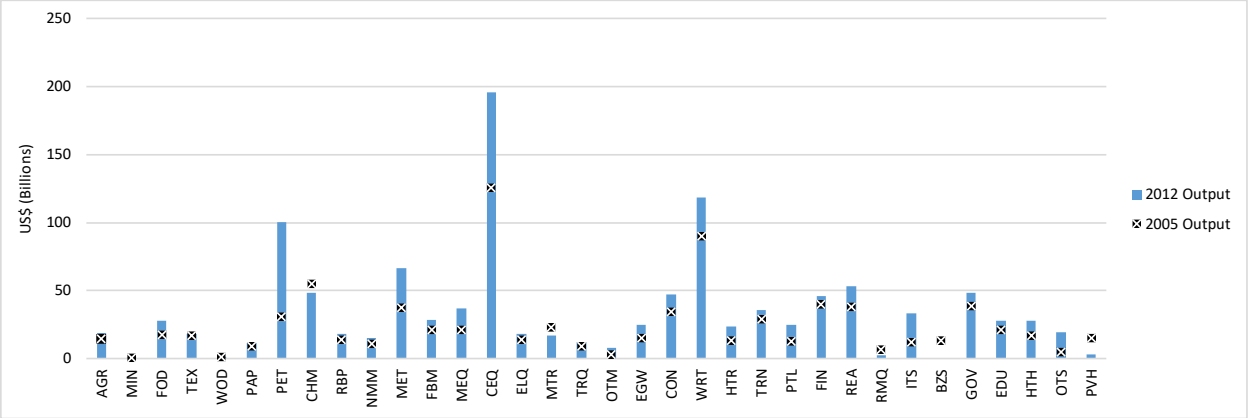


Figure 3.18.2 Value added (VA), by industry, 2005 and 2012, Chinese Taipei

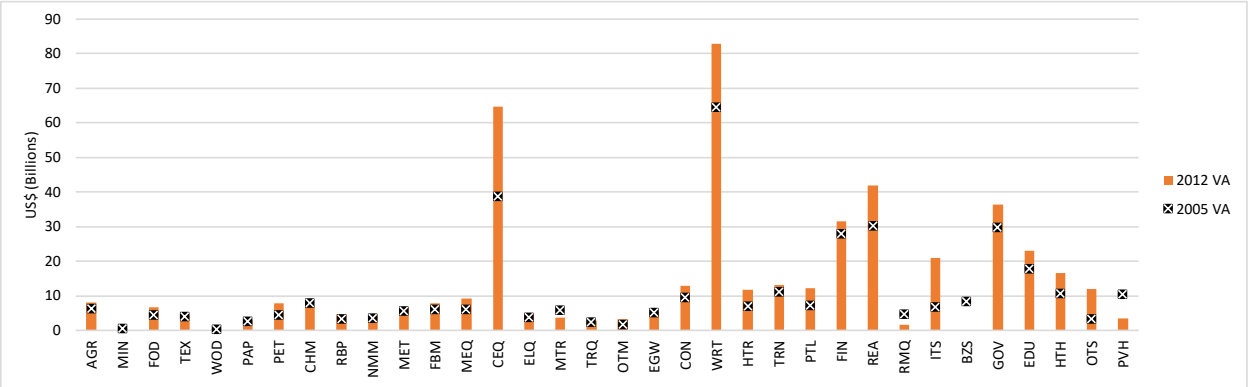
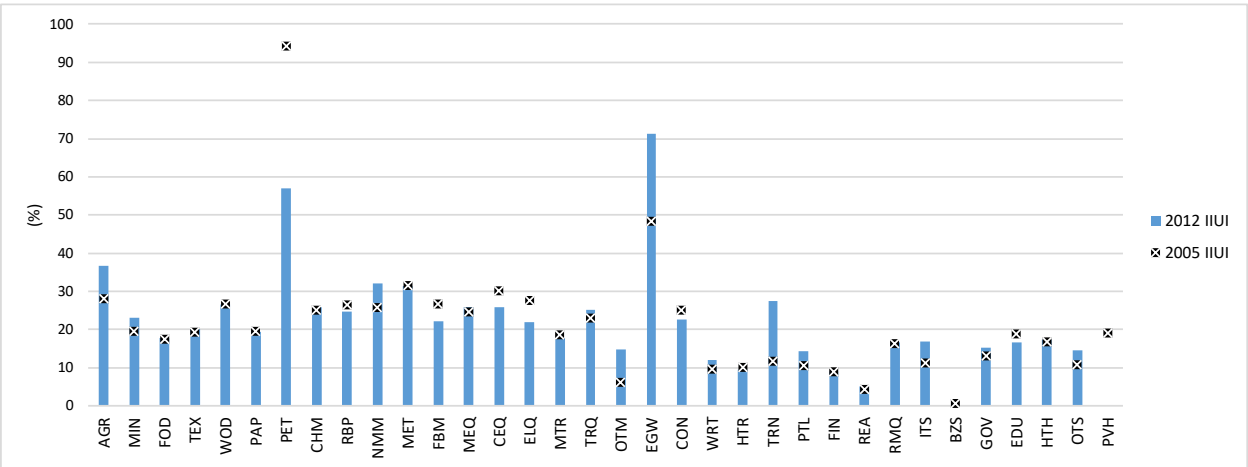


Figure 3.18.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, Chinese Taipei



Selected APEC TiVA Measures[190]

GVC-Related Trade and GVC Participations

GVC-Related Trade[191]

In 2012, Chinese Taipei's GVC-related trade amounted to $253.9 billion, increasing by 58.6 percent from $160.1 billion in 2005, and accounting for 84.4 percent of Chinese Taipei's gross exports. About 72.6 percent of GVC-related trade was in the form of complex GVCs. Computer, electronic and optical equipment (CEQ) topped all industries, accounting for 33.9 percent of Chinese Taipei's GVC-related trade. It was followed by coke, refined petroleum products and nuclear fuel (PET, 11.8 percent), and transport and storage (TRN, 9.4 percent) (figure 3.18.4).

Forward GVC Participation[192]

Chinese Taipei's forward GVC participation rate increased from 21.0 percent in 2005 to 24.9 percent in 2012, above the APEC average of 13.8 percent. The complex forward GVC participation rate increased from 7.8 percent to 10.3 percent during this period. The industries with the highest forward GVC participation rates in 2012 were coke, refined petroleum products and nuclear fuel (PET) at 66 percent, followed by transport and storage (TRN) at 64.8 percent, agriculture (AGR) at 61.7 percent (figure 3.18.5).

Backward GVC Participation[193]

Chinese Taipei's backward GVC participation rate increased from 24.8 percent in 2005 to 27.2 percent in 2012, far above the APEC average of 12.7 percent. The complex backward GVC participation rate increased from 9.5 percent to 12.4 percent during this period. The industries with the highest backward GVC participation rates in 2012 were PET at 83.5 percent, electricity, gas, and water (EGW) at 74.5 percent, chemicals (CHM) at 68.3 percent, basic metals (MET) at 66.7 percent (figure 3.18.6).

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[190] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[191] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[192] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[193] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.18.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, Chinese Taipei

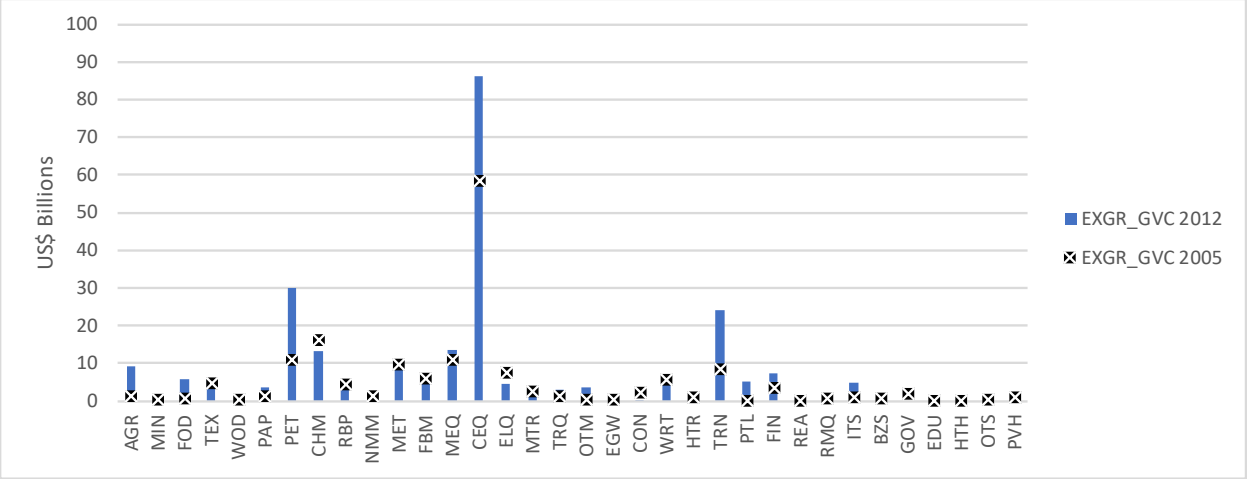


Figure 3.18.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, Chinese Taipei

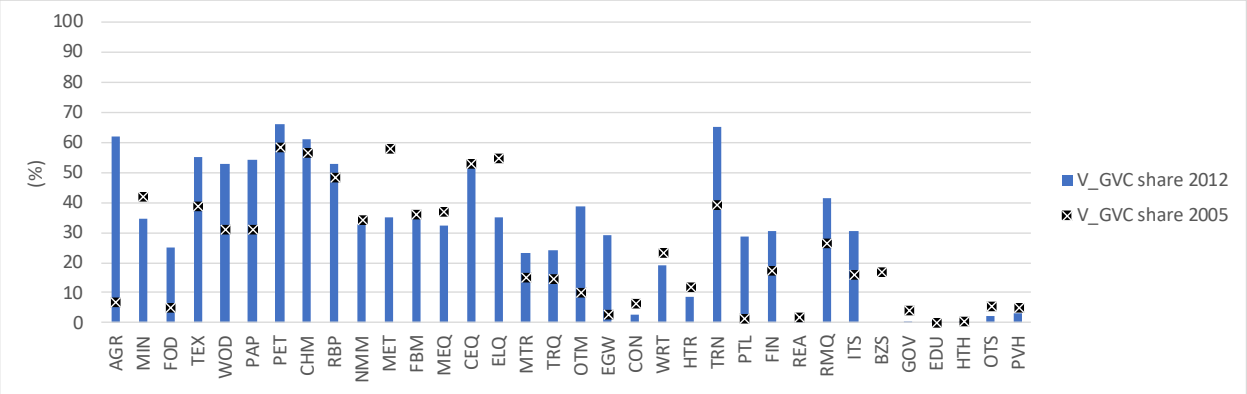
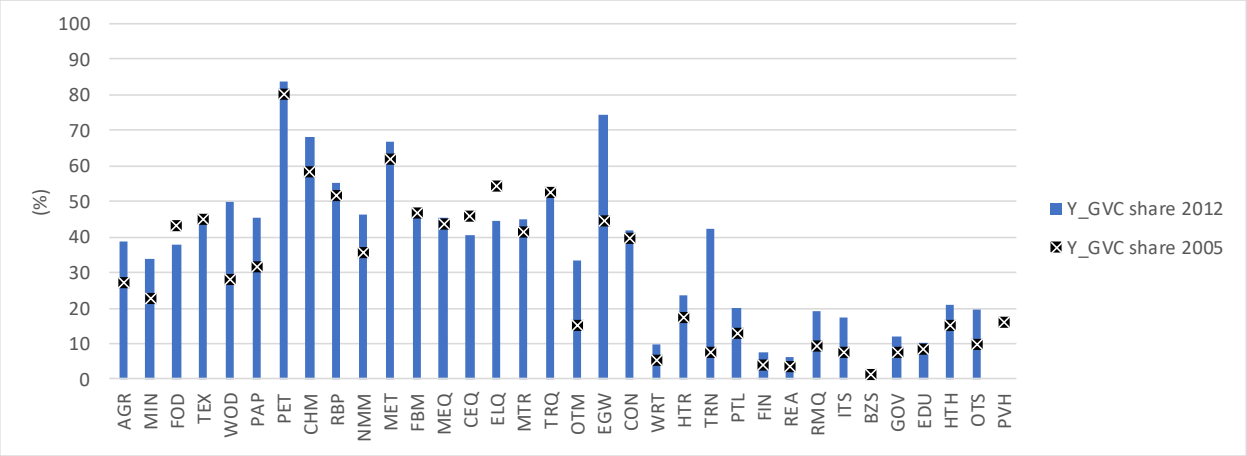


Figure 3.18.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, Chinese Taipei



Value Added Trade and Top APEC Trading Partners

Value-added exports[194]

In 2012, Chinese Taipei had value-added exports of $165.3 billion, increasing by 47.5 percent from $112.1 billion in 2005. Computer, electronic, and optical equipment (CEQ) topped all industries, accounting for 27.7 percent of Chinese Taipei's value-added exports in 2012. It was followed by wholesale and retail trade (WRT, 12.9 percent), finance and insurance (FIN, 9.5 percent), transport and storage (TRN, 5.8 percent) and computer and related activities (ITS, 5.0 percent). CEQ, FIN, and ITS also had the largest increases in value-added exports during this period (figure 3.18.7).

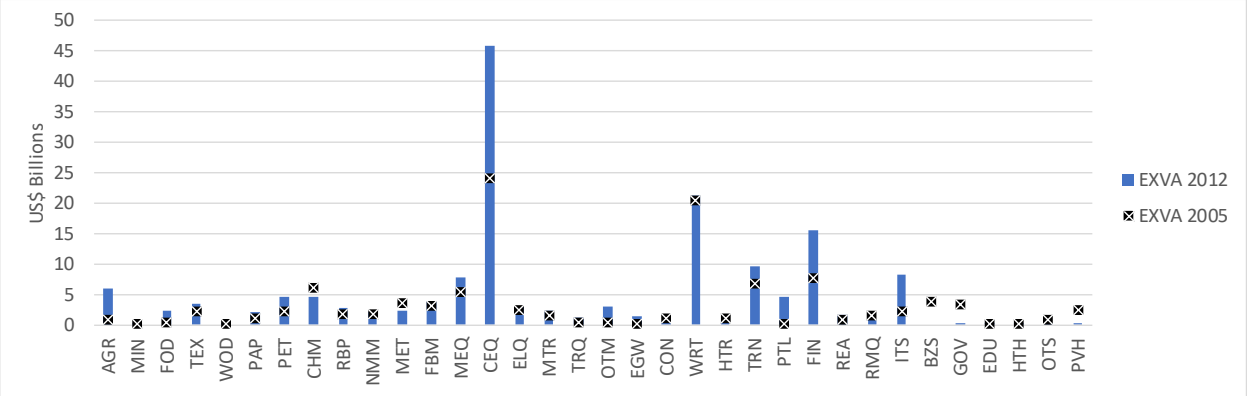
Value-added imports[195]

In 2012, Chinese Taipei had value-added imports of $128.4 billion, increasing from $96.4 billion in 2005. Mining (MIN) topped all industries, accounting for 11.9 percent of Chinese Taipei's value-added imports in 2012. It was followed by WRT (8.6 percent), agriculture (ARG, 6.5 percent), TRN (6.1percent) and FIN (6.0 percent). The industries that experienced the largest increases in value-added imports during this period were MIN, WRT, FIN and education (EDU) (figure 3.18.8).

Top APEC Trading Partners

In 2012, in the APEC region, China; the United States; Japan; Korea; and Thailand were the top destinations for Chinese Taipei's value-added exports (figure 3.18.9), and China; Japan; the United States; Australia; and Indonesia were the top sources for Chinese Taipei's value-added imports (figure 3.18.10).

Figure 3.18.7 Value-added exports (EXVA), by industry, 2005 and 2012, Chinese Taipei



[194] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.
[195] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.18.8 Value-added imports (IMVA), by industry, 2005 and 2012, Chinese Taipei

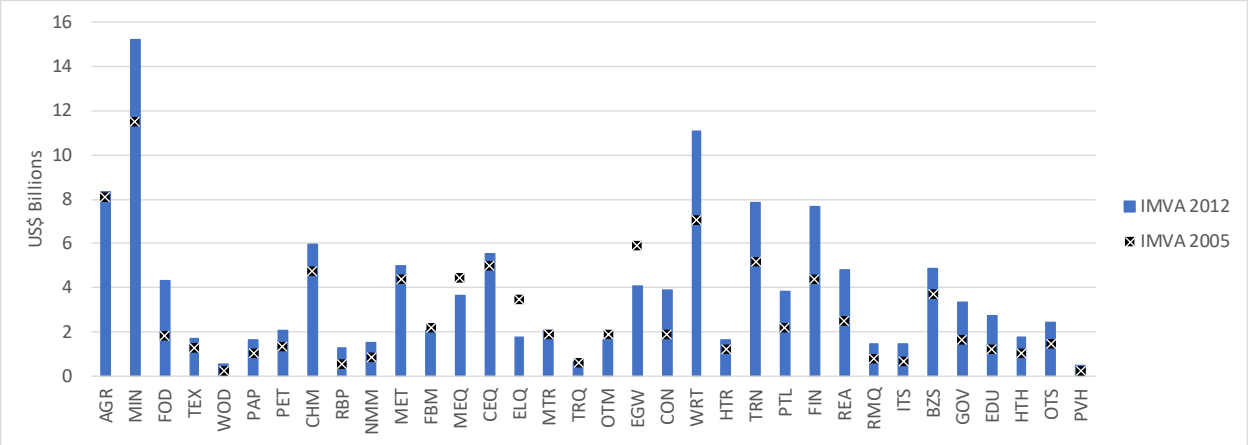


Figure 3.18.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, Chinese Taipei

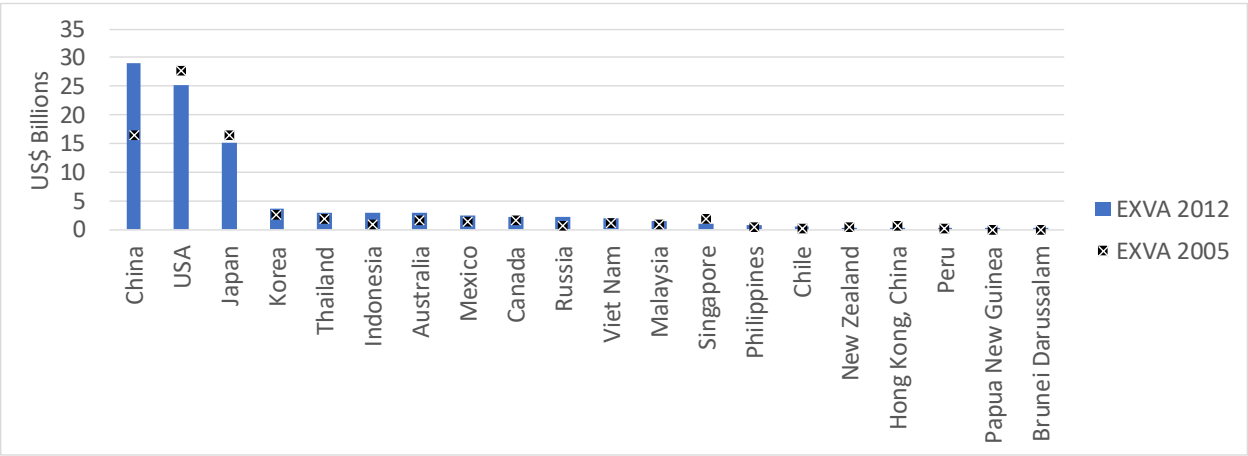
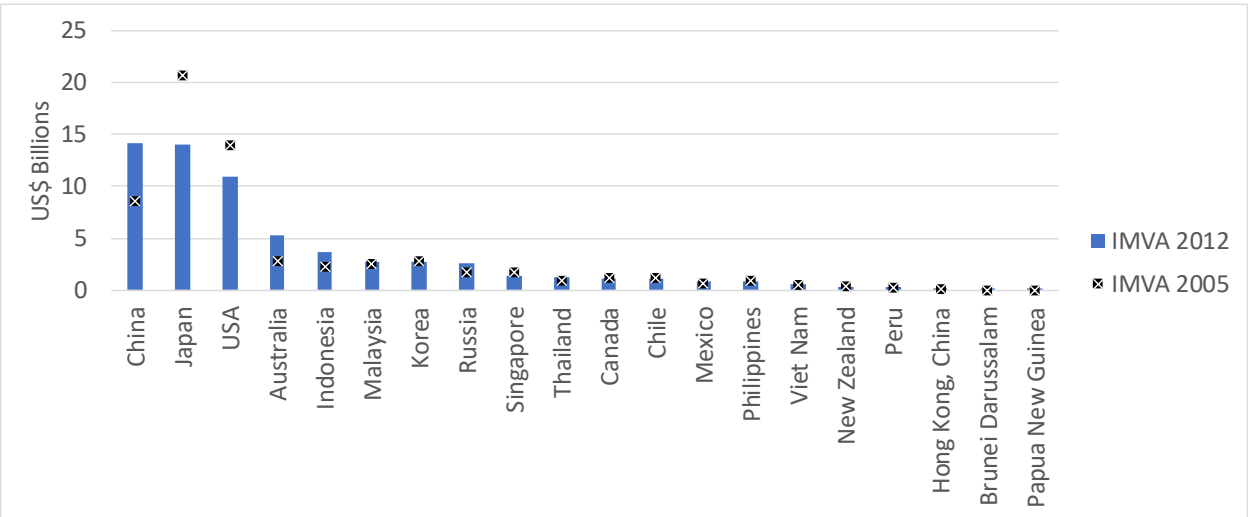


Figure 3.18.10 APEC sources of value-added imports (IMVA), 2005 and 2012, Chinese Taipei



Chapter 19: Thailand

Industry Data Summary Based on SUTs

Gross Output[196]

In 2012, Thailand's total gross output was $978.8 billion, more than doubling from $472.4 billion in 2005. Manufacturing and services sectors accounted for 45.5 percent and 46.8 percent of Thailand's total gross output, respectively.[197]

Of the 34 industries, wholesale and retail trade (WRT) had the largest industry gross output of $108.3 billion, a threefold increase from its 2005 level, and accounting for 11.1 percent of Thailand's total gross output. Other top industries included computer, electronic and optical equipment (CEQ, 8.6 percent), food products, beverages, and tobacco (FOD, 7.8 percent), agriculture, hunting, forestry and fishing (AGR, 6.2 percent), and motor vehicles, trailers and semi-trailers (MTR, 5.5 percent) (figure 3.19.1).

Value Added[198]

In 2012, Thailand's total value added, or GDP, was $350.4 billion, increasing from $189.3 billion in 2005. Services sectors together accounted for 62.0 percent of Thailand's total GDP, followed by manufacturing with a share of 25.8 percent, and agriculture with a share of 11.6 percent.

The industries with the top contribution to total GDP were WRT (17.0 percent of total GDP), AGR (11.6 percent), GOV (6.1 percent), and finance and insurance (FIN, 5.5 percent).

The largest manufacturing industries in terms of value added were MTR (5.4 percent of total GDP), electrical machinery and apparatus (ELQ, 3.4 percent), and CEQ (3.0 percent) (figure 3.19.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by Thai industries in 2012, about 30.1 percent came from the imported source, well above the average of 13.8 percent in the APEC region, and a significant increase from 16.6 percent in 2005. The industries with the highest imported intermediate use intensity (IIUI) rates were PET (70.7 percent); ELQ (52.5 percent); basic metals (MET, 48.9 percent), chemicals (CHM, 46.3 percent), MTR (42.9 percent), and CEQ (42.0 percent).

The average IIUI rate of manufacturing sector in Thailand was 37.3 percent in 2012, increasing from 18.5 percent in 2005. All manufacturing industries in Thailand experienced an increase in IIUI during this period. Of them, the most notable were MET, increasing by 687.7 percent; fabricated metal products (FBM), increasing by 589.8 percent; ELQ, increasing by 315.5 percent; MTR, increasing by 283.3 percent; machinery and equipment (MEQ), increasing by 252.6 percent; and CEQ, increasing by 246.3 percent.

The average IIUI rate of services sector in Thailand was 19.3 percent in 2012, increasing from 11.7 percent in 2005. All reported services industries also experienced an increase in IIUI during this period. Among the most notables were construction (CON), renting of machinery and equipment (RMQ), R&D and other business activities (BZS), and WRT (figure 3.19.3).

[196] Based on the supply tables at basic price, which could differ from the official NA data.
[197] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[198] Based on the use tables at basic price, which could differ from the official NA data.

Figure 3.19.1 Gross output, by industry, 2005 and 2012, Thailand

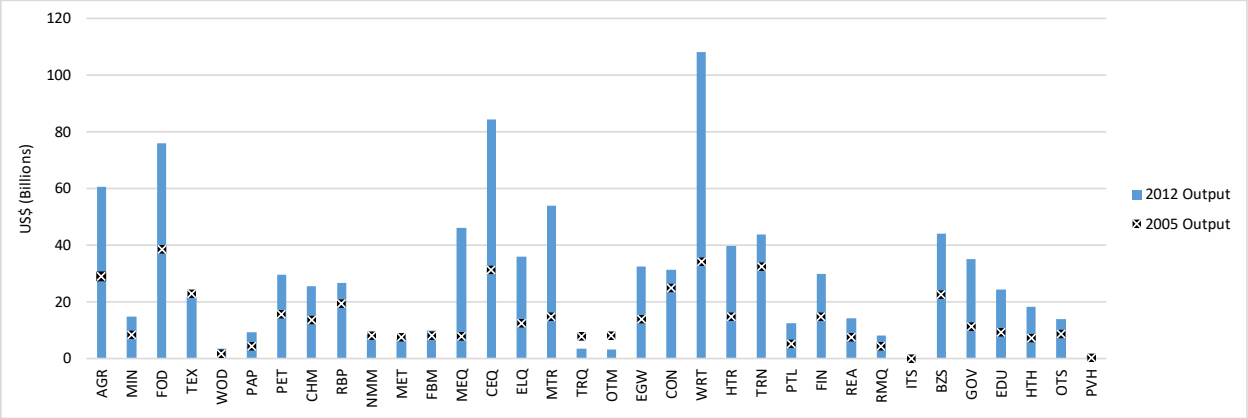


Figure 3.19.2 Value added (VA), by industry, 2005 and 2012, Thailand

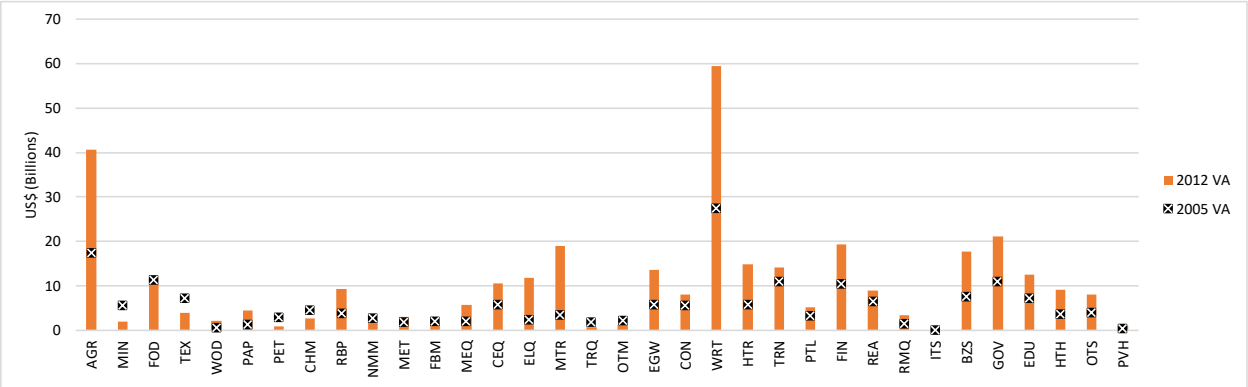
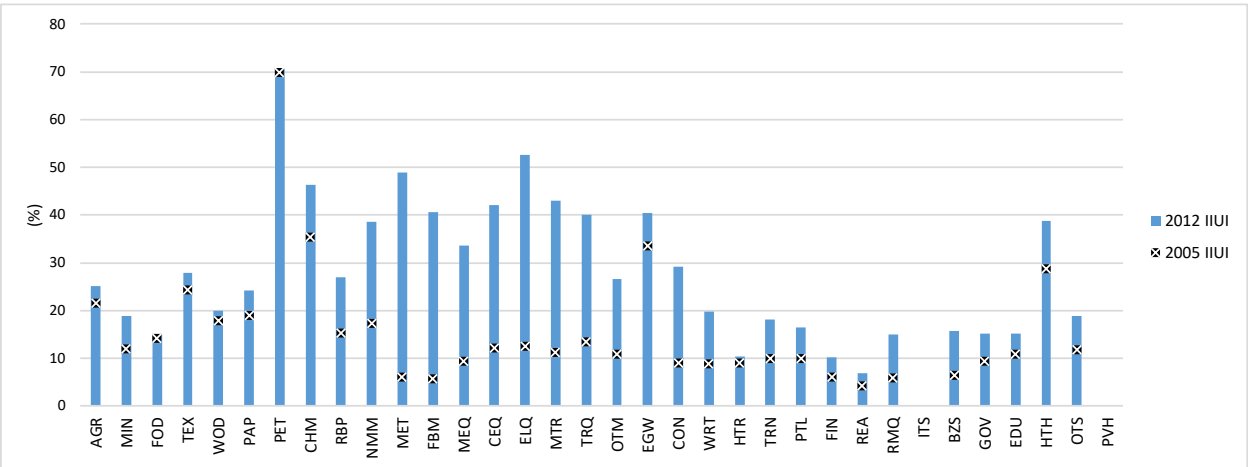


Figure 3.19.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, Thailand



Selected APEC TiVA Measures[199]

GVC-Related Trade and GVC Participations

GVC-Related Trade[200]

In 2012, Thailand's GVC-related trade amounted to $233.3 billion, more than doubled from $99.1 billion in 2005, and accounting for 87.7 percent of Thailand's gross exports. About 65.4 percent of GVC-related trade was in the form of complex GVCs. Motor vehicles, trailers and semi-trailers (MTR) topped all industries, accounting for 18 percent of Thailand's GVC-related trade. It was followed by computer, electronic and optical equipment (CEQ, 10.9 percent), and agriculture (AGR, 10.2 percent) (figure 3.19.4).

Forward GVC Participation[201]

Thailand's forward GVC participation rate increased from 30.8 percent in 2005 to 32.7 percent in 2012, far above the APEC average of 13.8 percent. The complex forward GVC participation rate decreased slightly from 11.2 percent to 11.0 percent during this period. The industries with the highest forward GVC participation rates in 2012 were MTR and other transport equipment (TRQ), both at 85.3 percent. They were followed by Chemical products (CHM, 76.3 percent) and Mining (MIN, 72.1 percent) (figure 3.19.5).

Backward GVC Participation[202]

Thailand's backward GVC participation rate increased from 29.9 percent in 2005 to 32.6 percent in 2012, far above the APEC average of 12.7 percent. The complex backward GVC participation rate increased from 13.8 percent to 14.7 percent during this period. The industries with the highest backward GVC participation rates in 2012 were coke, refined petroleum products and nuclear fuel (PET) at 81.5 percent, followed by CHM at 63.9 percent, CEQ at 60.5 percent, Machinery and equipment (MEQ) at 55.5 percent and Fabricated metal products (FBM) at 51.6 percent (figure 3.19.6).

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[199] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[200] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[201] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[202] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.19.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, Thailand

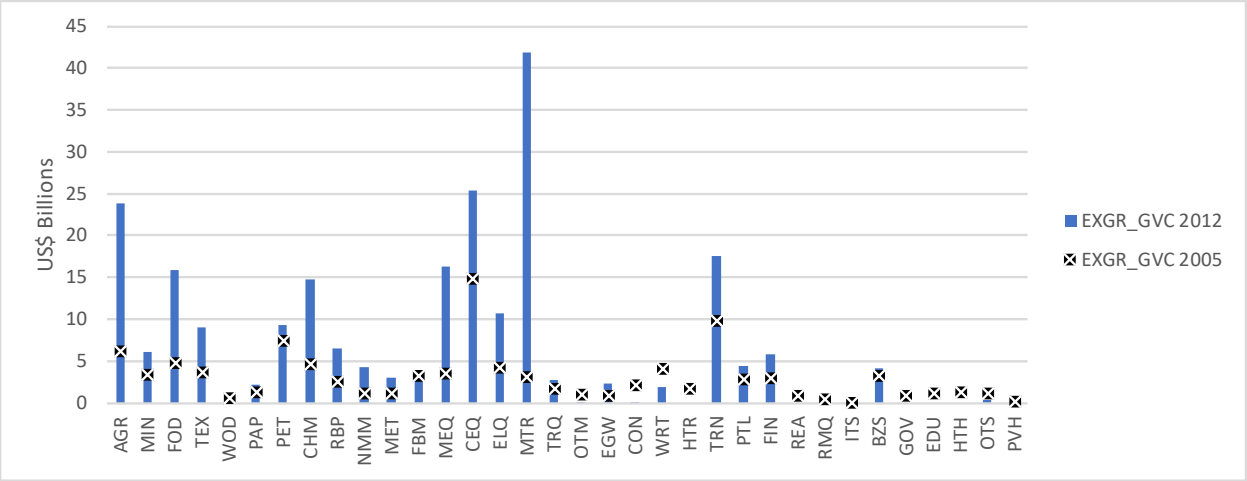


Figure 3.19.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, Thailand

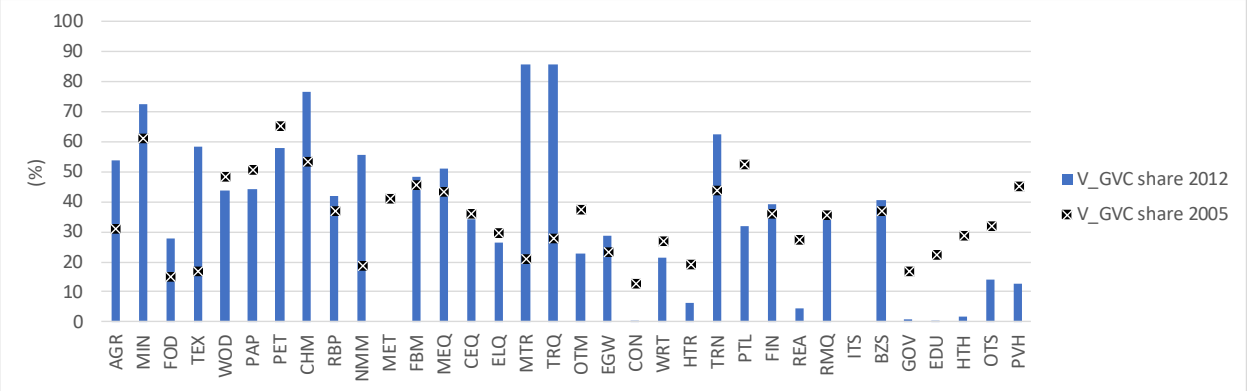
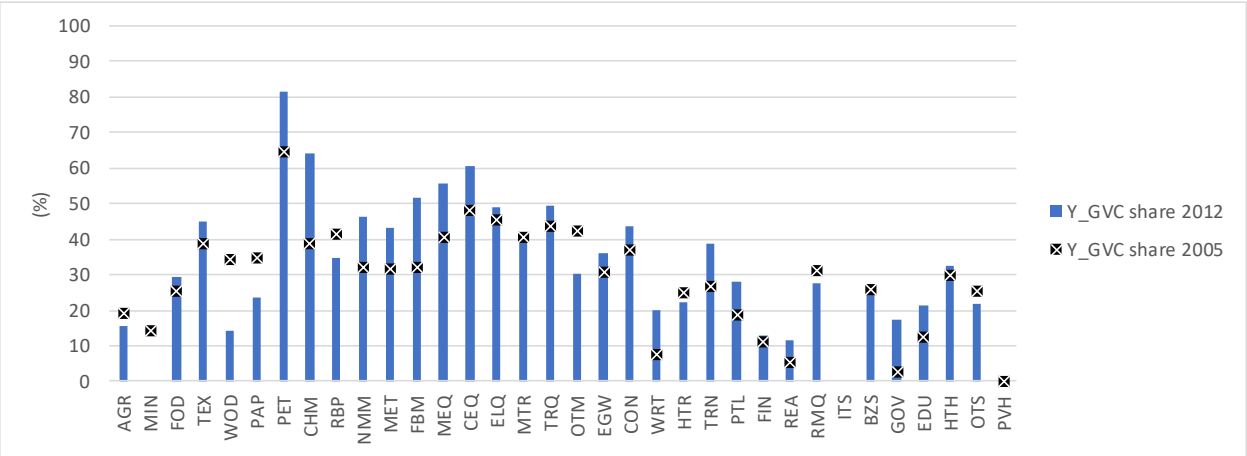


Figure 3.19.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, Thailand



Value Added Trade and Top APEC Trading Partners

Value-added exports[203]

In 2012, Thailand had value-added exports of $153.4 billion, increasing by 83.2 percent from $83.7 billion in 2005. Agriculture (AGR) topped all industries, accounting for 16.2 percent of Thailand's

[203] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.

value-added exports in 2012. It was followed by motor vehicles trailers and semi-trailers (MRT) at 12.8 percent, wholesale and retail trade (WRT, 10.4 percent), transport and storage (TRN, 7.4 percent) and finance and insurance (FIN, 7.3 percent). AGR and MTR also had the largest increases in value-added exports during this period (figure 3.19.7).

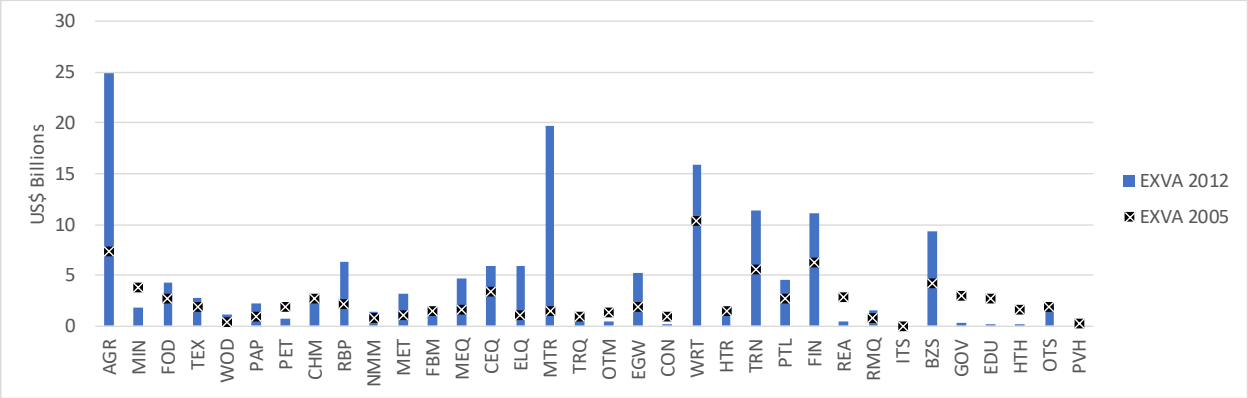
Value-added imports[204]

In 2012, Thailand had value-added imports of $144.7 billion, increasing from $84.2 billion in 2005. WRT topped all industries, accounting for 9.2 percent of Thailand's value-added imports in 2012. It was followed by mining (MIN, 8.8 percent), CEQ (7.1 percent) and transport and storage (TRN, 7.0 percent). The industries that experienced the largest increases in value-added imports during this period were ARG, MIN, CEQ, WRT, Machinery and equipment (MEQ) and some services industries such as finance and insurance (FIN) and education (EDU) (figure 3.19.8).

Top APEC Trading Partners

In 2012, in the APEC region, the United States; China; Japan; Australia; and Indonesia were the top destinations for Thailand's value-added exports (figure 3.19.9), and Japan; China; the United States; Malaysia; and Indonesia were the top sources for Thailand's value-added imports (figure 3.19.10).

Figure 3.19.7 Value-added exports (EXVA), by industry, 2005 and 2012, Thailand



[204] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.19.8 Value-added imports (IMVA), by industry, 2005 and 2012, Thailand

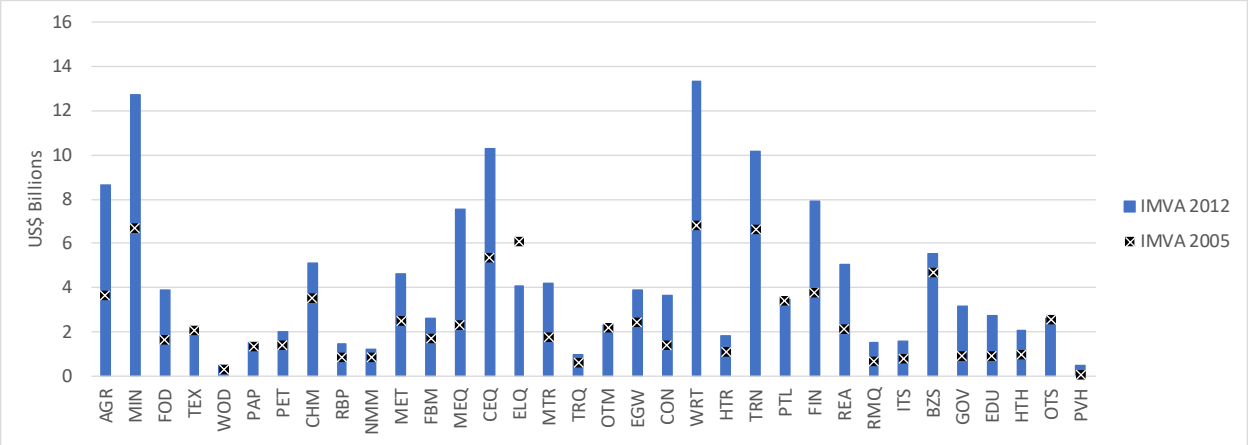


Figure 3.19.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, Thailand

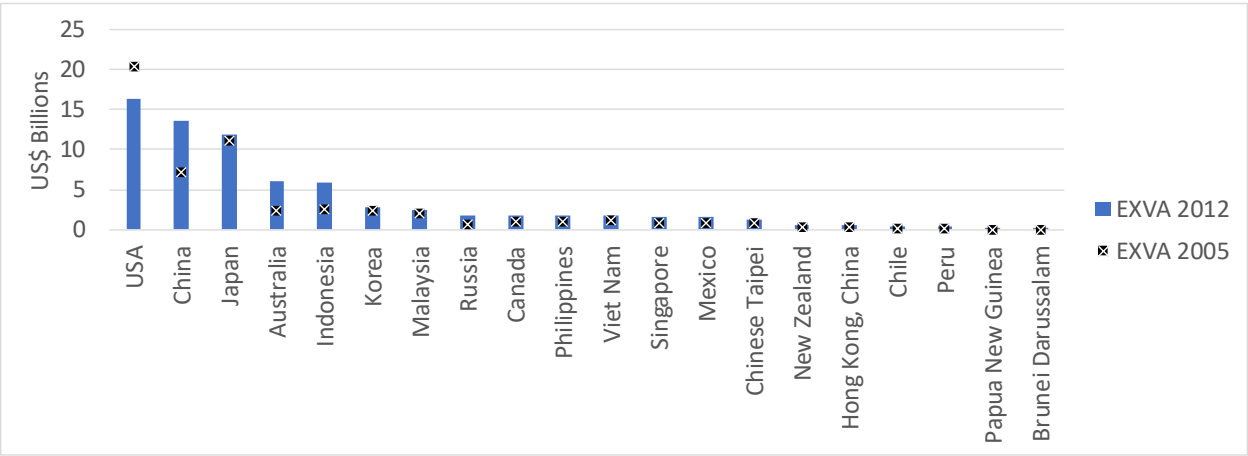
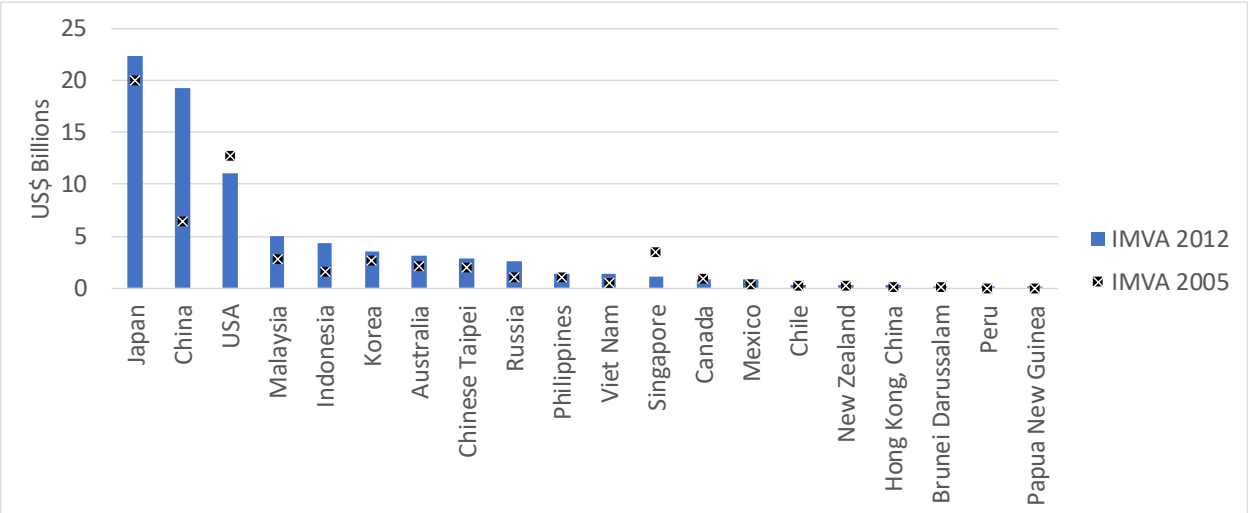


Figure 3.19.10 APEC sources of value-added imports (IMVA), 2005 and 2012, Thailand



Chapter 20: The United States

Industry Data Summary Based on SUTs

Gross Output[205]

In 2012, U.S. total gross output was $28.2 trillion, increasing by 22.0 percent from $23.1 trillion in 2005. Manufacturing and services sectors accounted for 21.7 percent and 74.7 percent of U.S. total gross output, respectively.[206]

Of the 34 industries, wholesale and retail trade (WRT) had the largest industry gross output of $2.7 trillion, accounting for 9.7 percent of U.S. total gross output. Other top industries included R&D and other business activities (BZS, 9.4 percent), real estate activities (REA, 9.1 percent), public administration and defense, compulsory social security (GOV, 8.7 percent), and health and social work (HTH, 7.0 percent) (figure 3.20.1).

Value Added[207]

In 2012, U.S. total value added, or GDP, was $15.6 trillion, increasing from $12.7 trillion in 2005, making it the largest economy in the world and in the APEC region. Services sectors together accounted for 82.5 percent of U.S. total GDP, followed by manufacturing with a share of 13.8 percent.

The industries with the top contribution to total GDP were REA (12.3 percent of total GDP), WRT (10.6 percent), BZS (10.5 percent), GOV (9.4 percent), HTH (7.5 percent), and finance and insurance (FIN, 7.2 percent).

The largest manufacturing industries in terms of value added were chemicals (CHM, 2.2 percent of total GDP), pulp, paper, paper products, printing and publishing (PAP, 1.8 percent), and computer, electronic and optical equipment (CEQ, 3.0 percent) (figure 3.20.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by U.S. industries in 2012, about 11.7 percent were imported, a slight increase from 10.3 percent in 2005, but below the average of 13.8 percent in the APEC region. The industries with the highest imported intermediate use intensity (IIUI) rates were coke, refined petroleum products and nuclear fuel (PET, 50.0 percent); CEQ (23.3 percent); other transport equipment (TRQ, 23.0 percent); and motor vehicles, trailers and semi-trailers (MTR, 22.1 percent).

The average IIUI rate of manufacturing sector in the United States was 18.2 percent in 2012, increasing from 17.6 percent in 2005. Four manufacturing industries experienced a decrease in IIUI during this period. Of them, the most notable were wood products (WOD), decreasing by 19.4 percent; PET, decreasing by 13.2 percent; and other non-metallic mineral products (NMM), decreasing by 11.0 percent. The remaining manufacturing industries experienced an increase in IIUI during this period, such as textile, leather and footwear (TEX), increasing by 20.9 percent; rubber and plastic products (RBP), increasing by 19.9 percent; and machinery and equipment (MEQ), increasing by 19.7 percent.

The average IIUI rate of services sector in the United States was 7.9 percent in 2012, increasing from 6.9 percent in 2005. Almost all services industries experienced an increase in IIUI during this period. The notable exceptions were HTH and transport and storage (TRN), both decreasing by 6.6 percent (figure 3.20.3).

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[205] Based on the supply tables at basic price, which could differ from the official NA data.
[206] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[207] Based on the use tables at basic price, which could differ from the official NA data.

Figure 3.20.1 Gross output, by industry, 2005 and 2012, USA

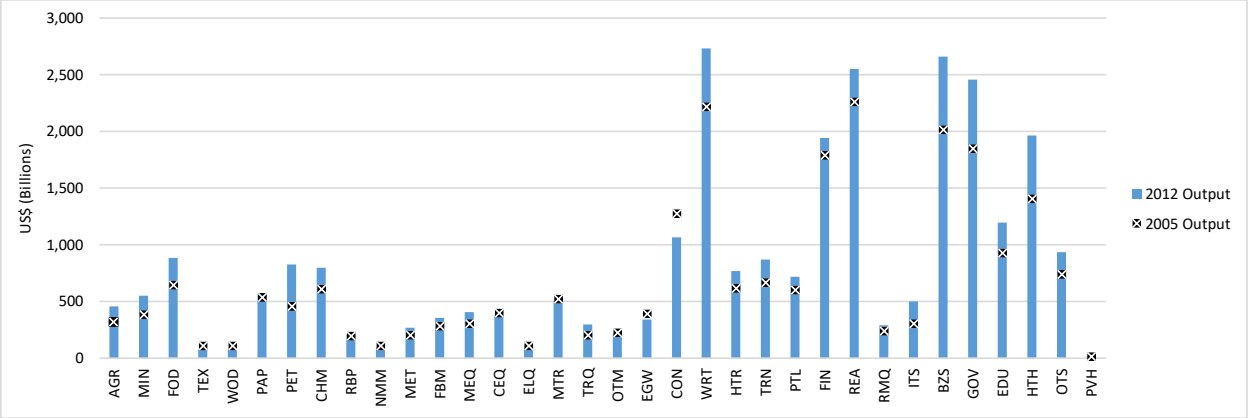


Figure 3.20.2 Value added (VA), by industry, 2005 and 2012, USA

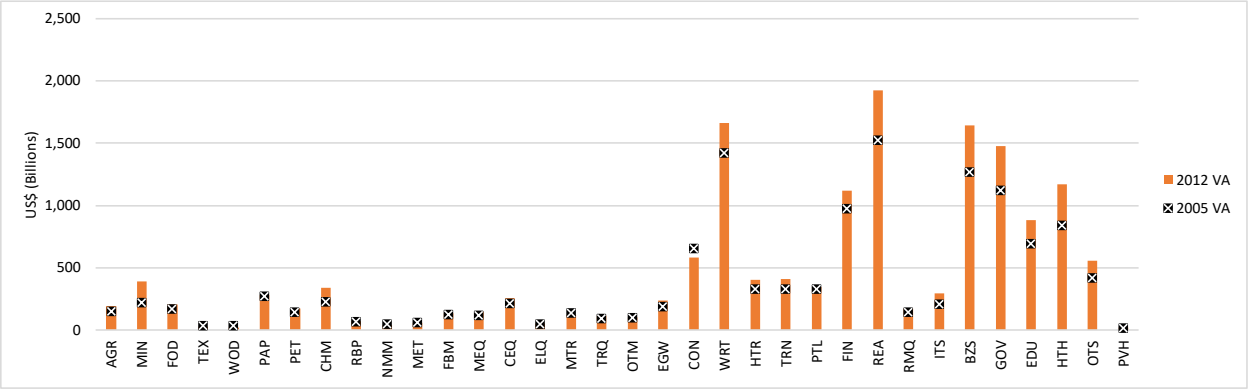
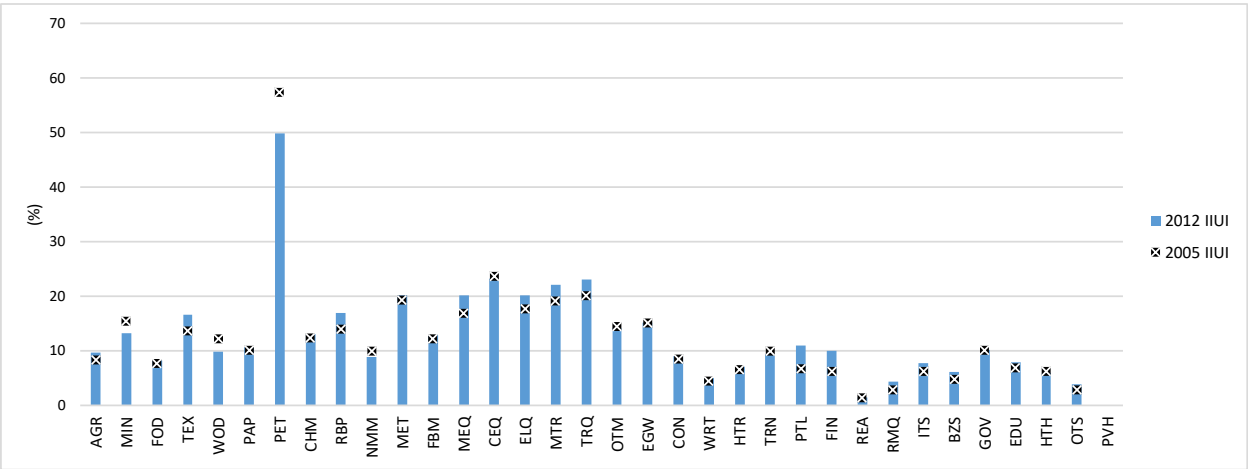


Figure 3.20.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, USA



Selected APEC TiVA Measures[208]

GVC-Related Trade and GVC Participations

GVC-Related Trade[209]

In 2012, U.S. GVC-related trade amounted to $1.8 trillion, increasing by 61.8 percent from $1.1 trillion in 2005, and accounting for 88.1 percent of U.S. gross exports. About 53.8 percent of GVC-related trade was in the form of complex GVCs. Several industries had GVC related exports that were over $100 billion: computer, electronic and optical equipment (CEQ), accounting for 7.2 percent of U.S. GVC-related trade; transport and storage (TRN, 7 percent); machinery and equipment (MEQ, 6.7 percent); finance and insurance (FIN, 6.5 percent); Chemical products (CHM, 6.4 percent) coke; refined petroleum products and nuclear fuel (PET, 6.3 percent); and R&D and other business activities (BZS, 5.9 percent) (figure 3.20.4).

Forward GVC Participation[210]

U.S. forward GVC participation rate increased from 6.9 percent in 2005 to 8.9 percent in 2012, below the APEC average of 13.8 percent. The complex forward GVC participation rate increased from 2.6 percent to 3.1 percent during this period. The industries with the highest forward GVC participation rates in 2012 were basic metals (MET) at 41.4 percent, electrical machinery and apparatus (ELQ, 39.3 percent), textile, leather, and footwear (TEX, 37.6 percent), CEQ (37.1 percent), and MEQ (30.5 percent) (figure 3.20.5).

Backward GVC Participation[211]

U.S. backward GVC participation rate increased from 8.0 percent in 2005 to 8.4 percent in 2012, below the APEC average of 12.7 percent. The complex backward GVC participation rate increased from 2.4 percent to 2.7 percent during this period. The industries with the highest backward GVC participation rates in 2012 were PET at 43.7 percent, motor vehicles (MTR, 27.2 percent), and MET (26 percent (figure 3.20.6).

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[208] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[209] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[210] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[211] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.20.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, USA

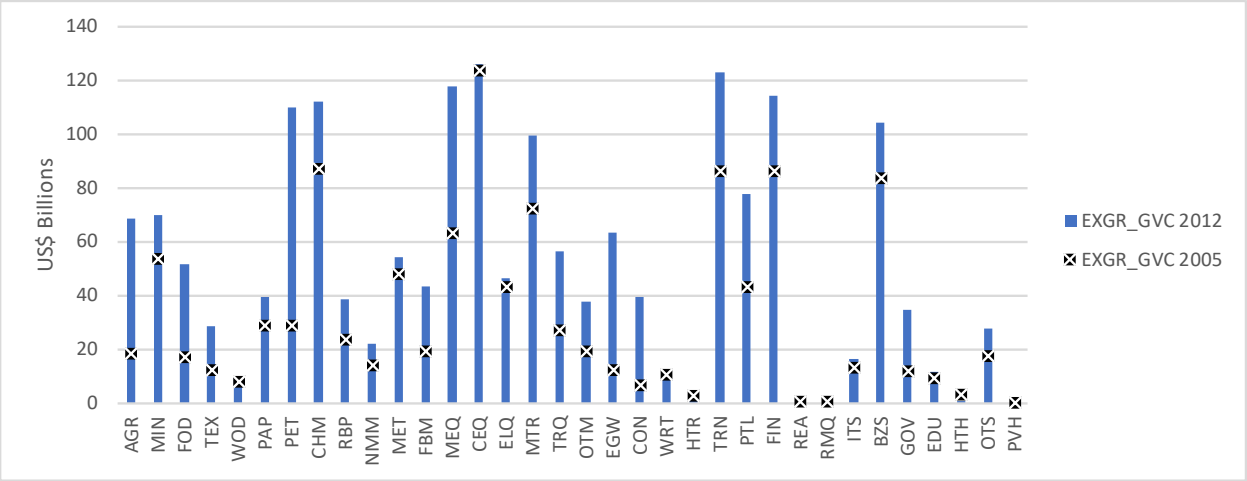


Figure 3.20.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, USA

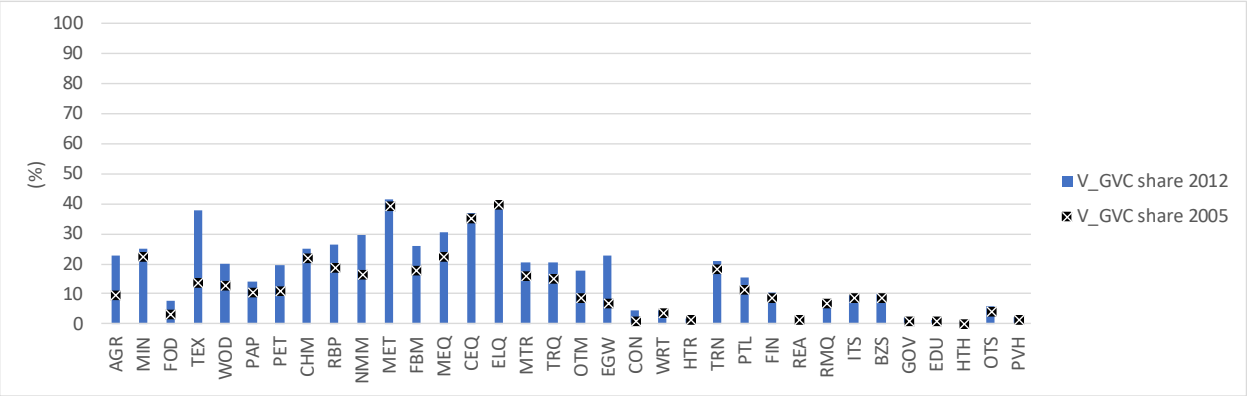
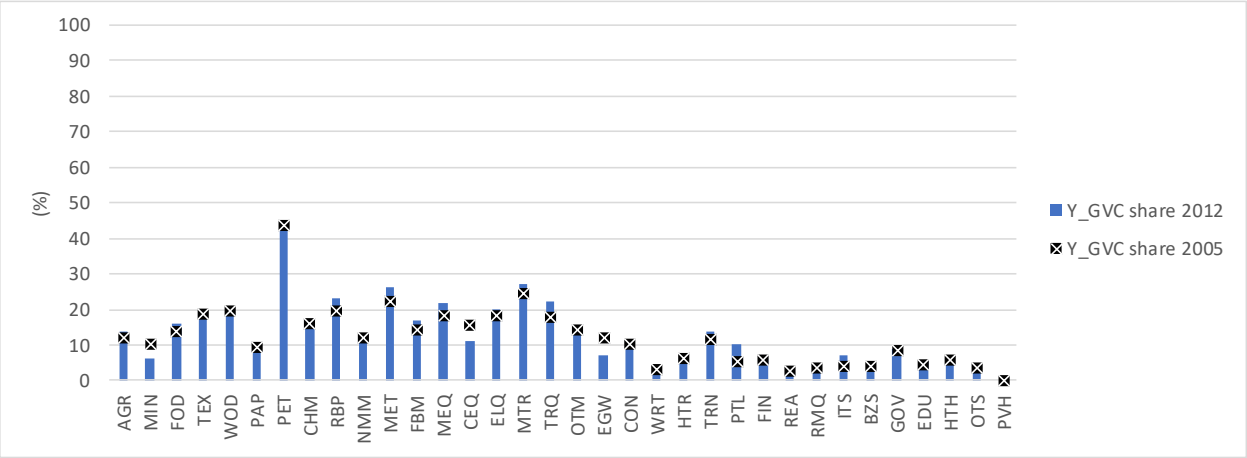


Figure 3.20.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, USA



Value Added Trade and Top APEC Trading Partners

Value-added exports[212]

In 2012, the United States had value-added exports of $1.5 trillion, increasing by 67.9 percent from $910.4 billion in 2005. R&D and other business activities (BZS) topped all industries, accounting for 12.2 percent of U.S. value-added exports in 2012. It was followed by finance and insurance (FIN, 7.7

[212] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.

percent), mining (MIN, 6.8 percent), and computer, electronic and optical equipment (CEQ, 6.5 percent), wholesale and retail trade (WRT) and transport and storage (TRN, both at 5.9 percent). BZS and MIN also had the largest increases in value-added exports during this period (figure 3.20.7).

Value-added imports[213]

In 2012, the United States had value-added imports of $2.1 trillion, increasing from $1.6 trillion in 2005. MIN topped all industries, accounting for 11.6 percent of U.S. value-added imports in 2012. It was followed by WRT (9.0 percent), TRN (6.0 percent) and FIN at 5.9 percent. The industries that experienced the largest increases in value-added imports during this period were AGR, WRT and renting of machinery and equipment (RMQ), and health and social work (HTH) (figure 3.20.8).

Top APEC Trading Partners

In 2012, in the APEC region, Canada; China; Mexico; Japan; and Korea were the top destinations for the United States' value-added exports (figure 3.20.9), and China; Canada; Japan; Mexico; and Korea were the top sources for the United States' value-added imports (figure 3.20.10).

Figure 3.20.7 Value-added exports (EXVA), by industry, 2005 and 2012, USA

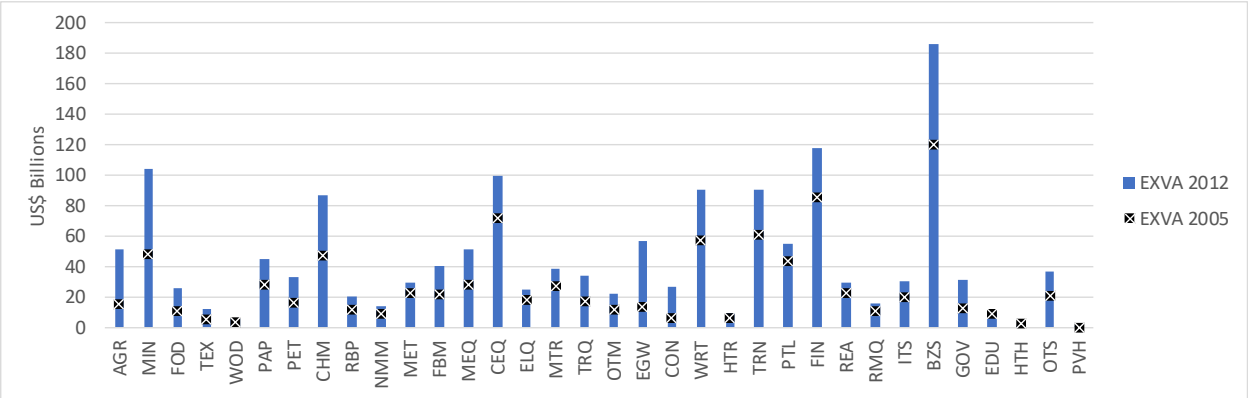
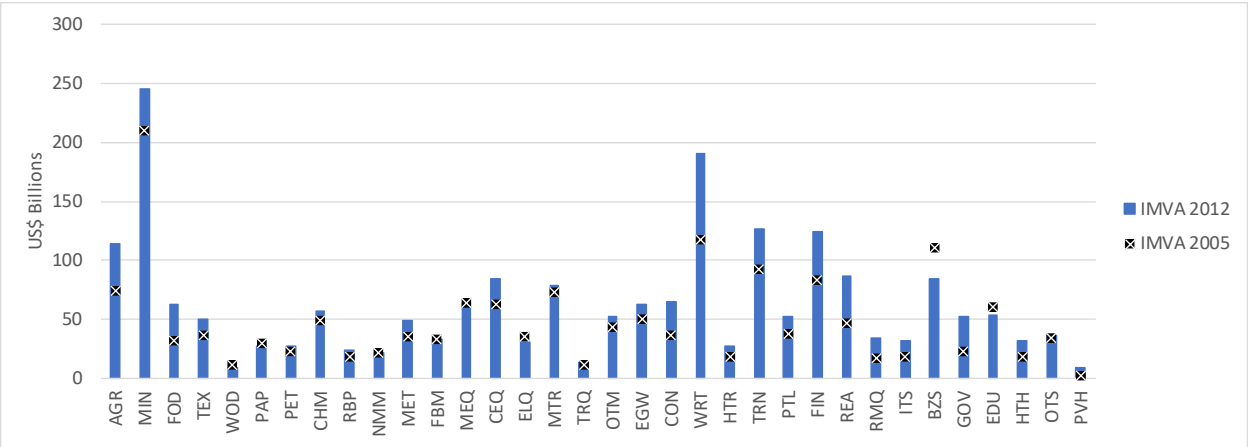


Figure 3.20.8 Value-added imports (IMVA), by industry, 2005 and 2012, USA



[213] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.20.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, USA

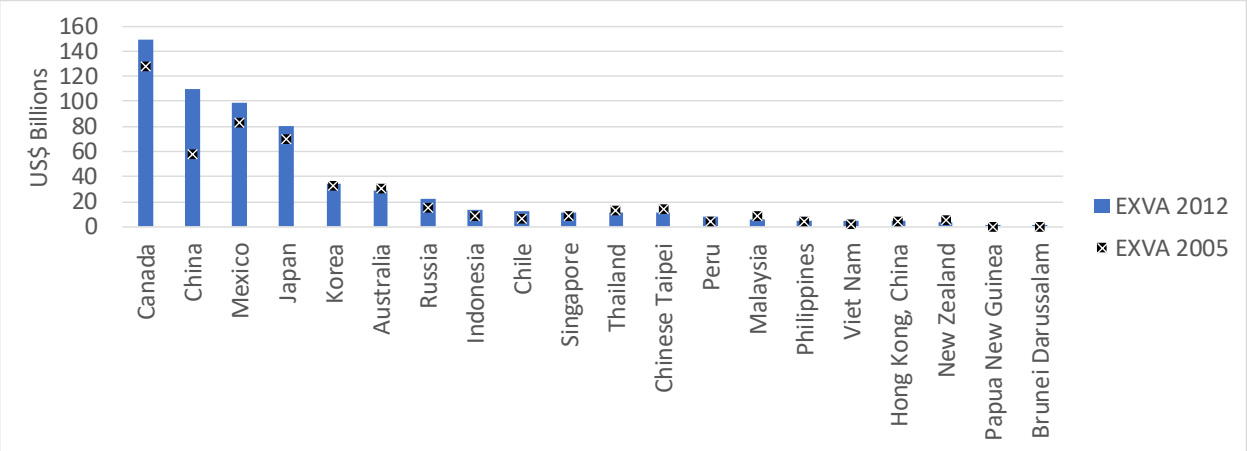
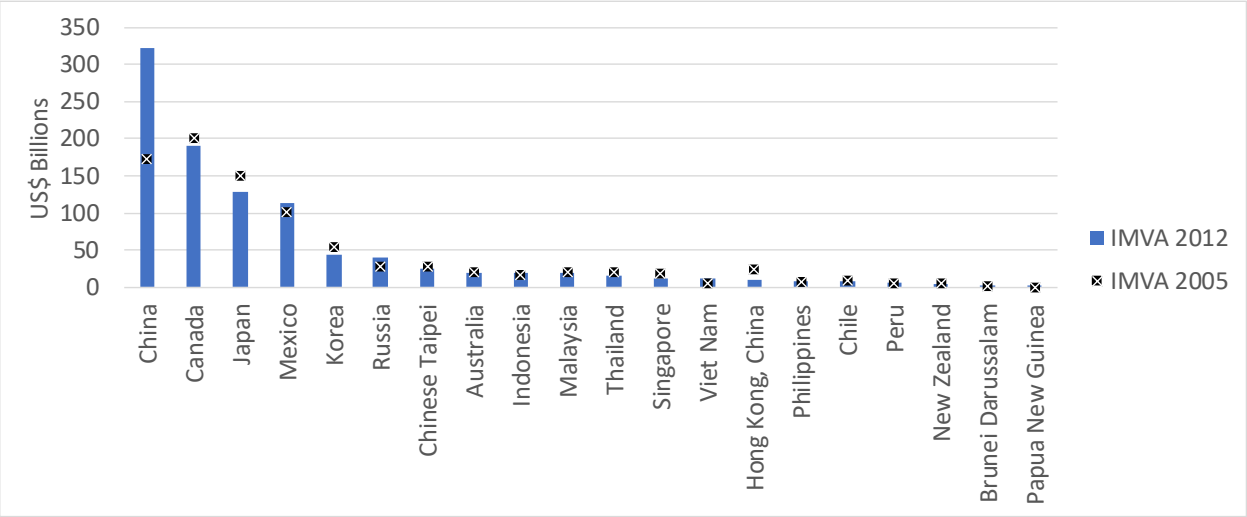


Figure 3.20.10 APEC sources of value-added imports (IMVA), 2005 and 2012, USA



Chapter 21: Viet Nam

Industry Data Summary Based on SUTs

Gross Output[214]

In 2012, Viet Nam's total gross output was $424.1 billion, increasing from $159.6 billion in 2005. Manufacturing and services sectors accounted for 48.7 percent and 32.1 percent of Viet Nam's total gross output, respectively.[215]

Of the 34 industries, agriculture, hunting, forestry and fishing (AGR) had the largest industry gross output of $58.6 billion, more than double its 2005 level, and accounting for 13.8 percent of Viet Nam's total gross output. Other top industries included food products, beverages, and tobacco (FOD, 13.2 percent), textile, leather and footwear (TEX, 8.1 percent), construction (CON, 6.9 percent), and wholesale and retail trade (WRT, 5.6 percent) (figure 3.21.1).

Value Added[216]

In 2012, Viet Nam's total value added, or GDP, was $141.3 billion, increasing from $57.6 billion in 2005. Manufacturing and services sectors as a whole accounted for 28.4 percent and 48.5 percent of Viet Nam's total GDP.

The industries with the top contribution to total GDP were AGR (15.8 percent of total GDP), WRT (10.7 percent), TEX (7.4 percent), mining (MIN, 7.3 percent), and CON (6.1 percent).

After TEX, the largest manufacturing industries in terms of value added were FOD (5.3 percent of total GDP); computer, electronic and optical equipment (CEQ, 2.4 percent); and other manufacturing (OTM, 2.2 percent) (figure 3.21.2).

Imported Intermediate Use Intensity

Of all intermediate inputs used by Vietnamese industries in 2012, about 33.3 percent came from the imported source, above the average of 13.8 percent in the APEC region, and an increase from 27.6 percent in 2005. The industries with the highest imported intermediate use intensity (IIUI) rates were CEQ (70.8 percent), machinery and equipment (MEQ, 64.6 percent), wood products and cork (WOD, 56.9 percent), health and social work (HTH, 52.4 percent), and basic metals (MET, 52.1 percent).

The average IIUI rate of manufacturing sector in Viet Nam was 42.4 percent in 2012, increasing from 35.2 percent in 2005. Most manufacturing industries in Viet Nam experienced an increase in IIUI during this period. Of them, the most notable were WOD, increasing by 159.9 percent; CEQ, increasing by 112.6 percent; and MEQ, increasing by 94.0 percent. Two notable exceptions were other transport equipment (TRQ), decreasing by 31.9 percent; and motor vehicles, trailers and semi-trailers (MTR), decreasing by 28.6 percent.

The average IIUI rate of services sector in Viet Nam was 27.6 percent in 2012, increasing from 20.3 percent in 2005. Most services industries experienced an increase in IIUI during this period, including post and telecommunications (PTL), increasing by 219.8 percent; hotels and restaurants (HTR), increasing by 161.5 percent; and finance and insurance (FIN), increasing by 114.8 percent. Two services industries were the exceptions, including TRN, decreasing by 332. Percent; and WRT, decreasing by 8.8 percent (figure 3.21.3).

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[214] Based on the supply tables at basic price, which could differ from the official NA data.
[215] Manufacturing covers Industry 3-18; services covers Industry 19-34. See appendix table 1 for more information.
[216] Based on the use tables at basic price, which could differ from the official NA data.

Figure 3.21.1 Gross output, by industry, 2005 and 2012, Viet Nam

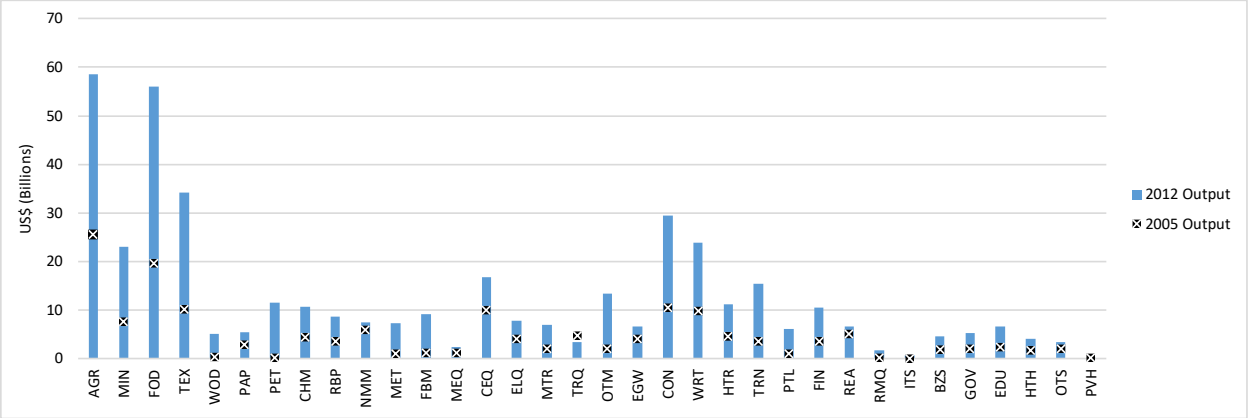


Figure 3.21.2 Value added (VA), by industry, 2005 and 2012, Viet Nam

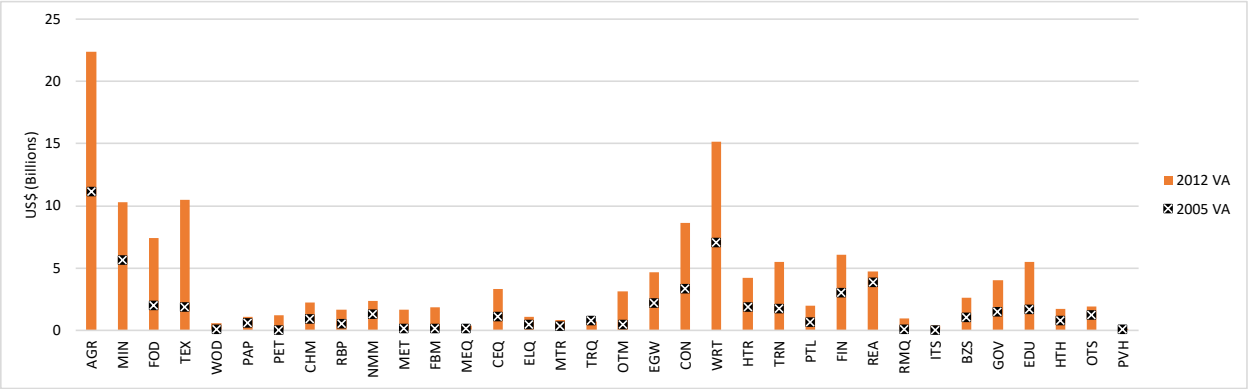
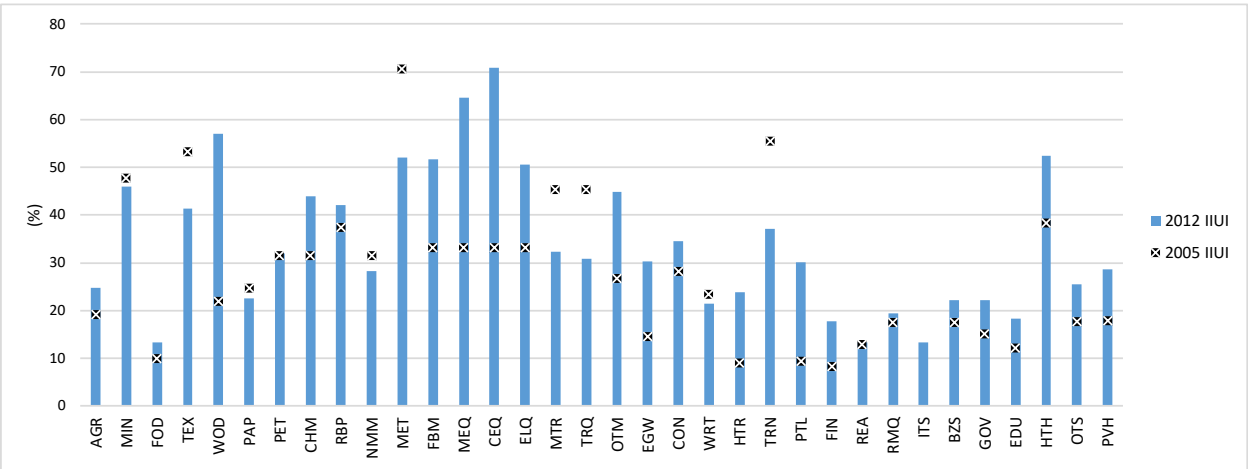


Figure 3.21.3 Imported intermediate use intensity (IIUI), by industry, 2005 and 2012, Viet Nam



Selected APEC TiVA Measures[217]

GVC-Related Trade and GVC Participations

GVC-Related Trade[218]

In 2012, Viet Nam's GVC-related trade amounted to $111.0 billion, more than tripled from $29.4 billion in 2005, and accounting for 85.6 percent of Viet Nam's gross exports. About 68.5 percent of GVC-related trade was in the form of complex GVCs. Agriculture (AGR) topped all industries, accounting for 16.2 percent of GVC-related trade. It was followed by textile, leather, and footwear (TEX, 15.4 percent), mining (MIN, 13.4 percent), and computer, electronic and optical equipment (CEQ, 9.8 percent) (figure 3.21.4).

Forward GVC Participation[219]

Viet Nam's forward GVC participation rate increased from 26.5 percent in 2005 to 35.7 percent in 2012, above the APEC average of 13.8 percent. The complex forward GVC participation rate increased from 9.9 percent to 12.2 percent during this period. The industries with the highest forward GVC participation rates in 2012 were R&D and other business activities (BZS) at 91.0 percent, MIN at 85.1 percent, chemicals (CHM) at 81.7 percent, and CEQ at 62.8 percent (figure 3.21.5).

Backward GVC Participation[220]

Viet Nam's backward GVC participation rate increased from 37.6 percent in 2005 to 39.2 percent in 2012, below the APEC average of 12.7 percent. The complex backward GVC participation rate increased from 19 percent to 20.2 percent during this period. The industries with the highest backward GVC participation rates in 2012 were machinery and equipment (MEQ, 69.5 percent), wood and wood products (WOD, 68.7 percent), CEQ (67.6 percent), Fabricated metal products (FBM, 62 percent), basic metals (MET, 61 percent) and motor vehicles (MTR, 60.8 percent) (figure 3.21.6).

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[217] For more information on the APEC TiVA indicators, please see Section One Chapter 2 and 3.

[218] APEC GVC-related trade is measured by domestic and foreign factor content embodied in gross exports that crosses border once or more for production. It consists of the simple and complex GVC activities. If factor content crosses border once for production, it is considered as the simple GVC, such as domestic value added (VA) in intermediate exports used by importers to produce domestically consumed products. If factor content crosses border more than once, it is considered as the complex GVC, such as foreign or domestic VA embodied in imported intermediates used by importers to produce gross exports. The APEC definition of GVC-related trade is broader than the one used in the World Bank World Development Report (WDR 2020) which includes only "world exports that flow through at least two borders," referred as the complex GVC activities here. It is worth to note these measures only count the numbers of international border crossing of factor content, and do not consider the complexity of domestic value chains.

[219] APEC forward GVC participation is measured by domestic VA used in producing intermediate exports for next stage of production in other economies. APEC forward GVC participation rate is measured by the share of forward GVC participation in total industry GDP. It consists of the simple and complex GVC activities. If intermediate exports are absorbed by direct importing economies, in which factor content crosses border for production only once, it is considered as the simple forward GVC participation. If intermediate exports are further re-exported to third economies or returned home, in which factor content crosses border more than once for production, it is considered as the complex forward GVC participation.

[220] APEC backward GVC participation is measured by imported intermediate inputs used in final production. APEC backward GVC participation rate is measured as the share of backward GVC participation in total final production. It consists of the simple and complex GVC activities. If foreign VA in imported intermediates is from direct trading partner and absorbed directly at home, in which factor content crosses border for production only once, it is considered as the simple backward GVC participation. If foreign VA in imported intermediates is from third economies other than direct trading partner, or domestic VA embodied in imported intermediates is returned home, in which factor content crosses border more than once for production, it is considered as the complex backward GVC participation.

Figure 3.21.4 GVC-related trade (EXGR_GVC), by industry, 2005 and 2012, Viet Nam

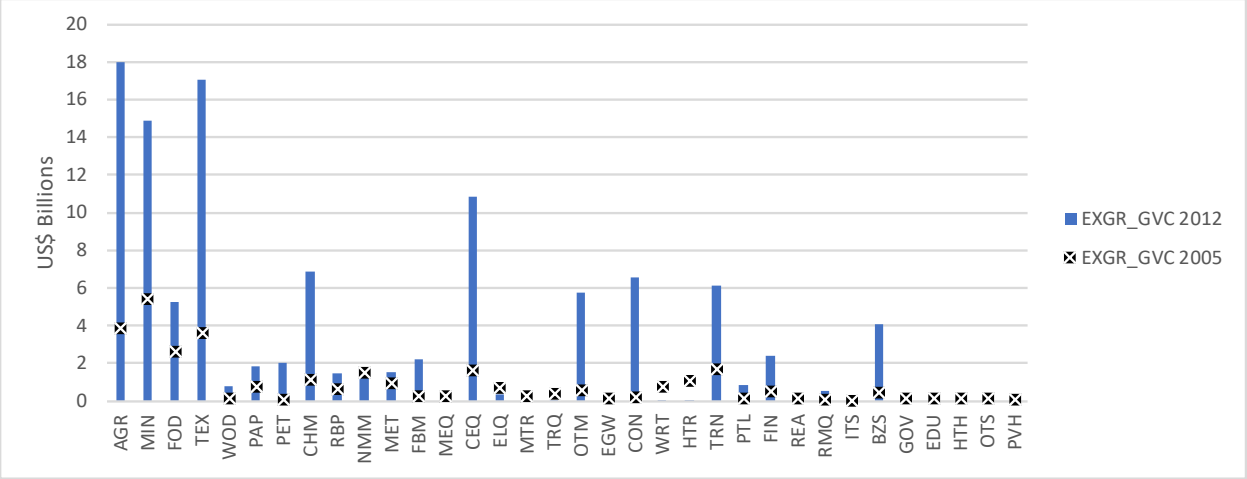


Figure 3.21.5 Forward GVC participation rate (V_GVC share), by industry, 2005 and 2012, Viet Nam

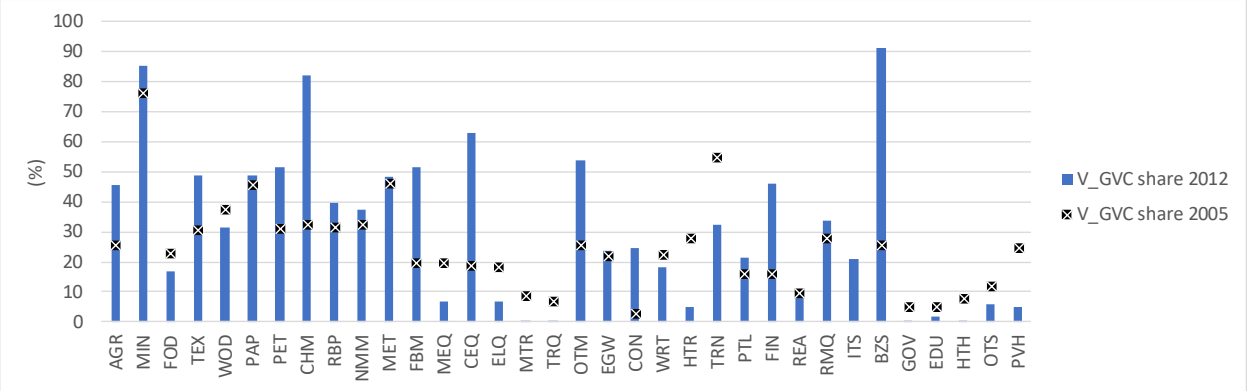
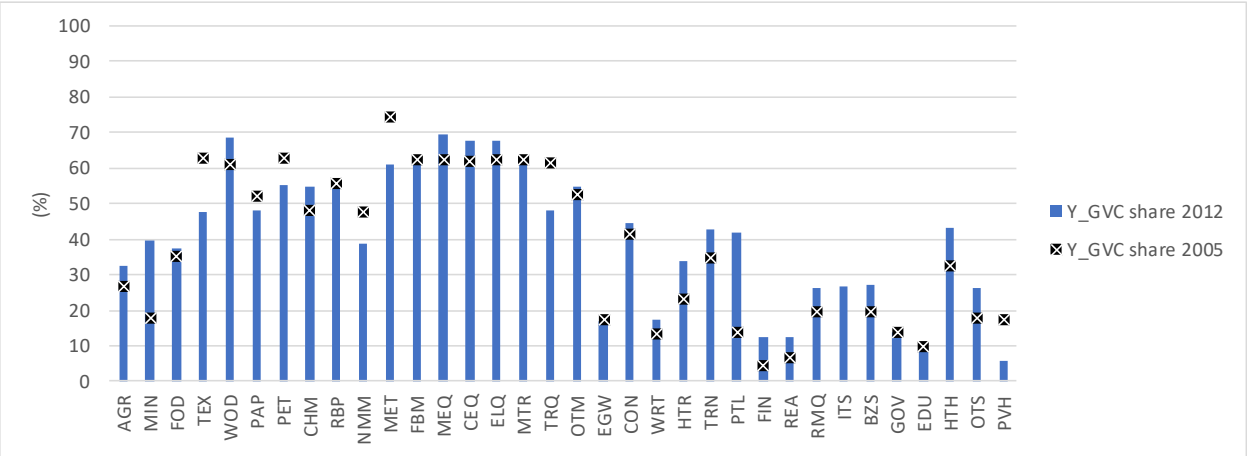


Figure 3.21.6 Backward GVC participation rate (Y_GVC share), by industry, 2005 and 2012, Viet Nam



Value Added Trade and Top APEC Trading Partners

Value-added exports[221]

In 2012, Viet Nam had value-added exports of $71.7 billion, nearly tripled from $24.4 billion in 2005. Agriculture (AGR) topped all industries, accounting for 18.5 percent of Viet Nam's value-added exports in 2012. It was followed by textile, leather, and footwear (TEX, 14.5 percent) and mining (MIN, 13.2 percent). These three industries also experienced the largest increases in value-added exports during this period (figure 3.21.7).

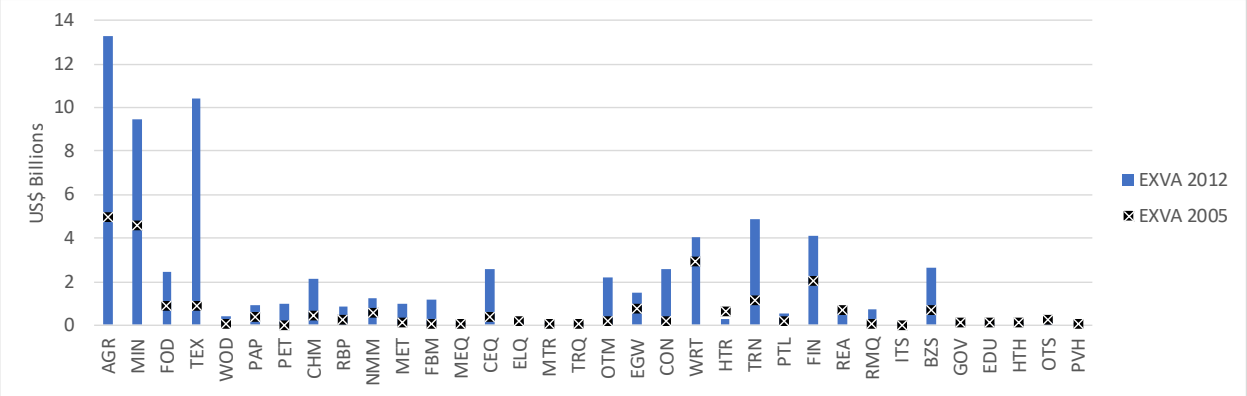
Value-added imports[222]

In 2012, Viet Nam had value-added imports of $66.1 billion, more than double from $25.3 billion in 2005. Wholesale and retail trade (WRT) topped all industries, accounting for 8.7 percent of Viet Nam's value-added imports in 2012. It was followed by MIN at 8.3 percent, AGR at 7.6 percent, computer, electronic, and optical equipment (CEQ) at 7.3 percent, and finance and insurance (FIN, 6.5 percent). The industries that experienced the largest increases in value-added imports during this period were CEQ and food products, beverages, and tobacco (FOD). In the same time, value-added imports of most services industries also experienced dramatic growth from a relative low base in 2005. (figure 3.21.8).

Top APEC Trading Partners

In 2012, in the APEC region, the United States; Japan; China; Korea; and Australia were the top destinations for Viet Nam's value-added exports (figure 3.21.9), and China; Japan; the United States; Korea; and Chinese Taipei were the top sources for Viet Nam's value-added imports (figure 3.21.10).

Figure 3.21.7 Value-added exports (EXVA), by industry, 2005 and 2012, Viet Nam



[221] Value-added exports refer to domestic value added embodied in foreign final demand and absorbed abroad.
[222] Value added imports refer to foreign value added embodied in domestic final demand.

Figure 3.21.8 Value-added imports (IMVA), by industry, 2005 and 2012, Viet Nam

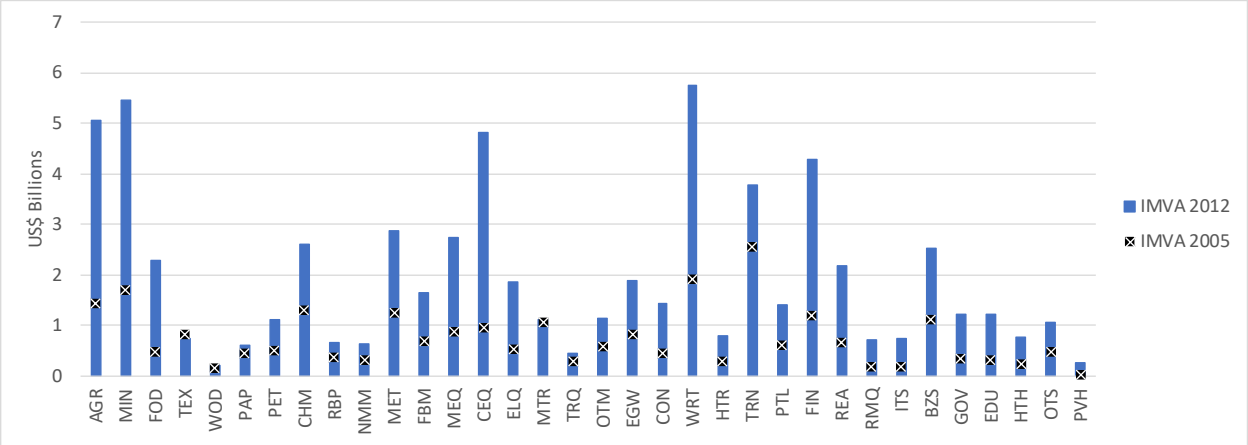


Figure 3.21.9 APEC destinations of value-added exports (EXVA), 2005 and 2012, Viet Nam

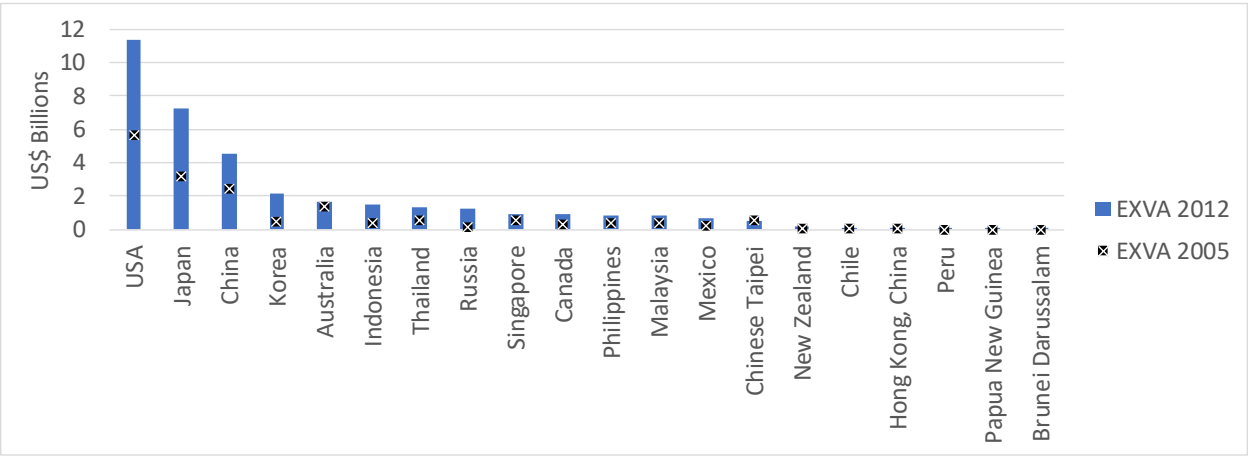
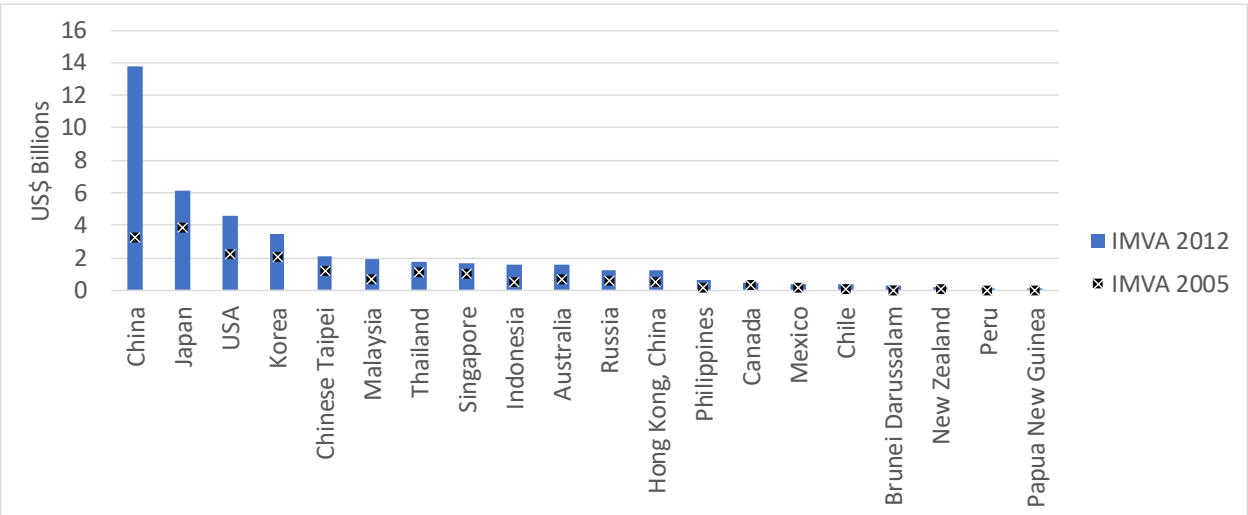


Figure 3.21.10 APEC sources of value-added imports (IMVA), 2005 and 2012, Viet Nam



Conclusion

APEC has become the most influential regional economic cooperation forum in the Asia-Pacific, unified by a common drive of building a dynamic, prosperous Asia-Pacific community. In pursuit of economic growth, better well-being of people, and inclusive prosperity, APEC has propelled progress through "two wheels"-trade and investment liberalization and facilitation and economic and technical cooperation. This has brought APEC economies together and made them become the main engine of global growth.

Global Value Chains (GVCs) have become a dominant feature of the APEC economy. GVC integration provides opportunities to achieve productivity growth, employment gains, increased living standards, and poverty reductions for APEC economies at all levels of development. By linking into GVCs, APEC economies (especially developing economies) do not need to build the entire course of production capacity for a product and instead can use their comparative advantage to concentrate on a specific task, allowing them to integrate into the global economy more rapidly.

Under this circumstance, APEC TiVA database produces tools to assist economies to better understand international production networks and GVC configuration in the APEC region. The main findings of this report read as follows:

1) GVC-related trade had become a dominant feature of gross exports in the APEC region, and grew at a faster pace than traditional trade between 2005 and 2012. In 2012, GVC-related trade accounted for 86.3 percent while traditional trade accounted for 13.7 percent of gross exports in the APEC region. In 2012, about 54.1 percent of GVC-related trade was in the form of complex GVCs and the 45.9 percent was in the form of simple GVCs.
2) In 2012, the pure domestic segment accounted for the largest share, 83.1 percent of APEC GDP production, while the traditional trade and the forward GVC segments accounted for 3.1 percent and 13.8 percent, respectively. Between 2005 and 2012, the forward GVC segment grew at the fastest pace and was also the segment experiencing the fastest increase in its share of APEC GDP production.
3) In 2012, the pure domestic segment accounted for the largest share, 84.1 percent of APEC final production, while the traditional trade and the backward GVC segments accounted for 3.2 percent and 12.7 percent, respectively. Between 2005 and 2012, the backward GVC segment grew at the fastest pace and was also the segment experiencing the fastest increase in its share of APEC final production.

As these data indicate, GVCs became more important and prominent than ever before. However, with changing economic and political environment, GVCs are constantly evolving. The application of TiVA-based GVC analysis will help policy makers and business alike to review the real picture about the overall GVCs situation and policy implications within APEC region and beyond.

APEC TiVA database is supported by wide participation among member economies and international organizations and thus demonstrates a significant milestone on economies' cooperation on Trade in Value-added measurement. May the APEC TiVA project be a good start to bring APEC economies together and enhance the future global and regional TiVA collaboration in the future.

Appendix

Appendix table 1. APEC TiVA industry classification

	Industry Code	Industry description
1	AGR	Agriculture, hunting, forestry and fishing
2	MIN	Mining and quarrying
3	FOD	Food products, beverages and tobacco
4	TEX	Textiles and textile products, leather and footwear
5	WOD	Wood and products of wood and cork
6	PAP	Pulp, paper, paper products, printing and publishing
7	PET	Coke, refined petroleum products and nuclear fuel
8	CHM	Chemicals
9	RBP	Rubber and plastics products
10	NMM	Other non-metallic mineral products
11	MET	Basic metals
12	FBM	Fabricated metal products, except machinery and equipment
13	MEQ	Machinery and equipment, nec
14	CEQ	Computer, electronic and optical equipment
15	ELQ	Electrical machinery and apparatus, nec
16	MTR	Motor vehicles, trailers and semi-trailers
17	TRQ	Other transportation equipment
18	OTM	Manufacturing nec recycling (include Furniture)
19	EGW	Electricity, gas and water supply
20	CON	Construction
21	WRT	Wholesale and retail trade
22	HTR	Hotels and restaurants
23	TRN	Transport and storage
24	PTL	Post and Telecommunications
25	FIN	Finance and insurance
26	REA	Real estate activities
27	RMQ	Renting of Machinery and equipment
28	ITS	Computer and related activities
29	BZS	R&D and other business activities
30	GOV	Public administration and defence, compulsory social security
31	EDU	Education
32	HTH	Health and social work
33	OTS	Other community, social and personal services
34	PVH	Private households with employed persons & extra-territorial organizations & bodies

Appendix table 2. Macroeconomic data based on single-economy SUTs, 2005 and 2012, US$ in millions and percentage

Economy	2005			2012		
	Gross output (millions $)	Total value added (millions $)	Imported intermediate use intensity (IIUI, %)	Gross output (millions $)	Total value added (millions $)	Imported intermediate use intensity (IIUI, %)
APEC	$50,612,745	$25,263,976	13.3	$87,621,262	$40,351,842	13.8
Australia	1,431,708	677,831	10.2	2,948,551	1,467,498	11.4
Brunei Darussalam	15,967	9,554	23.8	32,747	19,345	28.0
Canada	2,063,650	1,072,316	22.5	3,240,931	1,706,036	21.6
Chile	255,401	112,529	17.2	523,453	244,358	18.9
China	6,656,019	2,252,267	11.8	24,833,234	7,964,688	9.0
Hong Kong, China	311,069	174,119	32.1	481,906	254,214	39.0
Indonesia	696,779	348,850	15.4	1,729,562	899,411	16.7
Japan	8,605,910	4,525,654	10.1	11,555,346	5,822,839	13.5
Korea	1,945,252	810,352	21.9	3,081,085	1,110,529	27.9
Malaysia	423,519	134,476	32.2	792,266	310,414	20.1
Mexico	1,436,856	828,339	27.7	2,003,280	1,147,883	32.9
New Zealand	232,726	103,605	13.5	344,554	159,350	14.5
Papua New Guinea	9,997	4,961	17.5	31,302	14,901	20.1
Peru	134,005	69,266	14.2	337,539	176,031	16.9
the Philippines	200,694	97,719	25.0	513,332	252,778	14.3
Russia	1,311,430	654,743	8.6	3,667,081	1,912,989	11.8
Singapore	338,456	119,724	55.6	764,336	272,323	51.5
Chinese Taipei	829,722	360,278	26.8	1,181,816	476,563	28.5
Thailand	472,431	189,319	16.6	978,846	350,367	30.1
USA	23,081,603	12,660,441	10.3	28,155,968	15,647,977	11.7
Viet Nam	159,551	57,633	27.6	424,125	141,347	33.3

Note: Gross output is based on the supply tables at basic price, and total value added is based on the use tables at basic price. They could differ from the official NA data.

Source: APEC TiVA database

Appendix table 3. Gross exports decomposition, 2005 and 2012, US$ in millions and percentage

Economy	2005				2012			
	EXGR (millions $)	EXGR_RT (%)	EXGR_GVC (%)	EXVA (millions $)	EXGR (millions $)	EXGR_RT (%)	EXGR_GVC (%)	EXVA (millions $)
APEC	5,100,000	15.3	84.7	3,672,221	9,521,631	13.7	86.3	6,750,390
Australia	146,589	10.2	89.8	121,565	294,641	8.2	91.8	241,112
Brunei Darussalam	5,873	9.0	91.0	5,391	12,758	8.7	91.3	11,400
Canada	403,384	12.4	87.6	283,352	506,033	17.1	82.9	354,527
Chile	49,328	10.2	89.8	38,405	90,398	8.1	91.9	66,493
China	725,480	16.6	83.4	532,498	2,168,077	17.3	82.7	1,587,208
Hong Kong, China	86,118	23.4	76.6	59,640	117,562	4.0	96.0	65,723
Indonesia	105,466	24.5	75.5	84,228	233,686	20.0	80.0	195,274
Japan	667,719	23.9	76.1	560,496	883,831	15.6	84.4	705,296
Korea	338,286	16.5	83.5	224,818	702,227	12.8	87.2	400,122
Malaysia	160,320	13.3	86.7	86,019	225,468	15.4	84.6	150,442
Mexico	241,125	16.4	83.6	150,622	399,284	8.9	91.1	241,118
New Zealand	31,520	13.4	86.6	25,055	49,006	17.3	82.7	40,049
Papua New Guinea	4,185	41.6	58.4	3,435	17,980	37.7	62.3	9,954
Peru	17,393	21.0	79.0	14,710	46,350	7.6	92.4	37,282
the Philippines	42,559	8.6	91.4	28,661	63,869	15.3	84.7	52,325
Russia	270,973	5.7	94.3	231,132	588,336	6.1	93.9	479,704
Singapore	214,456	10.8	89.2	91,575	434,123	13.3	86.7	193,428
Chinese Taipei	194,889	17.8	82.2	112,118	300,839	15.6	84.4	165,330
Thailand	126,219	21.5	78.5	83,720	265,916	12.3	87.7	153,369
USA	1,229,564	11.9	88.1	910,424	1,991,628	11.9	88.1	1,528,582
Viet Nam	38,554	23.8	76.2	24,356	129,620	14.4	85.6	71,653

Note: EXGR, or gross exports, exclude re-exports.

Source: APEC TiVA database

Appendix table 4. GDP production decomposition, 2005 and 2012, US$ in millions and percentage

Economy	2005			2012		
	V (millions $)	V_RT (%)	V_GVC (%)	V (millions $)	V_RT (%)	V_GVC (%)
APEC	25,915,205	3.0	11.9	41,442,202	3.1	13.8
Australia	690,608	2.2	15.6	1,484,488	1.6	14.7
Brunei Darussalam	10,231	5.2	47.5	19,216	5.7	53.6
Canada	1,084,344	4.6	21.9	1,723,373	5.0	15.8
Chile	112,626	4.5	29.7	244,395	3.0	24.2
China	2,297,998	5.2	18.5	8,356,404	4.5	15.3
Hong Kong, China	167,248	12.0	23.7	227,196	2.1	26.9
Indonesia	315,858	8.2	18.6	897,759	5.2	16.7
Japan	4,620,800	3.5	9.0	5,957,263	2.3	9.8
Korea	837,792	6.6	20.4	1,152,992	7.8	27.2
Malaysia	136,503	15.6	47.8	312,779	11.1	37.2
Mexico	828,354	4.8	13.6	1,142,225	3.1	18.2
New Zealand	105,820	4.0	19.7	162,303	5.2	19.5
Papua New Guinea	5,021	34.7	33.8	14,901	45.5	21.3
Peru	69,142	5.3	16.0	175,999	2.0	19.2
the Philippines	100,169	3.7	25.0	250,515	3.9	17.0
Russia	697,633	2.2	31.2	1,892,866	1.9	23.7
Singapore	128,854	18.0	53.3	272,978	21.1	50.0
Chinese Taipei	370,036	9.4	21.0	479,024	9.8	24.9
Thailand	185,043	14.7	30.8	371,526	8.8	32.7
USA	13,093,696	1.1	6.9	16,155,242	1.5	8.9
Viet Nam	57,428	16.0	26.5	148,757	12.5	35.7

Source: APEC TiVA database

Appendix table 5. Final production decomposition, 2005 and 2012, US$ in millions and percentage

Economy	2005			2012		
	Y (millions $)	Y_RT (%)	Y_GVC (%)	Y (millions $)	Y_RT (%)	Y_GVC (%)
APEC	25,847,754	3.0	11.6	40,962,028	3.2	12.7
Australia	659,608	2.3	11.6	1,424,970	1.7	11.2
Brunei Darussalam	6,508	8.1	17.5	11,497	9.6	22.4
Canada	1,028,491	4.9	17.6	1,727,080	5.0	16.0
Chile	97,973	5.2	19.1	225,511	3.3	17.9
China	2,311,282	5.2	19.0	8,195,498	4.6	13.6
Hong Kong, China	168,277	12.0	24.2	222,229	2.1	25.3
Indonesia	311,518	8.3	17.5	881,029	5.3	15.2
Japan	4,590,301	3.5	8.4	6,023,509	2.3	10.8
Korea	853,684	6.5	21.9	1,209,415	7.4	30.6
Malaysia	125,442	17.0	43.2	265,693	13.1	26.0
Mexico	868,833	4.6	17.6	1,144,294	3.1	18.4
New Zealand	101,119	4.2	16.0	153,798	5.5	15.1
Papua New Guinea	3,952	44.0	15.9	20,155	33.7	41.8
Peru	67,269	5.4	13.7	166,188	2.1	14.4
the Philippines	92,985	4.0	19.2	243,123	4.0	14.5
Russia	558,847	2.7	14.1	1,679,021	2.1	14.0
Singapore	124,020	18.7	51.5	276,379	20.9	50.6
Chinese Taipei	388,515	9.0	24.8	494,813	9.5	27.2
Thailand	182,691	14.9	29.9	371,296	8.8	32.6
USA	13,238,991	1.1	8.0	16,069,815	1.5	8.4
Viet Nam	67,449	13.6	37.4	156,713	11.9	39.0

Source: APEC TiVA database