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## **Global Value Chains and the CPTPP**

Pao-Li Chang, Phuong T. B. Nguyen

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THE SCHOOL OF ECONOMICS, SMU

# Global Value Chains and the CPTPP\*

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## Abstract

The CPTPP, or the Comprehensive and Progressive Agreement for Trans-Pacific Partnership, is an example of a “mega-regional” free trade agreement, whose provisions on the rules of origin and trade facilitation can have potentially large impacts on the CPTPP-wide supply chains. In this paper, we investigate whether the CPTPP members are key upstream and downstream trade partners to each other in the global value chains. We develop formulas of bilateral upstreamness and downstreamness, based on the gross-export decomposition framework of Koopman, Wang and Wei (2014) and Borin and Mancini (2017). We demonstrate how the decomposition of gross exports can be used to construct informative measures of the position of countries in global value chains.

*Key Words:* global value chain (GVC); gross export decomposition; upstream/downstream trade partners; GVC position; CPTPP

*JEL Classification:* F14; F15

## 1 Introduction

The Comprehensive and Progressive Agreement for Trans-Pacific Partnership (“CPTPP”) is a free trade agreement (“FTA”) signed in 2018 among 11 countries: Japan, Singapore, Malaysia, Vietnam, Brunei Darussalam, Australia, New Zealand, Canada, Mexico, Chile and Peru. This is by far the largest FTA formed after the Uruguay Round (1985–1994).

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\*The data that support the findings of this study are openly available from OECD at <https://www.oecd.org/sti/ind/inter-country-input-output-tables.htm>.

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The initiative evolved from the Trans-Pacific Strategic Economic Partnership (TPSEP) or “P4”, among Singapore, Brunei Darussalam, New Zealand and Chile. In 2010, negotiations for Trans-Pacific Partnership (“TPP”) were launched among the four TPSEP members, Malaysia, Vietnam, Australia and Peru; the US, Canada and Mexico joined in 2012, and Japan in 2013. Since its first proposal, 18 rounds of negotiations were held. However, in January 2017 the US (with the change of administration) decided to withdraw from the pending TPP agreement. After modifications in the terms and conditions, the agreement was salvaged and concluded without the US in 2018 under the new name “CPTPP”.

Among its many high-standard provisions, the agreement’s provisions on rules of origin and trade facilitation have potentially large impacts on business incentives to develop and consolidate CPTPP-wide supply chains. In particular, the “full accumulation” provision recognizes all value-added created/accumulated in the territory of the members in justifying a good’s origin from the CPTPP territory, while a “self-certification system” allows firms to self certify their goods’ origins, minimizing customs clearance time. These benefits, in addition to the CPTPP’s broad tariff cuts, are likely to encourage greater fragmentation of the manufacturing process among the member territories.

Much of the existing work related to the CPTPP has mainly focused on the welfare impact of the agreement on member countries and nonmembers; see, for example, Li and Whalley (2014) on China and Narayanan and Sharma (2016) on India. Although large-group GVC studies (see De Backer and Miroudot, 2014; Kowalski et al., 2015; Antràs and Chor, 2018; Wang et al., 2017) have included individual CPTPP countries in their analysis, none of them focus on the CPTPP per se, and in particular, its grouping optimality.

In this paper, we evaluate how closely connected the CPTPP members were with one another in the global value chain (GVC) before the formation of CPTPP. Is this an ideal grouping in the sense that the members are key upstream or downstream trade partners to each other? Would alternative groupings with the addition of some third countries enhance the tightness and self-sufficiency of the network?

Using the most recent accounting framework to trace value-added trade embedded in gross exports (Koopman, Wang and Wei, 2014; Borin and Mancini, 2017), we develop formula of bilateral upstreamness and downstreamness to identify the key upstream and downstream trade partners of each CPTPP country. These are further disaggregated by the source of the value added (from the world, the CPTPP territories, or alternative groupings of interest) for the upstreamness measure, and the final absorption destination of the value added (by the world, the CPTPP markets, or others) for the downstreamness measure. We also construct measures to characterize the position of each CPTPP country in global value chains, and how they have moved upstream or downstream over the period of study. Through the analysis,

we demonstrate how the proposed formula can be used to provide informative measures on the GVC positions of countries and to draw comparisons across sectors, and different origins/destinations of the value added.

## 1.1 Related Literature

In the last three decades, production processes have become increasingly fragmented in stages and yet integrated across countries. Several case studies on the fragmentation of production have been conducted for products such as Apple’s Ipod and notebook PCs (Dedrick, Kraemer and Linden, 2010), cars (Sturgeon, van Biesebroeck and Gereffi, 2008), and smartphones (Ali-Yrkkö et al., 2011). Due to lower communication and trade costs, trade in intermediate inputs has become prevalent. Inputs nowadays travel across multiple countries in various production stages before reaching their final destination of consumption. According to Timmer et al. (2014), foreign value-added share in output increased from 28% to 34% during 1995–2008 for 85% of the 560 product chains they studied. These developments pose challenges in measuring countries’ contributions to international production chains. Standard trade statistics record the gross export flows, so the statistics “double count” the same value added when intermediate inputs cross international borders more than once. Johnson (2014), for example, characterizes the stylized facts on the discrepancies between gross exports and production value added reported in national accounts. In Section 2, we review the datasets and methodologies that have been developed in the recent literature to trace the value-added trade across countries. The different components of value-added trade will form the basis of our formula.

The rise of GVCs also raises the question of the specialization of countries and firms in the global production network: How much does a country participate in the network? Which sectors are relatively integrated with the GVC? Where is the position of a country in the global supply chains? A recent body of work has proposed several measures of the depth of integration and the position of a country and/or an industry in the GVC. The seminal article by Hummels, Ishii and Yi (2001) introduced the vertical specialization (VS) index. It measures the share of imported inputs in a country’s gross exports. The same study also proposed another index (VS1) that measures the extent of a country’s exports used as inputs in another country’s production of exports. Daudin, Riffart and Schweisguth (2011) proposed a measure (VS1\*) that further distinguishes the part of VS1 that returns to the country of origin as final goods. Johnson and Noguera (2012), in contrast, focused on value-added exports to measure a country’s domestic value added absorbed abroad via final or intermediate goods exports. They then used the ratio of value-added exports to gross

exports (“VAX ratio”) to summarize a country’s value-added content of trade. Koopman et al. (2010) suggested yet another index combining the share of foreign inputs (upstream links) and the share of local intermediate goods used in other countries’ exports (downstream links). Finally, Borin and Mancini (2017), through their modification of the decomposition of bilateral exports, provided a measure for value added that crosses national borders more than once and hence a new way to calculate the share of GVC-related trade in gross exports. In Section 3, we analyze the extent of GVC participation by the CPTPP countries based on some of the above indicators, using the gross export decomposition carried out in Section 2.

In parallel, another branch of the literature studies the relative position of a country or a sector within the GVC. Antràs et al. (2012) and Fally (2012) suggested two GVC indices that measure the upstreamness of a sector. A sector (country) is defined as being relatively more upstream in the production chain if it is more distant from final demand (or if it sells a disproportionate share of outputs to relatively upstream industries). On the other hand, Miller and Temurshoev (2017) and Fally (2012) proposed two downstreamness indices, where a sector (country) is considered to be relatively more downstream in the value chain if it is located farther away from its source of value added (or if it buys a disproportionate share of inputs from relatively downstream industries). All these measures basically take into account the forward and backward linkages of input-output relationship across sectors and countries. However, as noted by Antràs and Chor (2018), the above upstreamness measure tends to be positively correlated with the downstreamness measure (sectors that are considered more upstream by the upstreamness measure also tend to be more downstream by the downstreamness measure). This suggests that these measures are not informative of the GVC position of a country-sector.<sup>1</sup> In Sections 4 and 5, we propose bilateral upstream/downstream measures to identify the key downstream and upstream partners of the CPTPP countries. A country can simultaneously be a key upstream and downstream partner of another country relative to another trading partner (because the comparison is based on the volume of value-added trade intermediated across trading partners). In Section 6, we then propose measures (that are independent of gross export volume and hence scale-free) to characterize the absolute position of a country in the GVC. Section 7 extends the analysis further to the sector level.

Studies related to CPTPP have mainly analyzed its potential welfare impacts (or those of the TPP, its predecessor) based on computable general equilibrium model simulations (see Gilbert, Furusawa and Scollay, 2018, for a survey).<sup>2</sup> Some focus on individual countries, such

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<sup>1</sup>Wang et al. (2017) suggested a modified GVC position index to circumvent this inconsistency problem. The index is conceptually equivalent to the *ratio* of the upstreamness and the downstreamness measures introduced above, although it focuses on the part of forward/backward linkages that are GVC-related trade (and excludes purely domestic linkages and those due to traditional trade).

<sup>2</sup>Because CPTPP was only concluded in 2018, there are not sufficient data to conduct ex post analysis

as Vietnam (Nguyen et al., 2015), New Zealand (Strutt, Minor and Rae, 2015), Japan (Lee and Itakura, 2014), and the US (USITC, 2014; Thompson and Leister, 2015), while others analyze the impact of the agreement on nonmembers that could have strong trade connections with the bloc. These include, for example, China (Xin, 2014; Li and Whalley, 2014; Lu, 2015), India (Narayanan and Sharma, 2016), Korea (Petri, 2016; Roh and Oh, 2016), and Brazil (Thorstensen and Ferraz, 2014). There are, however, no systematic studies of the supply-chain relationships of the CPTPP countries in the literature. This paper contributes to the GVC literature and policy analysis of CPTPP in this regard.

## 2 ICIO Tables and Accounting Framework

### 2.1 ICIO Tables

To track input-output linkages on a global scale, datasets known as Inter-Country Input-Output (ICIO) tables have been developed in recent years. These tables are combined from a variety of sources including national accounts, country-level input-output tables, and standard trade statistics. National input-output tables are harmonized and reconciled with bilateral trade data in goods and services by end-use category. While country-wise input-output tables are available at disaggregated levels and for an extended period, most global input-output tables have been constructed at a level of aggregation higher than available in primary sources and cover only the post-1990 period (some only for certain benchmark years) (Johnson, 2018).

At present, there are six major ICIO tables. These are: Global Trade Analysis Project (GTAP), World Input-Output Database (WIOD), OECD-WTO TiVA Database, Eora Multi-Region Input-Output Table (MRIO), IDE-JETRO Asian Input-Output Table, and EXIOBASE Multi-Regional Environmentally Extended Supply and Use / Input Output (MR EE SUT/IOT) database.<sup>3</sup>

For our analysis, we use the OECD-WTO TiVA Database (2016 edition). The tables cover 63 economies (and one ROW) in 34 sectors for the period 1995–2011.<sup>4</sup> All 11 CPTPP countries are included in the database. The methodology and assumptions underlying the construction of the OECD ICIO tables are provided in details in OECD-WTO (2012).

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of the agreement.

<sup>3</sup>GTAP: [www.gtap.agecon.purdue.edu](http://www.gtap.agecon.purdue.edu). WIOD: [www.wiod.org](http://www.wiod.org). OECD-WTO TiVA: [oe.cd/tiva](http://oe.cd/tiva). Eora MRIO: [worldmrio.com](http://worldmrio.com). IDE-JETRO: [www.ide.go.jp/English/Data/Io](http://www.ide.go.jp/English/Data/Io). EXIOBASE: [www.exiobase.eu](http://www.exiobase.eu).

<sup>4</sup>Available at <https://www.oecd.org/sti/ind/inter-country-input-output-tables.htm>. The 2018 edition of the TiVA database covers the period 2005–2015, with one more economy, and is based on the industrial list of ISIC Rev.4 with 36 sectors (instead of Rev.3). More details are provided at <https://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm>.

## 2.2 Gross Export Decomposition Framework

In addition to the construction of input-output tables, new methods have been developed to account for gross trade flows. Koopman, Wang and Wei (2014) (hereafter KWW) provide a useful accounting framework to decompose a country's aggregate gross exports into domestic value added (DVA), foreign value added (FVA) and pure double-counting components. Borin and Mancini (2017) (hereafter BM) further provide accounting frameworks for such decomposition with respect to each trading partner and sector.<sup>5</sup>

As highlighted by Nagengast and Stehrer (2016), decomposition of a country's bilateral gross exports (instead of aggregate gross exports as in KWW) requires one to clearly identify the bilateral export flow that a value-added component is assigned to, and the other bilateral export flows where the component is labeled as purely double counted (DC) from the world GDP perspective, if the value-added component crosses country borders several times. The assignment rule depends on whether one takes the source-based or the sink-based approach.

In the source-based approach, a domestic value-added (DVA) component is attached to the bilateral gross exports the first time the value-added component leaves the country of origin (and is labeled as double-counted for the subsequent times it leaves the country of origin). On the other hand, the sink-based approach attaches a domestic value-added component to the bilateral gross exports the last time the value-added component leaves the country of origin. For example, if a value-added component originates from Singapore, is shipped to China, returns to Singapore, and is further shipped to Malaysia before reaching the US as a final destination, the Singapore value added would be considered by the source-based approach to be DVA in Singapore's gross exports to China and domestic double-counted (DDC) in Singapore's gross exports to Malaysia. The assignment is reversed if one adopts the sink-based approach.

In parallel, in the source-based approach, a foreign value-added component is attached to the bilateral gross exports the first time the value-added component is re-exported (and is labeled as double-counted for the subsequent times it crosses other country borders). On the other hand, the sink-based approach attaches a foreign value-added component to the bilateral gross exports the last time the value-added component is re-exported. Using the example above, the Singapore value-added component would be considered by the source-based approach to be FVA in China's gross exports to Singapore and foreign double-counted

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<sup>5</sup>In particular, the KWW framework decomposes a country's aggregate gross exports by source and destination of embedded value added, into nine components (of DVA FVA, or purely double-counted terms). This is further generalized by the literature (e.g., Wang, Wei and Zhu, 2013) to bilateral and sector-level trade. Most recently, Borin and Mancini (2017) refined the KWW method using the two distinct perspectives of Nagengast and Stehrer (2016) while correcting some value-added assignments in the original KWW decomposition.



(FDC) in Malaysia's gross exports to the US. In contrast, it would be labeled by the sink-based approach to be FVA in Malaysia's gross exports to the US, but FDC in China's gross exports to Singapore.

The choice obviously will affect the relative decomposition of value-added and double-counted components (domestic or foreign) in a country's bilateral exports (e.g., Singapore to China, or Singapore to Malaysia). It will also affect the decomposition of FVA and FDC (although not the DVA and DDC) of a country's aggregate exports (e.g., Singapore to the world). For example, a more upstream exporting country may be assigned another country's VA as FVA in its gross exports more often in the source-based approach and less often in the sink-based approach. The two approaches are equivalent only at the world exports level (as in either approach, a VA is only accounted for once in a certain trade flow and considered double counted in all other trade flows).

In this paper, we take the BM source-based approach, because our proposed formulas require information on bilateral value-added trade. Since it traces the value-added flows that cross country borders for the first time, the source-based approach will also help identify the value-added flows that cross country borders only once (thus associated with traditional trade) and other value-added flows (that cross country borders more than once and hence can be regarded as GVC-related trade).

We repeat the BM source-based decomposition framework below for easy reference. Suppose the world consists of  $N$  countries and  $G$  sectors. Define  $\mathbf{Y}_{sr}$  to be the demand vector of final goods produced in country  $s$  and consumed in country  $r$  (of dimension  $G \times 1$ ). Let  $\mathbf{A}$  be the global matrix of input coefficients (of dimension  $NG \times NG$ ), so that  $\mathbf{B} \equiv (\mathbf{I} - \mathbf{A})^{-1}$  is the global Leontief inverse matrix. In addition, let  $\mathbf{V}_s$  denote the value-added shares embedded in each unit of gross outputs produced by country  $s$  (of dimension  $1 \times G$ ),  $\mathbf{E}_{sr}$  the vector of bilateral gross exports from country  $s$  to country  $r$  (of dimension  $G \times 1$ ), and  $\mathbf{u}_G$  a  $1 \times G$  unit row vector.

The source-based approach decomposes the bilateral exports between country  $s$  and country  $r$  into domestic value added (component 1\* to 5\*), domestic double counted (component 6\*), foreign value added (components 7\* to 9b\*), and foreign double counted (components 9c\* and 9d\*) as follows:

$$\begin{aligned} \mathbf{u}_G \mathbf{E}_{sr} &= \mathbf{V}_s (\mathbf{I} - \mathbf{A}_{ss})^{-1} \mathbf{Y}_{sr} \\ &+ \mathbf{V}_s (\mathbf{I} - \mathbf{A}_{ss})^{-1} \mathbf{A}_{sr} (\mathbf{I} - \mathbf{A}_{rr})^{-1} \left[ \sum_{j \neq r}^N \mathbf{A}_{rj} \mathbf{B}_{js} \mathbf{Y}_{sr} + \sum_{j \neq r}^N \mathbf{A}_{rj} \sum_{k \neq s, r}^N \mathbf{B}_{js} \mathbf{Y}_{sk} \right] \end{aligned}$$

$$\begin{aligned}
& + \mathbf{V}_s(\mathbf{I} - \mathbf{A}_{ss})^{-1} \mathbf{A}_{sr}(\mathbf{I} - \mathbf{A}_{rr})^{-1} \left[ \begin{array}{l} \mathbf{Y}_{rr} + \sum_{j \neq r}^N \mathbf{A}_{rj} \mathbf{B}_{jr} \mathbf{Y}_{rr} + \sum_{j \neq r}^N \mathbf{A}_{rj} \sum_{k \neq s,r}^N \mathbf{B}_{jk} \mathbf{Y}_{kk} \\ \sum_{j \neq s,r}^N \mathbf{Y}_{rj} + \sum_{j \neq r}^N \mathbf{A}_{rj} \sum_{l \neq s,r}^N \mathbf{B}_{jr} \mathbf{Y}_{rl} \\ \sum_{j \neq r}^N \mathbf{A}_{rj} \sum_{k \neq s,r}^N \mathbf{B}_{jk} \mathbf{Y}_{kr} + \sum_{j \neq r}^N \mathbf{A}_{rj} \sum_{k \neq s,r,l}^N \sum_{l \neq s,r}^N \mathbf{B}_{jk} \mathbf{Y}_{kl} \end{array} \right] \\
& + \mathbf{V}_s(\mathbf{I} - \mathbf{A}_{ss})^{-1} \mathbf{A}_{sr}(\mathbf{I} - \mathbf{A}_{rr})^{-1} \left[ \begin{array}{l} \mathbf{Y}_{rs} + \sum_{j \neq r}^N \mathbf{A}_{rj} \mathbf{B}_{jr} \mathbf{Y}_{rs} + \sum_{j \neq r}^N \mathbf{A}_{rj} \sum_{k \neq s,r}^N \mathbf{B}_{jk} \mathbf{Y}_{ks} \end{array} \right] \\
& \quad \mathbf{5}^* \\
& + \mathbf{V}_s(\mathbf{I} - \mathbf{A}_{ss})^{-1} \mathbf{A}_{sr}(\mathbf{I} - \mathbf{A}_{rr})^{-1} \sum_{j \neq r}^N \mathbf{A}_{rj} \mathbf{B}_{js} \mathbf{Y}_{ss} \\
& \quad \mathbf{6}^* \\
& + \mathbf{V}_s(\mathbf{I} - \mathbf{A}_{ss})^{-1} \sum_{t \neq s}^N \mathbf{A}_{st} \mathbf{B}_{ts} \mathbf{E}_{sr} \\
& + \sum_{t \neq s}^N \mathbf{V}_t(\mathbf{I} - \mathbf{A}_{tt})^{-1} \mathbf{A}_{ts}(\mathbf{I} - \mathbf{A}_{ss})^{-1} \left[ \begin{array}{l} \mathbf{Y}_{sr} + \mathbf{A}_{sr}(\mathbf{I} - \mathbf{A}_{rr})^{-1} \mathbf{Y}_{rr} \end{array} \right] \\
& \quad \mathbf{9a}^* \\
& + \sum_{t \neq s}^N \mathbf{V}_t(\mathbf{I} - \mathbf{A}_{tt})^{-1} \mathbf{A}_{ts}(\mathbf{I} - \mathbf{A}_{ss})^{-1} \mathbf{A}_{sr}(\mathbf{I} - \mathbf{A}_{rr})^{-1} \sum_{j \neq r}^N \mathbf{Y}_{rj} \\
& \quad \mathbf{9b}^* \\
& + \sum_{t \neq s}^N \mathbf{V}_t(\mathbf{I} - \mathbf{A}_{tt})^{-1} \mathbf{A}_{ts}(\mathbf{I} - \mathbf{A}_{ss})^{-1} \mathbf{A}_{sr}(\mathbf{I} - \mathbf{A}_{rr})^{-1} \sum_{j \neq r}^N \mathbf{A}_{rj} \sum_k^N \sum_l^N \mathbf{B}_{jk} \mathbf{Y}_{kl} \\
& \quad \mathbf{9c}^* \quad \mathbf{9d}^* \\
& + \sum_{t \neq s}^N \mathbf{V}_t(\mathbf{I} - \mathbf{A}_{tt})^{-1} \left[ \begin{array}{l} \sum_{j \neq t,s}^N \mathbf{A}_{tj} \mathbf{B}_{js} \mathbf{E}_{sr} + \mathbf{A}_{ts}(\mathbf{I} - \mathbf{A}_{ss})^{-1} \sum_{t \neq s}^N \mathbf{A}_{st} \mathbf{B}_{ts} \mathbf{E}_{sr} \end{array} \right], \quad (1)
\end{aligned}$$

where (i)  $\mathbf{B}_{ts}$  is the country- $t$  to country- $s$  section in the global Leontief matrix  $\mathbf{B}$ , which corresponds to the total input requirement from each sector of country  $t$  to produce one unit of final demand in each sector of country  $s$ , and (ii)  $\mathbf{A}_{sr}$  is the country- $s$  to country- $r$  section in the inter-country input coefficient matrix  $\mathbf{A}$ , which corresponds to the direct input requirement from each sector of country  $s$  to produce a unit of gross output in each sector

of country  $r$ . Given that the source-based approach targets the first time a DVA leaves its country of origin or the first time a FVA is re-exported, it uses the local Leontief matrix  $(\mathbf{I} - \mathbf{A}_{ss})^{-1}$ , pre-multiplied by the value-added share vector  $\mathbf{V}_s$ . At the same time, it allows for all possible forward linkages by which such VA components can be routed (including repeatedly through the same country of origin or the same re-exporter), as captured by the global Leontief matrix  $\mathbf{B}$  before the final demand vector  $\mathbf{Y}$ .

Table 1 provides a summary of the interpretation of each term in equation (1). In short, this framework decomposes bilateral gross exports from country  $s$  to country  $r$  into DVA and FVA (and by where they are ultimately absorbed). The DVA can be embodied in either final goods or intermediate goods exports that are (i) absorbed directly in bilateral importers, (ii) absorbed in bilateral importers after further processing stages in other countries, (iii) absorbed by third countries, and (iv) reflected and absorbed at home. On the other hand, the FVA can be embedded in exports by  $s$  of final goods and of intermediate inputs directly absorbed by the importing country  $r$ , or in intermediate goods exports to  $r$  that are further processed and re-exported by the importing country  $r$ .

### 3 GVC Participation

We begin the analysis by characterizing the extent to which the CPTPP countries participated in the global value chains. Did they develop more backward linkages and/or forward linkages over the years of study 1995–2011? And how do the pattern and trend differ across the member countries?

We first use the  $VS$  (vertical specialization) index of Hummels, Ishii and Yi (2001), which measures the fraction of imported inputs used in a country’s gross exports. With the decomposition framework developed by KWW and BM, one can trace precisely the foreign contents embodied in trade flows. We thus use the fraction of foreign contents (foreign value added and foreign double counted) in a country’s gross exports as the revised  $VS$  indicator. The larger the fraction of such foreign contents, the more a country sources internationally in its production of gross exports (and, loosely speaking, the more backward linkages it has).

We then use the measure  $GVC^{KWW}$  suggested by Koopman et al. (2010). In addition to foreign contents, it further adds the domestic contents in gross exports that are not absorbed by bilateral importers. This includes domestic contents in gross exports that are absorbed by third countries (after further processing in bilateral importing countries) and that return home and are absorbed by the exporting country itself. Thus, in a sense, it takes into account both backward (upstream) linkages and forward (downstream) linkages in the consideration of a country’s involvement in global value chains.

Finally, Borin and Mancini (2017) further added to the above the domestic contents in gross exports that are absorbed by bilateral importers but only after additional processing stages abroad. In other words, they isolated the domestic value-added components that cross country borders only once (and are *directly* absorbed by bilateral importers) and regard them as “traditional trade”. This corresponds to components  $1a^*$  and  $2a^*$  in the BM decomposition. A country’s gross exports net of these two components are then regarded as its GVC-related trade flows.

Using the decomposition framework by BM, we calculate the three indices as below with reference to Table 1:

$$VS_s = \sum_{r \neq s} (7_{sr}^* + 8_{sr}^* + 9_{sr}^*) / E_{s^*}, \quad (2)$$

$$GVC_s^{KWW} = \sum_{r \neq s} (1c_{sr}^* + 2c_{sr}^* + 3a_{sr}^* + 3b_{sr}^* + 3d_{sr}^* + 4_{sr}^* + 5_{sr}^* + 6_{sr}^* + 7_{sr}^* + 8_{sr}^* + 9_{sr}^*) / E_{s^*}, \quad (3)$$

$$GVC_s^{BM} = \sum_{r \neq s} [E_{s^*} - (1a_{sr}^* + 2a_{sr}^*)] / E_{s^*}, \quad (4)$$

where  $E_{s^*}$  is the aggregate gross exports of country  $s$ . The  $VS$  index, by construct, is a subset of the  $GVC^{KWW}$  indicator, which is further a subset of the  $GVC^{BM}$  index. Thus, the magnitude increases as we use a more broadly defined measure of GVC.

Strictly speaking, the  $GVC_s^{KWW}$  index was proposed in the KWW accounting framework, a sink-based framework. By using the global Leontief matrix in calculating the value-added content  $\mathbf{V}_s \mathbf{B}_{ss}$  instead of the local Leontief matrix  $\mathbf{V}_s (\mathbf{I} - \mathbf{A}_{ss})^{-1}$  as in equation (1), it confounds domestic contents with all potential backward linkages and hence is not a clean way to isolate GVC-related trade. Its decompositions are also not exact in terms of the destinations where a certain value added is absorbed. We thus take the BM accounting framework and identify the right components to be used in (3) that are consistent with the spirit of the  $GVC_s^{KWW}$  index.

Table 2 reports the three GVC measures for the CPTPP countries in four benchmark years (1995, 2000, 2005, and 2011). We also add China, the US, and the world as reference points. In terms of the  $VS$  index, Japan and Brunei were among the lowest. Although Japan’s  $VS$  gradually increased over the period (from 5.61% to 14.66%), Brunei’s remained low and decreased (7.26% to 4.26%). Japan thus integrated more foreign inputs in its production of exports over the years. Despite their low degrees of vertical integration in terms of backward linkages, the two countries had equally high degrees of GVC participation as many other CPTPP countries (40.47% for Japan and 34.8% for Brunei in 2011 by the  $GVC^{BM}$  measure). This suggests that they participated in the GVC more via downstream linkages (contributing contents to be used in further processing and integrated in other

countries' exports). Countries with such similar profiles include Peru, Australia, and the US. In particular, the US had low levels of  $VS$  (yet higher than Japan) and became more involved in the GVC in the last two decades. Nonetheless, the pace of its increase was relatively slow compared to the world average.

In contrast to the countries above, Singapore and Malaysia had the highest  $VS$  index. Their gross exports consisted of 40–50% foreign contents across the years. Domestic contents other than those directly absorbed by bilateral importers contributed another 10–15% of gross exports. These countries thus had intensive backward linkages (but proportionally less intense forward linkages) in their international production networks. Countries with such similar profiles include Vietnam, China and Mexico.

Figure 1 illustrates the global value chain participation of CPTPP countries together with China and the US across the years. The extent of GVC trade increased for all CPTPP countries. In 1995, the average percentage of GVC participation across all CPTPP countries was 32.88% of total gross exports. This number increased by 10 percentage points by 2011. The GVC trend tended to slow down after 2000 for Singapore, Malaysia and China. In contrast, Vietnam grew steadily in its GVC participation (from 33.55% in 1995 to 48.70% in 2011). Although Singapore and Malaysia remained at the top (57% and 56% respectively in 2011) in GVC participation, Vietnam overtook Mexico in 2005 and became the third among the CPTPP countries.

Besides Vietnam, Japan, Chile and Peru also experienced fast growth in their GVC integration during the period. For example, Japan's GVC trade increased from 25.5% in 1995 to 40.5% in 2011 (close to a 15 percentage point increase). In contrast, countries such as Canada, New Zealand and Singapore experienced a much smaller increase. Among the CPTPP members, Singapore had the highest level of GVC trade in the 1990s, and Singapore used to have a big lead. However, its unique status was diluted over the years as the other countries gradually caught up in their GVC involvement.

## 4 Key Downstream Partners

In this section, we introduce our formula of bilateral downstreamness and use it to identify the key downstream partners of each CPTPP member country. Intuitively, the formula measures how much of a country's domestic content (domestic value added and domestic double counted) in all its gross exports is intermediated by a bilateral importer. The formula can be further refined to focus on specific destinations where such domestic content is finally absorbed.

For this purpose, we define  $DC_{sr}^G$  as the domestic content of country  $s$  in the gross

exports of country  $s$  to  $r$  that is finally absorbed in the set  $\mathcal{G}$  of destinations. The bilateral downstreamness of country  $r$  to  $s$  is defined as:

$$D_{sr}^{\mathcal{G}} = \frac{DC_{sr}^{\mathcal{G}} - \mathbf{1}[r \in \mathcal{G}](1a_{sr}^* + 2a_{sr}^*)}{\sum_c \{DC_{sc}^{\mathcal{G}} - \mathbf{1}[c \in \mathcal{G}](1a_{sc}^* + 2a_{sc}^*)\}} \quad (5)$$

where  $\mathbf{1}[\cdot]$  is an indicator function that takes value of 1 if the importer is part of the final destination market. The measure excludes the exporter's domestic content that is directly absorbed by the bilateral importer ( $1a_{sr}^* + 2a_{sr}^*$ ), since it crosses country borders only once (and hence is not associated with GVC trade). The numerator in (5) represents domestic contents of  $s$  that are further exported by the bilateral importer  $r$ . A country  $r$  is considered to be a more important downstream partner to country  $s$  than a country  $r'$  (with respect to the subset of domestic content that is finally absorbed by destinations in  $\mathcal{G}$ ) if a larger share of exporter  $s$ 's domestic content (absorbed in  $\mathcal{G}$ ) is intermediated by  $r$  than  $r'$ .

Table 3 reports the key downstream partners of the CPTPP members in 2011. We consider five regions of destination markets: the world, the CPTPP, the CPTPP with the US, the CPTPP with China, and the CPTPP with China and the US. The first row reports the relative shares of these markets in a country's gross exports. On average, the CPTPP countries sent 25% of their gross exports to the CPTPP market. The CPTPP market was most important to Brunei (59.83% of its gross exports) and least to Canada (7.3%), Japan (9.75%) and Mexico (10.4%). Except for Japan, the CPTPP market was important for all members in Asia and Australasia (typically more than 20% of their gross exports). When China was included as a destination, the shares rose above 35% for most countries (with the exception of Canada and Mexico). On the other hand, when the US was included instead, the importance of the destination market increased substantially for Canada (74.05%) and Mexico (80.06%).

We then calculate, for each exporting country and destination market, the domestic content (DC) that is directly absorbed by the bilateral importer (if it belongs to the destination market under consideration). These amounts of traditional trade are excluded from the calculation of bilateral downstreamness as indicated in equation (5). We then rank each country's bilateral importers by the share of GVC trade intermediated by the importer, for the DC destined for each of the markets, and highlight the top five downstream trade partners.

We find that in 2011, China was the most important downstream partner for seven out of eleven countries in the CPTPP (Japan, Singapore, Malaysia, Vietnam, Australia, Chile, and Peru). Of the domestic content of these countries not directly absorbed by bilateral importers, 20–35% was intermediated by China. Its importance tends to increase when the

destination is restricted to the CPTPP markets or the CPTPP plus the US markets. China was also among the top three downstream partners of all CPTPP members — with the exception of Brunei — illustrating China’s role as the world’s assembly factory. The other important downstream partners of the CPTPP countries in 2011 included members such as Japan and Singapore, but also nonmembers such as Korea, Taiwan and Thailand. The latter three regularly ranked among the top five downstream trade partners of the CPTPP countries. This highlights the important omission of these countries from the CPTPP grouping and the potential benefits they may bring to consolidate the CPTPP-wide supply networks.

As expected, the US was the most important downstream trade partner of Mexico and Canada. It intermediated more than half of these countries’ domestic contents related to GVC trade, leading the second most important downstream partner (China for Canada and Canada for Mexico) by a large margin of approximately 45 percentage points. When restricting the focus to the CPTPP markets for final absorption, the importance of the US as an intermediary only strengthens. This could be due to the fact that the CPTPP includes four countries in the Americas, and the US is geographically proximate to these destinations.

Interestingly, China was not among the top five downstream partners of Brunei. Instead, Korea was the most important downstream partner of Brunei in 2011 (followed by Australia, Japan, Indonesia and Vietnam). This remains the case even when the final absorption market is restricted to CPTPP or CPTPP augmented with the US or China. One possible explanation is that Brunei’s main exports were primary commodities (such as metal products, non-metallic mineral products, and basic metals). These sectors are relatively upstream and hence likely take a longer route through the GVC before reaching the place of final demand. Thus, countries that specialize in manufacturing assembly such as China may play a less significant role in Brunei’s immediate downstream connections.

Geography appears to have affected downstream partner selection to some extent. For example, Australia was the most important downstream partner of New Zealand, and the US was of Canada and Mexico. Similarly, countries that are part of CPTPP or located close to the CPTPP countries became more prominent as downstream partners for DC destined to the CPTPP markets. For instance, in the case of Mexico, Canada was its second most important downstream partner for the world market, followed by China, Spain, and ROW. However, for the CPTPP market, China and Korea became relatively more important and ranked as the second and fourth leading downstream partners of Mexico.

## 5 Key Upstream Partners

In this section, we identify the key upstream trade partners for each CPTPP member and for value added originating from a specified group of countries (such as the world or the CPTPP region). From an importing country’s perspective, another country is an important upstream trade partner in the GVC network if the country passes on a large amount of foreign contents from third countries to the importer for absorption or for further processing before being exported again. Formally, we define the bilateral upstreamness of country  $s$  to country  $r$  as:

$$U_{sr}^{\mathcal{G}} = \frac{FC_{sr}^{\mathcal{G}^o} - \mathbf{1}[r \in \mathcal{G}]FC_{sr}^r}{\sum_c \{FC_{cr}^{\mathcal{G}^o} - \mathbf{1}[r \in \mathcal{G}]FC_{cr}^r\}} \quad (6)$$

where  $FC_{sr}^{\mathcal{G}^o}$  measures all foreign contents originating from the countries in group  $\mathcal{G}$  that are embedded in bilateral exports from country  $s$  to country  $r$ . It corresponds to the sum of components 7\*–9\* in Table 1 across all countries  $t \neq s$  in group  $\mathcal{G}$ . This includes the foreign contents absorbed in  $r$  (components 7\*–8\*) but also those re-exported by country  $r$  and absorbed in third countries (component 9\*). We exclude the importer  $r$ ’s content in country  $s$ ’s gross exports to  $r$  since it is not clear in this case which country is upstream (or downstream) in relation to the other. As a result, the numerator of (6) corresponds to the GVC-trade in which exporter  $s$  passes on third countries’ contents to  $r$ . A country  $s$  with a higher value of  $U_{sr}^{\mathcal{G}}$  than country  $s'$  is regarded as a more important upstream trade partner of country  $r$  since it passes on a larger portion of third-country contents to the importer  $r$  among all third-country contents that  $r$  receives in its imports.

Table 4 summarizes the results for 2011, with each column corresponding to a specified source of contents ( $\mathcal{G}$  in our formula). First, the CPTPP countries imported 10.33–41.71% of their goods/services from each other. Brunei was the smallest importer (with a gross value of US\$4.2 billion in 2011) but had the highest share of imports from the region. For the CPTPP countries in the Americas (Canada, Mexico, Chile and Peru), imports from the CPTPP were around 10–15% of each country’s total imports. For the members in Asia, the proportion was substantially higher, with an average of about 26%. When the US and China are included as a source of imports, the shares increase significantly to around 50% for all countries (with the exception of Singapore). The US was in particular an essential source of imports for Canada and Mexico: the share increases from 10% to 60% when the source of imports is expanded from the CPTPP region to include the US.

Next, in calculating (6), we exclude the importer’s contents embedded in its bilateral gross imports. For most of the CPTPP countries, the importer’s own content embedded in its gross imports was negligible (at less than 1%, not reported in the table). Canada, Mexico



and Japan were on the high side, with 1.1–2% for the corresponding figures. The ranking of bilateral upstream partners by the index  $U_{sr}^G$  in equation (6) indicates that China was the most important upstream partner of Japan, Vietnam, Australia, New Zealand, Chile and Peru. In particular, for Japan and Vietnam, more than 25% of third-country contents they imported were intermediated by China. A majority (65%) of these third-country contents imported from China by Japan was absorbed in Japan (with 35% being re-exported again). In contrast, a majority (52%) of the third-country contents imported from China by Vietnam was re-exported after further processing in Vietnam. Thus, China played two distinct roles as an upstream partner: one as the world assembly factory for goods close to final demand as indicated in the previous section, and the other as the intermediary of intermediate inputs in the GVC. Invariably, China ranked among the top five upstream partners of all the CPTPP countries.

The US, on the other hand, was the most important upstream partner of Canada and Mexico, and also had a significant role as upstream partner of Chile and Peru. Singapore was the most important upstream partner of Malaysia and Brunei, while Singapore itself had a very diversified set of upstream partners with a low concentration at the top. Korea is a nonmember that stands out as a major upstream trade partner of CPTPP members, even for the Latin American countries. Taiwan and Thailand were similarly two important nonmembers that were critical upstream partners of several CPTPP countries.

When the source of content is restricted to the narrowest grouping of the CPTPP countries, typically Asian countries replaced European countries as important upstream partners (such as Thailand versus the UK for Brunei, Korea/Taiwan versus the UK/Germany for Canada, Taiwan/Malaysia versus Germany/Canada for Mexico, and Japan versus Germany for Chile). When the source of contents is restricted to the CPTPP plus the US or China (or both), the set (and the ranking) of key upstream partners for each of the members remains very similar to the case of the world. This reflects the importance of the US or China in world GDP (and their valued added in the GVC).

As noted from the analysis above, many countries were simultaneously important upstream and downstream trade partners of the CPTPP countries. This to some extent reflects the relative size of trade volumes across countries. A large trading country (such as China) will tend to intermediate large amounts of intermediate inputs from and to other countries, relative to a country with small trade volume (such as Brunei). Nonetheless, bilateral distance and underlying production technologies still play a role, as suggested by the close linkages among the American countries, and the minor role China played in Brunei's GVC linkages. In Section 7, we look at the bilateral supply chain relationships at the sector level, which reveal some interesting heterogeneous patterns of upstream-downstream relationships

across sectors (which might reflect the influence of trade cost and production technologies to different extents).

In the appendix, we discuss potential generalizations of the bilateral downstream/upstream indices, which encompass a larger set of gross-export decomposition components. The comparison of the narrow and broad indices will provide extra insights into the bilateral linkages across countries. But as will be shown, the general conclusions on the key downstream/upstream partners remain similar.

## 6 Position in Global Value Chains

In this section, we ask a slightly different question. Instead of ranking trading partners in terms of the intermediate inputs they intermediate for a country, we evaluate for each country the relative importance of different segments of GVC trade it engages in. In so doing, the measure neutralizes the impact of economic size (which played a significant role in the bilateral downstreamness/upstreamness measures), since the different segments of GVC trade are normalized relative to gross exports. The resulting measures characterize the absolute position (downstreamness) of the countries under study. We explore two potential indicators.

First, based on the BM decomposition, we examine the fraction of domestic content directly absorbed by bilateral importers, i.e., the amount of traditional trade ( $TT_{s^*}$ ), relative to domestic content ( $DC_{s^*}$ ) in a country's gross exports. This fraction is basically denoted by:

$$D1_s \equiv \frac{TT_{s^*}}{DC_{s^*}} = \frac{1 - GVC_s^{BM}}{1 - VS_s}, \quad (7)$$

where in the last term, the numerator is the fraction of domestic content directly absorbed by bilateral importers in gross exports and the denominator is the fraction of domestic content in gross exports. We can regard this as an index of a country's closeness to final demands or the downstreamness of a country in the supply chains. The results are summarized in Figure 2 for 2011. We find that more than half of domestic content from the CPTPP countries was directly absorbed by their bilateral importers, ranging from 68.10% for Brunei to 84.53% for New Zealand. The levels were however quite similar across CPTPP countries, and also close to the world average. Thus, it is not a very informative measure of downstreamness.

Next, we look at the fraction of foreign content in a country's total amount of GVC-related gross exports, that is:

$$D2_s \equiv \frac{FC_{s^*}}{FC_{s^*} + DC_{s^*} - TT_{s^*}} = \frac{VS_s}{GVC_s^{BM}}, \quad (8)$$

where  $FC_{s^*}$  and  $DC_{s^*}$  are respectively the foreign content and domestic content in country  $s$ 's total gross exports. A larger  $D2_s$  implies that a larger fraction of GVC-related exports of country  $s$  is contributed by foreign contents and less by domestic contents. In other words, the country has more backward linkages relative to forward linkages; hence, the country is positioned relatively downstream in the global value chains.

The results for this index are reported in Table 5 for two benchmark years, 1995 and 2011. In 1995, Singapore, Mexico, Canada, Malaysia and Vietnam were located relatively downstream in the global value chains (similar to China), while Japan, Brunei, Peru and Australia were the opposite (in the same league as the US). Between 1995 and 2011, countries such as Brunei, Peru and Australia moved even more upstream, while Japan became more downstream. Vietnam experienced the biggest changes, and became the most downstream country among the group in 2011. Malaysia similarly moved further downstream, although less dramatically than Vietnam.

Relative to CPTPP countries, China's position was relatively downstream in 1995, with its  $D2_s$  index only second to Singapore's. However, it moved upstream in the chains over the years (even though it was still on the relatively downstream side). The US, on the other hand, moved downstream. Thus, the two large trading blocs became closer competitors in their GVC positions.

## 7 CPTPP and Global Value Chains at Sector Levels

In this section, we characterize the GVC participation of the CPTPP countries at the sector level. We disaggregate the bilateral gross exports of a country  $s$  by sector of exports. In equation (1), we define  $\tilde{\mathbf{B}}_{cc} \equiv (\mathbf{I} - \mathbf{A}_{cc})^{-1}$  for  $c = s, t$ . Recall that it is the local Leontief matrix of country  $c$ . The decomposition of equation (1) by sector of exports is obtained by expanding  $\mathbf{V}_c \tilde{\mathbf{B}}_{cc}$  (a  $1 \times G$  vector) to a  $G \times G$  diagonal matrix with each element of  $\mathbf{V}_c \tilde{\mathbf{B}}_{cc}$  placed along the principal diagonal and zeros elsewhere.

### 7.1 GVC Participation

Given the sectoral disaggregation, we calculate the GVC participation index  $GVC^{BM}$  as in equation (4) for each export sector. For example, component  $1a^*$  of country  $s$ 's exports of electronics includes country  $s$ 's DVA from all its domestic sectors embodied in electronics exports (as  $s$ 's final goods) directly absorbed by the bilateral importer  $r$ . Similarly, component  $2a^*$  of country  $s$ 's exports of electronics includes country  $s$ 's DVA from all its domestic sectors embodied in electronics exports (as intermediate inputs for further processing in the

bilateral importer) and absorbed by the bilateral importer as  $r$ 's local final goods/services. The remaining components consist of country  $s$ 's domestic contents embedded in country  $s$ 's exports of electronics not directly absorbed by bilateral importers, and also foreign contents in  $s$ 's exports of electronics. The resulting  $GVC^{BM}$  index measures how much of country  $s$ 's electronics exports are associated with GVC trade.

The results are presented in Table 6. For each country, we highlight sectors whose percentages of GVC-related trade in gross exports exceed the country's in the aggregate, where the country's overall GVC participation is as indicated in Table 2 under the column  $GVC^{BM}$ . We note that manufacturing sectors in CPTPP countries were deeply intertwined in the global value chains. Basic metals was a particularly GVC-intensive sector for most countries in the group, with the lowest level for Mexico (46.99%) and the highest for Singapore (81.78%). This is against a world average of 64.00%. The other industries typically involved in GVC of CPTPP countries included computer, electronic and optical equipment, fabricated metal products, rubber and plastics, chemicals and chemical products. Coke, refined petroleum products and nuclear fuel was a GVC-active sector in some CPTPP countries such as Japan, Singapore, Vietnam and Chile. On the other hand, Canada, Mexico and the US were characterized with a very high level of GVC trade in motor vehicles (65.50%–53.26%), relative to a world average of 49.64%.

The service sectors of CPTPP countries in general were not heavily engaged in GVC. Nonetheless, R&D and other business activities, and financial intermediation were two service industries that appeared to be highly GVC-intensive for some countries. For instance, New Zealand had 44.03% of financial intermediation and 38.59% of R&D activities associated with GVC. The corresponding figures were 43.93% and 49.07% for Malaysia, 45.41% and 54.24% for Singapore, and 50.52% and 53.19% for Vietnam. In comparison, the world averages of GVC trade were 37% for financial intermediation and 42.71% for R&D. Thus, all these countries stood out in terms of GVC participation in the sector of financial intermediation, but the three Southeast Asian countries stood out even more in the sector of R&D and other business activities. It is also noteworthy that Mexico's construction sector (51.28%) and Chile's transport and storage services (50%) were prominent in their GVC participation, against the world benchmarks of 29.79% and 39.97% respectively.

## 7.2 Upstream/Downstream Partners

We now select five sectors that are GVC-intensive (as analyzed above) and identify the key upstream/downstream partners for the CPTPP countries in each of these sectors. These include rubber and plastics products (Sector 9), basic metals (Sector 11), computer, electronic

and optical equipment (Sector 14), electrical machinery and apparatus, nec (Sector 15), and motor vehicles, trailers and semi-trailers (Sector 16). This exercise provides a more comprehensive understanding of the supply chain relationship across countries in GVC-intensive sectors. Tables 7 and 8 summarize the results. The ranking is based on the world as the final destination of contents for the downstreamness measure and the world as the source of contents for the upstreamness measure.

Overall, in 2011 China was a critical partner for most CPTPP countries, especially in computers and electrical machinery. Next to China, Korea, Taiwan, Thailand also played important downstream intermediary roles for several CPTPP countries in these two industries. The four countries together also played significant downstream intermediary roles in rubber and plastics products, and in basic metals, for CPTPP countries in Asia.

Nonetheless, Tables 7 and 8 indicate there are substantial heterogeneities across sectors in bilateral GVC linkages. For example, China was a dominant downstream partner of Japan in computers and electrical machinery, but this status was replaced by the US in Japan's car exports. Similarly, the dominance of China and Malaysia as downstream partners of Singapore in computers and electrical machinery was replaced by Indonesia and ROW in the car industry. Thailand and Japan were, respectively, Malaysia's and Vietnam's most important downstream partners in the car industry.

The US was an essential downstream partner of Canada and Mexico in all five industries, with the US intermediating typically more than half of their GVC-related domestic contents. This is especially pronounced in Canada's car exports, with 87.24% of Canada's domestic contents in forward linkages intermediated by the US. There are, however, exceptions. In the computer industry, China intermediated equally large amounts (nearly 30%) of Canada's domestic contents as the US in forward linkages. In addition to the big two, European countries such as Germany, Norway, Hungary and the UK were often among the top five downstream partners of Canada. On the other hand, Chile and Peru had more diversified and regional forward linkages.

In turn Table 8 shows that in sectors of rubber/plastics, computers, and electrical machinery, the set of top five upstream trade partners often overlapped with those of downstream partners. However, for heavy items such as basic metals and cars, this was less the case. For example, in basic metals, Thailand and Malaysia were key downstream partners of Japan (but not its key upstream partners), while Russia and South Africa were key upstream partners of Japan (but not the other way around). Similarly, in the car industry, Russia was among the top five downstream partners of Japan (but not upstream), while Germany topped the list of Japan's upstream partners (but not downstream). Thus, the direction of the GVC in these two industries had a more defined pattern of upstream-downstream rela-

tionships. This is likely due to the higher transportation cost involved in these industries, and as a result, lower frequencies of back-and-forth shipping across countries in production arrangements.

While China still was a dominant upstream partner to most CPTPP countries in most sectors, Germany clearly stood out as a key upstream partner of all in the car industry (except Chile and Peru). For example, it transferred 25–26% of third-country contents to Singapore and Japan. Thailand (and Taiwan to a lesser extent) also played an important upstream role in the rubber and plastics industry for CPTPP countries, with their joint share sometimes rivaling that of China. Finally, Taiwan and Korea were prominent upstream partners in the computer industry (next to China), while Japan and Germany were non-negligible upstream players in the sector of basic metals.

## 8 Conclusion

In this paper, by decomposing a country’s gross exports à la Koopman, Wang and Wei (2014) and Borin and Mancini (2017), we propose formulas that measure the relative importance of bilateral trading partners in intermediating a country’s backward and forward linkages. By exploiting the relative proportion of foreign contents and domestic contents in a country’s GVC-related gross exports, we also suggest a GVC-positioning index that measures a country’s absolute downstreamness in the global production network. These formulas and indices can be further generalized to the sector level and/or with respect to a subset of market destinations for absorption or countries of origin of contents.

We apply these measures to study whether the grouping of CPTPP countries is ideal in the sense that members are important downstream/upstream partners of one another. Given their dominant economy sizes, we also analyze the interaction of China and the US with the CPTPP countries in the GVC. We find that the CPTPP countries were deeply integrated in the global value chains with strong dependence on one another. In 2011, at least one third of every country’s gross exports was associated with GVC trade. Among the eleven countries, Singapore had the highest level of GVC trade (57.26%) and Brunei the lowest (34.80%). Of their GVC-related gross exports, countries such as Singapore had a dominant proportion made up of foreign contents (41.59% out of 57.26%), while others such as Japan had a large fraction consisting of domestic contents that are further processed and embedded in other countries’ gross exports. Such differences show that CPTPP countries such as Japan (as well as Brunei, Peru and Australia) were located relatively upstream, while countries such as Singapore (and similarly, Mexico, Malaysia and Vietnam) were located relatively downstream in the global value chains. Relative to CPTPP countries, China’s position was

relatively downstream in 1995, only second to Singapore. However, it moved upstream in the chains over the years (even though it was still on the relatively downstream side). The US (in the same league as Japan in 1995), on the other hand, moved downstream. Thus, the two large trading blocs became closer competitors in their GVC positions.

China and the US, although not part of the partnership, were often among the top five downstream and upstream partners of CPTPP countries. The US played a particularly important role for Canada and Mexico, for both intermediating their domestic contents to final absorption destinations as well as transferring third-country contents to these two countries for absorption or for further processing. China, on the other hand, was a critical downstream and upstream partner of CPTPP members in Asia but also in South America. Relative to Canada and Mexico, the other CPTPP members had more diversified forward and backward linkages across trading partners. The linkages were typically strong among Asian/Australasian CPTPP members and less so across the Pacific. Nonmembers such as Korea, Taiwan and Thailand stood out as dominant downstream and upstream trade partners of many CPTPP countries. Their omission from the partnership thus implies some potential ramifications on the re-alignment of the supply chains in the region.

Relative to CPTPP's high levels of participation in GVC trade in the aggregate, several manufacturing and service sectors of these countries were even more involved in the global value chains. These included rubber and plastics products, basic metals, computer, electronic and optical equipment in manufacturing, as well as R&D, construction, and financial intermediation in services. Leading upstream and downstream partners at the sector level exhibited more fundamental heterogeneities across industries compared to those at the aggregate trade level. While China continued to play a dominant intermediary role in both downstream and upstream linkages in computers and electrical machinery, sectors characterized by high trade cost such as cars typically had distinct sets of key downstream partners from upstream partners. The set of important trade partners were also more diversified at the sector levels, with European and South American countries also playing significant roles in different sectors for different CPTPP members.

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# Appendix

## A.1 Alternative measures of bilateral downstreamness and upstreamness

In this section, we propose an augmented version of the bilateral downstreamness formula in (5) and also for the bilateral upstreamness formula in (6). To identify the key downstream trade partners, we have taken a local GDP perspective in (5) and examined how much of local content is intermediated by a bilateral importer in forward linkage in the GVC. We can argue that a bilateral importer  $r$  can also be considered an important downstream partner of country  $s$  if it receives a lot of third country contents embedded in exports of country  $s$  to country  $r$  for absorption locally or for further processing before being exported again. With this taken into account, the augmented bilateral downstream formula instead takes the following form:

$$\tilde{D}_{sr}^{\mathcal{G}} = \frac{FC_{sr}^{\circ\mathcal{G}} - FC_{sr}^{r\mathcal{G}} + (DC_{sr}^{\mathcal{G}} - \mathbf{1}[r \in \mathcal{G}](1a_{sr}^* + 2a_{sr}^*))}{\sum_c \{FC_{sc}^{\circ\mathcal{G}} - FC_{sc}^{c\mathcal{G}} + (DC_{sc}^{\mathcal{G}} - \mathbf{1}[c \in \mathcal{G}](1a_{sc}^* + 2a_{sc}^*))\}} \quad (9)$$

where  $FC_{sr}^{\circ\mathcal{G}}$  is the foreign content embedded in the gross exports of country  $s$  to country  $r$  absorbed in destinations  $\mathcal{G}$ ,  $FC_{sr}^{r\mathcal{G}}$  is the content of country  $r$  re-exported by country  $s$  to country  $r$  absorbed in destinations  $\mathcal{G}$ ,  $DC_{sr}^{\mathcal{G}}$  is the domestic content of country  $s$  in gross exports of  $s$  to  $r$  absorbed in destinations  $\mathcal{G}$ , and  $(1a_{sr}^* + 2a_{sr}^*)$  is the domestic content of country  $s$  directly absorbed by bilateral importer  $r$ . A bilateral importer  $r$  is a more important downstream partner to country  $s$  than importer  $r'$  if country  $r$  receives a larger portion of third country contents from country  $s$  or intermediates a larger portion of exporter  $s$ 's domestic content to third countries than does importer  $r'$ .

Similarly, we can augment the bilateral upstreamness formula of country  $s$  to country  $r$  in (6) as:

$$\tilde{U}_{sr}^{\mathcal{G}} = \frac{FC_{sr}^{\mathcal{G}\circ} - \mathbf{1}[r \in \mathcal{G}]FC_{sr}^r + \mathbf{1}[s \in \mathcal{G}](DC_{sr} - (1a_{sr}^* + 2a_{sr}^*))}{\sum_c \{FC_{cr}^{\mathcal{G}\circ} - \mathbf{1}[r \in \mathcal{G}]FC_{cr}^r + \mathbf{1}[c \in \mathcal{G}](DC_{cr} - (1a_{cr}^* + 2a_{cr}^*))\}} \quad (10)$$

where  $FC_{sr}^{\mathcal{G}\circ}$  is the foreign content originating from countries in  $\mathcal{G}$  that are passed on by country  $s$  to country  $r$ ,  $FC_{sr}^r$  is the importer  $r$ 's content re-exported by country  $s$ ,  $DC_{sr}$  is the domestic content of country  $s$  in its exports to  $r$ , and  $(1a_{sr}^* + 2a_{sr}^*)$  is the content of country  $s$  directly absorbed by bilateral importer  $r$ . The first part of (10) corresponds to the GVC-trade in which the exporter  $s$  passes on third countries' contents to  $r$ , while the second part in (10) accounts for the exporter's content that is further processed and re-exported by

$r$ . A country  $s$  is regarded as a more important upstream trade partner of country  $r$  than country  $s'$  if country  $s$  passes on a larger portion of foreign contents from third countries to the importer, or contributes a larger portion of its domestic content to importer  $r$ 's gross exports.

Tables A.1 and A.2 summarize the results. China remained among the top five downstream trade partners of all CPTPP countries except Brunei. Nonetheless, its dominance decreased overall compared to Table 3, which is based on the narrow index of bilateral downstreamness in (5). This suggests that the CPTPP countries tended to export their domestic contents to China for further processing before reaching third-country destinations. Third-country contents, however, did not pass on from CPTPP countries to China as predominantly, and other downstream countries such as the US and Japan weighed more heavily in this regard. Similarly, Korea's overall importance as a downstream partner of the CPTPP countries also decreased with the broad definition of bilateral downstreamness in (9). In contrast, the US's dominance as a downstream partner of Canada and Mexico further increased when taking into account third-country contents received by the US from these two countries (in addition to these two countries' domestic contents intermediated by the US). This might reflect the US's status as a large final demand destination of third-country contents.

Turning to key bilateral upstream partners of CPTPP members in Table A.2, China and the US remained key upstream partners of these countries based on the alternative broad definition in (10). But again, China's importance tended to decrease while that of the US with respect to Canada and Mexico increased (by around 5 percentage points) compared to Table 4 based on formula (6). This suggests that China did not pass on domestic contents to be incorporated in bilateral importers' gross exports as substantially as it passed on third countries' contents to its bilateral importers. The reverse is true in the case of the US with respect to its two neighboring countries. In other words, the US domestic contents were heavily used in the gross exports of Canada and Mexico, more so than the proportion of third-country contents passed on by the US to the two countries. These observations are consistent with the finding in Section 6 that China is relatively downstream in the GVC, while the US is relatively upstream.

With the exception of Canada and Mexico, most CPTPP countries were rather diversified in their sourcing, as the index  $\tilde{U}_{sr}^G$  was not highly concentrated at the top. The top upstream partner typically intermediated around 20% of GVC-related gross imports of the bilateral importer, followed closely by the second key upstream partner of the bilateral importer. Canada and Mexico imported foreign contents disproportionately from the US, at more than 40% and up to 65% if we focus on contents sourcing from the CPTPP region plus the US.

Table 1: Decomposition of gross exports by source-based approach

Gross exports from country $s$ to $r$	DVA		(1a*) in final goods exports $\mathbf{Y}_{sr}$ directly absorbed by bilateral importers (2a*) in intermediate exports $\mathbf{A}_{sr}$ absorbed by direct importers as local final goods $\mathbf{Y}_{rr}$
		in intermediate exports $\mathbf{A}_{sr}$ absorbed by bilateral importer $r$	(1b*) as $s$ 's final goods $\mathbf{Y}_{sr}$ after additional processing stages (2b*) as local final goods $\mathbf{Y}_{rr}$ but only after further processing stages (3c*) as final goods from third countries $\mathbf{Y}_{kr}$
		in intermediate goods exports $\mathbf{A}_{sr}$ absorbed by third countries	(1c*) as $s$ 's final goods $\mathbf{Y}_{sk}$ after additional processing stages (2c*) as local final goods $\mathbf{Y}_{kk}$ (3a*) as final goods from direct bilateral importer $\mathbf{Y}_{rj}$ (3b*) as final goods from direct bilateral importer $\mathbf{Y}_{rl}$ but only after further processing stages (3d*) as final goods from other third countries $\mathbf{Y}_{kl}$
		in intermediate goods exports $\mathbf{A}_{sr}$ absorbed at home	(4a*) as final goods of the bilateral importer $\mathbf{Y}_{rs}$ (4b*) as final goods of the bilateral importer $\mathbf{Y}_{rs}$ but only after additional processing stages (4c*) as final goods of a third country $\mathbf{Y}_{ks}$ (5*) as domestic final goods $\mathbf{Y}_{ss}$
	FVA, $\mathbf{V}_{t \neq s}$		(7*) in exports of final goods $\mathbf{Y}_{sr}$ (8*) in exports of intermediate goods $\mathbf{A}_{sr}$ directly absorbed by the importing country $\mathbf{Y}_{rr}$
		in intermediate exports $\mathbf{A}_{sr}$ re-exported by $r$	(9a*) via final goods exports $\mathbf{Y}_{rj}$ (9b*) via intermediate exports $\mathbf{A}_{rj}$
	purely double-counted components		(6*) of domestic content (9c*-9d*) of foreign content

Table 2: Participation of CPTPP members in GVC

<b>JAPAN</b>	<i>VS</i>	<i>GVC<sup>KWW</sup></i>	<i>GVC<sup>BM</sup></i>	<b>AUSTRALIA</b>	<i>VS</i>	<i>GVC<sup>KWW</sup></i>	<i>GVC<sup>BM</sup></i>
1995	5.61%	24.64%	25.54%	1995	11.97%	26.81%	27.00%
2000	7.38%	30.05%	31.12%	2000	15.69%	33.15%	33.43%
2005	11.07%	35.38%	36.32%	2005	11.97%	31.78%	32.04%
2011	14.66%	39.46%	40.47%	2011	13.90%	35.89%	36.24%
<b>SINGAPORE</b>	<i>VS</i>	<i>GVC<sup>KWW</sup></i>	<i>GVC<sup>BM</sup></i>	<b>NEW ZEALAND</b>	<i>VS</i>	<i>GVC<sup>KWW</sup></i>	<i>GVC<sup>BM</sup></i>
1995	42.02%	52.12%	52.57%	1995	16.79%	25.77%	26.23%
2000	45.22%	59.45%	60.02%	2000	22.09%	33.33%	34.02%
2005	39.66%	55.38%	56.00%	2005	15.67%	27.10%	27.70%
2011	41.59%	56.48%	57.26%	2011	16.76%	29.36%	30.18%
<b>MALAYSIA</b>	<i>VS</i>	<i>GVC<sup>KWW</sup></i>	<i>GVC<sup>BM</sup></i>	<b>CANADA</b>	<i>VS</i>	<i>GVC<sup>KWW</sup></i>	<i>GVC<sup>BM</sup></i>
1995	30.40%	43.10%	43.51%	1995	24.15%	33.21%	34.44%
2000	47.64%	60.09%	60.52%	2000	26.80%	35.56%	36.81%
2005	45.85%	58.48%	58.86%	2005	23.39%	32.78%	33.87%
2011	40.51%	55.67%	56.17%	2011	23.55%	37.95%	38.77%
<b>VIETNAM</b>	<i>VS</i>	<i>GVC<sup>KWW</sup></i>	<i>GVC<sup>BM</sup></i>	<b>MEXICO</b>	<i>VS</i>	<i>GVC<sup>KWW</sup></i>	<i>GVC<sup>BM</sup></i>
1995	21.43%	31.70%	33.55%	1995	27.27%	36.01%	36.82%
2000	27.15%	42.04%	42.84%	2000	34.33%	42.20%	43.11%
2005	30.93%	44.72%	45.27%	2005	32.98%	40.92%	41.63%
2011	36.33%	48.52%	48.70%	2011	31.65%	43.21%	44.02%
<b>BRUNEI</b>	<i>VS</i>	<i>GVC<sup>KWW</sup></i>	<i>GVC<sup>BM</sup></i>	<b>CHILE</b>	<i>VS</i>	<i>GVC<sup>KWW</sup></i>	<i>GVC<sup>BM</sup></i>
1995	7.26%	23.88%	24.09%	1995	14.10%	29.68%	30.10%
2000	5.35%	29.59%	29.91%	2000	21.34%	38.73%	40.60%
2005	4.64%	31.80%	32.16%	2005	18.72%	40.57%	41.73%
2011	4.26%	34.39%	34.80%	2011	19.98%	43.29%	44.75%
<b>CHINA</b>	<i>VS</i>	<i>GVC<sup>KWW</sup></i>	<i>GVC<sup>BM</sup></i>	<b>PERU</b>	<i>VS</i>	<i>GVC<sup>KWW</sup></i>	<i>GVC<sup>BM</sup></i>
1995	30.96%	39.23%	39.54%	1995	9.85%	27.57%	27.89%
2000	35.89%	44.68%	45.27%	2000	10.71%	29.81%	30.51%
2005	37.31%	48.38%	48.93%	2005	12.31%	34.86%	35.42%
2011	32.04%	45.22%	45.82%	2011	11.79%	38.42%	38.97%
<b>WORLD</b>	<i>VS</i>	<i>GVC<sup>KWW</sup></i>	<i>GVC<sup>BM</sup></i>	<b>USA</b>	<i>VS</i>	<i>GVC<sup>KWW</sup></i>	<i>GVC<sup>BM</sup></i>
1995	17.87%	32.71%	33.32%	1995	11.43%	28.75%	29.08%
2000	21.40%	38.42%	39.16%	2000	12.52%	33.87%	34.30%
2005	22.75%	40.51%	41.15%	2005	12.99%	33.87%	34.41%
2011	24.32%	43.02%	43.74%	2011	14.95%	35.25%	35.75%

Note: The measures are defined in equation (2) for  $VS$ , equation (3) for  $GVC^{KWW}$ , and equation (4) for  $GVC^{BM}$ .

Table 3: Key downstream trade partners of CPTPP members (2011)

<b>JAPAN</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	99.50	9.75	25.27	34.77	50.29
1st downstream partner	CHN (34.37)	CHN (37.08)	CHN (40.58)	CHN (28.06)	CHN (34.51)
2nd downstream partner	KOR (11.86)	USA (12.06)	KOR (9.94)	KOR (14.98)	KOR (12.73)
3rd downstream partner	TWN (9.53)	KOR (10.44)	TWN (8.95)	TWN (14.58)	TWN (12.25)
4th downstream partner	USA (6.48)	TWN (9.02)	USA (7.78)	USA (9.25)	USA (7.01)
5th downstream partner	THA (5.83)	THA (8.02)	THA (5.75)	THA (7.60)	THA (5.97)
<b>SINGAPORE</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	99.44	23.60	33.35	35.88	45.63
1st downstream partner	CHN (19.81)	CHN (23.79)	CHN (26.66)	MYS (20.94)	CHN (21.19)
2nd downstream partner	MYS (14.84)	MYS (16.64)	MYS (15.81)	CHN (16.25)	MYS (18.72)
3rd downstream partner	KOR (6.25)	THA (7.92)	KOR (6.10)	KOR (8.93)	KOR (7.90)
4th downstream partner	THA (5.76)	USA (7.19)	THA (6.05)	TWN (8.31)	TWN (7.33)
5th downstream partner	TWN (5.15)	KOR (6.04)	TWN (5.35)	THA (7.34)	THA (6.17)
<b>MALAYSIA</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	99.76	21.58	30.42	47.06	55.90
1st downstream partner	CHN (32.26)	CHN (33.49)	CHN (39.57)	CHN (26.35)	CHN (33.85)
2nd downstream partner	SGP (7.82)	SGP (9.56)	SGP (7.32)	KOR (9.60)	KOR (8.02)
3rd downstream partner	THA (7.32)	THA (9.39)	THA (7.17)	THA (9.40)	TWN (7.69)
4th downstream partner	KOR (7.06)	KOR (7.08)	KOR (6.29)	TWN (9.16)	THA (7.63)
5th downstream partner	TWN (6.24)	AUS (6.73)	TWN (5.87)	SGP (9.01)	SGP (7.45)
<b>VIETNAM</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	100	22.55	37.81	36.39	51.65
1st downstream partner	CHN (21.08)	CHN (23.61)	CHN (27.54)	CHN (16.90)	CHN (22.14)
2nd downstream partner	MYS (11.82)	MYS (12.95)	KOR (11.05)	MYS (14.70)	KOR (13.05)
3rd downstream partner	KOR (11.03)	KOR (11.58)	MYS (10.99)	KOR (14.39)	MYS (12.62)
4th downstream partner	AUS (8.33)	AUS (11.03)	AUS (8.05)	AUS (13.24)	AUS (10.23)
5th downstream partner	JPN (6.46)	USA (9.11)	JPN (6.32)	JPN (7.12)	JPN (7.35)
<b>BRUNEI</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	100	59.83	61.95	64.38	66.51
1st downstream partner	KOR (24.52)	KOR (23.91)	KOR (23.98)	KOR (26.23)	KOR (25.75)
2nd downstream partner	AUS (20.71)	AUS (22.24)	AUS (19.14)	AUS (24.92)	AUS (22.18)
3rd downstream partner	JPN (19.13)	IDN (15.23)	JPN (18.34)	JPN (17.16)	JPN (18.86)
4th downstream partner	IDN (11.67)	JPN (15.22)	IDN (13.37)	IDN (12.96)	IDN (12.20)
5th downstream partner	VNM (5.48)	NZL (8.28)	NZL (7.07)	NZL (6.08)	NZL (5.75)

<b>AUSTRALIA</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	100	26.37	31.75	53.18	58.56
1st downstream partner	CHN (27.78)	CHN (28.84)	CHN (31.85)	KOR (23.51)	CHN (26.19)
2nd downstream partner	KOR (17.12)	KOR (19.31)	KOR (16.89)	CHN (21.39)	KOR (20.24)
3rd downstream partner	JPN (10.55)	JPN (9.82)	JPN (10.23)	JPN (12.36)	JPN (11.83)
4th downstream partner	TWN (7.73)	TWN (8.67)	TWN (7.93)	TWN (10.84)	TWN (9.55)
5th downstream partner	IND (5.32)	THA (7.09)	THA (5.50)	THA (6.27)	THA (5.32)
<b>NEW ZEALAND</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	99.36	39.51	49.31	50.27	60.06
1st downstream partner	AUS (25.15)	AUS (31.61)	AUS (25.01)	AUS (36.31)	AUS (29.86)
2nd downstream partner	CHN (17.45)	CHN (20.06)	CHN (23.24)	CHN (13.93)	CHN (18.25)
3rd downstream partner	SGP (7.86)	SGP (9.37)	SGP (7.94)	SGP (8.50)	SGP (7.69)
4th downstream partner	KOR (5.73)	USA (6.01)	KOR (5.80)	KOR (6.99)	KOR (6.70)
5th downstream partner	JPN (4.66)	KOR (5.59)	MYS (4.23)	MYS (5.30)	JPN (4.91)
<b>CANADA</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	99.87	7.30	74.05	12.19	78.93
1st downstream partner	USA (52.67)	USA (72.27)	USA (60.62)	USA (66.73)	USA (58.48)
2nd downstream partner	CHN (8.98)	CHN (7.59)	CHN (10.10)	CHN (6.90)	CHN (9.26)
3rd downstream partner	KOR (4.15)	KOR (3.57)	MEX (6.49)	KOR (5.37)	MEX (5.71)
4th downstream partner	GBR (4.03)	MEX (1.89)	KOR (3.67)	JPN (2.16)	KOR (4.90)
5th downstream partner	MEX (3.20)	GBR (1.58)	GBR (2.60)	TWN (1.90)	GBR (2.58)
<b>MEXICO</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	99.82	10.40	80.06	13.54	83.21
1st downstream partner	USA (57.60)	USA (78.22)	USA (59.89)	USA (73.90)	USA (59.40)
2nd downstream partner	CAN (10.43)	CHN (4.78)	CAN (18.46)	CAN (4.92)	CAN (16.91)
3rd downstream partner	CHN (6.03)	CAN (4.69)	CHN (5.89)	CHN (4.48)	CHN (5.56)
4th downstream partner	ESP (5.27)	KOR (1.88)	ESP (2.67)	KOR (2.93)	ESP (2.61)
5th downstream partner	ROW (2.49)	ESP (1.30)	KOR (1.86)	ROW (1.52)	KOR (2.53)
<b>CHILE</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	99.05	18.80	29.11	42.52	52.83
1st downstream partner	CHN (34.19)	CHN (39.57)	CHN (39.58)	CHN (31.50)	CHN (35.02)
2nd downstream partner	KOR (9.41)	USA (11.63)	KOR (8.64)	KOR (14.08)	KOR (10.88)
3rd downstream partner	USA (5.60)	KOR (10.72)	CAN (7.08)	USA (9.78)	USA (6.70)
4th downstream partner	JPN (5.12)	TWN (5.84)	USA (6.97)	TWN (8.09)	TWN (6.65)
5th downstream partner	TWN (5.00)	JPN (5.13)	MEX (5.84)	JPN (7.25)	CAN (6.28)
<b>PERU</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	100	25.92	40.54	46.10	60.73
1st downstream partner	CHN (19.05)	CHN (24.25)	CAN (30.08)	KOR (19.93)	CAN (26.51)
2nd downstream partner	CAN (16.62)	KOR (15.91)	CHN (19.97)	CHN (18.35)	CHN (17.59)
3rd downstream partner	KOR (11.24)	USA (13.05)	KOR (10.28)	CHL (13.09)	KOR (13.35)
4th downstream partner	CHL (8.78)	CAN (11.58)	CHL (7.52)	CAN (10.76)	CHL (9.57)
5th downstream partner	ESP (8.23)	CHL (9.99)	USA (6.84)	USA (10.40)	USA (6.49)



Table 4: Key upstream trade partners of CPTPP members (2011)

<b>JAPAN</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	15.37	28.07	36.72	49.43
1st upstream partner	CHN (29.28)	CHN (32.57)	CHN (32.47)	CHN (22.18)	CHN (25.60)
2nd upstream partner	KOR (10.97)	USA (14.52)	KOR (11.18)	KOR (14.17)	KOR (12.05)
3rd upstream partner	USA (7.19)	KOR (13.64)	USA (8.32)	USA (14.07)	USA (9.33)
4th upstream partner	THA (4.31)	THA (5.31)	AUS (4.55)	THA (6.23)	THA (5.25)
5th upstream partner	TWN (3.94)	AUS (5.21)	THA (4.46)	TWN (5.48)	TWN (5.10)
<b>SINGAPORE</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	16.22	29.29	24.46	37.52
1st upstream partner	MYS (9.18)	CHN (14.60)	CHN (12.35)	USA (12.63)	MYS (11.01)
2nd upstream partner	CHN (9.11)	USA (13.37)	MYS (10.18)	MYS (11.66)	CHN (9.64)
3rd upstream partner	TWN (8.83)	TWN (12.21)	TWN (9.66)	TWN (10.60)	KOR (9.15)
4th upstream partner	IND (7.99)	MYS (10.65)	KOR (9.00)	KOR (10.18)	USA (9.13)
5th upstream partner	KOR (7.44)	KOR (10.40)	USA (8.62)	CHN (10.16)	TWN (9.06)
<b>MALAYSIA</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	26.96	35.59	40.78	49.40
1st upstream partner	SGP (17.96)	CHN (24.71)	CHN (22.49)	CHN (17.32)	CHN (17.48)
2nd upstream partner	CHN (17.56)	THA (12.89)	SGP (15.34)	SGP (13.63)	SGP (15.47)
3rd upstream partner	THA (9.39)	SGP (12.67)	THA (10.84)	THA (12.50)	THA (11.00)
4th upstream partner	TWN (7.58)	TWN (10.51)	TWN (9.20)	TWN (10.35)	TWN (9.37)
5th upstream partner	KOR (6.01)	KOR (7.90)	KOR (7.20)	KOR (8.32)	KOR (7.66)
<b>VIETNAM</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	20.70	25.05	43.57	47.92
1st upstream partner	CHN (25.09)	CHN (30.78)	CHN (29.37)	CHN (23.94)	CHN (24.25)
2nd upstream partner	KOR (16.19)	KOR (18.20)	KOR (17.54)	KOR (20.02)	KOR (19.08)
3rd upstream partner	TWN (13.51)	TWN (15.30)	TWN (13.84)	TWN (15.16)	TWN (13.98)
4th upstream partner	THA (9.53)	THA (11.16)	THA (10.03)	THA (11.27)	THA (10.31)
5th upstream partner	SGP (6.16)	MYS (4.48)	SGP (5.01)	MYS (5.01)	SGP (5.17)
<b>BRUNEI</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	41.71	62.03	49.35	69.67
1st upstream partner	SGP (28.91)	SGP (24.63)	SGP (30.25)	SGP (25.34)	SGP (29.47)
2nd upstream partner	MYS (19.73)	MYS (22.73)	MYS (19.93)	MYS (22.00)	MYS (20.03)
3rd upstream partner	USA (11.80)	USA (19.60)	USA (13.20)	USA (19.20)	USA (14.39)
4th upstream partner	GBR (5.35)	CHN (7.15)	CHN (6.38)	THA (5.17)	CHN (4.90)
5th upstream partner	CHN (5.30)	THA (5.71)	THA (4.69)	CHN (4.93)	THA (4.52)

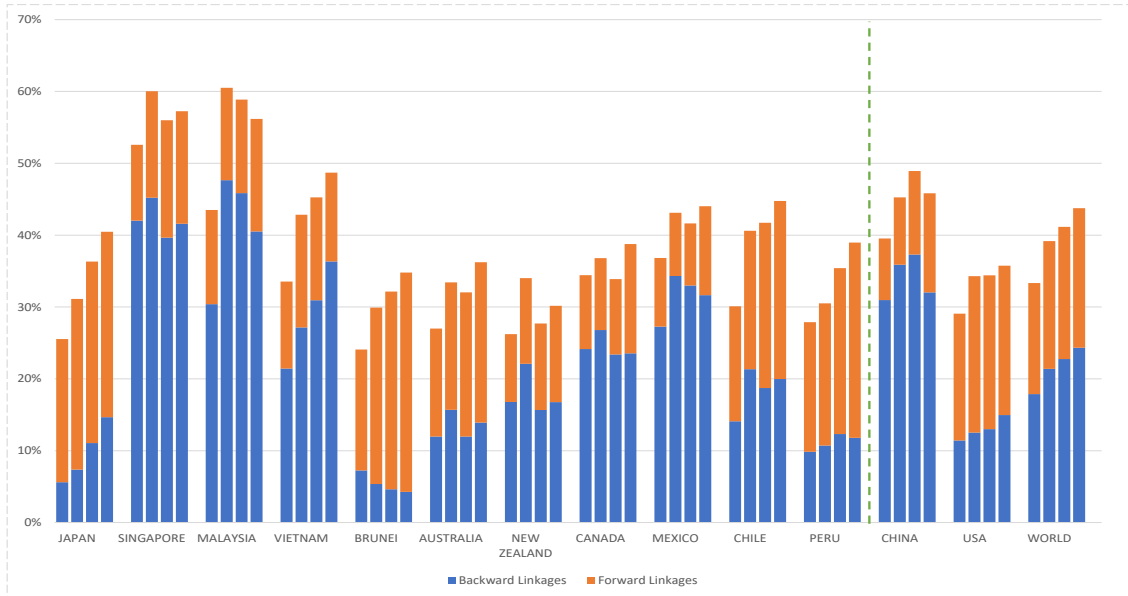
<b>AUSTRALIA</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	23.57	37.34	39.03	52.80
1st upstream partner	CHN (19.60)	CHN (28.59)	CHN (26.11)	CHN (20.68)	CHN (20.91)
2nd upstream partner	SGP (10.26)	USA (15.10)	USA (9.80)	USA (14.68)	USA (10.56)
3rd upstream partner	USA (7.74)	THA (10.25)	SGP (8.64)	THA (10.03)	SGP (8.90)
4th upstream partner	THA (6.35)	SGP (7.63)	THA (8.22)	SGP (8.27)	THA (8.46)
5th upstream partner	KOR (5.68)	KOR (5.87)	KOR (5.28)	KOR (6.27)	KOR (5.69)
<b>NEW ZEALAND</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	34.98	45.01	45.89	55.92
1st upstream partner	CHN (15.12)	CHN (22.58)	CHN (19.95)	CHN (16.32)	CHN (15.98)
2nd upstream partner	AUS (12.44)	AUS (12.75)	AUS (14.22)	AUS (14.50)	AUS (15.18)
3rd upstream partner	SGP (10.64)	USA (11.03)	SGP (9.64)	USA (10.95)	SGP (9.73)
4th upstream partner	KOR (6.73)	SGP (9.07)	USA (7.15)	SGP (9.35)	USA (7.86)
5th upstream partner	USA (6.10)	KOR (8.67)	KOR (7.06)	KOR (8.25)	KOR (7.08)
<b>CANADA</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	10.33	59.70	19.86	69.22
1st upstream partner	USA (37.25)	USA (50.26)	USA (34.46)	USA (51.10)	USA (39.08)
2nd upstream partner	CHN (14.68)	CHN (21.06)	CHN (19.63)	CHN (14.12)	CHN (14.68)
3rd upstream partner	MEX (8.14)	MEX (5.31)	MEX (14.94)	MEX (7.56)	MEX (14.24)
4th upstream partner	GBR (3.82)	KOR (3.85)	KOR (3.61)	KOR (3.91)	KOR (3.71)
5th upstream partner	DEU (3.67)	TWN (2.91)	TWN (2.60)	TWN (2.78)	TWN (2.58)
<b>MEXICO</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	10.72	62.20	23.49	74.96
1st upstream partner	USA (38.56)	USA (49.08)	USA (37.18)	USA (50.07)	USA (40.43)
2nd upstream partner	CHN (20.73)	CHN (26.18)	CHN (26.25)	CHN (19.51)	CHN (20.85)
3rd upstream partner	KOR (5.01)	KOR (5.77)	CAN (7.34)	KOR (6.62)	CAN (6.66)
4th upstream partner	DEU (4.61)	TWN (3.00)	KOR (6.01)	TWN (3.18)	KOR (6.65)
5th upstream partner	CAN (4.27)	MYS (2.47)	TWN (2.96)	MYS (2.77)	TWN (3.11)
<b>CHILE</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	11.75	32.64	25.68	46.30
1st upstream partner	CHN (19.28)	USA (34.79)	CHN (23.39)	USA (31.62)	USA (22.92)
2nd upstream partner	USA (19.09)	CHN (25.67)	USA (23.20)	CHN (19.51)	CHN (19.32)
3rd upstream partner	ROW (8.45)	KOR (7.42)	ROW (7.33)	KOR (8.20)	ROW (8.76)
4th upstream partner	KOR (5.95)	ROW (5.55)	KOR (6.62)	ROW (7.95)	KOR (7.32)
5th upstream partner	DEU (4.63)	JPN (3.26)	MEX (6.41)	MEX (3.96)	MEX (6.67)
<b>PERU</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	14.71	34.19	30.45	49.92
1st upstream partner	CHN (22.76)	CHN (30.74)	CHN (26.26)	USA (25.75)	CHN (21.62)
2nd upstream partner	USA (16.05)	USA (27.66)	USA (17.58)	CHN (22.98)	USA (18.03)
3rd upstream partner	MEX (7.79)	KOR (6.84)	MEX (13.00)	KOR (7.66)	MEX (13.13)
4th upstream partner	ROW (6.03)	MEX (5.42)	KOR (5.92)	MEX (7.52)	KOR (6.66)
5th upstream partner	KOR (5.37)	THA (3.58)	ROW (4.37)	ROW (4.82)	ROW (5.17)

Table 5: Position of CPTPP countries in the GVC (1995 and 2011)

	1995				2011		
	VS	GVC <sup>BM</sup>	Ratio		VS	GVC <sup>BM</sup>	Ratio
Japan	5.62%	25.54%	0.22	Brunei	4.26%	34.80%	0.12
Brunei	7.26%	24.09%	0.30	Peru	11.79%	38.97%	0.30
Peru	9.85%	27.89%	0.35	Japan	14.70%	40.47%	0.36
United States	11.43%	29.08%	0.39	Australia	13.90%	36.24%	0.38
Australia	11.97%	27.00%	0.44	United States	14.97%	35.75%	0.42
Chile	14.11%	30.10%	0.47	Chile	20.21%	44.75%	0.45
New Zealand	16.83%	26.33%	0.64	New Zealand	16.82%	30.18%	0.56
Vietnam	21.62%	33.55%	0.64	Canada	23.57%	38.77%	0.61
Malaysia	30.41%	43.51%	0.70	China	32.11%	45.82%	0.70
Canada	24.21%	34.44%	0.70	Mexico	31.69%	44.02%	0.72
Mexico	27.28%	36.82%	0.74	Malaysia	40.58%	56.17%	0.72
China	30.98%	39.54%	0.78	Singapore	41.73%	57.26%	0.73
Singapore	42.06%	52.57%	0.80	Vietnam	36.33%	48.70%	0.75

Note: The measures are defined in equation (2) for  $VS$ , and equation (4) for  $GVC^{BM}$ . The ratio is defined by  $VS/GVC^{BM}$ .

Figure 1: GVC participation (for year 1995, 2000, 2005, and 2011)



Note: Backward linkage is measured by  $VS$  in equation (2); forward linkage is measured by  $GVC^{BM}$  in equation (4) net of  $VS$  in equation (2).

Table 6: Participation in GVC by sector

Sectors	JPN	Sectors	AUS
07 Coke, refined petroleum products and nuclear fuel	70.11%	11 Basic metals	62.23%
11 Basic metals	60.60%	07 Coke, refined petroleum products and nuclear fuel	49.79%
08 Chemicals and chemical products	56.11%	15 Electrical machinery and apparatus, nec	47.58%
04 Textiles, textile products, leather and footwear	55.99%	09 Rubber and plastics products	46.09%
09 Rubber and plastics products	50.95%	12 Fabricated metal products	39.89%
14 Computer, electronic and optical equipment	50.80%	19 Electricity, gas and water supply	39.27%
15 Electrical machinery and apparatus, nec	46.00%	14 Computer, electronic and optical equipment	39.19%
02 Mining and quarrying	46.00%	08 Chemicals and chemical products	39.02%
12 Fabricated metal products	44.36%	02 Mining and quarrying	38.98%
24 Post and telecommunications	42.02%	17 Other transport equipment	38.79%
10 Other non-metallic mineral products	41.53%	13 Machinery and equipment, nec	38.73%
05 Wood and products of wood and cork	40.91%	29 R&D and other business activities	38.48%
06 Pulp, paper, paper products, printing and publishing	39.91%	06 Pulp, paper, paper products, printing and publishing	38.39%
23 Transport and storage	39.83%	24 Post and telecommunications	38.21%
29 R&D and other business activities	34.88%	30 Public admin. and defense, compulsory social security	35.32%
13 Machinery and equipment, nec	34.65%	20 Construction	34.55%
18 Manufacturing nec, recycling	33.48%	10 Other non-metallic mineral products	34.17%
21 Wholesale and retail trade, repairs	33.32%	21 Wholesale and retail trade, repairs	33.62%
25 Financial intermediation	31.80%	16 Motor vehicles, trailers and semi-trailers	32.92%
17 Other transport equipment	27.19%	23 Transport and storage	30.52%
16 Motor vehicles, trailers and semi-trailers	25.90%	18 Manufacturing nec, recycling	30.32%
03 Food products, beverages and tobacco	21.88%	04 Textiles, textile products, leather and footwear	29.53%
01 Agriculture, hunting, forestry and fishing	21.55%	05 Wood and products of wood and cork	28.90%
30 Public admin. and defense, compulsory social security	17.70%	01 Agriculture, hunting, forestry and fishing	25.20%
33 Other community, social and personal services	16.91%	03 Food products, beverages and tobacco	22.51%
28 Computer and related activities	15.99%	25 Financial intermediation	22.28%
27 Renting of machinery and equipment	13.87%	28 Computer and related activities	21.47%
20 Construction	13.38%	27 Renting of machinery and equipment	21.44%
22 Hotels and restaurants	9.93%	32 Health and social work	14.78%
32 Health and social work	9.20%	33 Other community, social and personal services	12.55%
26 Real estate activities	5.67%	22 Hotels and restaurants	10.79%
31 Education	3.23%	31 Education	5.15%
19 Electricity, gas and water supply	0%	26 Real estate activities	4.68%
34 Private households with employed persons	0%	34 Private households with employed persons	0%

Sectors	SGP	Sectors	NZL
07 Coke, refined petroleum products and nuclear fuel	85.00%	11 Basic metals	57.80%
11 Basic metals	81.78%	08 Chemicals and chemical products	54.20%
10 Other non-metallic mineral products	71.46%	02 Mining and quarrying	50.85%
15 Electrical machinery and apparatus, nec	65.69%	19 Electricity, gas and water supply	44.36%
12 Fabricated metal products	64.20%	25 Financial intermediation	44.02%
19 Electricity, gas and water supply	63.58%	29 R&D and other business activities	38.59%
08 Chemicals and chemical products	62.76%	09 Rubber and plastics products	38.07%
14 Computer, electronic and optical equipment	62.49%	10 Other non-metallic mineral products	37.90%
04 Textiles, textile products, leather and footwear	59.68%	04 Textiles, textile products, leather and footwear	37.83%
09 Rubber and plastics products	59.13%	20 Construction	37.44%
02 Mining and quarrying	59.06%	15 Electrical machinery and apparatus, nec	37.42%
28 Computer and related activities	58.71%	06 Pulp, paper, paper products, printing and publishing	37.35%
23 Transport and storage	57.72%	17 Other transport equipment	36.77%
13 Machinery and equipment, nec	57.59%	14 Computer, electronic and optical equipment	34.76%
06 Pulp, paper, paper products, printing and publishing	57.05%	12 Fabricated metal products	34.47%
16 Motor vehicles, trailers and semi-trailers	54.98%	13 Machinery and equipment, nec	33.92%
03 Food products, beverages and tobacco	54.80%	07 Coke, refined petroleum products and nuclear fuel	33.89%
29 R&D and other business activities	54.24%	24 Post and telecommunications	33.08%
05 Wood and products of wood and cork	53.36%	16 Motor vehicles, trailers and semi-trailers	32.19%
18 Manufacturing nec, recycling	50.09%	05 Wood and products of wood and cork	28.98%
24 Post and telecommunications	49.39%	21 Wholesale and retail trade, repairs	28.09%
30 Public admin. and defense, compulsory social security	47.79%	18 Manufacturing nec, recycling	27.99%
17 Other transport equipment	46.88%	03 Food products, beverages and tobacco	27.58%
20 Construction	46.13%	23 Transport and storage	24.80%
25 Financial intermediation	45.41%	28 Computer and related activities	21.90%
27 Renting of machinery and equipment	45.27%	01 Agriculture, hunting, forestry and fishing	19.23%
21 Wholesale and retail trade, repairs	44.94%	30 Public admin. and defense, compulsory social security	17.98%
01 Agriculture, hunting, forestry and fishing	43.20%	26 Real estate activities	16.15%
31 Education	41.73%	27 Renting of machinery and equipment	15.94%
33 Other community, social and personal services	35.12%	32 Health and social work	15.52%
32 Health and social work	34.37%	33 Other community, social and personal services	15.34%
22 Hotels and restaurants	33.25%	22 Hotels and restaurants	13.01%
26 Real estate activities	33.18%	31 Education	12.75%
34 Private households with employed persons	0%	34 Private households with employed persons	0%

Sectors	MYS	Sectors	CAN
14 Computer, electronic and optical equipment	78.99%	16 Motor vehicles, trailers and semi-trailers	65.50%
15 Electrical machinery and apparatus, nec	74.55%	11 Basic metals	62.56%
11 Basic metals	73.92%	14 Computer, electronic and optical equipment	49.82%
12 Fabricated metal products	67.70%	15 Electrical machinery and apparatus, nec	49.77%
16 Motor vehicles, trailers and semi-trailers	64.81%	12 Fabricated metal products	49.04%
13 Machinery and equipment, nec	61.55%	13 Machinery and equipment, nec	48.08%
08 Chemicals and chemical products	61.35%	09 Rubber and plastics products	46.76%
09 Rubber and plastics products	59.25%	17 Other transport equipment	46.26%
17 Other transport equipment	59.23%	08 Chemicals and chemical products	45.52%
07 Coke, refined petroleum products and nuclear fuel	57.92%	04 Textiles, textile products, leather and footwear	37.34%
06 Pulp, paper, paper products, printing and publishing	57.88%	07 Coke, refined petroleum products and nuclear fuel	36.65%
10 Other non-metallic mineral products	56.99%	05 Wood and products of wood and cork	34.24%
18 Manufacturing nec, recycling	56.29%	02 Mining and quarrying	32.41%
04 Textiles, textile products, leather and footwear	54.87%	06 Pulp, paper, paper products, printing and publishing	32.21%
19 Electricity, gas and water supply	52.18%	18 Manufacturing nec, recycling	32.10%
29 R&D and other business activities	49.07%	20 Construction	31.76%
23 Transport and storage	48.35%	23 Transport and storage	28.96%
25 Financial intermediation	43.93%	10 Other non-metallic mineral products	28.22%
02 Mining and quarrying	43.90%	29 R&D and other business activities	28.07%
20 Construction	43.17%	24 Post and telecommunications	27.27%
28 Computer and related activities	40.30%	01 Agriculture, hunting, forestry and fishing	26.71%
32 Health and social work	39.82%	21 Wholesale and retail trade, repairs	25.74%
24 Post and telecommunications	39.79%	03 Food products, beverages and tobacco	25.69%
03 Food products, beverages and tobacco	39.13%	30 Public admin. and defense, compulsory social security	23.56%
21 Wholesale and retail trade, repairs	37.75%	33 Other community, social and personal services	20.18%
05 Wood and products of wood and cork	37.49%	25 Financial intermediation	18.57%
01 Agriculture, hunting, forestry and fishing	33.21%	27 Renting of machinery and equipment	17.70%
33 Other community, social and personal services	32.51%	32 Health and social work	17.06%
27 Renting of machinery and equipment	28.98%	19 Electricity, gas and water supply	14.31%
22 Hotels and restaurants	23.66%	28 Computer and related activities	14.16%
31 Education	13.51%	22 Hotels and restaurants	13.07%
26 Real estate activities	5.93%	31 Education	7.63%
30 Public admin. and defense, compulsory social security	0%	26 Real estate activities	6.72%
34 Private households with employed persons	0%	34 Private households with employed persons	0%

Sectors	VNM	Sectors	MEX
11 Basic metals	81.32%	14 Computer, electronic and optical equipment	69.31%
14 Computer, electronic and optical equipment	79.21%	16 Motor vehicles, trailers and semi-trailers	57.12%
13 Machinery and equipment, nec	76.80%	12 Fabricated metal products	57.00%
15 Electrical machinery and apparatus, nec	76.01%	15 Electrical machinery and apparatus, nec	54.54%
08 Chemicals and chemical products	74.90%	18 Manufacturing nec, recycling	51.76%
09 Rubber and plastics products	73.10%	09 Rubber and plastics products	51.46%
12 Fabricated metal products	67.59%	20 Construction	51.28%
07 Coke, refined petroleum products and nuclear fuel	67.56%	13 Machinery and equipment, nec	48.96%
17 Other transport equipment	67.27%	11 Basic metals	46.99%
16 Motor vehicles, trailers and semi-trailers	64.19%	17 Other transport equipment	43.86%
05 Wood and products of wood and cork	58.14%	06 Pulp, paper, paper products, printing and publishing	41.33%
29 R&D and other business activities	53.19%	04 Textiles, textile products, leather and footwear	41.20%
06 Pulp, paper, paper products, printing and publishing	53.06%	08 Chemicals and chemical products	41.08%
10 Other non-metallic mineral products	51.67%	29 R&D and other business activities	38.37%
25 Financial intermediation	50.52%	24 Post and telecommunications	32.77%
02 Mining and quarrying	46.92%	07 Coke, refined petroleum products and nuclear fuel	32.74%
18 Manufacturing nec, recycling	46.22%	28 Computer and related activities	30.57%
20 Construction	45.25%	02 Mining and quarrying	29.51%
04 Textiles, textile products, leather and footwear	44.80%	05 Wood and products of wood and cork	28.88%
23 Transport and storage	42.41%	10 Other non-metallic mineral products	27.01%
24 Post and telecommunications	36.28%	01 Agriculture, hunting, forestry and fishing	23.46%
28 Computer and related activities	35.32%	19 Electricity, gas and water supply	21.42%
21 Wholesale and retail trade, repairs	33.86%	03 Food products, beverages and tobacco	20.58%
03 Food products, beverages and tobacco	30.97%	23 Transport and storage	20.34%
01 Agriculture, hunting, forestry and fishing	29.52%	21 Wholesale and retail trade, repairs	19.41%
32 Health and social work	28.17%	27 Renting of machinery and equipment	14.98%
27 Renting of machinery and equipment	26.43%	25 Financial intermediation	14.32%
30 Public admin. and defense, compulsory social security	23.33%	33 Other community, social and personal services	5.72%
26 Real estate activities	22.69%	32 Health and social work	4.75%
33 Other community, social and personal services	14.74%	22 Hotels and restaurants	4.07%
22 Hotels and restaurants	13.40%	26 Real estate activities	2.53%
31 Education	12.96%	31 Education	1.39%
19 Electricity, gas and water supply	11.38%	30 Public admin. and defense, compulsory social security	0%
34 Private households with employed persons	0%	34 Private households with employed persons	0%

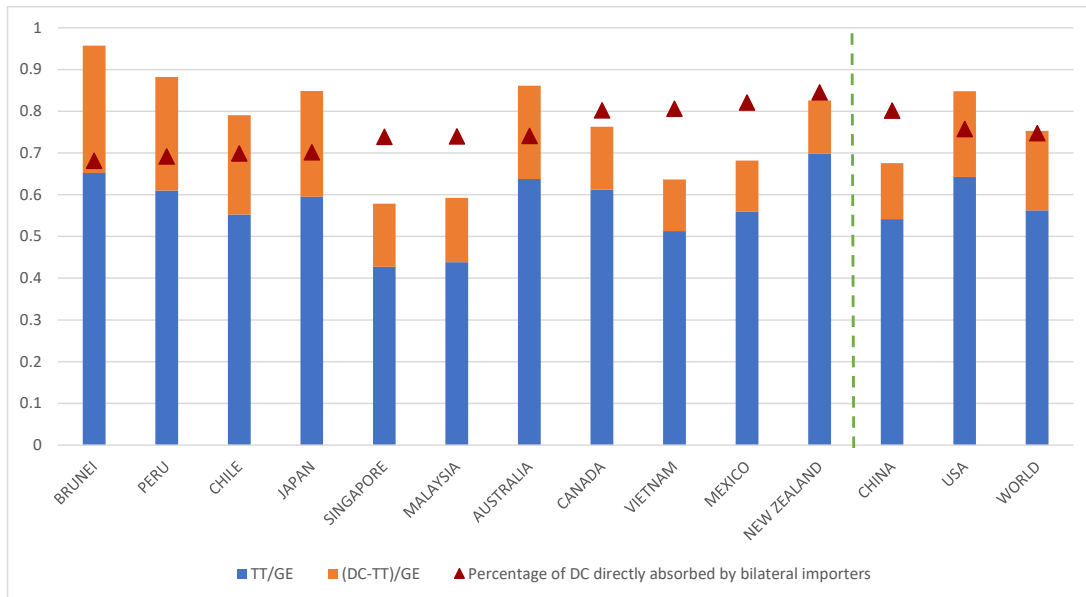
Sectors	BRN	Sectors	CHL
12 Fabricated metal products	71.70%	11 Basic metals	59.94%
10 Other non-metallic mineral products	62.38%	07 Coke, refined petroleum products and nuclear fuel	59.21%
11 Basic metals	60.61%	23 Transport and storage	50.05%
06 Pulp, paper, paper products, printing and publishing	57.10%	19 Electricity, gas and water supply	47.42%
13 Machinery and equipment, nec	55.44%	09 Rubber and plastics products	46.54%
15 Electrical machinery and apparatus, nec	54.81%	08 Chemicals and chemical products	45.75%
09 Rubber and plastics products	54.39%	15 Electrical machinery and apparatus, nec	43.38%
08 Chemicals and chemical products	53.70%	06 Pulp, paper, paper products, printing and publishing	42.31%
29 R&D and other business activities	48.44%	02 Mining and quarrying	42.07%
14 Computer, electronic and optical equipment	48.36%	04 Textiles, textile products, leather and footwear	40.28%
17 Other transport equipment	46.26%	10 Other non-metallic mineral products	36.19%
18 Manufacturing nec, recycling	45.16%	12 Fabricated metal products	35.54%
03 Food products, beverages and tobacco	44.95%	29 R&D and other business activities	33.86%
16 Motor vehicles, trailers and semi-trailers	42.16%	21 Wholesale and retail trade, repairs	33.58%
04 Textiles, textile products, leather and footwear	39.85%	13 Machinery and equipment, nec	33.18%
20 Construction	39.14%	01 Agriculture, hunting, forestry and fishing	32.34%
25 Financial intermediation	38.83%	17 Other transport equipment	31.95%
27 Renting of machinery and equipment	37.95%	05 Wood and products of wood and cork	31.48%
02 Mining and quarrying	35.03%	25 Financial intermediation	30.54%
24 Post and telecommunications	34.28%	16 Motor vehicles, trailers and semi-trailers	28.96%
22 Hotels and restaurants	31.11%	30 Public admin. and defense, compulsory social security	28.33%
01 Agriculture, hunting, forestry and fishing	28.97%	18 Manufacturing nec, recycling	26.92%
23 Transport and storage	28.88%	27 Renting of machinery and equipment	25.83%
28 Computer and related activities	26.10%	14 Computer, electronic and optical equipment	25.68%
33 Other community, social and personal services	25.81%	03 Food products, beverages and tobacco	24.38%
21 Wholesale and retail trade, repairs	22.92%	24 Post and telecommunications	22.76%
05 Wood and products of wood and cork	18.82%	28 Computer and related activities	20.60%
31 Education	11.64%	20 Construction	19.53%
26 Real estate activities	3.76%	22 Hotels and restaurants	14.56%
07 Coke, refined petroleum products and nuclear fuel	2.18%	31 Education	13.45%
19 Electricity, gas and water supply	0%	26 Real estate activities	11.60%
30 Public admin. and defense, compulsory social security	0%	32 Health and social work	11.05%
32 Health and social work	0%	33 Other community, social and personal services	10.75%
34 Private households with employed persons	0%	34 Private households with employed persons	0%

Sectors	CHN	Sectors	PER
14 Computer, electronic and optical equipment	66.63%	11 Basic metals	60.89%
15 Electrical machinery and apparatus, nec	61.89%	14 Computer, electronic and optical equipment	54.10%
08 Chemicals and chemical products	60.84%	12 Fabricated metal products	50.19%
07 Coke, refined petroleum products and nuclear fuel	60.81%	09 Rubber and plastics products	46.33%
11 Basic metals	57.32%	13 Machinery and equipment, nec	43.25%
12 Fabricated metal products	55.87%	02 Mining and quarrying	41.45%
06 Pulp, paper, paper products, printing and publishing	55.24%	05 Wood and products of wood and cork	40.71%
09 Rubber and plastics products	55.04%	07 Coke, refined petroleum products and nuclear fuel	39.88%
02 Mining and quarrying	54.34%	08 Chemicals and chemical products	35.41%
05 Wood and products of wood and cork	49.85%	06 Pulp, paper, paper products, printing and publishing	30.33%
16 Motor vehicles, trailers and semi-trailers	43.71%	04 Textiles, textile products, leather and footwear	29.24%
13 Machinery and equipment, nec	43.62%	29 R&D and other business activities	27.39%
19 Electricity, gas and water supply	41.55%	03 Food products, beverages and tobacco	27.02%
29 R&D and other business activities	40.93%	21 Wholesale and retail trade, repairs	25.62%
10 Other non-metallic mineral products	40.25%	23 Transport and storage	25.58%
17 Other transport equipment	38.71%	17 Other transport equipment	24.44%
24 Post and telecommunications	36.01%	15 Electrical machinery and apparatus, nec	24.39%
04 Textiles, textile products, leather and footwear	34.02%	27 Renting of machinery and equipment	24.28%
18 Manufacturing nec, recycling	33.00%	18 Manufacturing nec, recycling	24.04%
03 Food products, beverages and tobacco	30.41%	16 Motor vehicles, trailers and semi-trailers	24.01%
28 Computer and related activities	29.61%	28 Computer and related activities	22.54%
23 Transport and storage	29.16%	10 Other non-metallic mineral products	21.16%
27 Renting of machinery and equipment	26.14%	01 Agriculture, hunting, forestry and fishing	20.63%
20 Construction	24.31%	25 Financial intermediation	17.55%
01 Agriculture, hunting, forestry and fishing	22.50%	24 Post and telecommunications	17.49%
21 Wholesale and retail trade, repairs	19.87%	33 Other community, social and personal services	15.98%
33 Other community, social and personal services	14.75%	22 Hotels and restaurants	10.84%
25 Financial intermediation	11.50%	32 Health and social work	8.80%
32 Health and social work	10.05%	31 Education	3.67%
26 Real estate activities	8.14%	26 Real estate activities	1.57%
22 Hotels and restaurants	5.28%	19 Electricity, gas and water supply	0%
31 Education	5.09%	20 Construction	0%
30 Public admin. and defense, compulsory social security	0%	30 Public admin. and defense, compulsory social security	0%
34 Private households with employed persons	0%	34 Private households with employed persons	0%

Sectors	WORLD	Sectors	USA
11 Basic metals	64.00%	11 Basic metals	68.33%
14 Computer, electronic and optical equipment	60.09%	16 Motor vehicles, trailers and semi-trailers	53.26%
07 Coke, refined petroleum products and nuclear fuel	57.48%	07 Coke, refined petroleum products and nuclear fuel	47.39%
09 Rubber and plastics products	57.03%	15 Electrical machinery and apparatus, nec	47.14%
15 Electrical machinery and apparatus, nec	55.10%	09 Rubber and plastics products	46.93%
12 Fabricated metal products	53.70%	12 Fabricated metal products	46.08%
08 Chemicals and chemical products	53.12%	08 Chemicals and chemical products	44.10%
16 Motor vehicles, trailers and semi-trailers	49.64%	02 Mining and quarrying	43.57%
19 Electricity, gas and water supply	46.85%	14 Computer, electronic and optical equipment	40.98%
13 Machinery and equipment, nec	45.24%	13 Machinery and equipment, nec	40.19%
17 Other transport equipment	44.73%	29 R&D and other business activities	39.37%
29 R&D and other business activities	42.71%	27 Renting of machinery and equipment	38.51%
06 Pulp, paper, paper products, printing and publishing	42.20%	17 Other transport equipment	36.96%
05 Wood and products of wood and cork	41.15%	10 Other non-metallic mineral products	36.76%
10 Other non-metallic mineral products	40.74%	06 Pulp, paper, paper products, printing and publishing	36.48%
23 Transport and storage	39.97%	05 Wood and products of wood and cork	34.92%
02 Mining and quarrying	39.05%	24 Post and telecommunications	32.53%
18 Manufacturing nec, recycling	39.03%	18 Manufacturing nec, recycling	29.78%
25 Financial intermediation	37.46%	04 Textiles, textile products, leather and footwear	29.07%
04 Textiles, textile products, leather and footwear	36.93%	25 Financial intermediation	28.92%
27 Renting of machinery and equipment	36.74%	32 Health and social work	28.83%
24 Post and telecommunications	35.62%	30 Public admin. and defense, compulsory social security	27.95%
28 Computer and related activities	35.35%	28 Computer and related activities	27.25%
21 Wholesale and retail trade, repairs	31.16%	23 Transport and storage	27.16%
20 Construction	29.79%	21 Wholesale and retail trade, repairs	25.73%
03 Food products, beverages and tobacco	29.50%	01 Agriculture, hunting, forestry and fishing	24.44%
30 Public admin. and defense, compulsory social security	29.14%	19 Electricity, gas and water supply	23.15%
01 Agriculture, hunting, forestry and fishing	28.12%	31 Education	20.34%
33 Other community, social and personal services	22.21%	03 Food products, beverages and tobacco	20.24%
22 Hotels and restaurants	19.80%	20 Construction	17.68%
32 Health and social work	18.32%	33 Other community, social and personal services	15.44%
31 Education	13.91%	22 Hotels and restaurants	7.92%
26 Real estate activities	9.16%	26 Real estate activities	6.33%
34 Private households with employed persons	0%	34 Private households with employed persons	0%

Figure 2: Fraction of domestic contents directly absorbed by bilateral importers (2011)



Note: The fraction of traditional trade in gross exports,  $TT/GE$ , is measured by:  $TT_{s^*}/E_{s^*} = \sum_{r \neq s} (1a_{sr}^* + 2a_{sr}^*)/E_{s^*}$ . The fraction of DC not directly absorbed by bilateral importers,  $(DC - TT)/GE$ , is measured by:  $(DC_{s^*} - TT_{s^*})/E_{s^*} = \sum_{r \neq s} (1_{sr}^* + 2_{sr}^* + 3_{sr}^* + 4_{sr}^* + 5_{sr}^* + 6_{sr}^* - 1a_{sr}^* - 2a_{sr}^*)/E_{s^*}$ . The fraction of domestic content directly absorbed by bilateral importers is measured by  $TT_{s^*}/DC_{s^*} = \sum_{r \neq s} (1a_{sr}^* + 2a_{sr}^*)/(1_{sr}^* + 2_{sr}^* + 3_{sr}^* + 4_{sr}^* + 5_{sr}^* + 6_{sr}^*)$ .

Table 7: Key downstream trade partners for selected sectors (2011)

<b>JAPAN</b>	<b>Sector 9</b>	<b>Sector 11</b>	<b>Sector 14</b>	<b>Sector 15</b>	<b>Sector 16</b>
1st downstream partner	CHN (27.82)	CHN (25.82)	CHN (51.21)	CHN (55.98)	USA (20.01)
2nd downstream partner	KOR (20.50)	KOR (20.99)	TWN (10.80)	KOR (7.96)	CHN (12.09)
3rd downstream partner	TWN (13.71)	THA (14.04)	KOR (8.10)	THA (6.00)	CAN (9.69)
4th downstream partner	THA (6.48)	TWN (11.79)	MYS (7.17)	DEU (3.89)	RUS (8.80)
5th downstream partner	USA (3.90)	MYS (5.98)	USA (3.85)	MEX (3.82)	THA (5.48)
<b>SINGAPORE</b>	<b>Sector 9</b>	<b>Sector 11</b>	<b>Sector 14</b>	<b>Sector 15</b>	<b>Sector 16</b>
1st downstream partner	MYS (25.20)	MYS (31.79)	CHN (25.62)	MYS (26.68)	IDN (13.54)
2nd downstream partner	CHN (20.50)	TWN (10.37)	MYS (25.42)	CHN (24.39)	ROW (13.17)
3rd downstream partner	THA (10.72)	CHN (6.64)	KOR (11.18)	IDN (8.83)	KOR (8.55)
4th downstream partner	KOR (5.58)	THA (6.54)	TWN (10.85)	THA (8.20)	DEU (8.41)
5th downstream partner	IDN (4.66)	JPN (5.26)	USA (3.64)	KOR (3.91)	THA (8.34)
<b>MALAYSIA</b>	<b>Sector 9</b>	<b>Sector 11</b>	<b>Sector 14</b>	<b>Sector 15</b>	<b>Sector 16</b>
1st downstream partner	CHN (39.12)	CHN (35.11)	CHN (64.77)	CHN (39.59)	THA (20.66)
2nd downstream partner	USA (6.97)	THA (11.10)	USA (4.74)	THA (11.93)	IDN (11.50)
3rd downstream partner	THA (6.34)	KOR (9.73)	MEX (4.56)	MEX (8.63)	JPN (10.55)
4th downstream partner	JPN (6.17)	JPN (6.58)	TWN (4.31)	DEU (6.82)	CHN (8.10)
5th downstream partner	SGP (4.56)	TWN (5.66)	KOR (3.44)	SGP (5.79)	ROW (7.93)
<b>VIETNAM</b>	<b>Sector 9</b>	<b>Sector 11</b>	<b>Sector 14</b>	<b>Sector 15</b>	<b>Sector 16</b>
1st downstream partner	MYS (13.46)	THA (15.52)	CHN (42.84)	CHN (41.09)	JPN (34.85)
2nd downstream partner	JPN (13.09)	KOR (13.87)	MYS (7.03)	JPN (21.31)	KOR (13.72)
3rd downstream partner	CHN (11.30)	MYS (13.58)	THA (5.15)	KOR (9.27)	CZE (11.46)
4th downstream partner	USA (6.46)	TWN (11.34)	TWN (4.15)	THA (5.22)	USA (8.52)
5th downstream partner	DEU (5.66)	JPN (6.99)	RUS (3.91)	USA (4.07)	CHN (7.19)
<b>BRUNEI</b>	<b>Sector 9</b>	<b>Sector 11</b>	<b>Sector 14</b>	<b>Sector 15</b>	<b>Sector 16</b>
1st downstream partner	CHN (39.25)	MYS (23.70)	MYS (48.60)	MYS (28.11)	MYS (58.61)
2nd downstream partner	TWN (19.21)	THA (20.60)	SGP (22.40)	SGP (20.34)	KOR (17.59)
3rd downstream partner	AUS (13.07)	USA (19.91)	GBR (10.08)	DEU (17.31)	ROW (6.00)
4th downstream partner	MYS (5.73)	SGP (13.49)	DEU (7.74)	TWN (16.27)	USA (4.17)
5th downstream partner	SGP (4.49)	CHN (6.10)	TWN (4.12)	THA (6.50)	GBR (3.44)
<b>AUSTRALIA</b>	<b>Sector 9</b>	<b>Sector 11</b>	<b>Sector 14</b>	<b>Sector 15</b>	<b>Sector 16</b>
1st downstream partner	CHN (23.09)	CHN (24.40)	CHN (22.97)	CHN (31.17)	KOR (35.54)
2nd downstream partner	NZL (13.74)	THA (19.20)	USA (12.93)	KOR (10.45)	CHN (12.00)
3rd downstream partner	MEX (6.93)	KOR (10.79)	MYS (9.64)	MYS (8.70)	ROW (10.32)
4th downstream partner	ROW (6.77)	TWN (8.56)	GBR (8.46)	THA (6.27)	USA (7.02)
5th downstream partner	MYS (6.50)	MYS (6.63)	KOR (7.16)	DEU (4.71)	CAN (4.86)
<b>NEW ZEALAND</b>	<b>Sector 9</b>	<b>Sector 11</b>	<b>Sector 14</b>	<b>Sector 15</b>	<b>Sector 16</b>
1st downstream partner	AUS (49.20)	AUS (30.23)	CHN (22.10)	AUS (25.51)	AUS (36.56)
2nd downstream partner	CHN (8.75)	JPN (25.81)	USA (14.50)	CHN (14.15)	ROW (13.65)
3rd downstream partner	THA (4.75)	KOR (12.52)	FRA (7.51)	KOR (12.58)	USA (10.20)
4th downstream partner	USA (4.62)	USA (5.27)	TWN (6.91)	USA (7.04)	GBR (4.79)
5th downstream partner	GBR (4.51)	GBR (3.52)	MYS (6.86)	GBR (4.87)	CHN (3.50)
<b>CANADA</b>	<b>Sector 9</b>	<b>Sector 11</b>	<b>Sector 14</b>	<b>Sector 15</b>	<b>Sector 16</b>
1st downstream partner	USA (70.92)	USA (55.41)	CHN (29.73)	USA (43.50)	USA (87.24)
2nd downstream partner	MEX (11.47)	NOR (9.61)	USA (29.23)	CHN (16.13)	MEX (6.82)
3rd downstream partner	CHN (5.43)	GBR (6.90)	HUN (9.80)	MEX (14.73)	CHN (1.24)
4th downstream partner	DEU (1.13)	CHN (5.67)	MEX (6.42)	DEU (3.07)	ROW (0.68)
5th downstream partner	KOR (1.01)	MEX (5.61)	GBR (3.30)	GBR (3.01)	DEU (0.55)
<b>MEXICO</b>	<b>Sector 9</b>	<b>Sector 11</b>	<b>Sector 14</b>	<b>Sector 15</b>	<b>Sector 16</b>
1st downstream partner	USA (57.01)	USA (57.49)	USA (55.73)	USA (63.26)	USA (51.27)
2nd downstream partner	CAN (9.25)	CAN (13.2)	CHN (14.56)	CAN (12.98)	CAN (30.39)
3rd downstream partner	CHN (6.31)	KOR (5.64)	CAN (7.59)	CHN (9.51)	DEU (8.04)
4th downstream partner	CRI (4.30)	CHN (5.47)	KOR (2.27)	DEU (3.07)	CHN (1.49)
5th downstream partner	ROW (3.82)	JPN (2.56)	JPN (1.84)	KOR (1.07)	ARG (1.24)
<b>CHILE</b>	<b>Sector 9</b>	<b>Sector 11</b>	<b>Sector 14</b>	<b>Sector 15</b>	<b>Sector 16</b>
1st downstream partner	MEX (21.82)	CHN (41.31)	ROW (74.35)	CHN (27.36)	ARG (24.89)
2nd downstream partner	USA (19.89)	KOR (9.43)	DEU (5.42)	PER (8.01)	ROW (11.14)
3rd downstream partner	ARG (14.98)	TWN (7.85)	VNM (3.20)	KOR (5.32)	CAN (10.68)
4th downstream partner	ROW (14.08)	ITA (6.92)	MEX (3.17)	MEX (5.03)	BRA (10.50)
5th downstream partner	BRA (7.21)	USA (6.29)	IRL (2.37)	COL (4.96)	MEX (10.44)
<b>PERU</b>	<b>Sector 9</b>	<b>Sector 11</b>	<b>Sector 14</b>	<b>Sector 15</b>	<b>Sector 16</b>
1st downstream partner	CHN (27.91)	CAN (55.41)	ROW (65.36)	CRI (40.02)	ROW (71.45)
2nd downstream partner	COL (21.78)	ITA (11.13)	MAR (10.45)	ROW (25.30)	MAR (15.22)
3rd downstream partner	MEX (16.31)	CHN (8.91)	KOR (4.24)	CHL (7.75)	COL (9.14)
4th downstream partner	USA (6.69)	USA (8.48)	FRA (3.59)	COL (3.99)	USA (1.12)
5th downstream partner	CHL (6.55)	TWN (3.99)	USA (2.97)	MAR (3.99)	CHL (1.05)

Sector descriptions: Sector 9 – Rubber and plastics products, Sector 11 – Basic metals, Sector 14 – Computer, electronic and optical equipment, Sector 15 – Electrical machinery and apparatus, nec, and Sector 16 – Motor vehicles, trailers and semi-trailers.



Table 8: Key upstream trade partners for selected sectors (2011)

	Sector 9	Sector 11	Sector 14	Sector 15	Sector 16
<b>JAPAN</b>					
1st upstream partner	CHN (40.55)	KOR (24.67)	CHN (61.16)	CHN (55.67)	DEU (26.09)
2nd upstream partner	TWN (9.08)	CHN (9.32)	TWN (5.90)	VNM (9.33)	CHN (13.92)
3rd upstream partner	KOR (8.36)	RUS (8.06)	MYS (5.81)	THA (6.74)	THA (7.86)
4th upstream partner	THA (7.87)	TWN (7.23)	KOR (5.34)	MYS (4.01)	USA (6.05)
5th upstream partner	MYS (6.43)	ZAF (6.09)	USA (3.50)	KOR (3.57)	KOR (5.47)
<b>SINGAPORE</b>					
1st upstream partner	MYS (24.64)	CHN (10.82)	CHN (28.60)	CHN (28.54)	DEU (24.18)
2nd upstream partner	CHN (17.16)	MYS (10.34)	MYS (18.05)	MYS (19.08)	USA (12.07)
3rd upstream partner	USA (6.92)	JPN (9.50)	TWN (14.23)	IDN (7.62)	IND (8.28)
4th upstream partner	THA (6.18)	KOR (9.00)	KOR (8.86)	USA (6.18)	GBR (6.25)
5th upstream partner	DEU (5.13)	TUR (6.73)	USA (3.22)	DEU (4.82)	MYS (5.83)
<b>MALAYSIA</b>					
1st upstream partner	CHN (22.27)	KOR (14.77)	CHN (32.83)	CHN (41.23)	THA (37.43)
2nd upstream partner	THA (19.44)	JPN (12.96)	SGP (16.61)	THA (16.41)	DEU (15.89)
3rd upstream partner	VNM (10.12)	TWN (12.52)	TWN (9.76)	USA (5.04)	JPN (14.43)
4th upstream partner	JPN (6.52)	CHN (8.20)	KOR (6.32)	DEU (4.44)	CHN (8.36)
5th upstream partner	SGP (6.06)	AUS (7.00)	JPN (6.28)	JPN (3.94)	KOR (5.08)
<b>VIETNAM</b>					
1st upstream partner	CHN (26.14)	KOR (27.62)	CHN (54.80)	CHN (51.32)	THA (25.94)
2nd upstream partner	THA (16.05)	TWN (17.23)	KOR (18.23)	THA (12.71)	KOR (25.89)
3rd upstream partner	KOR (13.65)	CHN (12.23)	MYS (4.92)	KOR (9.65)	CHN (16.98)
4th upstream partner	TWN (12.38)	JPN (9.08)	JPN (4.62)	JPN (4.01)	DEU (4.42)
5th upstream partner	JPN (11.02)	AUS (6.01)	TWN (3.27)	MYS (3.75)	JPN (4.01)
<b>BRUNEI</b>					
1st upstream partner	MYS (31.22)	MYS (27.75)	SGP (30.84)	MYS (19.98)	THA (25.41)
2nd upstream partner	SGP (16.67)	CHN (19.09)	CHN (20.71)	THA (15.12)	JPN (17.62)
3rd upstream partner	CHN (11.66)	JPN (17.67)	MYS (10.45)	ITA (13.98)	MYS (15.91)
4th upstream partner	THA (7.59)	USA (6.40)	TWN (9.15)	SGP (10.75)	KOR (11.42)
5th upstream partner	KOR (7.29)	SGP (4.67)	USA (5.55)	GBR (7.32)	DEU (11.21)
<b>AUSTRALIA</b>					
1st upstream partner	CHN (30.77)	ROW (15.27)	CHN (61.30)	CHN (38.46)	THA (20.75)
2nd upstream partner	THA (8.73)	THA (14.73)	MYS (7.02)	DEU (6.97)	KOR (15.04)
3rd upstream partner	MYS (6.10)	GBR (7.37)	USA (3.39)	USA (5.64)	DEU (13.21)
4th upstream partner	TWN (5.92)	CHN (6.64)	SGP (2.70)	GBR (4.40)	JPN (12.05)
5th upstream partner	USA (5.55)	JPN (6.58)	TWN (2.30)	MYS (3.77)	USA (8.15)
<b>NEW ZEALAND</b>					
1st upstream partner	CHN (25.60)	AUS (27.91)	CHN (54.46)	CHN (30.98)	JPN (14.93)
2nd upstream partner	AUS (14.76)	RUS (16.14)	MYS (7.98)	AUS (13.13)	THA (14.31)
3rd upstream partner	THA (8.02)	TWN (11.55)	AUS (5.62)	DEU (8.69)	DEU (13.93)
4th upstream partner	TWN (5.69)	KOR (7.33)	SGP (4.22)	MYS (4.28)	AUS (12.18)
5th upstream partner	MYS (5.37)	CHN (6.70)	USA (3.46)	USA (3.98)	KOR (10.76)
<b>CANADA</b>					
1st upstream partner	USA (36.61)	USA (29.27)	CHN (51.11)	CHN (29.88)	USA (60.47)
2nd upstream partner	CHN (25.87)	PER (6.48)	MEX (14.90)	MEX (22.33)	MEX (18.82)
3rd upstream partner	TWN (4.14)	ROW (6.03)	USA (8.05)	USA (21.46)	DEU (5.48)
4th upstream partner	MEX (3.91)	DEU (5.61)	TWN (4.45)	DEU (4.37)	KOR (4.57)
5th upstream partner	DEU (3.57)	ARG (5.42)	MYS (3.34)	MYS (1.69)	JPN (3.03)
<b>MEXICO</b>					
1st upstream partner	USA (35.64)	USA (31.58)	CHN (60.55)	CHN (39.61)	USA (53.88)
2nd upstream partner	CHN (19.64)	CAN (12.32)	KOR (8.62)	USA (22.68)	DEU (9.24)
3rd upstream partner	DEU (6.07)	CHN (9.28)	MYS (7.31)	DEU (5.16)	CAN (8.41)
4th upstream partner	KOR (5.81)	DEU (7.68)	USA (5.05)	MYS (4.51)	KOR (5.31)
5th upstream partner	CAN (5.79)	ITA (7.33)	TWN (3.74)	KOR (3.48)	JPN (4.41)
<b>CHILE</b>					
1st upstream partner	ROW (30.41)	CHN (23.44)	CHN (61.32)	CHN (32.57)	KOR (20.71)
2nd upstream partner	CHN (21.57)	KOR (9.63)	MEX (11.14)	DEU (8.11)	USA (11.31)
3rd upstream partner	USA (5.39)	BRA (9.48)	ROW (8.44)	USA (7.63)	MEX (10.74)
4th upstream partner	ARG (5.35)	ESP (6.68)	USA (3.49)	ESP (7.24)	CHN (10.11)
5th upstream partner	BRA (3.87)	DEU (6.17)	KOR (1.65)	MEX (5.06)	THA (7.40)
<b>PERU</b>					
1st upstream partner	CHN (21.80)	TUR (17.69)	CHN (57.32)	CHN (35.74)	KOR (17.30)
2nd upstream partner	MEX (13.04)	CHN (17.68)	MEX (14.56)	USA (13.03)	CHN (13.72)
3rd upstream partner	USA (8.29)	KOR (10.57)	MYS (4.99)	MEX (6.35)	MEX (10.11)
4th upstream partner	ROW (5.59)	USA (8.90)	KOR (3.95)	ROW (5.51)	USA (9.90)
5th upstream partner	KOR (4.51)	MEX (8.28)	ROW (3.29)	ESP (4.81)	THA (9.82)

Sector descriptions: Sector 9 – Rubber and plastics products, Sector 11 – Basic metals, Sector 14 – Computer, electronic and optical equipment, Sector 15 – Electrical machinery and apparatus, nec, and Sector 16 – Motor vehicles, trailers and semi-trailers.

Table A.1: Key downstream trade partners of CPTPP members (2011) by formula (9)

<b>JAPAN</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	99.50	9.75	25.27	34.77	50.29
1st downstream partner	CHN (30.64)	CHN (30.07)	CHN (32.33)	CHN (36.15)	CHN (35.46)
2nd downstream partner	KOR (11.10)	USA (9.65)	USA (16.93)	KOR (11.36)	USA (13.22)
3rd downstream partner	USA (8.77)	KOR (8.86)	KOR (8.27)	TWN (10.94)	KOR (9.94)
4th downstream partner	TWN (8.59)	AUS (7.83)	TWN (7.38)	USA (6.63)	TWN (9.48)
5th downstream partner	THA (5.49)	TWN (7.58)	THA (4.76)	MYS (6.01)	MYS (4.87)
<b>SINGAPORE</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	99.44	23.60	33.35	35.88	45.63
1st downstream partner	CHN (14.10)	AUS (24.04)	MYS (17.44)	CHN (22.22)	CHN (21.01)
2nd downstream partner	MYS (10.92)	MYS (21.79)	USA (15.82)	MYS (19.51)	MYS (16.83)
3rd downstream partner	IDN (7.15)	JPN (15.30)	AUS (15.57)	AUS (16.95)	AUS (12.46)
4th downstream partner	USA (6.49)	CHN (8.43)	CHN (11.90)	JPN (10.95)	USA (12.34)
5th downstream partner	AUS (6.23)	VNM (4.82)	JPN (10.33)	KOR (3.70)	JPN (8.37)
<b>MALAYSIA</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	99.76	21.58	30.42	47.06	55.90
1st downstream partner	CHN (30.17)	JPN (23.62)	CHN (24.21)	CHN (44.70)	CHN (40.34)
2nd downstream partner	USA (7.87)	CHN (19.08)	USA (19.46)	JPN (14.19)	USA (13.53)
3rd downstream partner	JPN (6.88)	AUS (13.41)	JPN (14.29)	AUS (8.42)	JPN (10.70)
4th downstream partner	THA (5.63)	SGP (10.73)	AUS (7.81)	SGP (6.89)	AUS (6.12)
5th downstream partner	ROW (5.23)	THA (4.48)	SGP (7.07)	THA (3.78)	SGP (5.57)
<b>VIETNAM</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	100	22.55	37.81	36.39	51.65
1st downstream partner	CHN (14.44)	JPN (37.58)	USA (29.34)	JPN (26.88)	USA (23.38)
2nd downstream partner	USA (11.97)	AUS (11.65)	JPN (22.02)	CHN (25.31)	CHN (20.98)
3rd downstream partner	JPN (10.05)	MYS (10.86)	CHN (11.28)	MYS (9.85)	JPN (18.47)
4th downstream partner	KOR (7.19)	CHN (9.69)	MYS (7.42)	AUS (9.73)	MYS (7.51)
5th downstream partner	MYS (5.80)	CAN (4.59)	AUS (6.91)	KOR (5.56)	AUS (6.69)
<b>BRUNEI</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	100	59.83	61.95	64.38	66.51
1st downstream partner	KOR (22.77)	JPN (22.34)	JPN (22.35)	KOR (23.28)	KOR (22.98)
2nd downstream partner	JPN (19.73)	AUS (20.79)	KOR (20.85)	AUS (23.26)	JPN (21.32)
3rd downstream partner	AUS (19.26)	KOR (20.35)	AUS (17.91)	JPN (21.02)	AUS (20.68)
4th downstream partner	IDN (11.15)	IDN (12.96)	IDN (11.63)	IDN (11.49)	IDN (10.88)
5th downstream partner	VNM (5.21)	NZL (8.18)	NZL (6.92)	NZL (6.10)	NZL (5.68)

<b>AUSTRALIA</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	100	26.37	31.75	53.18	58.56
1st downstream partner	CHN (26.49)	JPN (28.52)	CHN (23.48)	CHN (30.78)	CHN (30.85)
2nd downstream partner	KOR (14.12)	CHN (19.06)	JPN (21.41)	JPN (21.01)	JPN (17.92)
3rd downstream partner	JPN (12.44)	KOR (12.72)	KOR (12.41)	KOR (14.40)	KOR (13.74)
4th downstream partner	TWN (6.40)	NZL (6.46)	USA (6.38)	TWN (6.83)	TWN (6.67)
5th downstream partner	IND (6.34)	TWN (5.86)	TWN (6.00)	NZL (4.30)	USA (4.74)
<b>NEW ZEALAND</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	99.36	39.51	49.31	50.27	60.06
1st downstream partner	AUS (25.04)	AUS (51.39)	AUS (38.78)	AUS (44.68)	AUS (36.23)
2nd downstream partner	CHN (13.57)	JPN (13.83)	USA (13.34)	CHN (16.72)	CHN (16.76)
3rd downstream partner	ROW (7.64)	CHN (7.47)	JPN (10.82)	JPN (11.43)	USA (10.92)
4th downstream partner	USA (6.63)	SGP (4.48)	CHN (10.33)	SGP (4.32)	JPN (9.61)
5th downstream partner	JPN (6.47)	MYS (4.28)	SGP (4.17)	MYS (4.19)	SGP (4.11)
<b>CANADA</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	99.87	7.30	74.05	12.19	78.93
1st downstream partner	USA (56.69)	USA (56.88)	USA (75.47)	USA (50.58)	USA (71.13)
2nd downstream partner	CHN (7.21)	MEX (10.24)	MEX (6.21)	CHN (13.15)	CHN (7.39)
3rd downstream partner	MEX (3.78)	JPN (8.57)	CHN (4.41)	MEX (8.00)	MEX (5.70)
4th downstream partner	GBR (3.52)	CHN (6.18)	JPN (3.27)	JPN (7.35)	JPN (3.29)
5th downstream partner	KOR (2.93)	KOR (2.75)	KOR (1.52)	KOR (3.99)	KOR (2.14)
<b>MEXICO</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	99.82	10.40	80.06	13.54	83.21
1st downstream partner	USA (60.31)	USA (45.36)	USA (74.03)	USA (43.97)	USA (71.85)
2nd downstream partner	CAN (11.00)	CAN (32.14)	CAN (15.53)	CAN (27.30)	CAN (14.88)
3rd downstream partner	CHN (4.06)	JPN (3.92)	CHN (1.96)	CHN (8.26)	CHN (3.80)
4th downstream partner	ROW (3.68)	PER (3.13)	JPN (1.32)	JPN (3.64)	JPN (1.38)
5th downstream partner	ESP (2.23)	CHN (3.04)	PER (1.04)	PER (2.73)	PER (1.02)
<b>CHILE</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	99.05	18.80	29.11	42.52	52.83
1st downstream partner	CHN (29.84)	CHN (24.93)	CHN (28.60)	CHN (38.80)	CHN (36.21)
2nd downstream partner	KOR (7.82)	JPN (22.96)	USA (14.48)	JPN (16.38)	JPN (11.73)
3rd downstream partner	USA (7.13)	USA (7.49)	JPN (13.71)	KOR (8.14)	USA (11.56)
4th downstream partner	JPN (7.08)	KOR (7.01)	CAN (7.05)	USA (5.58)	KOR (7.15)
5th downstream partner	BRA (4.92)	MEX (5.63)	MEX (6.54)	TWN (4.76)	CAN (5.60)
<b>PERU</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross exports to countries in $\mathcal{G}$	100	25.92	40.54	46.10	60.73
1st downstream partner	CHN (17.76)	CAN (19.31)	CAN (28.88)	CHN (23.47)	CAN (24.76)
2nd downstream partner	CAN (15.95)	CHN (17.01)	USA (15.97)	CAN (15.06)	CHN (18.78)
3rd downstream partner	USA (9.35)	CHL (13.29)	CHN (14.78)	KOR (13.49)	USA (13.66)
4th downstream partner	KOR (9.14)	KOR (10.94)	CHL (8.41)	CHL (13.21)	KOR (9.51)
5th downstream partner	CHL (7.99)	JPN (10.03)	KOR (7.45)	JPN (8.44)	CHL (9.27)

Table A.2: Key upstream trade partners of CPTPP members (2011) by formula (10)

<b>JAPAN</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	15.37	28.07	36.72	49.43
1st upstream partner	CHN (25.24)	AUS (21.03)	USA (21.25)	CHN (37.27)	CHN (32.12)
2nd upstream partner	USA (8.66)	CHN (19.84)	CHN (19.90)	AUS (12.80)	USA (16.46)
3rd upstream partner	KOR (8.46)	USA (8.84)	AUS (13.09)	KOR (7.31)	AUS (9.67)
4th upstream partner	ROW (7.03)	MYS (8.44)	KOR (6.85)	USA (7.26)	KOR (6.59)
5th upstream partner	AUS (4.84)	KOR (8.31)	MYS (5.88)	MYS (6.01)	MYS (4.94)
<b>SINGAPORE</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	16.22	29.29	24.46	37.52
1st upstream partner	USA (11.43)	JPN (34.82)	USA (35.37)	CHN (25.59)	USA (28.62)
2nd upstream partner	CHN (8.08)	MYS (18.30)	JPN (20.37)	JPN (24.28)	CHN (17.60)
3rd upstream partner	ROW (7.94)	AUS (12.21)	MYS (11.39)	MYS (13.78)	JPN (16.41)
4th upstream partner	JPN (6.65)	CHN (4.41)	AUS (7.24)	AUS (8.55)	MYS (9.84)
5th upstream partner	IND(6.59)	CAN (4.39)	CHN (3.32)	USA (3.75)	AUS (5.85)
<b>MALAYSIA</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	26.96	35.59	40.78	49.40
1st upstream partner	CHN (14.56)	JPN (32.24)	JPN (23.27)	CHN (26.91)	CHN (22.29)
2nd upstream partner	SGP (12.10)	SGP (23.78)	USA (20.52)	JPN (23.34)	JPN (18.56)
3rd upstream partner	JPN (9.69)	CHN (8.41)	SGP (18.99)	SGP (17.97)	USA (16.25)
4th upstream partner	USA (8.19)	AUS (8.33)	CHN (7.94)	AUS (4.93)	SGP (15.66)
5th upstream partner	THA (6.34)	VNM (5.17)	AUS (6.05)	THA (4.18)	AUS (4.75)
<b>VIETNAM</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	20.70	25.05	43.57	47.92
1st upstream partner	CHN (24.32)	JPN (21.56)	CHN (17.57)	CHN (38.34)	CHN (35.07)
2nd upstream partner	KOR (13.76)	CHN (17.62)	SGP (14.47)	SGP (14.39)	SGP (12.71)
3rd upstream partner	TWN (10.02)	KOR (10.42)	KOR (10.49)	KOR (9.20)	KOR (9.44)
4th upstream partner	THA (7.90)	MYS (10.06)	MYS (8.48)	MYS (6.99)	TWN (6.92)
5th upstream partner	JPN (6.87)	TWN (8.76)	USA (8.37)	TWN (6.97)	MYS (6.39)
<b>BRUNEI</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	41.71	62.03	49.35	69.67
1st upstream partner	SGP (24.79)	SGP (28.92)	SGP (27.12)	SGP (43.97)	SGP (25.62)
2nd upstream partner	MYS (18.07)	MYS (27.58)	USA (21.86)	MYS (32.05)	USA (20.19)
3rd upstream partner	USA (14.05)	JPN (12.33)	MYS (21.13)	CHN (11.35)	MYS (19.88)
4th upstream partner	CHN (6.40)	USA (11.06)	JPN (8.96)	JPN (9.41)	CHN (8.32)
5th upstream partner	JPN (5.31)	CHN (4.03)	CHN (3.59)	CAN (1.51)	JPN (7.97)

<b>AUSTRALIA</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	23.57	37.34	39.03	52.80
1st upstream partner	CHN (16.27)	CHN (17.11)	USA (18.02)	CHN (23.07)	CHN (20.58)
2nd upstream partner	ROW (10.17)	MYS (12.35)	CHN (15.99)	MYS (10.17)	USA (16.08)
3rd upstream partner	USA (8.82)	JPN (10.20)	MYS (9.16)	USA (8.83)	MYS (8.20)
4th upstream partner	SGP (7.91)	SGP (9.11)	SGP (8.31)	JPN (8.70)	SGP (7.87)
5th upstream partner	JPN (5.38)	USA (9.03)	JPN (7.72)	SGP (8.28)	JPN (7.12)
<b>NEW ZEALAND</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	34.98	45.01	45.89	55.92
1st upstream partner	AUS (24.79)	AUS (38.30)	AUS (30.93)	AUS (32.74)	AUS (27.84)
2nd upstream partner	CHN (11.51)	CHN (10.14)	USA (12.92)	CHN (15.69)	CHN (14.38)
3rd upstream partner	SGP (7.55)	SGP (8.69)	CHN (10.08)	SGP (8.21)	USA (11.92)
4th upstream partner	ROW (7.19)	MYS (7.20)	SGP (8.23)	MYS (6.45)	SGP (7.94)
5th upstream partner	USA (6.79)	JPN (5.11)	MYS (5.87)	USA (5.36)	MYS (5.51)
<b>CANADA</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	10.33	59.70	19.86	69.22
1st upstream partner	USA (42.94)	USA (31.95)	USA (65.12)	USA (32.25)	USA (60.20)
2nd upstream partner	CHN (10.72)	MEX (16.89)	MEX (9.82)	CHN (21.54)	CHN (11.3)
3rd upstream partner	MEX (6.41)	CHN (13.38)	CHN (6.53)	MEX (13.77)	MEX (9.48)
4th upstream partner	ROW (5.61)	JPN (11.35)	JPN (4.31)	JPN (8.20)	JPN (3.95)
5th upstream partner	GBR (3.49)	PER (7.03)	PER (2.65)	PER (4.84)	PER (2.32)
<b>MEXICO</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	10.72	62.20	23.49	74.96
1st upstream partner	USA (43.18)	USA (33.10)	USA (64.98)	CHN(36.05)	USA (55.56)
2nd upstream partner	CHN (18.16)	JPN (17.75)	CHN (9.25)	USA (27.49)	CHN (20.52)
3rd upstream partner	DEU (4.50)	CHN (17.66)	JPN (7.35)	JPN (11.51)	JPN (6.24)
4th upstream partner	KOR (4.29)	CAN (9.79)	CAN (5.94)	CAN (6.51)	CAN (5.02)
5th upstream partner	JPN (4.25)	MYS (4.06)	KOR (2.12)	KOR (3.63)	KOR (2.35)
<b>CHILE</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	11.75	32.64	25.68	46.30
1st upstream partner	USA (19.05)	USA (21.48)	USA (40.27)	CHN (25.18)	USA (35.17)
2nd upstream partner	CHN (13.51)	PER (20.55)	PER (11.86)	USA (18.54)	CHN (18.36)
3rd upstream partner	ROW (10.16)	CHN (15.85)	CHN (11.83)	PER (15.16)	PER (10.00)
4th upstream partner	BRA (8.48)	JPN (6.47)	MEX (5.56)	MEX (5.39)	MEX (5.29)
5th upstream partner	COL (5.20)	MEX (5.92)	CA (4.07)	JPN (5.22)	ROW (4.43)
<b>PERU</b>	<b>World</b>	<b>CPTPP</b>	<b>CPTPP+USA</b>	<b>CPTPP+CHN</b>	<b>CPTPP+CHN+USA</b>
% of gross imports from countries in $\mathcal{G}$	100	14.71	34.19	30.45	49.92
1st upstream partner	CHN (18.47)	CHN (23.71)	USA (34.36)	CHN (29.34)	USA (29.97)
2nd upstream partner	USA (18.25)	USA (21.34)	CHN (17.02)	USA (18.34)	CHN (21.83)
3rd upstream partner	ROW (10.15)	MEX (14.90)	MEX (14.15)	MEX (12.76)	MEX (12.96)
4th upstream partner	MEX (7.07)	CHL (5.88)	CHL (4.12)	KOR (5.45)	KOR (4.23)
5th upstream partner	BRA (5.11)	KOR (5.28)	KOR (3.84)	CHL (4.49)	CHL (3.59)